Practical MECHANICS

NOVEMBER 1960

1/6

ANOTHER FREE 3 IN 1 BLUEPRINT INSIDE

WITH FULL CONSTRUCTIONAL DETAILS FOR MAKING

1. A PRECISION ENLARGER FOR 35 m m.
2. A BOX OF CONJURING TRICKS
3. A BEDSIDE TEA-MAKER

The Handiest of handy Outfits for the household handyman

the RAWLPLUG 'Do-it-yourself' Outfit

LIST PRICE 12/6

Here is a clever innovation from the Rawlplug Company. Seven popular Rawlplug products packed into one attractively printed box.

One handy box of No. 8 assorted Rawlplugs. One No. 8 Metalide Masonry drill in plastic container. One 1/6 tube Durofix. One tube Natural Plastic Wood. One tube Duroglue. One card Fuse Wire. Six No. 316 Rawlnuts (for making vibration-proof fixings to thin and hollow materials). One 64-page Rawlplug instructional handbook.

This assortment of Rawlplug products will find many uses in the home. Selling at 12/6 it makes an ideal present for the wife to buy for her husband or the handyman to buy for himself.

Rawlplug Do-it-Yourself Outfits are in the shops, why not call in to your local Rawlplug dealer and ask to see one now?

RAWLPLUG METALIDE

for masonry drilling *the easy way*

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

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

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

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

1/- & 1/6

All Purpose Adhesive. Clear. Waterproof. Heatproof. Insulating. Handy tube 1/-, Large tubes 1/6d. **DUROFIX** is undoubtedly the finest value for money today. It has such a wide range of applications from simple woodwork repairs to fine china, porcelain and glassware that no home should be without a tube. **Commercial tubes 5/-; ¼ lb. tins 2/9; 1 lb. tins 10/6.**

1/-

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

1/-

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

10½D.

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

RAWLPLUGS IN HANDY 1/- BOXES

This is the now famous 1/- Rawlplug Handy box providing the handyman with the popular sizes of Rawlplugs to suit all his household fixing needs. Each box contains three lengths of any one Nos. 6, 8, 10, 12 and 14 Rawlplugs.

DUROFAST

1/9

Durofast is the new contact adhesive by Rawlplug. It has absolutely amazing strength yet is so flexible you can even fix rubber soles to shoes with it. Durofast is ideal for fixing laminated plastics to cabinet tops and can also be used for fixing metal to metal or glass to metal, rubber and felt to wood, etc.

THE RAWLPLUG COMPANY LIMITED, CROMWELL ROAD, LONDON, S.W.7

B657A

Practical MECHANICS

Vol. XXVIII November, 1960 No. 319

Editorial and Advertisement Offices
"PRACTICAL MECHANICS"
George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2.

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

SUBSCRIPTION RATES
including postage for one year
Inland - - 22s. per annum
Abroad - 20s. 6d. per annum
Canada - - 19s. per annum

CONTENTS

CONTRIBUTIONS

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

FAIR COMMENT

THE AGE OF SYNTHETICS

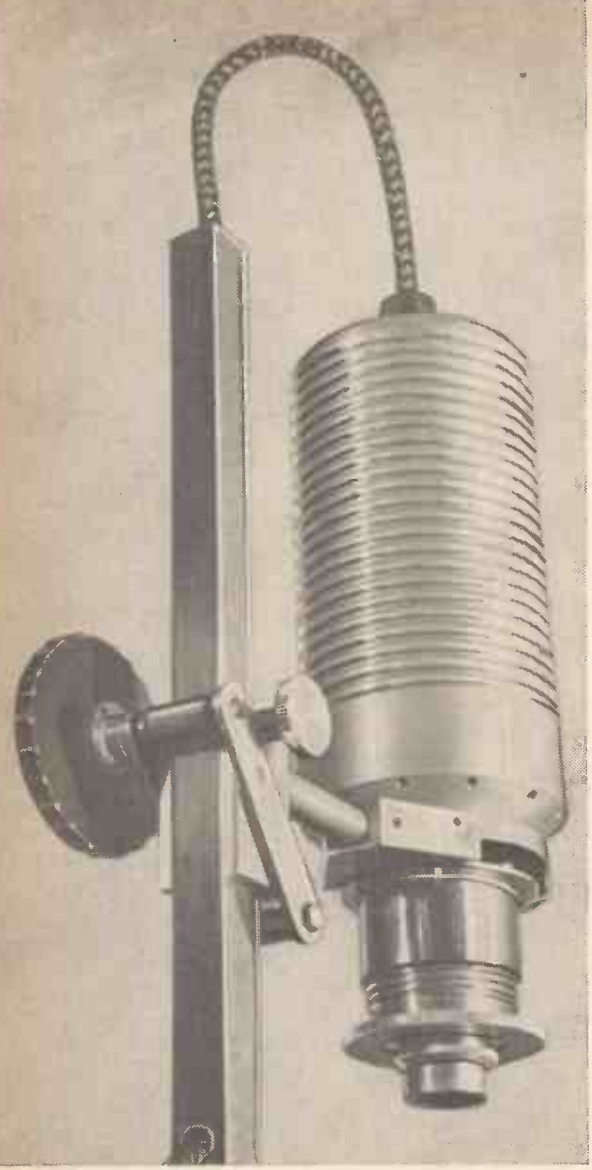
IT would be an extremely interesting experience if we could take a few spins in Mr. H. G. Wells' Time Machine and emerge, say, 30 or 40 years ago. We should not live long in the year 1920 without noticing the absence of very many items which in 1960 are so familiar. Conspicuous by their absence would be jet planes, universal television, diesel electric locomotives, micro-groove records, tape-recorders and the modern range of antibiotics. Also noticeably absent would be a streamlined design of hundreds of items in domestic and general use, due of course to the fact that the materials largely responsible for modern design trends—the ubiquitous plastics were not invented in 1920. Only if plastics were entirely removed from modern life would we notice the great extent to which they have permeated almost every sphere of our existence. They have been replacing the traditional materials so gradually that we have not noticed their arrival. They have been responsible for a number of minor revolutions in the manufacturing world and although these have taken place gradually and quietly, their effects have, none the less, been considerable.

In the kitchen, not only are plastics being used for increasing numbers of utensils and implements, such as washing up bowls, rubbish bins, and heatproof handles, but they also form part of the structure and folding doors, sinks and draining boards, window frames, working tops and wall tiles are now being made from synthetic materials.

There is a strong possibility that the car bodies of the future will be made from reinforced plastic; a number of them are already made of this material. The toy making industry is using more and more plastic, as is the electrical industry and the radio and television industries. Furniture and soft furnishings are now substituting plastic sheet when resistance to dirt and moisture is required and tools are being fitted with moulded plastic handles instead of the traditional wood. Synthetic fibres have been known and used for some time now but many are of the opinion that these materials have yet to reach their peak of usefulness.

One of the more recent fields invaded by the march of synthetics is that of packaging and container making and hundreds of households have in regular use flexible plastic bottles containing liquid detergents and cosmetics. No one could fail to have noticed the amount of transparent plastic sheet used for pre-packaging recently, and in America the glass milk bottle is a thing of the past. There are hundreds of other applications, including the making of cameras, vacuum cleaners, electric shavers, ornaments, pens, adhesive tape, telephones, water pipes, electric cable insulation, and the list could go on and on.

The aspects of the production of synthetics so far mentioned are merely a fraction of the whole. It is quite likely that synthetic substitutes for most of the materials in common use could be found; many have been found already. A fairly recent discovery, a plastic derived from oil, will be a serviceable replacement for steel and another might possibly replace concrete. Others, as yet unguessed at, will not stop at serving as mere substitutes; they will be in every way superior substances to the materials they replace. Anything is possible to our busy chemists and physicists.



A Precision

The design is simple but you will need a lathe and accessories to build it.

THE model engineer or amateur mechanic who possesses a 3in. to 4in. lathe and the usual accessories is in a position to turn out a first-class precision enlarger, equally as good as any commercial product, and in many cases better. It will be evident that any piece of apparatus which is designed primarily for 35mm. work has to be of the first order. The standard of workmanship, mechanically and optically, is certainly not confined to the camera; the enlarger is equally important in these respects.

Lenses Required

In the instrument about to be described many difficulties have been overcome in order that it can be made solely on the lathe. The lens, condenser, electrical fittings and the bulb are the only parts which will need to be purchased. Practically any make of enlarging lens will suit this design, providing the focal length is 2in. or thereabouts. The condensers are double, optically ground, 60mm. in diameter and approximately 2in. focal length; this size is very common in 35mm. enlargers and should not prove very difficult to obtain. The lamp-holder is of the standard household variety and the bulb is a specially prepared one for photographic enlargers and can be obtained from most photographic dealers, the size being 75 or 100 watts. It will be seen that the majority of parts are aluminium, this material being most suitable for enlargers, and the most easily worked.

Taking a look at the principle of an enlarger, it is evident that the object is to project an image, in this case the negative, through a lens on to a baseboard. In more detail, a light source, in this case an electric light bulb working in conjunction with a condenser, throws a parallel beam of light on to the negative and evenly illuminates it. By virtue of the varying distance between the negative and lens, and lens and baseboard, we can obtain an enlarged image of the negative on the baseboard of the enlarger. These features can be clearly seen from the general arrangement drawing (Fig. 1). Each part has been separately detailed and numbered and can be quickly referred to on the drawing. Therefore a few comments on the making of the various parts will be helpful.

The Focusing Screw (1)

This part and its companion the nut (2) are the most important parts of the whole job. The screw will undoubtedly have to be a casting (unless a piece of bar is available), and a chucking piece on the opposite end to the thread will greatly facilitate machining. Gripping the casting by the spigot in the chuck, the whole job can be bored out, turned on the outside, knurled and screw-cut at one setting. Turning the job round and gripping by the bore, the focusing screw can be faced and the $\frac{1}{8}$in. wall at the end bored out and screw-cut if necessary to suit the lens. Care must be taken with the surface finish of the 8 t.p.i. portion. The success of the smooth focusing action depends on this.

The Focusing Nut (2)

This is a very similar operation on the lathe. In this case the thread is internal and care must again be taken with the finish. Very little clearance is permissible between the two threads. Face the $2\frac{3}{4}$in. dia. flange at the same setting as the screw-cutting operation. Since the negative carrier rests on this face, it ensures the negative is normal to the lens axis.

The Support Ring (3)

This component is the most complicated, yet the design has catered for its manufacture in the three-jaw chuck. By chucking on the outside diameter the

boring and recessing on one face can be carried out, and similarly, by turning round, the other face can be recessed to the dimensions shown. This then leaves the slot 2in. wide and $\frac{5}{16}$in. deep to be put in. If the lathe is not capable of milling this slot, it will have to be put in by file; rule dimensions are quite satisfactory for this.

The Lamphouse Ring (4)

This part could be spun out of thin material if the necessary equipment is available; failing this a casting will have to be resorted to.

The Arm (5)

An aluminium casting is used for this; the best way of machining it is to turn the $\frac{3}{8}$in. dia. portion between centres before slotting for the $\frac{3}{4}$in. square bar. The slotting can be carried out on the lathe by mounting the arm on the saddle and milling with a $\frac{3}{4}$in. dia. slot-drill held in the chuck.

Light Baffles (6 and 7)

These are made from 16-gauge aluminium sheet.

Enlarger for 35mm.

The Tension Arms (8)

These are made by straightforward drilling in $\frac{1}{8}$in. aluminium sheet, the small brass bushes being pressed in.

The Rubber-covered Roller (9)

This has a length of rubber tube cemented on with Bostick.

Parts 10, 11, 12 and 13 are all straightforward turning operations.

The Square Bar Pillar (14)

This has a hole drilled down the centre to house the flex for the lamp. This operation might prove difficult on a small lathe, and can be omitted without affecting the working of the enlarger.

The Negative Carrier (15)

This component is in two pieces. The guide is aluminium, grooved to suit the width of negative material, i.e., 1$\frac{3}{8}$in. An alternative method to milling the groove is to rivet two strips of $\frac{1}{16}$in. material $\frac{9}{32}$in. wide on to a piece of aluminium 4$\frac{1}{2}$in. × 1$\frac{15}{16}$in. The pressure plate is glass, preferably optical, and pressure is brought to bear by means of two swing-away clips at the ends.

Lamphouse and Baseboard

Only two items now remain for comment, namely, the lamphouse and the baseboard. For the lamphouse a commercially produced aluminium hot-water bottle was used.

The baseboard can be made of any substantial material providing it is rigid, e.g., good thick plywood. The prototype was made from the top of a box and the interior used for the storage of paper, etc. The square bar pillar and the focusing nut can be chromium-plated to bring the finish in line with the rest of the enlarger.

Degree of Enlargement

The degree of enlargement permissible with this design can be altered somewhat to suit individual tastes. The maximum enlargement is dependent upon the length of pillar, the length of the arm, and the distance between negative and lens. The design permits a 12in. × 8in. print to be made—the format of the negative, i.e., 36mm. by 24mm. To increase this size the pillar will have to be lengthened and the arm made longer; the focusing arrangement will be all right as it stands. The baseboard will have to be capable of taking larger papers, dependent upon the degree of enlargement required, unless one is prepared to project, say, off a table on to the floor.

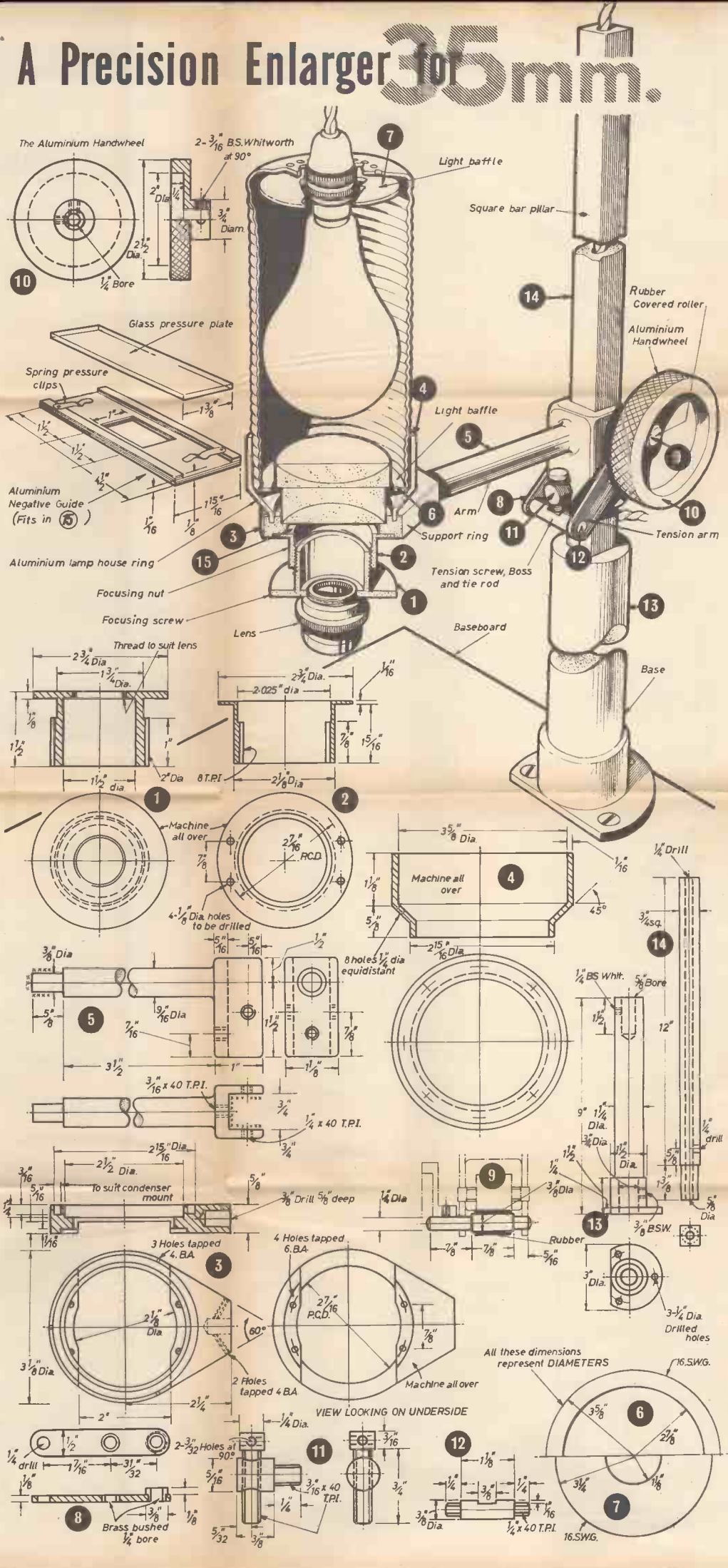
Negative Carrier

The design of the negative carrier does not cater for projecting from a roll of film, but from strips in, say, three or four exposure lengths. It is preferable to support the film over as great an area as possible rather than by the two perforated edges as found in the glassless type of carrier. By sandwiching the negative between two pieces of optical glass, the film remains perfectly flat and rigid. This is particularly important when there may be a chance of heat from the lamp causing the negative to distort. One of the greatest advantages with glassless carriers is that the image projected is free from dust-marks, which are apt to be troublesome in the glass type.

A very important feature in 35mm. enlargers is the high degree of enlargement which is necessary in, say, exhibition prints, so it will be appreciated that any small foreign matter present on the negative will show itself in magnified form on the print. Therefore, if we take into consideration all these points, it seems obvious that, firstly, we must obtain a correctly projected image, and secondly, exceptional care must be taken with the mounting of the negative. After considering all the points for and against each type of carrier, the optical glass type is definitely the lesser evil of the two. Slight imperfections on the print can easily be removed by spotting, whereas there is no remedy for an incorrectly projected negative, i.e., one that has been distorted during exposure.

In conclusion, a first-class instrument can result if care is taken in the making and assembly of the various parts, and the user will be amply repaid for his efforts when the enlarger is put to work in the darkroom.

A Precision Enlarger for 35mm.



A Box of Conjuring Tricks

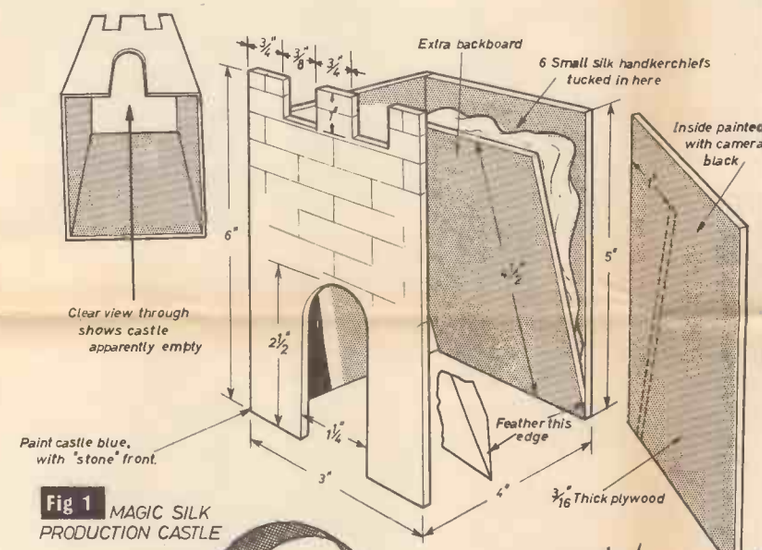


Fig 1 MAGIC SILK PRODUCTION CASTLE

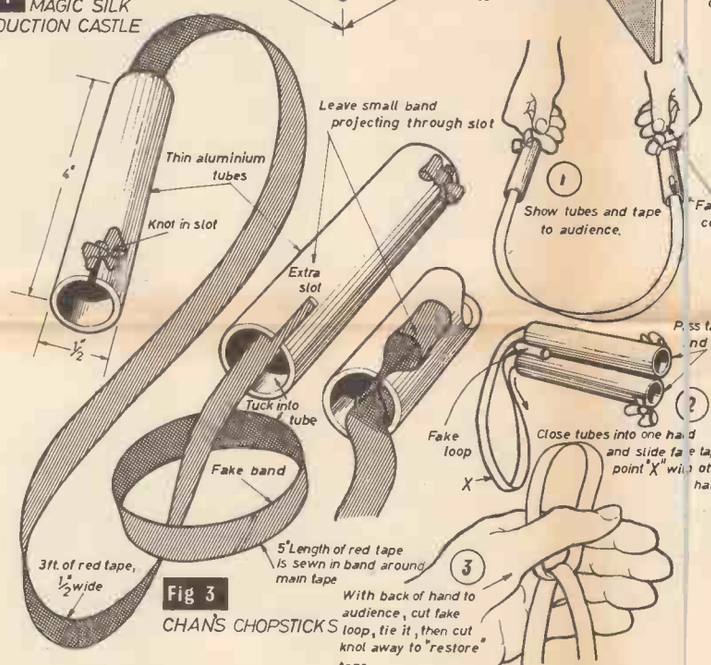


Fig 3 CHAN'S CHOPSTICKS

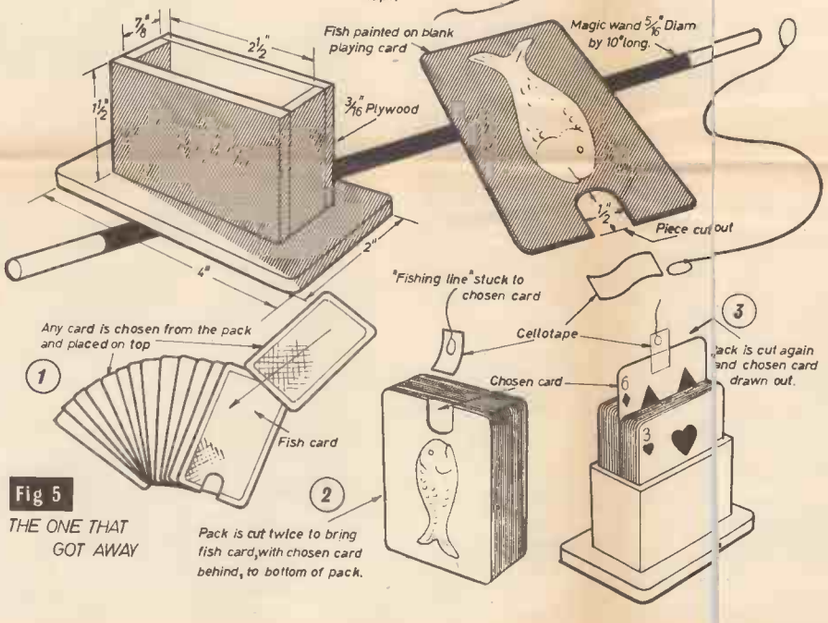


Fig 5 THE ONE THAT GOT AWAY

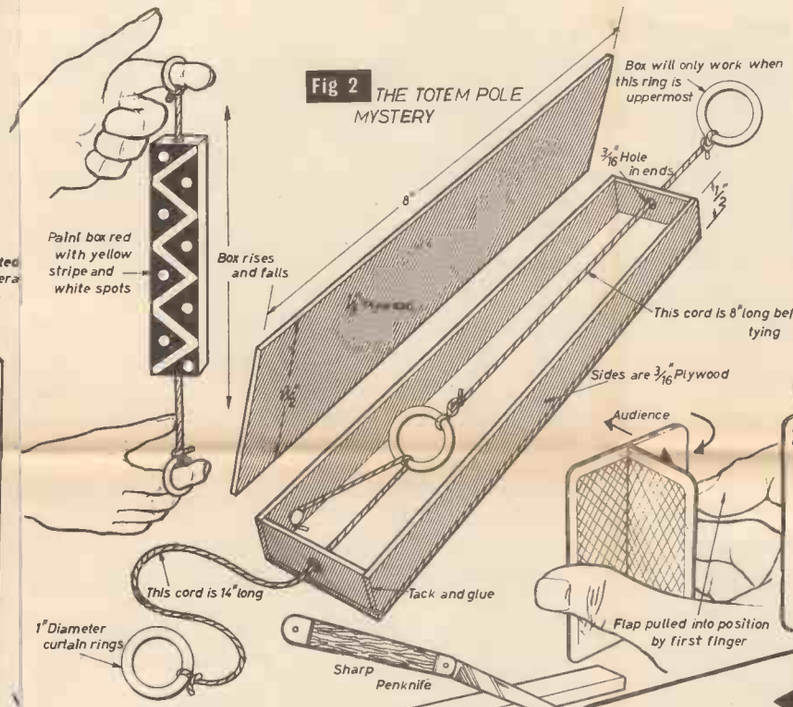


Fig 2 THE TOTEM POLE MYSTERY

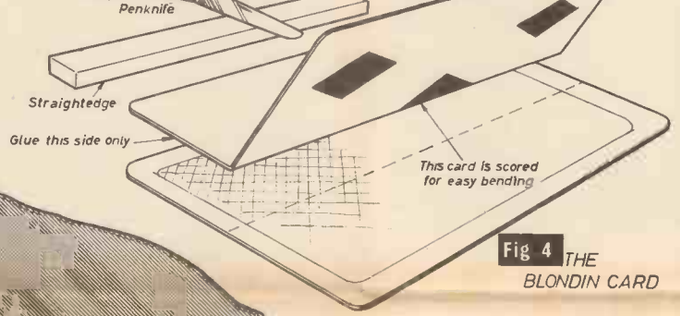


Fig 4 THE BLONDIN CARD

Fig 6 THE SPACE DICE

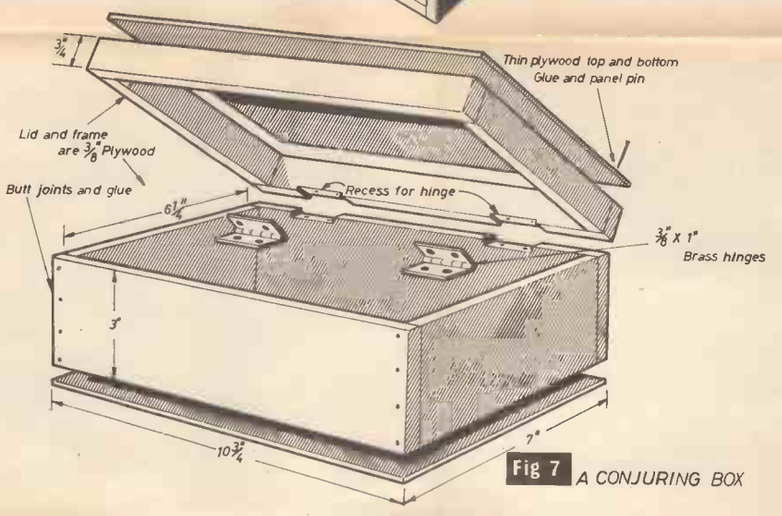


Fig 7 A CONJURING BOX

PM 3 IN BLUEPRINT

A BOX OF CONJURING TRICKS

The six tricks complete with carrying case.

THE secrets of modern magic are, naturally, closely guarded by conjurors but this set of six tricks complete with carrying case has been devised for the amateur magician so as to bridge the gap between the elementary box of tricks and the professional magic kit. By actually constructing the apparatus, the aspiring conjuror will understand more fully how each trick works and this experience, coupled with plenty of practice, will enable him to present, with confidence, the 15-minute programme of magical entertainment.

An outline of the patter—what to say with each trick—is included in the performing notes and should be learned by heart before attempting to show the programme in public. Remember, the possession of a few " secrets " does not, automatically, make one a magician; trick and patter must be blended together to produce the effect of real mystery.

Magic Silk Production Castle

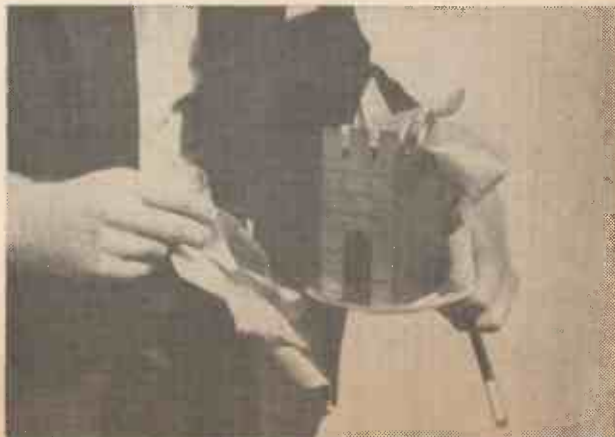
A small, open ended castle is shown to be clearly empty by allowing the audience to look through the tube at close quarters. The magic wand is poked inside the castle to prove absence of mirrors or traps. The castle is stood on a plate and rapped with the wand and then the conjuror reaches inside the tiny structure and produces at least six small silk handkerchiefs (Fig. 1).

The principle of distorted perspective is responsible for this seeming magical effect. Old-time temple builders deliberately put columns and blocks out of true to deceive the eye and the extra tapering back flap of our castle does exactly the same thing. When viewed at eye level, it is impossible to tell the difference between inner and outer castle walls. Six silks tuck away in the " V " shaped compartment as shown.

Make the castle tube from $\frac{3}{16}$in. thick plywood and the extra back from thinner material. The castle measures 3in. × 4in. round and is 5in. high, except for the front which is 6in. to the top of the battlements. Use small panel pins and glue to construct.

Before fixing the extra flap in place, feather-edge the bottom for an invisible fit where it joins the

These three photographs show the tricks being practised. This is essential for a successful technique.



The " Totem Pole Mystery."

base of the castle. Paint the inside of the tube with flat camera black and finish the outside with blue enamel. Castle front is painted light stone. Prepare for performance by folding the silk squares into the " V " space together with a rolled paper streamer or two.

Performing the Trick

Explain to your audience that somewhere in the sandy wastes of the Holy Land stands a deserted crusader castle. The small model that you show is a miniature replica of this castle. During wars of long ago, crusader knights buried rich treasure within the walls and set a spell over the building that no one should ever take the treasure and live.

Here, the castle tube is held so that the audience can see right through. The wand is pushed inside then the castle is stood on the plate. Rap the castle with the wand and pronounce: " Long lost treasure of the sand, your spell I break with magic wand!"

Start the production with the streamers and continue until the compartment is empty.

The Totem Pole Mystery

The totem pole rises and falls on its cord to answer questions put by the audience. The pole rises and falls to say " Yes " but stays put when the answer is " No." The magician asks a member of the audience to hold the totem pole but in the hands of this stranger, the pole refuses to move!

Fig. 2 shows the construction of the totem pole and explains the method of working. The box is 8in. long, 1½in. wide and ¾in. thick. Sides and ends are of $\frac{3}{16}$in. thick plywood but the top and bottom of the box may be thinner. The upper piece of thin cord or string is 8in. long and is tied to a pair of plastic curtain rings 1in. dia. The bottom cord—14in. long—is tied off inside the box and then passes through one of the upper rings as shown.

Paint the entire box red then decorate with wavy yellow lines and coloured spots to resemble a Red Indian totem pole.

Performing

Take up the pole with the short cord uppermost and patter: " Red Indians take their problems to the pole . . . the totem pole! Are my audience enjoying the show? I'll put my question to the pole and see if he says yes!" Here, the hands are gently separated causing the box to climb the cord. Both hands should move away from each other and the illusion is perfect.

The simple movements of "Chan's Chopsticks" need to be rehearsed.

When you ask someone else to try, the rings are reversed so that the short cord is at the bottom. The box will stay where it was . . . at the bottom!

" Chan's chopsticks " being performed.

Chan's Chopsticks

Chan's Chopsticks is a trick in which a length of red tape is cut and then restored to its original condition. Little skill is required in its performing but the simple moves must be rehearsed.

A 3ft. length of ½in. wide red tape is knotted into a pair of aluminium tube handles. The tubes are ½in. dia. and are 4in. long. Two slots are sawn in the ends for the purpose of securing the main tape (Fig. 3). An extra slot is cut in the other end of one tube as shown. The fake band is a 5in. length of red tape which is sewn in a loop round the long tape. After sewing, the small band is tucked into the tube handle with the extra slot. A small loop of the small band is

The fish card has a ¼in. wide and deep slot cut in one edge.

left protruding through this slot and the trick is ready to work.

Performing

Show the main tape by holding the tubes in right and left hands. Right thumb covers the protruding fake band. Patter: " Imperial Emperor Chan decided to cut some of the red tape surrounding his diplomatic affairs." Here, the tubes are gathered into the left hand but the right thumb and first finger take the end of the fake band and slide it up the folded tapes to point " X " shown in Fig. 3. The movement should be smooth and unhurried with the fake band concealed in the closed hand. With a pair of scissors, which are taken in the left hand now, the fake loop is cut through—apparently cutting the main tape in half.

Tell the audience that Chan reckoned without his crafty Chief

The " Blondin Card Trick " being used with a match box.

The card stand, fish card, magic wand and line being used.

of Staff. The Chief tied the red tape together and cut away the knot—here, the ends of the cut fake band are tied into a knot round the main tape and the small band is cut completely away.

" Emperor Chan found that he couldn't get rid of his red tape so easily!" The tape is fully restored.

The Blondin Card

This highly mystifying card trick in which a wineglass—or similar object—is balanced on a playing card taken from the pack, is made doubly effective if the moves are carefully followed.

Two cards are used to make the Blondin Card (Fig. 4). Using a straightedge and sharp penknife, lightly score a line down the back of one of the cards so that it will bend easily. Apply glue to the face of one side of this card and press it to the back of the second playing card. When dry, the card can be shown as an ordinary one—with the flap held down—or used to balance the glass—with the flap pulled open with the forefinger as shown.

Place the Blondin Card somewhere in the pack and the trick is ready to work at anytime.

Performing

Explain, taking the special card from the pack: " Blondin was a famous balancer who pushed a wheelbarrow over Niagara Falls on a tightrope. If I tap this card with the wand and place this wineglass—so, PRESTO! It balances! "

After taking the card from the pack, it is shown back and front. The flap is opened as the glass is placed in position on the top of the card. Afterwards, one hand takes the glass while the other picks up the card, closing the flap at the same time. Replace card in pack.

The One That Got Away

A fish is painted—using Indian ink—on the blank card of the pack. This fish card is attached by tape and thread to the magic wand and buried in the rest of the pack. On pulling the line however, it is a card that has been previously chosen by an audience volunteer that is fished out of the pack!

Make up the card stand, fish card, magic wand and line as shown in Fig. 5. Use $\frac{3}{16}$in. plywood for the stand and note that it will hold a pack of cards easily. The fish card has a $\frac{1}{4}$in. wide and deep slot cut in one edge and is on top of the pack at the start of the trick.

Performing

Offer to give your audience a demonstration of magic fishing. Ask for someone to remove any card from the pack. After the card has been chosen and shown to the audience it is replaced on top of the pack—immediately over the fish card. The pack is cut bringing fish card and selected card to the middle of the pack. Fan the cards face towards you and locate the fish card, chosen card is—of course—behind it now, then cut the pack again so as to bring the fish and selected cards to the bottom. See sketch.

A thumb is kept over the slot while you show audience the fish card. Patter: " We are going to ask our fish to find us the chosen card." Stick the adhesive tape over the slot—actually fastening it to the chosen card behind. Cut this card to the middle of the pack and place the whole pack in the stand. You are now ready to fish out the chosen card. Lift gently on the wand and up comes the selected card.

The Space Dice

To finish the programme, a wooden dice is made to travel from beneath a handkerchief into an empty hat. Afterwards, a variety of goods are produced from the hat to bring the programme to an effective finish.

The apparatus comprises a hollow plywood dice 3in. cubed. One side is open and this contains the final production load. Paint the dice black and fix white paper spots on the five sides (Fig. 6).

Two red and white cotton handkerchiefs are sewn together round the hems and a wire shape—3in. square—is tacked between the centres. Borrow a hat from a member of the audience and you are ready.

Performing

Show the dice and cover it with the handkerchief taking care to have the wire shape exactly over the dice. Ask the audience if they'd like to see the dice travel visibly or invisibly from under the handkerchief to the hat. As you say this, lower the handkerchief and dice into the hat as though to demonstrate.

The Space Dice.

The wire shape gives the impression that the dice is still under the scarf.

You leave the wooden dice behind in the hat and bring out the handkerchief still holding by the wire shape. It appears as though the dice is still underneath.

From the other side of the stage, flick the handkerchief and show that the dice has vanished. Walk over and remove the dice from the hat but leave the production load behind in the hat.

As you take your bow, thank the fellow for the loan of his hat then just as you are about to give it back, notice the load inside and produce for your final surprise!

A Conjuring Box

A carrying case of sufficient capacity to carry the tricks is made as shown in Fig. 7. The frames for box and lid are of $\frac{3}{8}$in. plywood glued and pinned and the top and base are of a thinner plywood. A pair of brass hinges and a suitable catch complete the box.

Simple Intercom Unit

It can be used 100 different ways

says Colin Weston

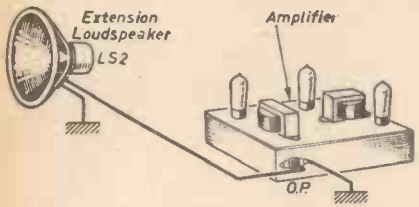


Fig. 1.—Basic circuit.

THIS article deals with a simple intercom system which makes uses of basic apparatus such as an amplifier, radio or tape-recorder and extension loudspeakers and it needs no elaborate ancillary equipment.

The first stage is the circuit shown in Fig. 1, in which the extension loudspeaker LS 2 is operated in conjunction with the main amplifier. The main amplifier may in fact be part of a radio, record-player or tape-recorder besides a straight amplifier. In the author's system, a tape-recorder was used so that the tape-recorded programmes could be heard on the extension loudspeaker and/or the internal speaker of the tape-recorder. Since the extension loudspeaker is situated in the author's workshop and the tape-recorder in the house, it soon became evident that a simple intercom whereby communication between the workshop and the house, in addition to the normal advantage of the extension loudspeaker, would be a considerable improvement on the system. Various ideas have been tried out and this article is based on the successful experiments. The final circuit, however, will depend largely on what the constructor has available.

A Second Loudspeaker

The first modification to Fig. 1 is to add a second extension loudspeaker LS 3 which is placed near to the main amplifier. It should be emphasised here that the loudspeakers should be of the moving coil, permanent magnet type.

The Switch

Basically, the circuit is as shown in Fig. 2. It is assumed for the present that the main amplifier has no internal loudspeaker or that it can be muted; later a means of utilising the internal loudspeaker will be described. The switch S.1 serves to connect either:

LS 3 to amplifier output and LS 2 to amplifier input for " Receive," or LS 2 to amplifier output and LS 3 to amplifier input for " Transmit."

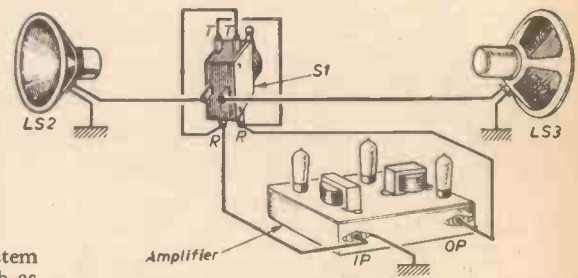


Fig. 2.—Adding a second loudspeaker and a two-pole, two-way switch.

In order that LS 2 and LS 3 may receive the normal programme from the amplifier at the same time, the switch must be provided with a third position. With the circuit shown in Fig. 2, it is only possible for either LS 3 to receive the normal programme (switch S.1 in position T) or LS 2 to receive it (switch S.1 in position R). If the amplifier has an internal loudspeaker, this could be switched on and the switch S.1 turned to position T, in which case both LS 2 and the internal loudspeaker would receive the normal programme. However, it has been assumed that the internal speaker is not used, and therefore the switching circuit must be modified as shown in Fig. 3. Here by turning switch S.1 to position S, both LS 2 and LS 3 are connected to the amplifier output whilst the amplifier input is left disconnected. By this means both LS 2 and LS 3 can receive the normal programme.

Calling

It will be noticed that no facilities for calling have been included. It is possible for a person at the amplifier to call a person at LS 2 merely by switching S.1 to position T and speaking through LS 3. For LS 2 to call LS 3, a battery, buzzer and two-way switch must be added to the LS 2 circuit being built either into the speaker cabinet or on to a separate baseboard. The circuit of LS 2 then becomes that shown in Fig. 4 which is self-explanatory. The completed circuit is then as shown in Fig. 5.

Summary of Modifications

In order to clarify the modifications which have been made so far, the operations with switch S.1 in the three positions T, R and S are summarised:

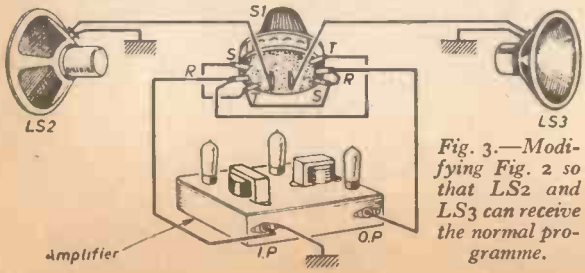
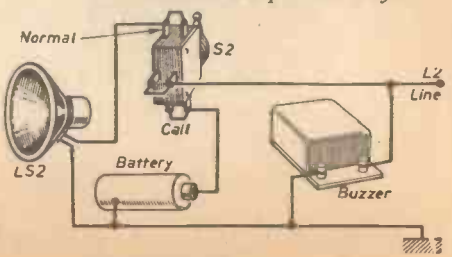


Fig. 3.—Modifying Fig. 2 so that LS2 and LS3 can receive the normal programme.

Fig. 4.—Adding battery and buzzer to LS2 circuit. Switch is one-pole two-way.



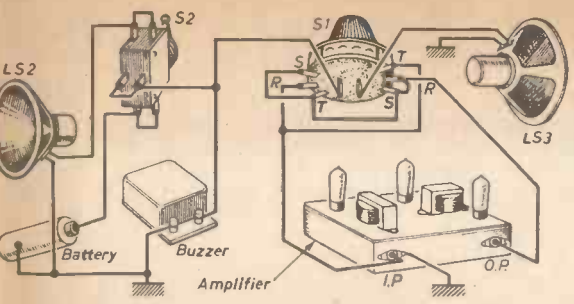


Fig. 5 (Left). — Circuit of Fig. 3 with battery, buzzer and switch added.

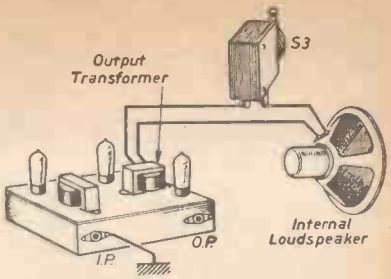


Fig. 6.—Modifying to include internal loudspeaker.

Position T: LS 3 talks to LS 2.
Position R: LS 2 talks to LS 3.
Position S: Programme can be heard through LS 2 and LS 3. In order for LS 2 to call LS 3 (with or without the programme being heard over the loudspeakers), switch S.2 is turned to the call position whereupon the buzzer will be heard in LS 3. By turning to position T on S.1 (and disconnecting the programme source if there is one) LS 3 can then reply to the call from LS 2. The procedure for LS 3 calling LS 2 has already been described.

Using Internal Loudspeaker on Amplifier

In order to utilise the internal loudspeaker of the amplifier in place of LS 3, certain modifications must be made inside the amplifier. It is most probable that the output circuit of the amplifier is as shown in Fig. 6 where a muting switch for the internal speaker is shown. The complete modified circuit is then as shown in Fig. 7. One of the leads between the internal speaker and the output transformer needs to be earthed. This can best be achieved by trying each one in turn and whichever connection has no shorting effect on the internal loudspeaker is the correct one. In many cases, the earth connection will already be present. For normal intercom operation, switch S.3 should be " off."

Fitting Output Socket to Amplifier

If no output socket is available, one can easily be fitted as shown in Fig. 8. If an output socket is already fitted, it will in any case most probably be connected as shown in Fig. 8.

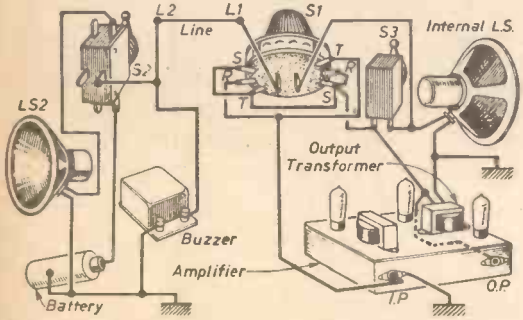
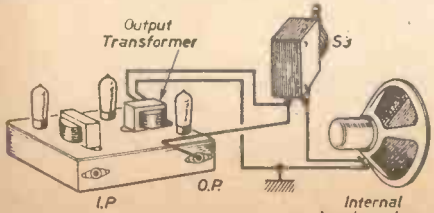


Fig. 7 (Above).—Internal loudspeaker included in the complete circuit, adding a simple on/off switch.

Fig. 8 (Below).—Fitting an output socket.

Fig. 9 (Right).—Fig. 7 redrawn for double line switching. A four-pole three-way switch is used.



Fitting an Input Socket to a Radio

If a radio is being used and there is no " gram " input socket, one can easily be wired in by using the two outside tags of the volume control to which the input signal should be applied. Incidentally, an output from the radio tuner part of the receiver may be taken from the same two tags, the output level in this case is then independent of the volume control setting of the receiver.

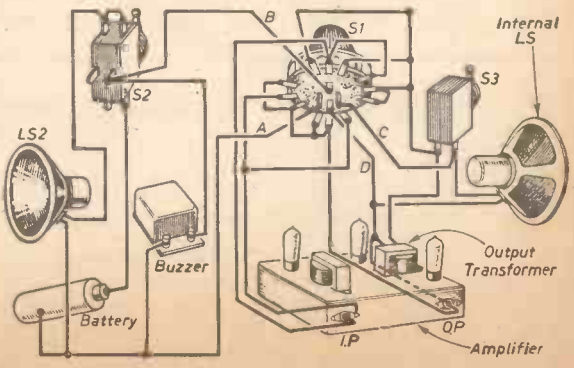
Adding Extra Extension Loudspeakers

It is possible to use extra extension loudspeakers as required. The circuit for each additional loudspeaker is the same as that shown in Fig. 4. Terminal L.2 (see Fig. 4) is connected by a suitable length of wire to terminal L.1 on the main amplifier unit, as in Fig. 7. Using this circuitry, the main amplifier can converse with any extension loudspeaker whilst the remaining loudspeakers can overhear one side of the conversation only, that from the main amplifier. Usually this does not matter so that no modifications for " secret " communications will be discussed.

Type of Switching Circuitry

So far, it has been assumed that single-line switching is satisfactory, i.e. the switching is carried out in only one line, the second line being either earthed or joined to a common return line. This assumption will only be valid if both input and output sockets of the amplifier have one connection earthed. If this is not so, it may well be necessary to use double-line switching in which case switching is carried out in both lines simultaneously, the switching circuit in the second line being identical to that in the first line. For the sake of clarity, Fig. 7 is redrawn for double-line switching in Fig. 9.

The circuits given are only basic circuits and the individual constructor will easily be able to adapt this intercom system to meet his own particular needs using the equipment which he has available.



a delta winged model

For the enthusiast

PEE WEE PETE is a delta wing power model, designed on a flat plan form and having no dihedral. The "Pee Wee" motor gives exceptional power for its size and consequently the model may appear rather large. The construction should prove very easy and can be built entirely from items in the scrap box, otherwise the purchase of 5s. worth of balsa will be more than enough. Also taking into account that a "Pee Wee" motor 0·032 c.c. now costs only 42s. 6d. this is indeed a very cheap model to build.

Construction

Building is commenced by cutting out from balsa sheet the centre rib and L.E., these being of medium soft quality. All spars are cut from a sheet

designed and described by Colin Read

The completed model.

Details of the fin, spars and body.

of $\frac{1}{8}$in. medium and the two end ribs from $\frac{1}{16}$in. sheet. Pin down and cement together the centre and tip ribs, main spars and leading and trailing edge. (The $\frac{3}{32}$in. sheet soft elevators are added later.) Add the $\frac{1}{16}$in. square strip to the T.E. where indicated and also the $\frac{1}{8}$in. sheet to the L.E., this gives both support for the ribs and makes a stronger wing. Do not on any account use hard balsa as the C/G position comes out exactly using medium light wood. Remove the wing from the building board and add the $\frac{1}{4}$in. × $\frac{1}{16}$in. capping strips on the bottom. When dry add the top capping strips and the $\frac{1}{8}$in. × $\frac{1}{16}$in. sheet gussets.

Fill in with $\frac{1}{16}$in. sheet around the nose top and bottom as shown below and add the $\frac{1}{8}$in. ply motor mount, well cementing to give slight lift and several degrees of down thrust. Lastly add the $\frac{1}{8}$in. sheet fairing on the top and bottom of the nose. Sand well and add the tip blocks, carving these from soft balsa. If any joints seem doubtful reinforce with plenty of balsa cement using Britfix for the nose and a non shrinking type of cement for the remaining airframe. Nothing is more annoying than sagging ribs, etc., caused by using a shrinking type of balsa cement especially on a lightly built frame.

Fins and Elevators

After the basic frame has been completed cut the two fins and elevators from the specified sheet using soft balsa, sand and cement in position, raising the elevators the necessary $\frac{3}{16}$in. from level. Finally cover with jap tissue or if not available lightweight model-span and trim as desired. The original model was red with black trim, the fins being left natural.

Cut the small elevons from the elevators and install two small pieces of thin aluminium or tin to serve as a hinge to give that final adjustment which is characteristic of delta models.

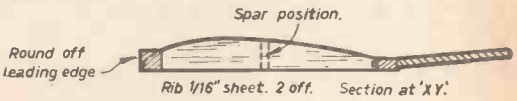
Testing

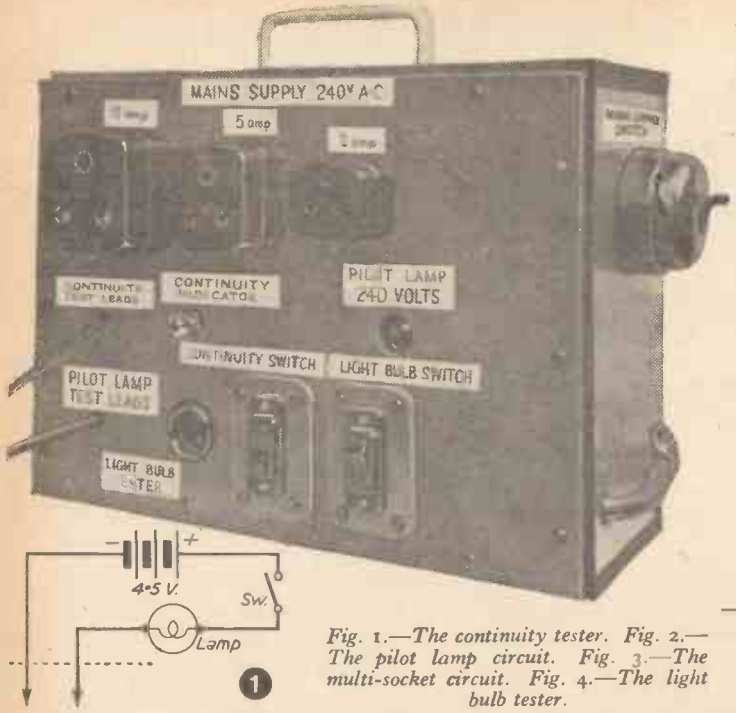
Test glide the model and if any signs of nose heaviness appear raise the two elevons slightly, or if the model stalls lower them but only a very small amount at a time and alter both at the same time. This is important, as they work as a rudder and will make the model very manoeuvreable. Launch for the first flight with engine running at three-quarter power and if it flies satisfactorily and safely to the left, open the engine up and stand back.

If on any account the model turns right under power, evasive action is to be called for not only by moving out of the way as " Pee Wee Pete " flies very fast but by giving more left thrust or left rudder.

When fully trimmed, flights in any weather are possible, the original model flew extremely well at both this year's Nationals and Northern Heights rally.

Further constructional details.





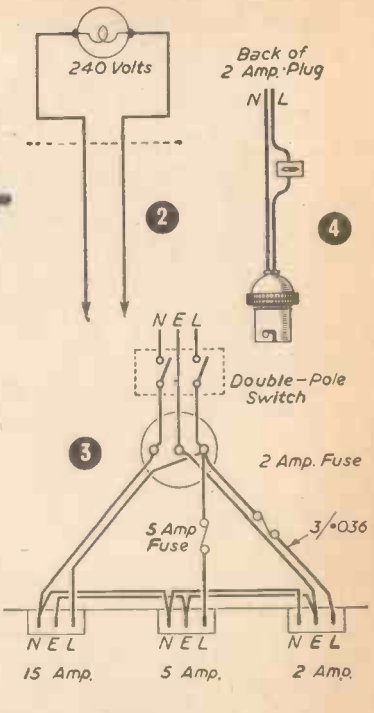


Fig. 1.—The continuity tester. Fig. 2.—The pilot lamp circuit. Fig. 3.—The multi-socket circuit. Fig. 4.—The light bulb tester.

An Electrician's Mate

for your Workshop

By K. B. Kearney

THE tester has four circuits: continuity tester, multi-socket circuit: light bulb tester and pilot lamp. Its appearance can be seen in the photograph.

Continuity Tester

This is used in the following way: assuming an electric iron is being tested for a suspected short, the end of a test lead is attached to a plug pin and the other to the casing of the iron. The bulb will only light if some part of the element or connection is actually in contact with the casing.

The continuity tester may be used to find out if there is a fracture in a piece of cable or wire by attaching one end of the test lead to one end of the cable and the other test lead to the other end. If the bulb does not light, there is a break.

The continuity tester consists of a battery (internal) continuity test leads and a continuity indicator (low voltage light bulb). The switch is optional. The circuit is wired as shown in Fig. 1. The battery used was a 4½V. bell battery, chosen because it is easy to mount and replace, having two screwed terminals. The bulb is of suitable voltage and is mounted in an appropriate holder.

The test leads are of rubber-covered flexible cable. The ends may be cut back and the wire soldered, or test probes attached. The leads are clamped down before leaving the unit to prevent them from being pulled out.

Pilot Lamp

This is a rough, but efficient way of finding if current is flowing in a 250V. circuit or of identifying a "live" wire. The method of finding the "live" wire is to put one end of the pilot lamp test lead to the end of the cable and the other to the conduit or lead casing. The lamp will light if the cable is "live," assuming, of course, there is good earthing continuity.

The pilot lamp circuit consists of an ordinary 250V. light bulb of low wattage, a lamp holder and twin flexible cable (tough rubber sheathed 250V. grade) for the test leads (see Fig. 2).

The Multi-Socket Circuit

The multi-socket circuit is used to save changing the plug of a piece of apparatus being repaired or tested, if it does not fit into your workshop socket. With this unit you plug the apparatus into the appropriate socket on the panel, then plug the unit into your own workshop socket. When the mains supply switch is closed the socket on the panel will be alive. The plug used on this unit was a 13A. fused plug therefore the sockets on the panel will be 15A., 5A. and 2A., but if you have a 15A. socket in your workshop you would use a 15A. fused plug on the unit lead and 13A., 5A. and 2A. sockets on the panel. The 5A. and 2A. sockets must be protected by fuses (internal). These may be cartridge fuses mounted in clips as used in TV and radio receivers. This circuit

(*concluded on page 76*)

THE WORLD'S FASTEST TYRES

Fig. 1.—This 10ft. high flywheel simulates landings and take-offs at speeds up to 320 m.p.h.

Pre-record attempt testing for "Bluebird" described by Donald S. Fraser

IT took the combined efforts of approximately 80 leading manufacturing concerns to produce Donald Campbell's "Bluebird" (Fig. 4) in which he crashed recently while practising for his attempt to break Sir John Cobb's 394·196 m.p.h. record, set up in 1947 on the Bonneville Salt Flats. Five years of planning and research work; over 1,000,000 man hours spent on construction; and "a long way over £1,000,000 have so far been spent on the project."

Some Details of "Bluebird"

Needless to say, the "Bluebird," which was designed by Norris Brothers, of Burgess Hill, Sussex, will when rebuilt represent the ultimate in mechanical completeness from the tiniest nut and bolt to the powerful Bristol Siddeley Proteus 705 gas turbine, capable of developing 4,250 b.h.p.

The 4 ton car is 30ft. long, 8ft. wide, with a 4in. ground clearance. Height 4¾ft. and wheelbase 13½ft. (Fig. 5). The engine, which is installed in the centre of the car, has been modified by a drive shaft at the rear which, together with the front drive shaft, enables power to be transmitted to all four wheels. The power to weight ratio is, amazingly, approximately 2lb. for 1 b.h.p. The braking system comprises air brakes which will slow the car down to 400 m.p.h. and disc brakes, acting inboard on either side of the front and rear reduction gears, for bringing the car to a stop. The car has been designed for an ultimate peak speed of 500 m.p.h.

Motor Panels (Coventry) Ltd., constructed the body of the "Bluebird," and also installed all the other components supplied by the many companies interested in the venture. The chief body requirements were, naturally, maximum strength with minimum weight. With this in mind, a light alloy foil, in honeycomb form, was centred between sheet metal. The engine is enclosed in a pressurised chamber, the walls of which are incorporated into the main body structure.

Tyre Testing

An important feature of motor racing is the tyres. Testing equipment, for this phase of the "Bluebird's" performance and safety has already cost the Dunlop Rubber Company a considerable amount of money. The machinery used is intricate, delicate and massive. Tyres are run up to speeds of 500 m.p.h. against a heavy steel drum (Fig. 2). The tyre and wheel are "anchored" to a 12 ton bed which floats on compressed air. This eliminates friction and reproduces actual driving stress problems. It takes 700 h.p. to accelerate the wheel and tyre in tests. All measurements of speeds, temperatures and stresses are monitored by closed-circuit Pye television (Fig. 2). The tyres are made from natural rubber, with rayon casings and a special steel beading to hold them to the wheels. Inflation is approximately 100 p.s.i. with nitrogen. With racing car tyres the centrifugal forces are sometimes 500 times as great as an ordinary tyre.

An American System

It might, at this point, be interesting to compare the type of tyre testing equipment being used by another challenger for a new world land speed record. The Goodyear Company, prepared the tyres for Mickey Thompson's "Challenger," a four-engined racing car with which he attacked the record earlier this year.

The equipment used by Goodyear is known as a multi-stage dynamometer system. Through the magic of electronics and the "brute force" of high-powered motors, tyres can be torture-tested at 510 m.p.h. It is a $2,000,000 engineering facility powered by two electric motors to reach its peak power of 8,600 American h.p., and is designed so that both ends of the motor shaft can be utilised as drivers. One side drives the flywheel, with a test carriage on

Fig. 2.—A Goodyear technician monitors a high-speea tyre test on closed-circuit television.

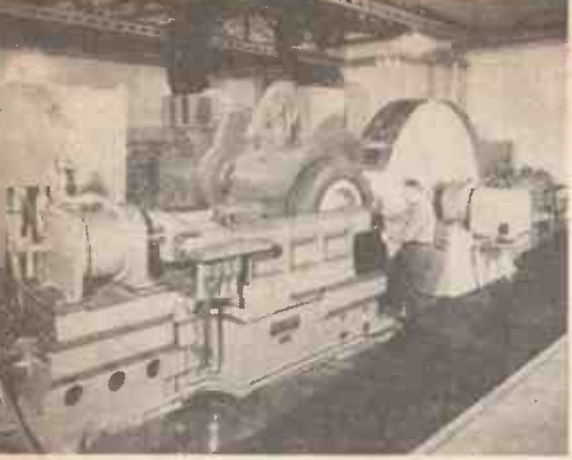


Fig. 3.—A technician checks an aeroplane tyre. A second side of this machine features an unusual tyre-on-tyre arrangement on which racing and conventional automobile tyres can be tested.

each end. The opposite end of the shaft actuates a gear which, in turn, drives two pinions on which tyres are mounted. There are a total of four test carriages which can be operated independently to a predetermined load or speed. Floor space for the entire operating of the testing facility is 9,375 sq. ft., including controls, power equipment, wheel and components and storage area.

The dynamometer system is used by Goodyear's—and the same is true of the Dunlop equipment—for aircraft tyres and provides the means of duplicating exactly all of the operational conditions of taxiing, take-off and landing, and even the tremendous impact and the yawing and twisting of tyres as a plane touches down on a runway. Although the American dynamometer system is designed for rigorous " destruction point " testing of aircraft and racing tyres, rather than for standard tyres, the knowledge gained from these tests, it is claimed, will be reflected in improved passenger car tyres of the future.

Because of the physical danger involved in running tyres at high speeds, the actual testing is monitored on a closed circuit television.

The American testing equipment was built by the Adamson-United Company of Akron, Ohio, has two separate units and is capable of testing either aeroplane, racing or standard motor-car tyres. One side of the machine features a " tyre-on-tyre " test facility. On this unit, two tyres are pressed together, tread to tread (Fig. 3), to duplicate actual load conditions, and then driven at surface speeds that can be boosted to 500 m.p.h.

The second unit features a huge flywheel, 10ft. in diameter, with a tyre carriage on each side. Used primarily for testing aeroplane tyres, it is capable of reaching surface speeds of 320 m.p.h. (see Fig. 1). Loads of better than 80,000lb. and tyre sizes from 16in. to over 6ft. in diameter can be accommodated. Landing conditions are simulated when a tyre effects a " touch down " against the flywheel, which is turning at the speed for which the tyre is being tested. Take-off conditions are achieved when a tyre, in contact with the flywheel is accelerated from zero to take-off speed. It was on the " tyre-on-tyre " unit that specially designed racing tyres were accelerated to 510 m.p.h.

Donald Campbell and his " Bluebird " took 80 specially designed and tested tyres to be used in his ill-fated world land speed record bid at the Bonneville Salt Flats.

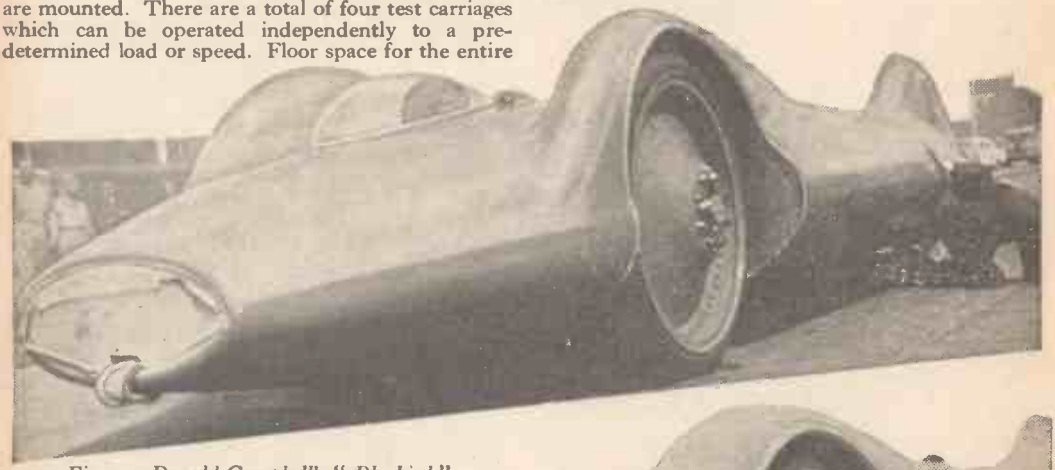


Fig. 4.—Donald Campbell's " Bluebird."

Fig. 5.—Donald Campbell looking at one of the giant 4ft. 4in. dia. front wheels of the " Bluebird."

MODEL MAKERS!

THIS FLEXIBLE DRIVE IS FOR YOU

It is quite simple to make says Peter Wix

A DENTAL burr rotating at high speed is a useful tool for many jobs besides drilling teeth. The home jewellery craftsman uses the flexible drive for drilling and piercing, and finds that it simplifies and speeds up the most intricate work, the carver of Perspex has in the round burr the perfect tool for undercutting a design, and the model engineer will never stop finding uses for a piece of equipment which can be either drill, grinder or miniature milling machine as the need arises.

The commercial unit, as seen in nearly all jewellers' workshops, and used by many other craftsmen too, is known as a pendant drill because the motor is generally suspended from the ceiling and the flexible shaft allowed to hang down over the bench. The chuck is thus always to hand, no vibration can be felt in the bench, and because most of the weight is taken off the cable, the drill or burr can be controlled with great accuracy. This type of unit costs something like £15, but one can be made for less than £2.

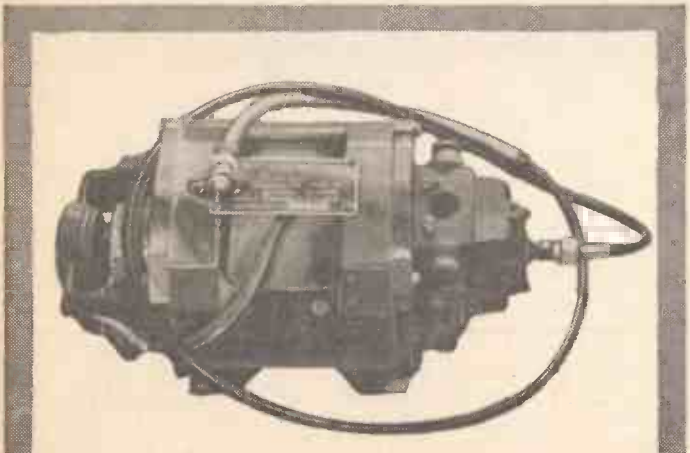


Fig. 1.—This ex-WD motor generator is suitable for the unit.

Parts Required

The three main items needed are a suitable motor, an old speedometer, and a speedometer cable. In order to reduce friction, the cable should not be too long. An old motor cycle cable—the type driven from the front wheel—was found to be ideal, and, incidentally, very cheap to purchase. The speedometer used in my case was from an Austin 10 of about 1942 vintage, but this was an instrument used in many vehicles both before and after this date, and the motor cycle cable—this one from a BSA—happens to fit it.

The Motor

A motor which is ideal for the job is the ex-WD motor generator, Type 28 (Fig. 1). This is stated to have an input of 12V. at 32A. and an output of 1,200V. at 0·2A. It can easily be converted to run off 240V. A.C. mains. It must be wired as shown in Fig. 2. The two brushes not used are simply removed from their holders, and the holders bent so as not to foul the commutator. Other motors, if they have a driving spindle of $\frac{3}{16}$in. or $\frac{1}{4}$in. dia., may well be suitable, if they will run between 3,000 and 5,000 r.p.m. and develop from $\frac{1}{16}$ to $\frac{1}{8}$ h.p.

Having re-wired this motor, ensure that fingers cannot come in contact with any " live " parts such as the brushes. If, of course, it is hung from the ceiling and out of reach, that should provide a reasonable safeguard. It is advisable to use a three-pin plug for the supply and fix the earth wire to a convenient screw on the body of the motor.

Selecting a Speedometer

In the speedometer the case back and threaded spindle housing must be undamaged, and the square-keyed spindle inside should have no perceptible sideways play. To check for side play when you are looking for a suitable instru-

ment, insert a piece of rod, the end of which has been filed to a slightly tapered square, and try to rock the spindle from side to side. The pin should also spin freely; if it does not, you can assume that it has rusted solid.

A car breakers yard will generally supply a broken speedometer for next to nothing, and a cable at a very reasonable price.

Making the Chuck

To make the chuck, first remove the rim of the speedometer, the dial and all the inside mechanism, until the back of the case is reached and you begin to see a vague resemblance appearing to the chuck, shown in the heading photograph. The steel retaining clip is held by two small screws and the back of the speedometer must be cut around the contour of this retaining clip, leaving a little to spare all round. Cutting can be done by making four cuts through the back with a hacksaw so as to remove a square, then holding this in the vice and cutting and filing to shape. The soft alloy cuts easily.

Remove the retaining clip and withdraw the spindle. Drill a small oil hole through the alloy casting in the position indicated in Fig. 4. remove all metal particles and reassemble the parts just as they were before, putting plenty of thin oil on the surfaces.

Now concentrate on finishing the motor, for when it is running it can be used to turn the chuck components, thus avoiding having to use a lathe. Lathe owners, however, will find the illustration self-explanatory, and may prefer to complete the chuck by their own methods.

Drilling the Motor Spindle

The easiest way to make a squared hole in the end of the motor spindle is to drill a hole of just sufficient diameter and depth to accommodate the squared end of the inner flexible cable. The spindle should first be very accurately centre punched, then the motor can be started, and the drill, fixed in some suitable holder, offered to it. Next flux the hole, heat the end of the spindle with a blowpipe flame or a really large soldering iron, and run tinman's solder into the hole until it is nearly full. Warm, but do not overheat the squared cable end, grease it, and then push it quickly into the molten solder. The idea is not to solder the cable in position, but only to use it for forming the correct sized hole. Thus it is a good idea to leave the cable end dirty—which it certainly will be if it has run many miles on some vehicle. Now remove the cable from the hole.

A brass plate about $\frac{1}{16}$ in. thick is now cut to fit the end of the motor, a hole drilled to accommodate the spindle with sufficient clearance, small holes drilled near each corner of the plate, and corresponding holes drilled and tapped in the motor body.

A hollow, threaded bush must now be made and brazed on the brass plate. The threaded female end of the outer cable must screw on to this and carry the squared cable end into the hole in the motor spindle (Figs. 1 & 4).

You can make this hollow bush on a lathe, or, alternatively, find a brass or steel bolt with the correct thread, cut it to length, bore a hole through its centre and braze or silver solder it to the brass plate. Hard soldering is advisable, but tinman's solder may suffice.

In use, the cable should be regularly oiled at this end, as the direction of rotation tends gradually to work oil towards the chuck end. Drill an oil hole (Fig. 3), and make it as near as possible to the screw-on portion of the outer cable when this is in position.

It pays to remove the inner cable from its outer casing and wash both thoroughly in white spirit, petrol or paraffin to remove all old grease. Light engine oil should be used when reassembling, as grease creates too much resistance and slows up the motor.

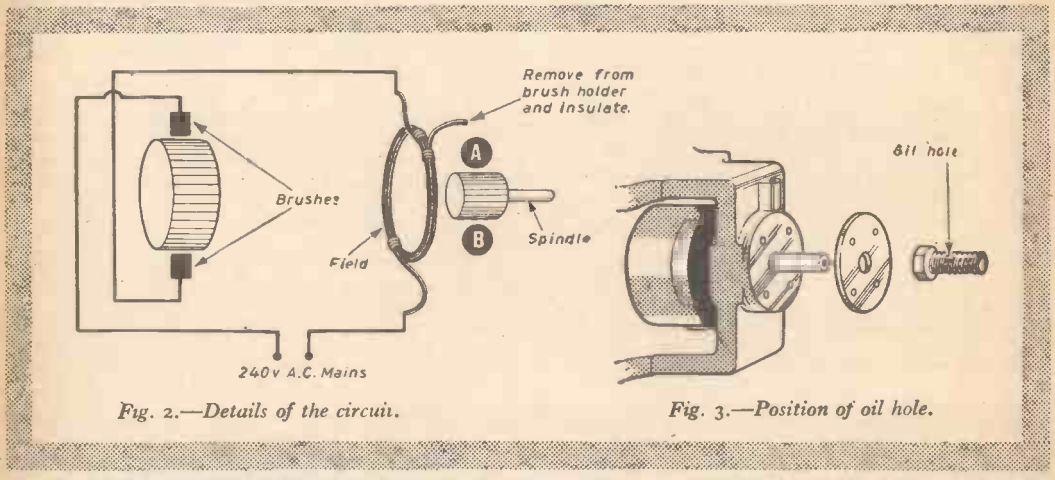


Fig. 2.—Details of the circuit.

Fig. 3.—Position of oil hole.

Testing

Assemble plate and bush, attach the cable, and the chuck components on the other end. Now start up and see if the motor will run at full speed: you can judge this by comparing the sound with that of the motor running free. Try bending the cable slightly, as you would with it in actual use, and note whether the motor slows down. If it does, the tension on the inner cable is probably too great, and you can try loosening the bush at the motor end by one or two turns. Having found the best position, secure it with a turn or two of soft wire.

Shaping the Chuck

The chuck is next formed by the simple expedient of clamping the outer bush gently in a vice (Fig. 4), and holding the ground-off end of a triangular file against the rotating metal, until it takes the shape shown in the photograph. The gear in the speedometer, which is turned down in this way to form the chuck may, in some instruments, have a centre hole larger than the $\frac{3}{32}$in. dia. which the chuck will need in order to take standard dental burrs. In this case it is a simple matter to solder a piece of brass rod in the hole and cut it off flush before actually drilling the hole.

This hole is best bored in a small lathe. An alternative method is, with the partly fashioned chuck spinning and clamped in the vice as before, mark the centre with a sharp pointed tool until a tiny pit is formed. Finally, the $\frac{3}{32}$in. drill, in a suitable holder, is offered up to it by hand. If the drill enters all the way without the slightest vibration, the hole must be accurate. Drill the hole as deep as possible; you may be able to drill all the way through to the hollow spindle. A small hole is now bored through one side of the chuck, tapped, and a grub screw fitted.

but it is worth mentioning that dentists discard burrs which are still quite sharp enough for cutting metal. Spear-point drills can also be used, and sets of these are quite cheap to buy. You can, if you wish, make your own from $\frac{3}{32}$in. dia. tool steel, shaping them on a grinder.

Other useful accessories available with $\frac{3}{32}$in. dia. shanks are abrasive wheels and abrasive tips of many shapes and sizes, small felt mops, wire scratch-brushes, and bristle brushes. Used with special drills, the flexible drive is an excellent tool for drilling pottery and porcelain, as, for example, when riveted repairs have to be made. You can even drill pearls, precious and semi-precious stones. Pearls are quite soft, but stones must be drilled with a paste of diamond dust and grease as a cutting compound. A small blob of the paste will cut hundreds of holes. The drill is made from a piece of $\frac{3}{32}$in. dia. copper rod. Put a suitable length of rod in the chuck, and taper it to whatever size you want by holding a file against it. Drill the end hollow to a depth at least equal to that of the hole you must drill, and leaving the walls as thin as possible. Put a smear of the diamond paste on a piece of glass and press the hollow

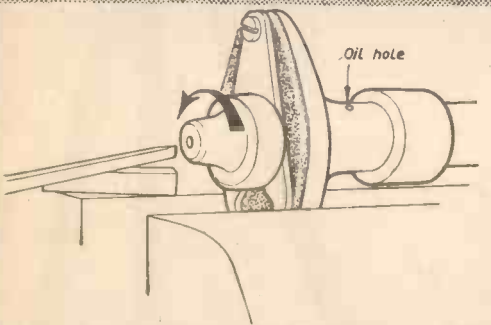


Fig. 4.—Shaping the chuck.

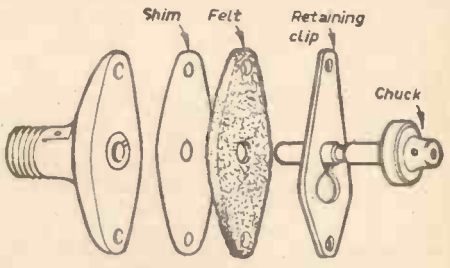


Fig. 5.—A thin piece of felt and shim prevents oil working through to the chuck.

If the unit is used as it is, oil may gradually work through the chuck and on to the fingers: a thin piece of felt and the shim shown in Fig. 5, screwed under the steel retaining clip, will prevent this. Some adjustment for end play can be effected by adding one or more washers of very thin shim material between the chuck and the retaining clip.

Dental burrs, even when inserted as far as possible in the chuck, usually leave too much shank projecting for really accurate and vibrationless drilling, and it pays to cut or grind off as much metal as you can afford from the shank. Bevel the rough edges to avoid damaging the inside of the hole when pushing the drill or burr home. The grub screw should be tightened only very slightly.

The Drive in Use

Round " bud " or straight-sided burrs can be used, and are available in a wide range of sizes. The end of a straight-sided burr will also drill quite rapidly, and once through a piece of sheet metal, sideways pressure will produce a slot, and can follow the outline of the most intricate design. Burrs can be bought from suppliers of jewellers' as well as dentists' equipment, tube on it several times. Then commence drilling. Anoint the end of the tube fairly frequently with a trace of cutting compound. The diamond particles gradually become embedded in the softer copper, and the result is the sharpest of all cutting surfaces; one which will cut the hardest materials known to man. Such a drill will even cut another diamond—given time.

The bearing of your chuck should last a very long time if kept properly lubricated. The spindle runs in a split phosphor bronze bush—or, in some instruments a white metal bush. If this should wear out in time it is a simple matter to remove it and have a new one turned; or to buy another broken speedometer and simply extract the bush.

There is scope for experiment, too, with a pair of the very small ball races which are now quite easily obtainable.

Constructional details for the workshop enthusiast who wishes to make

A CAMERA TRIPOD

Also included are details of a tilting head

The tripod will have many other uses including surveying

Described by John Waller

FIG. 1 illustrates the general arrangement of the tripod and the first assembly for consideration is the three-way head in which the legs are located. This member has a tube as the main detail and to this is brazed or riveted three channel section sheet metal parts. Incidentally as duralumin is suggested as being the ideal material for this assembly, it is stressed that soldering of aluminium alloys is performed with the aid of zinc base or cadmium base alloys with a suitable flux specially produced for that purpose. Fig. 2 gives the necessary dimensions for these parts and except for the legs all the remaining parts are easily turned from scrap ends of bar. The legs are formed from duralumin tube as shown in Fig. 4.

Locking Arrangement

The method of locking the vertical member and the legs does not rely on the fit of one tube inside the other, and within reason any diameter tube will give satisfactory results. The screw " J " is tightened in the usual manner and this pushes the inner tube against the two pins " H " until such time the tube is locked in the centre of these three details. These pins are inserted from the inside of the tube and the ends lightly riveted over to retain them in place. Spreading with the aid of a centre punch is possibly the easiest way of preventing them falling out of the tube, and it is suggested that they are best secured in position prior to adding the sheet metal U-shaped details " C." The drilling of the holes in these sheet metal parts is best performed after they have been attached to the tubular members using any odd piece of material as packing between the fork to prevent them closing inward. A final ream through these parts together with the insert on the top leg, will ensure the bolt can slide freely yet without any severe slackness.

Tilting Head

The tilting head depicted at Fig. 3 requires considerably more machining than the legs, and though the head can rotate and swivel it does give a rigid setting when the screws are finally locked. The insert " P " is a flanged member pinned into the top of the vertical tube " B " and it is important that the shank of this insert is a tight fit in the bore of the tube. Though O.B.A. is suitable thread for the screwed portion, this is best threaded to suit the camera as there are occasions when the latter does not require the tilting mechanism and is preferably mounted directly on to a rigid top.

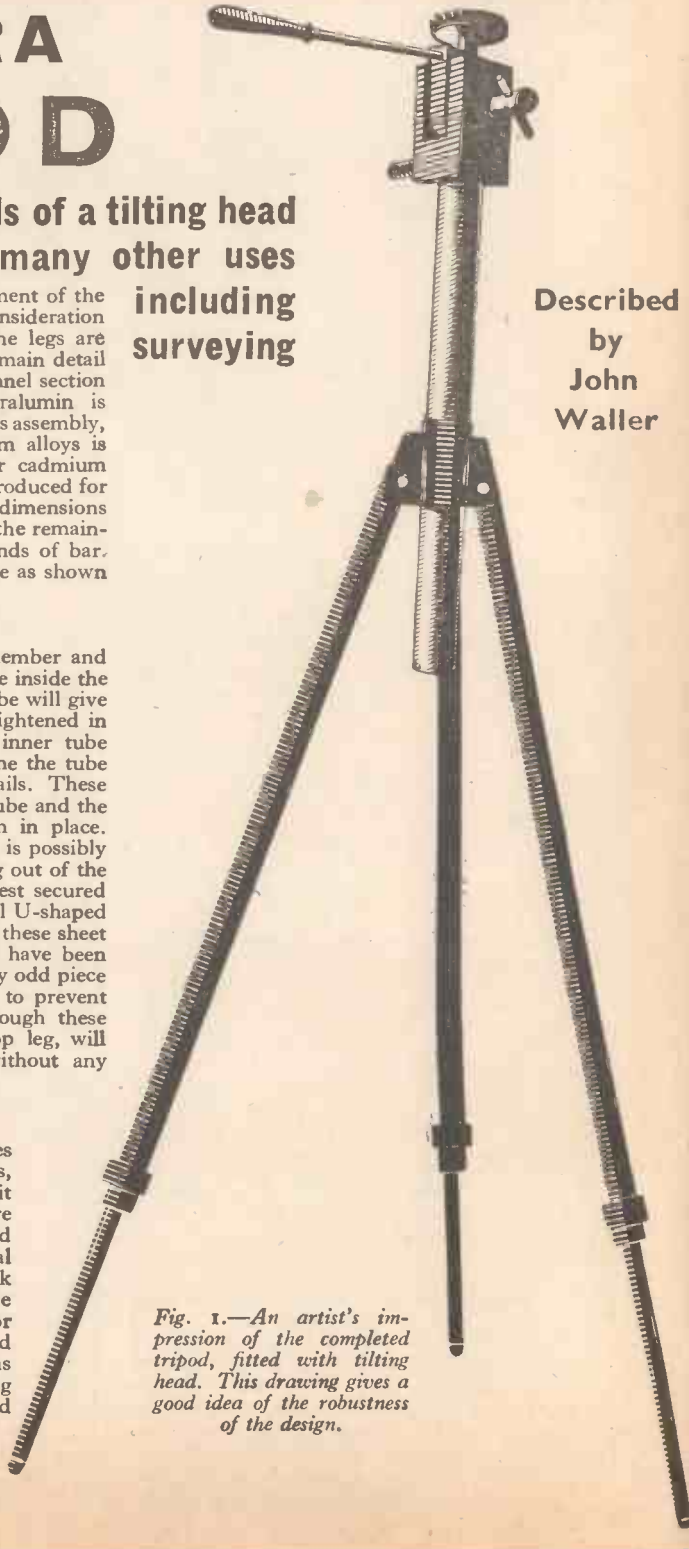


Fig. 1.—An artist's impression of the completed tripod, fitted with tilting head. This drawing gives a good idea of the robustness of the design.

Fig. 2.—Details of the pivoting and locking arrangement of the legs and adjustable centre column. Dimensional details are given at the foot of the figure.

A base " R " is next considered and this item is threaded to match the insert. The critical operation here is the boring of the recess which must correspond to the turned diameter on the rotating portion " U." A fit without any sign of slackness is essential despite the fact the assembly is locked with the aid of the screw " T."

Above the base are two half rings " S "—these are merely a solid ring sawn through to make two separate items, and the purpose of this is to provide an arrangement which stops the upper component " U " from lifting. Four tapped holes—two in each half—are used to hold these half rings in place and an essential feature is the fit obtained between the width of the ring and the slot turned in detail " U." The groove is made initially and the ring finally faced until it slides into it—a tight slide fit is perhaps a better description as this prevents any possibility of an upward movement in operation. The small set screw " T " locks the top detail and the provision of a tapered face turned in the manner shown does to some extent assist in pulling the head downwards but reliance should not be placed on this holding medium.

The alignment of the two holes which form the hinge with the tilting head " W " is also important, and the most efficient way to machine these bores is to use a single point tool on a lathe and finish both holes at the same setting. The bolt " V " is then finally turned to ensure that the diameters are a run fit in the holes and any small errors are easily compensated by making each respective diameter fit the corresponding hole.

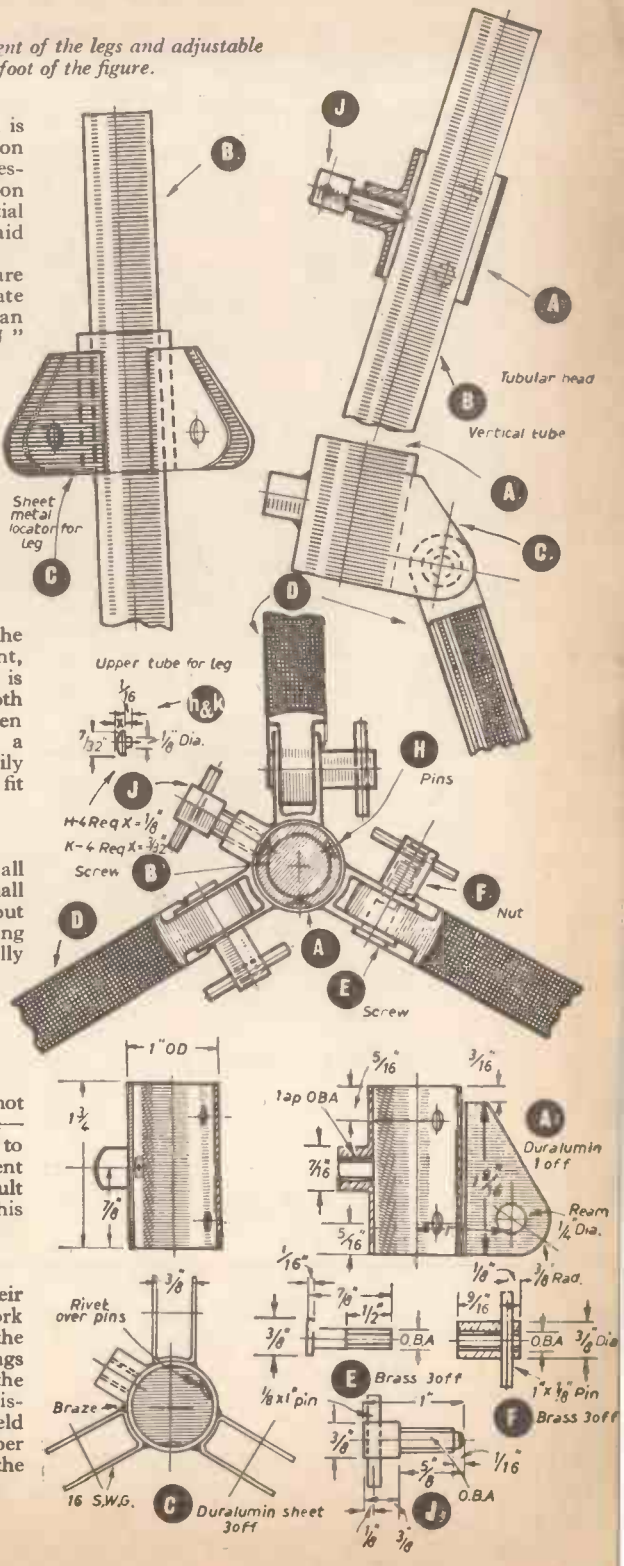
Materials

Duralumin is the best material for practically all these items: brass has been substituted for the small details where the saving in weight is negligible, but the latter is of some importance if continued carrying is anticipated. Aluminium tubes are not really suitable for the legs of tripods because the metal is so soft and damages easily, and as clamping by a screw is also necessary in this case, this is yet another point against using them. Duralumin is harder and is thus less easily damaged by the pressing action of the ball ended details.

The rod for applying the tilting action is not detailed as the length and shape is a matter of taste—perhaps bending the rod is considered necessary to give an offset action rather than a pushing movement directly behind the camera, and this is not difficult to achieve because a small diameter rod of this nature is quickly bent by merely using the fingers.

The Feet

Rubber feet are shown in this assembly but their desirability is a matter of opinion. For indoor work these rubber pads do not slip and cannot damage the surface of a highly polished floor. Outdoor settings really require metal points which bite into the surface and cannot slip, so the rubber feet are dispensed with and inserts used instead. These are held in position in exactly the same way as the top member " P "; a cross pin being ample if a drive fit in the insert is secured.



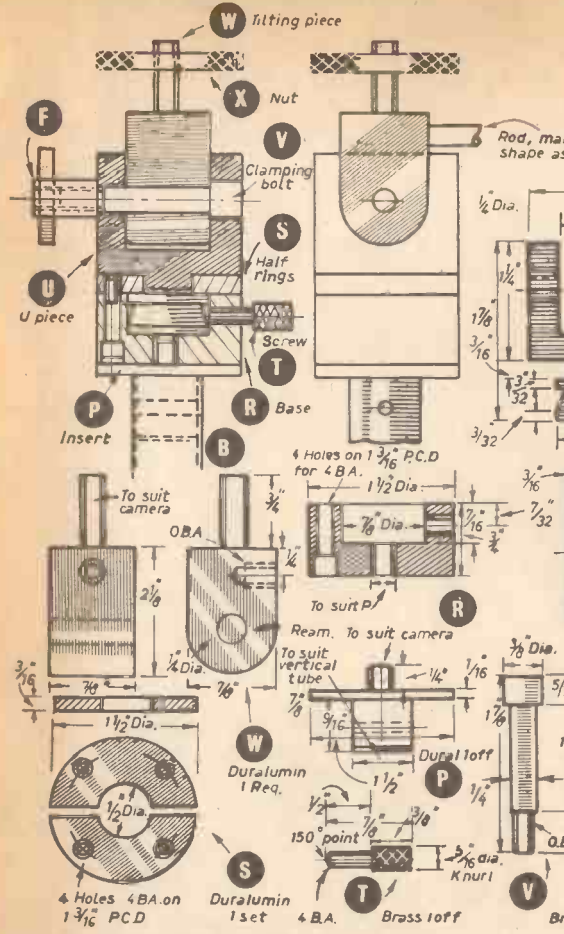


Fig. 3.—Details of the tilting head.

Fig. 4.—Details of the legs.

Finish

Finally the question of finishing arises and though painting the various parts is feasible, the metal is best left in the "natural" state as the paint soon shows signs of chipping. While treatments are available for blacking aluminium alloys, such processes are often more bother than the final result justifies. Duralumin will assume a dull finish which is not displeasing and does not, of course, rust.

Electrician's Mate (*Concluded from page* 68)

is switched by a 15A. D.P. switch and wired with 3/·036 single-core cable (Fig. 3).

Light bulb Tester

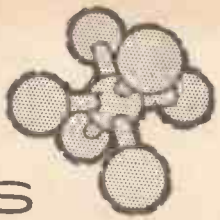
A light bulb socket is wired to the back of the 2A. socket (so as to be protected by the 2A. fuse). This part of the unit is used to test light bulbs or apparatus having an adaptor plug. The circuit is switched for safety so that the operator is not exposed to the danger of the "live" pins on the socket. Flexible cable is used in connecting up (Fig. 4).

Construction of the Unit

Exact dimensions do not matter, but the prototype dimensions were: length, 12in.; height, 9in.; width, 4½in. (not including the ¼in. nine-ply panel on the front). The sides, top and bottom of the box are made from ⅜in. soft wood. The joints used at the corners are rebated corner joints or dovetail joints, but an ordinary butt joint will serve just as well. Fix together with three 1½in. × No. 6 c'sk. screws at each corner. The joints are not glued because when wiring, it helps to be able to remove the top. The ¼in. plywood panel is fixed on with 1in. × No. 8 round-headed japanned screws and the ⅛in. hardboard back is fitted on with ¾in. × No. 6 round-headed japanned screws.

The switches are fitted in different ways according to the type used. To drill the holes for the wire to enter the socket terminals, screw the socket on the panel with a suitable wood screw then unscrew the terminal screws and drill the hole from the front via the terminal straight through the plywood panel, this then leaves a hole for the cable in the exact position. The pilot lamp may be fixed in position by clamping it down over the 1in. hole on the panel with a piece of tinplate, which may be obtained from a tin can. When wiring the light bulb tester, push the light bulb socket through the required size hole (in the panel) and secure to an L-shaped bracket screwed to the base immediately behind the front panel. When the unit is finished, paint it and attach a handle at the top for easy carrying.

SCIENCE NOTES



Second Atom Sub for R.N.

A SECOND nuclear powered submarine is to be built for the Admiralty by Vickers-Armstrongs Ltd. Rolls Royce and associates will supply the nuclear steam raising plant.

A New Plastic

A NEW plastic which is the lightest of them all has been developed. It is called Polypropylene and is derived from oil. It will resist high temperatures, is capable of being sterilised and has excellent surface gloss and hardness. These properties make it suitable for injection moulded items. Excellent transparent film, fibres for rope, netting, textiles and clothing are also promising possibilities.

Automatic Lighthouse for India

LIGHTHOUSE equipment, designed to operate completely unattended for periods of six weeks has been built by the British firm of Stone-Chance Ltd. The eight-panel lens rotates on a mercury bath and is driven by weights which are rewound by duplicate motors, one acting as a standby to the other. Either of two spare lamps can be brought in automatically if the main lamp fails. At one hour before sunset the light comes on and the lens starts to rotate. At one hour after sunrise the lamp is switched off automatically, and one of the duplicate generating sets starts up to recharge the battery. The following morning the procedure is automatically alternated and the other generating set is used for battery charging. In the event that both generating sets fail between the six-weekly service visits, the battery is capable of operating the light at emergency power for 45 nights.

Signals "Bounced" from Satellite

USING an aerial only 20ft. in diameter, a team of scientists at Malvern, Worcs., has successfully received signals reflected from the satellite ECHO 1. The signals, which included both unmodulated carrier waves and speech transmissions, were transmitted from the Bell Telephone Laboratories at New Jersey, U.S.A.

ECHO 1 is a 10ft. dia. balloon, coated with a special thin film of metal; it orbits the earth 1,000 miles up every two hours.

First Electric Wrist Watches

THE first battery-powered wrist watches are now on sale here. The battery is housed in a separate compartment from the movement at the back of the waterproof case. It can be replaced within seconds. In conventional watches the balance is impulsed by the power produced by the mainspring. An electric watch needs no mainspring because its balance is impulsed electrically. At each vibration the contact finger touches the contact springs (two, to ensure reliability), making and breaking the electric circuit. The balance wheel drives the train of the watch by the use of a click lever and click wheel similar to the lever and the escapement wheel of a conventional watch.

Activated Oil

NEW Vigzol "activated" oil repairs the chief inadequacy of multi-grade oils, that of insufficient adhesion to metal surfaces, and achieves an unbroken oil film at all times. Adequate oil film at a cold start eliminates acid corrosion, thereby reducing engine wear. Details are obtainable from the Vigzol Oil Co. Ltd., Vigzol House, Greenwich, London, S.E.10.

"Practical Welding Repairs" by C. G. Bainbridge. 128 pages. Price 15s. net. Published by Temple Press Ltd.

THIS is the first book to deal exclusively with repair welding and the three main fields—castings, sheet metal and the rebuilding of worn parts are dealt with fully. Actual jobs have been used as a basis for description and simple language is employed throughout.

"Automobile Workshop Practice" by Staton Abbey. 175 pages. Price 15s. net. Published by Sir Isaac Pitman and Sons, Ltd.

THE material in this book is designed to run parallel to actual workshop practice and although it consists mainly of theory it is linked to the practical side in that actual jobs are described and illustrated. Special emphasis is laid on aspects of repair and maintenance work which are not necessarily mastered by workshop experience alone.

"A Glossary of Metalworking Terms" by H. Winfield. 80 pages. Price 5s. net. Published by Blackie and Son, Ltd.

THE beginner or apprentice to any craft is always faced with the problem of learning the numerous specialised terms and expressions which apply to it. Even the experienced craftsman may at times be faced with a word which is new to him. This little book removes the difficulty by alphabetically listing each term and explaining it.

"The Other Side of the Moon," translated from the Russian by J. B. Sykes. 40 pages. Price 10s. 6d. Issued by the U.S.S.R. Academy of Sciences and published by Pergamon Press.

IN addition to being of great interest to all those of scientific bent, this slim, expensively produced volume will effectively commemorate one of man's greatest achievements. It contains large reproductions of the Russian photographs of the other side of the moon and details and diagrams of the automatic interplanetary space station by means of which the pictures were obtained.

A Bedsi

Tea

HOW the device works is shown in Fig. 1. An alarm clock or time clock is made to switch on a heater at a preset time. This takes 14 minutes to boil the water in an adapted picnic kettle; then steam pressure forces the water out of the kettle and into the teapot. When the required amount of water has been blown into the pot (which of course contains the tea leaves) the heater is shut off by a weight-operated switch. Steam continues to blow into the teapot, bringing the temperature up to boiling. This obviates pre-warming the pot. After a pre-set period a bi-metal strip under the teapot bends from radiated heat and makes a contact, ringing an alarm bell. The bell continues to ring until a muting switch is put off. This same switch also puts off the heater so that when the teapot is raised the weight-operated switch does not produce a circuit again.

Various adaptations of the above are possible and in the two prototypes a bedside lamp comes on when the teapot is filled and the alarm rings when it is actually brewed.

There are two models, the first primarily of wooden construction and the second, metal. Instructions are given for the wooden version first.

Making the Case

From the small prepared wood cut and screw together the framework of Figs. 4 and 5.

The top and bottom panels are then marked out from the framework, cut out and roughly planed to size. Holes are drilled in the top panel (Fig. 5) as shown. It may be advisable to leave the heater holes until the actual heater has been made.

Wiring S1, Neon and Fuses

Fix S1 in position and tighten the nut securely. The rotary toggle switch shown is Bulgin 255 which is slightly over-run. Bulgin 253 can, however, be used. Bulgin components may be obtained by post in case of difficulty from Messrs. A. F. Bulgin & Co. Ltd., Bye-Pass Road, Barking, Essex.

Fix the neon warning lamp in position. S.L. 160 for 250V. is suitable and obtainable from dealers or Messrs. Arcolectric Switches Ltd., Central Avenue, West Molesey, Surrey. Do not bend the thick lead near the neon or the internal resistor may be broken.

PARTS REQUIRED

5ft. of ½in. × 2in. prepared soft wood.
2 sq. ft. of ⅛in. plywood.
1¼in. dowel or square section about 1ft. long for lamp standard.
Small electric bell or buzzer.
Small bell transformer.
450W. electric iron element.
11in. × 8in. mild steel ¼in. thick.
¼ sq. ft. of thin copper or aluminium sheet.
Two large cooking asbestos mats, asbestos string.
S1. On/Off toggle, must carry over 2A.
S2. Micro-switch n/o (normally open).
S4. (a and b) in one switch, toggle, 2-pole, 2-way over 2A.
S3. Micro-switch with change-over contacts.
S6. Small thermostat as used for making aquarium heaters.
Warning neon lamp, mains voltage.
Lamp holder, 60W. lamp.
Picnic kettle with screw-on air-tight lid.
15in. of ½in. or ⅜in. copper pipe.
Short piece of Polythene pipe to fit over latter.
Petrol pipe union.
Small *aluminium* teapot.
Alarm clock, about 4in. dia., miniature one is not suitable.
Ceramic Beads for heater wires, 3 dozen.
Three core cable, fuses (If not fused plug), terminal blocks, nuts, bolts, pins, screws, and a few odds and ends.
Terry's No. 757 Spring Assortment will be useful.

Screw the fuse holder in position if one is not fitted in the mains plug. Bulgin F.26/1 is suitable and must be fitted with F283 fuses rated at 3A. Use 3A. fuses in the mains plug even if the plug is 13A.

Take some 5A. 3-core cable and wire it *correctly* to the 3-pin plug. Take the lead through the hole in the top panel and solder it to two tags of the fuses nearest to the hole. Take the green earth wire to an earth tag (Fig. 4) screwed to the wood.

Now wire up as in Fig. 7a. If plugged in, the neon should work when S1 is put on. If not, suspect fuses or wrong tags of S1. The fuses have not been shown in the circuits of Fig. 2.

Soldering

No acid flux of any kind must be used. Each part of every joint must be " tinned " before actually mating. Cored solder as sold by radio dealers is ideal and a small but *hot* iron is essential.

Earthing

For additional safety an earth is fitted and all the major metal components in this device are earthed to the green mains lead via the solder tag in Fig. 4. Be careful that the steel switch *cases* are tinned properly before soldering a wire on.

The Time Clock

A suitable time clock can be made from a " Jock " alarm clock from a well-known chain store as shown in Fig. 8 and was described in detail in the August 1960 issue. Briefly, a special type of micro-switch is required and must be ordered as " S502 (reset) " from Messrs. Bulgin. The clock is taken to pieces so as to get inside the back. The micro-switch is then bolted on tightly and the pivot " X " of Fig. 8 is attached. The clock is reassembled and the key slightly modified before screwing back. A piece of spring steel is softened in a flame, cooled and drilled as necessary, reheated and quenched from just below red heat in water. Slight adjustment of the tappet will mean that when the alarm goes the micro-switch is actuated and remains " on " until the reset button is pushed underneath the switch. The lever is moved out of the way for rewinding.

The alarm has to be rewound for each use, and the reset button pressed. In addition the alarm clock functions as an ordinary alarm unless the bell or clappers are removed or bent, etc.

Modifying a chain chemists' " TimeCal " clock is a somewhat more difficult modification than the above, but the result is somewhat better for this purpose. The alarm does not now function for more than a few beats, it does not have to be rewound and no re-setting of the micro-switch is necessary.

Suitable switches are the Burgress BR made by Messrs. Burgess Products Co. Ltd., Team Valley, Gateshead, 11 and various surplus types from Messrs. Whistons, New Mills, Stockport.

The micro-switch must be very carefully clamped in position so that when the alarm key unwinds in the direction " B " of Fig. 8, it will hit and push and hold in the plunger of the switch. It is necessary to modify the key slightly as with the other clock, or (as in prototype) by putting a few washers under the winder key to " lift " it slightly. Experiment also with the number of turns necessary on the winder to give *just enough* pressure on the switch to work it and no more.

PRICE 12/6

PRESENTED FREE WITH PRACTICAL MECHANICS NOVEMBER 1960

A PRECISION ENLARGER FOR 35 mm

A BOX OF CONJURING TRICKS

A BEDSIDE TEA-MAKER

PRACTICAL MECHANICS 3 IN 1 CONSTRUCTIONAL PLANS

A Bedside Tea-maker

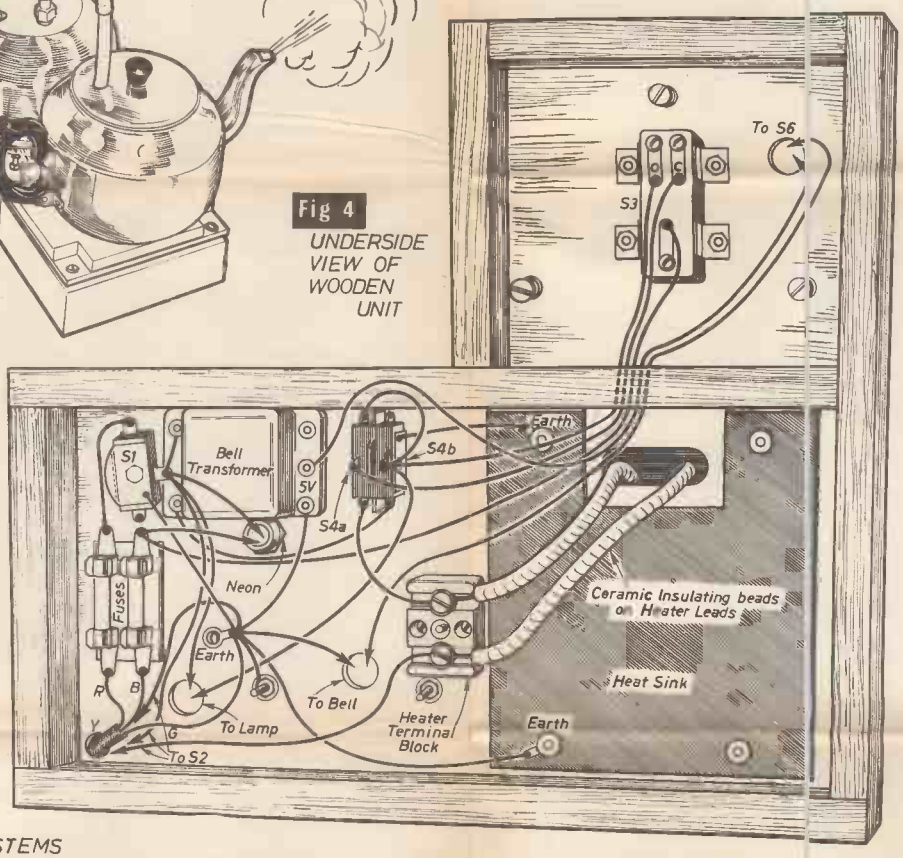


Fig 4 UNDERSIDE VIEW OF WOODEN UNIT

1 CLOCK SWITCHE ON CURRENT

Fig 1 HOW IT WO

N/O Mic

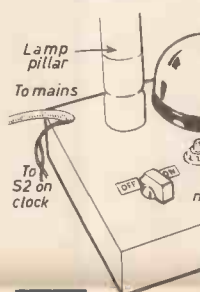


Fig 10 TOP VIEW

Fig 5 TOP AND BOTTOM PANEL DETAILS

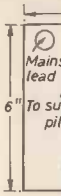
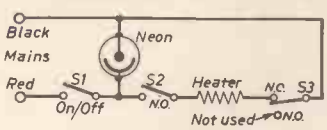
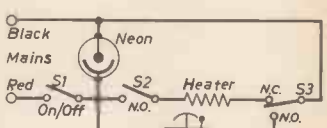


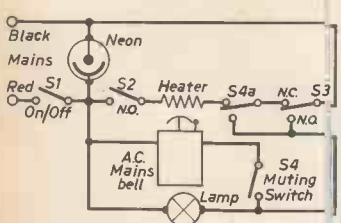
Fig 2 WIRING SYSTEMS



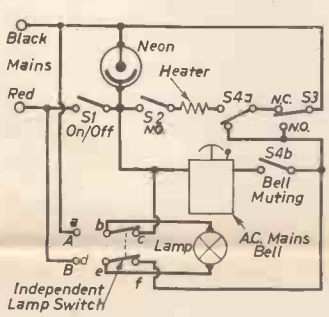
(a) Makes tea at pre-set time no "tea's made" alarm



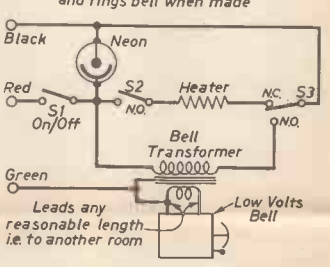
(b) Makes tea at pre-set time and rings bell when made



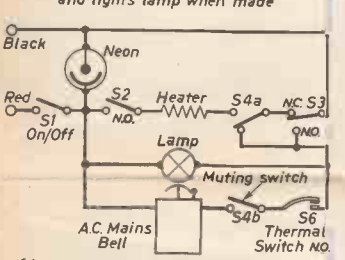
(c) Makes tea at pre-set time rings bell and lights lamp when made



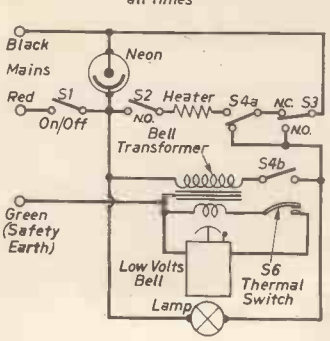
(d) As for (c) but lamp may be used at all times



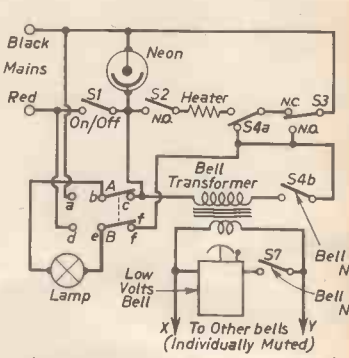
(e) Circuit (b) using low voltage bell



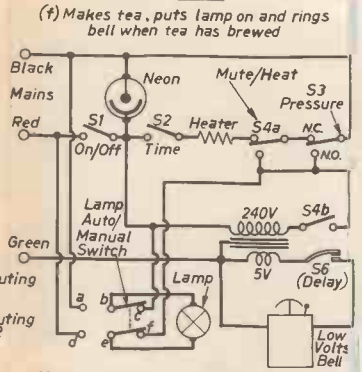
(f) Makes tea, puts lamp on and rings bell when tea has brewed



(g) As for (f) but uses low voltage bell for additional safety

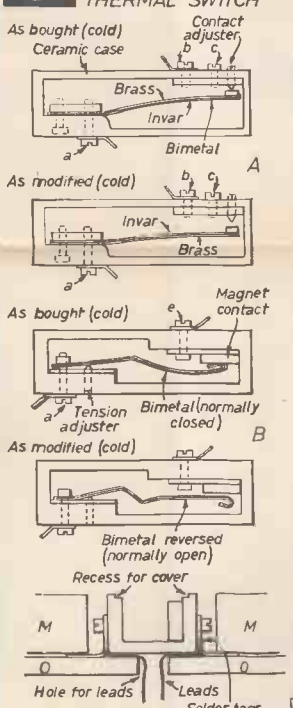


(h) One of the possible circuits (see text)



(j) For using independent bedside lamp with low volts bell

Fig 3 THERMAL SWITCH



2 CURRENT HEATS WATER
3 STEAM PUSHES WATER INTO TEAPOT
4 WT. OF WATER SHUTS HEATER OFF
5 TEA WARMS BI-METAL
6 BIMETAL BENDS RINGS BELL AND LIGHTS BEDSIDE LAMP
7 BELL SILENCED BY SWITCH TEA READY
8 SWITCHING HAS MADE HEATER SAFE

Fig 9 TESTING

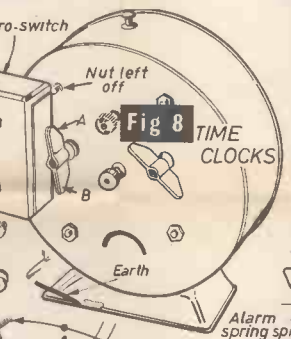
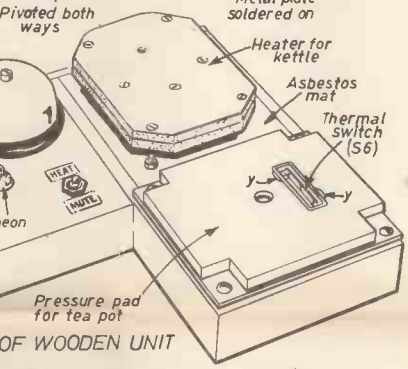


Fig 8 TIME CLOCKS



OF WOODEN UNIT

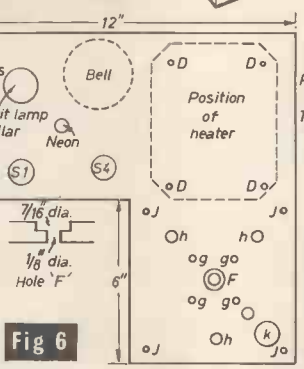


Fig 6 LAMP

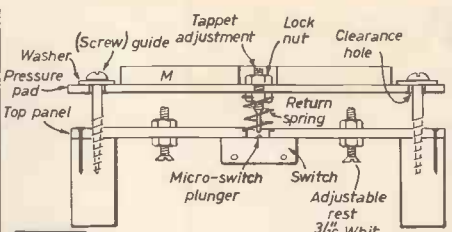
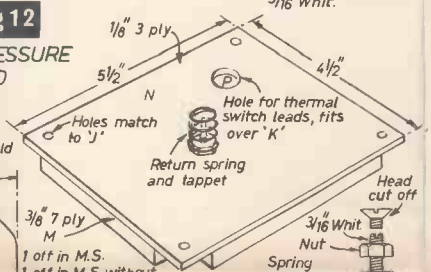


Fig 12 PRESSURE PAD



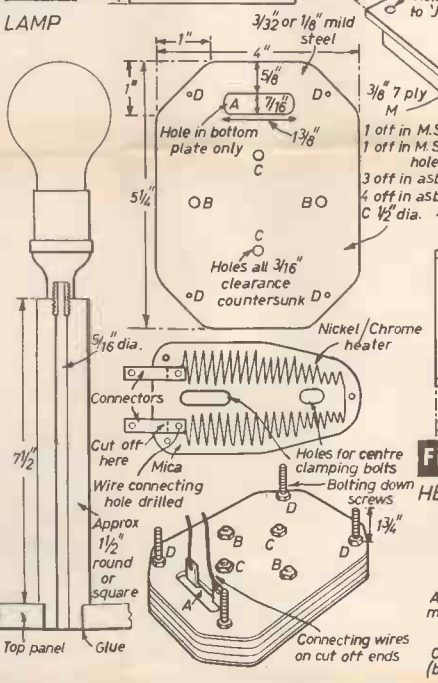


Fig 11 HEATER

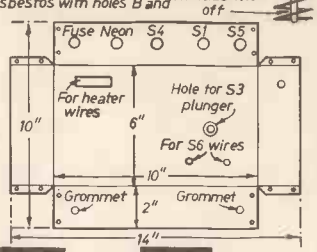
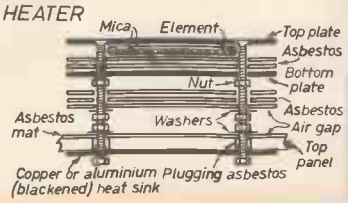


Fig 17 CHASSIS



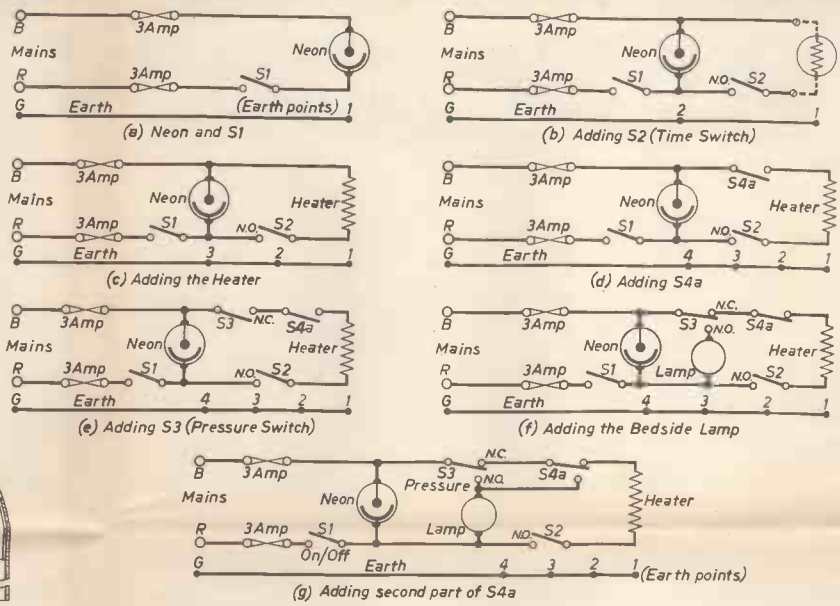


Fig 7 STEP BY STEP WIRING TEST

Fig 13 PICNIC KETTLE

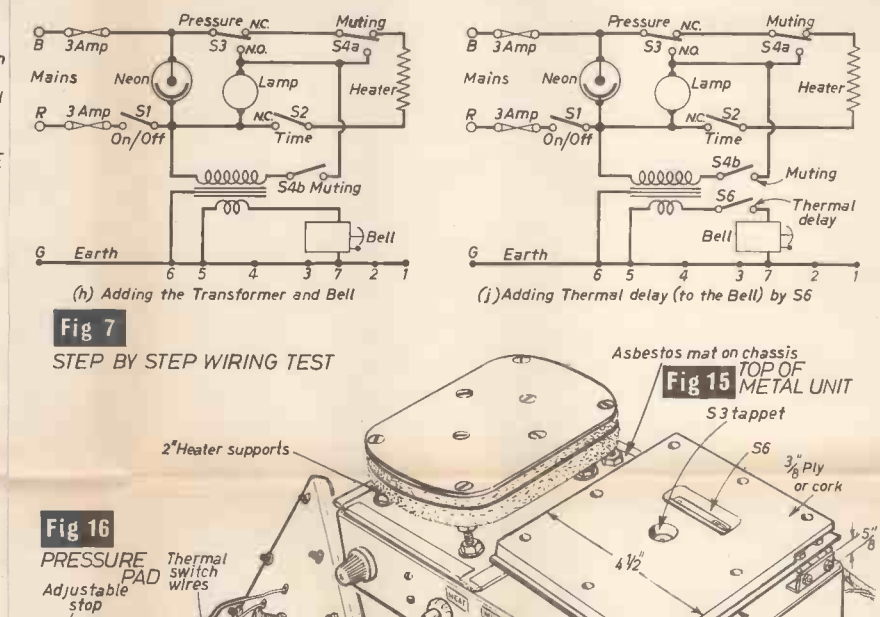


Fig 15 TOP OF METAL UNIT

Fig 16 PRESSURE PAD

2 FURTHER PLANS OVER

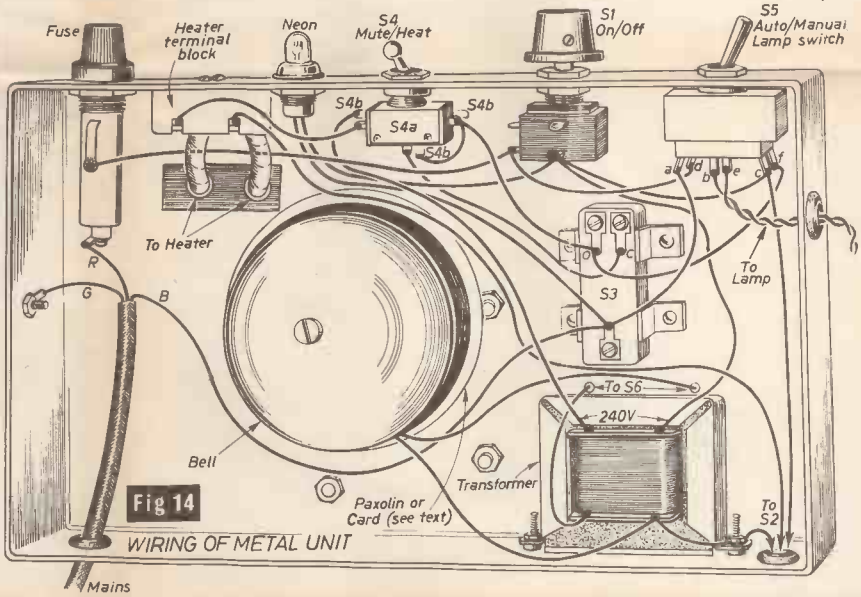


Fig 14 WIRING OF METAL UNIT

Then strip the clock by easing out the front glass frame and removing four nuts on the back. Drill for the switch, but do not fix it. Put the necessary bolts through and holding the clock " face " upwards fit the mechanism back while gravity holds the bolts hanging downwards. Put the alarm key and washers in position and wind the necessary number of turns. Now carefully slide the micro-switch over the bolts hanging down and tighten the nuts.

To test, set time on clock a good deal *off* the time of the alarm set pointer. Press the winder (alarm) in the direction "A" of Fig. 8. It will click over and hold. Now turn the clock hands on until the alarm " rings." It will ring briefly only, as the winder moves in direction " B " *holding* the micro-switch in. It cannot be reset until the hands have moved on an hour or so. The clock " bell " may be removed if required or the " hammer " slightly bent. Readers may, if they wish, use other commercial time switches.

Test the time clock it is proposed to use with a bulb and battery as shown in Fig. 9. If the switch has a normally closed contact ignore it.

Wiring the Time Switch

Any 3-core cable taking 2A. will suit. Take one end of the earth lead and solder it to the casing of the clock and the other end through the hole " Y " of Fig. 4 to the earth tag. The other leads are soldered to the switch (S2) terminals (N/O) and the two ends to S1 and the heater terminal block. For this any block would do, Messrs. Milligans, 2 Harford Street, Liverpool can supply the one shown in Fig. 4 (S124) for 9d. Temporarily wire a mains lamp from the same terminal (just used) to 4 on fuse-holder.

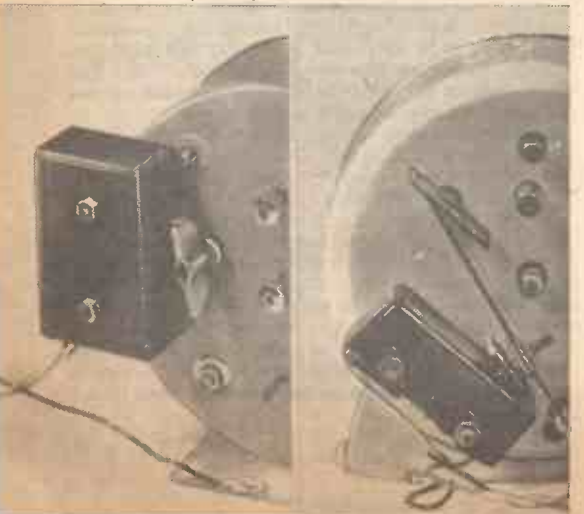
Now test the unit. The lamp should come on at a preset time and should remain on for at least 20 minutes. The complete wiring will eventually be as in Figs. 2g and 4.

Making the Heater

A home-made hot plate is made up cheaply with an element costing 2s. 6d. from a chain store and some asbestos and iron sheet.

The heater is seen in Fig. 10 about 1in. plus above the woodwork. The element is shown in Fig. 11. Two steel plates are made up to the plan shown, provided the " Timothy Whites " aluminium picnic kettle is used. It is 5¼in. dia. and the rim must definitely fit over the heater plates. Before putting together test the kettle for fit. The holes are all countersunk to take ⅜in. Whit. bolts at least 2in. long, the screw heads must not project or they must be ground off level.

(Below) the two time blocks.



The element is tightly clamped directly between the top plate (without the hole " A ") and two sheets of cooking mat asbestos backed up with the other steel plate. Note that the mica element lies directly under the top plate with no asbestos in between. The asbestos sheets lie underneath the element (see Fig. 11). Having tested this for arrangement slip the element out and cut the connecting strips short to about ¼in. Drill small holes and clamp on two lengths of thickish copper wire, about 20 s.w.g. would suit (Fig. 11). Now clamp up the heater tightly. The heater is checked with flash lamp and battery to make sure there is no connection between the connecting wires and plates and the frame. It is then connected to the mains temporarily to observe if it heats up. In 30 seconds it should be too hot to touch. Leave it for 3 minutes and then switch off. When cool re-tighten the bolts. Grind or file the bump which will have formed in the middle on the top side between BB and CC due to expansion in the centre part. Now fix on loosely three more asbestos mat layers using four nuts and bolts only as the bolts BB and CC may be cut off. Allow holes for the nuts B and C in the sheets of asbestos. Now fit four more nuts and washers and place another asbestos mat in the heater position of Fig. 5, then slip the heater in position. Underneath a suitably cut piece of aluminium or copper sheet, thinly painted black to help radiation, is fitted as in Fig. 4 and bolted down tightly with four more nuts.

A section through the heater and heater mounting is shown bottom right in Fig. 11.

Wiring and Testing the Heater

The temporary lamp of Fig. 7b is now removed. About 18 interlocking ceramic beads are slid over each heater wire. This will prevent any shorts. The wires are taken to the terminals as shown in Fig. 4. Suitable insulating beads can be obtained for a few pence from Messrs. Technical Services Ltd., Banstead, Surrey. Take a lead from the unwired terminal of the block temporarily to tag 4 of the fuse-holder.

Plug into the mains, put time clock to " on " and S1 on. The heater should get very hot in 30 seconds. Try boiling water on it; it should take about 20 minutes. Since the kettle has not yet been modified remember to take off the screw-on lid, or an explosion may result. The kettle used holds 1¾ pints of water of which up to 1½ pints may be used for brewing purposes. The circuit now is that of Fig. 7c.

Adding the Heater/Muting Switch

This is a 2-pole throw-over toggle which must take 2A.: the prototype used Bulgin S270, which is rather over-run, but is satisfactory. The Bulgin S265 would not be overun. The switch (S4) position is shown in Figs. 4, 5 and 10.

Temporarily wire the centre left section (a of S4, Figs. 7 and 4) to fuse B and remove wire leading to heater terminal block, this wire is now shortened and soldered to the lower left tag of S4 (Fig. 4).

The circuit is now as in Fig. 7d. When S1 and the time switch are on, S4a should control the heater.

Pressure-operated Micro-Switch S3

The prototype used a Burgress BRL micro-switch, which operates on 6 oz. It is mounted so that the

plunger " ball " is under the hole, which is specially countersunk as shown at F of Fig. 5 by using four small metal brackets cut from aluminium, as shown in Fig. 4. When tightened up, make sure the plunger is approximately central in the countersunk hole.

The wire going from centre of side a of S4 to fuse B is now removed. A wire is taken from centre tag of side a of S4 through a hole in the batten to the micro-switch (S3) marked " normally closed " (Fig. 4). The common terminal of the switch (S3) is then wired back to fuse B.

Plug in. Switch on S1 and time switch S2 then put S4 to " Heat." The heater should get hot. Press down S3 using a pencil carefully (not much over-travel can be tolerated), and the heater should slowly cool down while the switch is under pressure. The wiring is now as shown in Fig. 7e.

The Pressure Pad

Basically this is a wooden pad to take the teapot, guided by four loosely fitted wood screws and kept out of the way of the micro-switch plunger when unloaded by a helper spring situated in its " dead centre."

The top view of the pad can be seen in Fig. 10, and an underneath view and section in Fig. 12.

The all-metal version of the teamaker.

Fixing the Thermostat (delay switch)

It is necessary at this stage to fix in the small thermostatic switch which will operate the bell. It is known as model SN/40 and is sold by Messrs. Technical Services Ltd. at 5s. 6d. As bought it will open when heated and it has to be modified to work the other way round as shown in Fig. 3b.

Test first with a lighted match. Finally, place a teapot full of boiling water on top and find out how long it takes to close. If the time is less than 2 or 3 minutes bend the strip further away from the magnet and vice versa if more. Fine adjustment is also possible on using the tappet adjuster.

Fixing S6 in the Pressure Pad

A hole to take the thermostat ($\frac{1}{2}$in. × $1\frac{7}{8}$in. approximately) is now cut in the upper part (thick) of the pad, but not in the lower part. The position can be seen in Fig. 10 and the hole " P " in Fig. 12 must lie immediately underneath.

File small slots (y) in the large hole of Fig. 10 to take the terminal screws. The thermostat is not screwed down but the solder tags are bent over under the thick pad M as shown in Fig. 3c. Before actually fixing the thermostat 18in. thin flexible insulated wires are soldered to the solder tags and led through the hole " P." The two halves of the pressure pad are then pinned or glued together, and once done the thermostat cannot be removed. It will not yet be wired in circuit.

Making the Adjustable Tappet and Helper Spring

The spring used is $\frac{3}{8}$in. dia., about 20 s.w.g. and is $\frac{1}{2}$in. long with four turns of wire. No doubt this could be made or adapted from an existing type.

The tappet is made from a $\frac{3}{16}$in. Whit bolt as shown in Fig. 12.

The 1in. tappet is then fitted into the pressure pad as shown in Fig. 12. Test that the spring will rest *on* and the tappet will go *in* the hole F of Fig. 5 when the pad is held in the position shown in Fig. 10.

Four chromium or brass wood screws about 1in. long, of thin gauge, serve as guides. Each is fitted with a small brass washer and the screws are fixed directly into the top panel. Three of them are visible in Fig. 10 and the method can be seen in the section of Fig. 12.

Adjustment

Tighten up the four guide screws so that the carriage is held down against spring pressure so that the correct amount of water for tea making in the teapot will operate the switch. Adjust by means of the tappet.

On no account must the carriage require *more than* $1\frac{1}{2}$ pints of water with the recommended kettle, or damage will be done both to kettle and heater.

Three overtravel rests are made from $\frac{3}{16}$in. Whit. bolts (Fig. 12).

To adjust, unscrew the three bolts until the tips of the bolts rest just beneath the pressure plate so that a fraction of an inch after the " click " is heard the pressure plate rests on the stops and prevents any overtravel. Finally test out with the amount of water required to operate the switch, connect up to the mains with S1 and S2 on, and S4 to " Heater." The heater should heat up, but when the full teapot is placed on the pressure pad it should shut off the current and the heater should cool off rapidly.

Fixing and Testing the Bedside Lamp

The lamp standard is made as in Fig. 6 and is fitted with a bulb holder and long leads. A red hot iron rod will burn the hole if no long drill is available. The pillar is fitted in the hole shown in Fig. 5.

Connect one lead from the lamp to S1 (Fig. 4) and the other to open contacts of the micro-switch, S3, pressure operated.

Plug in and test. With all switches on and S4 at " Heater," when the pressure pad is pushed down, the heater should cool down and the lamp should light. The circuit is now as in Fig. 7f. So that the

(*Continued on page* 93).

JAMESON ERROLL BUILDS . . . . . .

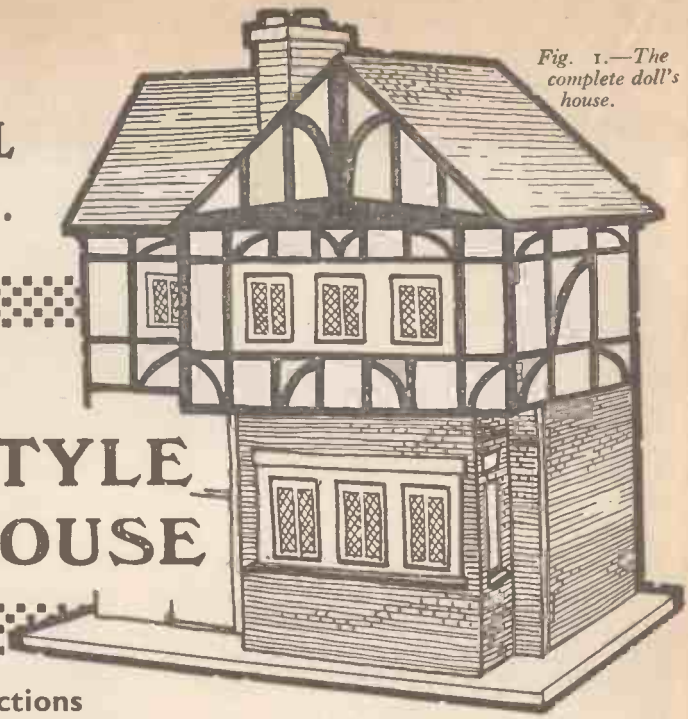


Fig. 1.—The complete doll's house.

A TUDOR STYLE DOLL'S HOUSE

By following his instructions and diagrams you can build your child one in time for Xmas

ONE of the features of this splendid doll's house is the simplicity of construction. Although an elaborate Tudor exterior is shown in Fig. 1, the actual making demands only care and precision. Finish is entirely at the discretion of the reader; the simple construction remains the same.

Materials

The best material to use would be ¼in. wood throughout or, failing this, a good quality plywood about 7mm. or $\frac{5}{16}$in. thick. Hardboard *can* be used, but it will be found extremely difficult to nail into the edges. Whatever the material, use only ⅝in. veneer pins; the thicker panel pins or brads will tend to split the wood.

A chimney stack has been shown in the finished drawing but has been omitted from constructional sketches for the sake of clarity. In the interior, excellent chimney breasts can be made from 2½in. × ⅝in. wood, and excellent reproduction fire-places in stamped tin plate can be bought. Similarly, metal windows and doors can also be bought; they are beautifully finished in cream and green enamel, all windows and doors opening. A red tiled porch, 3½in. × 1⅝in. can also be bought. The windows range from one to six lights. But do not cut out the holes for windows and door nor recess the chimney breasts for the fireplaces until they have actually been bought. Allow about a ¼in. all round for fixing.

Constructional drawings are not necessarily to scale (although nearly so) and the house can, of course, be made smaller or larger according to taste provided due proportion is maintained. The sizes shown accommodate the normal doll's house furniture which can be bought in toy shops.

Construction

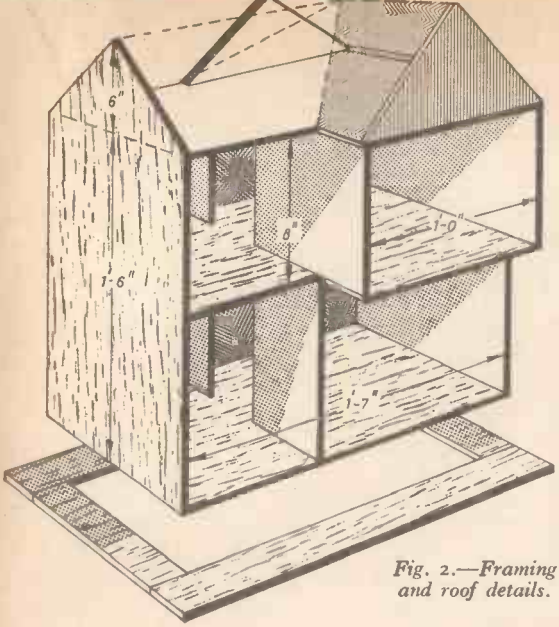
The base-board, see Fig. 2, may be a built-up frame as shown or may be a solid piece of plywood ⅝in. or ½in. thick. Screw the lower floor of the house to it from the underside. Next fit the two main sides and the back; then the partition—having first cut out the door. Fix the middle floor next and then the top partition, also with door. Finally, fit the top floor ceiling, having first glued and pinned the gable ends, back and front, as these will be difficult to fix afterwards.

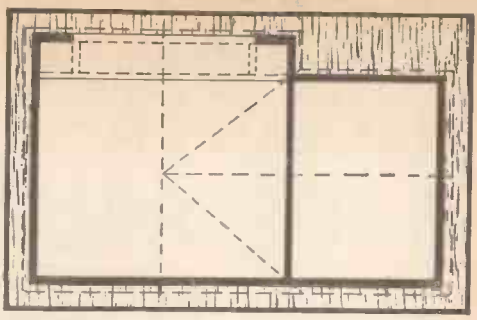
The Staircase

If it is decided to fit a staircase, the well for this should be cut in the middle floor and the staircase fitted before going too far with the construction. If the stairs are made in one long flight they will have to slope at rather more than 45 deg. or they will come too close to the front of the house. The better way is to make two flights at right angles with an intermediate landing as depicted in Fig. 4. It is more trouble but quite worth while. Material for the steps should be 1¼in. × ⅝in. and they are glued and pinned from the underside where they overlap. The balusters—solid in this case—are then cut and the stairs fixed to them by pins in the end grain and a dab or two of glue. One side of the baluster is then fastened to the wall, the upper landing fitting against the inside-back of the house. The hole in the middle floor should be cut so that there is about 7in. perpendicular height between the beginning of the upper floor and the stair. A second baluster may be run along this on the upper floor about 3in. high if desired.

Roof

The roof should be cut from stout cardboard or thin fibre board, the main gable being fixed first. For the secondary gable it is advisable to cut a template of thick brown paper in order to ensure correct angles where it joins the main gable, to which it





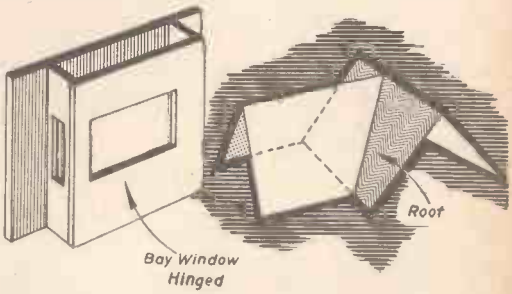


Fig. 2.—Framing and roof details.

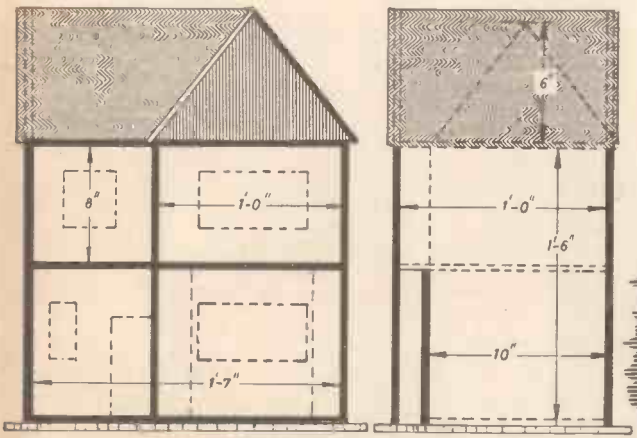
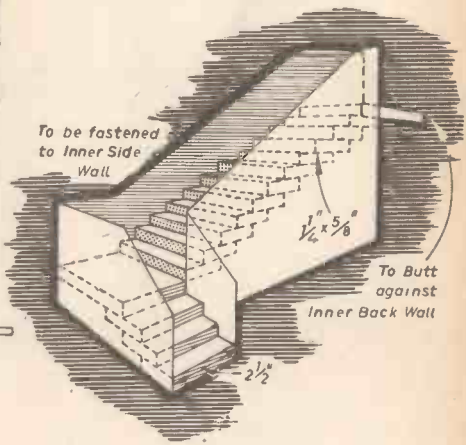


Fig. 3.—Suggested sizes of the rooms. The house can be made proportionately larger if desired.

Fig. 4. (Below).—Details for making the staircase.



is fastened by means of gummed linen or wide tape. The chimney can be cut from a piece of 2in. × ¾in., the end being mitred to fit the slope of the gable. This should be fastened with two screws from under the roof before the latter is fixed. The pots may be of ¾in. dowelling, suitably painted.

Finishing

There is a large variety of doll's house papers now on the market, and these include wall-papers and parquet flooring as well as imitation brick and stone, and red, green and grey tiling and dark grey slates. The fixing of these wall-papers and imitation oak flooring should be done before the house is assembled —it is a very finicky job afterwards. Use good paste or light gum, and see that all wrinkles and air bubbles are pressed out. Brick and tile paper should be fixed when the house is complete, and when dry may be varnished if desired.

If the Tudor finish is chosen, the oak beams may be represented by thin card cut to shape, painted an old oak colour, and glued and pressed on the outside top walls which should previously have received a coat or two of broken white or light cream paint. The door and windows are put into position after the outside papering is done, and are fastened with ¼in brass pins. The overhanging parts of the baseboard should be painted dark green to imitate grass.

The front of the house opens in three parts by means of 1in. or 1½in. brass hinges. The wall carrying the lower brick bay window opens as one part; the overhanging top storey immediately above it also opens; and the whole of the left front with door, etc., is also hinged. Thus, the whole of the front of the house opens giving easy access to the inside for furnishing and playing.

AUTOMATIC DOOR BOLTS

By E. V. KING

Fig. 75.—Motor-driven cam-operated door bolt device.

The devices for the automatic bolting of doors described in this article are cam-operated

THIS is a robust and strong system. The bolt is forced one way by a cam driven at slow speed through suitable gearing from a small electric motor. Other cams are used to work limiting switches to switch off the motor when the bolt is either in or out. No current is thus consumed except while the bolts are moving. This system, while powerful, is slow acting and takes up to about 20 sec. for a bolt to move fully in or out.

The system may be used with secret contacts (i.e. hinges) (Figs. 76A and 79) and remote operation via flexible shafting, etc., as in the other systems. Generally it will be found necessary to use the apparatus shown last month in Fig. 70 as the system necessarily incorporates rather large control gear.

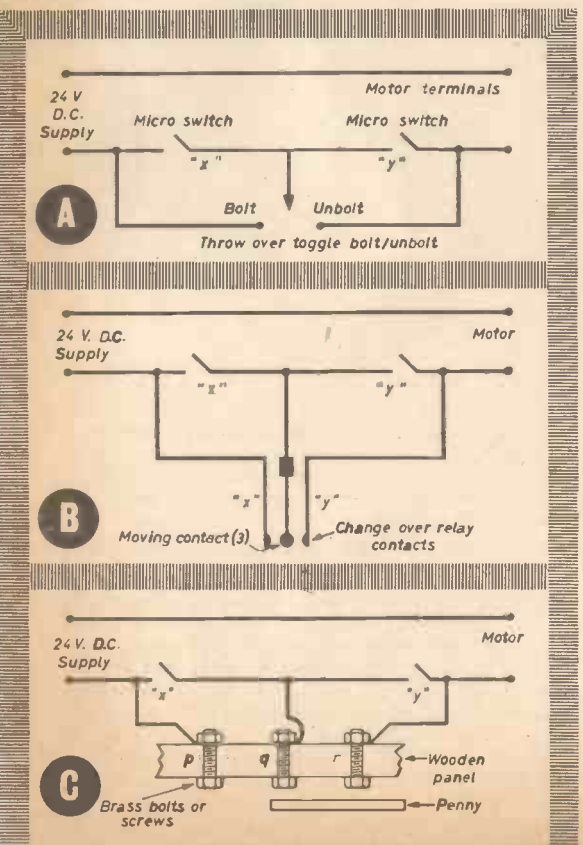


Fig. 76.—Three circuits: (A) Toggle switch operation, (B) Relay operation (photo-switch, etc.), (C) Secret operation (penny on screws).

The Motor

This is the John Oster Motor available from many Government Surplus Dealers. The prototypes used motors purchased from Messrs. H. W. English, Rayleigh Road, Brentwood, Essex and Messrs. Milligans, 2 Hartford Street, Liverpool 3. It is fitted with a 24V. D.C. motor, gear box and three cams with adjustable tappets. It will work satisfactorily on only 12V. It costs round about 20s. and must have cost over £10 to make. On arrival it should be tested on a D.C. supply or car battery (12V.).

Altering the Cams

Refer to Fig. 77 and mark the cams in pencil A, B, C and D.

Cams A and B are modified. The author did not remove the cams from the shafts. Cam A was cut with a hacksaw to the shape of Fig. 78A and the edges rounded off. Cut the cam on the large side and when testing it may be gently filed away if necessary. Cam "B" has a small piece of $\frac{1}{16}$in. brass sheet soldered to its side as shown in Fig. 78B. Make the cam slightly larger than shown and file down later on test. Baker's fluid soldering flux will make tinning of the steel cam easier. The views of Fig. 78 are as looking along the motor from cams to terminals.

Mounting the Motor

BA screw holes are situated under the motor and a fillet of $\frac{1}{2}$in. approximately wood under it (see Fig. 77). Another block is screwed underneath, finally the lot is screwed to a wooden base. The height of the motor will depend on the switches to be used but it is not critical as there is about an inch of play in the tappet adjusters.

Mounting the Switches

Two normally open (n.o.) micro switches are mounted underneath the cam mechanism so that the tappet operated by cam "A" pushes on the plunger of switch "X" and that of cam "B" on switch "Y." Each switch will need four small metal brackets. Do *not* run the motor until you are sure that all the tappet adjusters are freed off. Run the motor and adjust the tappets so that as the cams come round, the switch underneath just clicks over automatically. At the same time cam "D" will be working the "push-pull" rod backwards and forwards; this is what is used to actuate the bolt.

Wiring

Wire up as in Fig. 76A using a coventional throw-over toggle switch. If the door is required to bolt

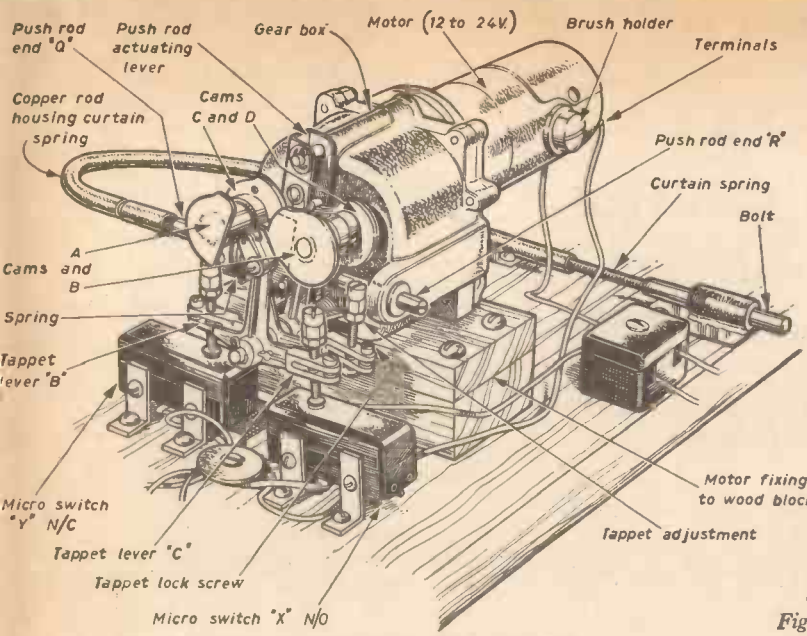


Fig. 77.—Perspective view of the John Oster motor.

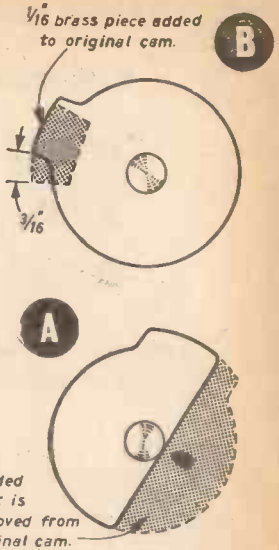


Fig. 78.—Cam modification details.

automatically as it is closed, wire as in Fig. 80. An opening switch (or two in parallel) will be required to unbolt the door.

Additional Notes

On the prototype (Fig. 77) the bolt is closed by a cam and is opened by a spring. This spring as supplied is a weak one. If much tubing is used for remote bolt operation the spring can be replaced by a stronger one. Make sure the compressed total length of the spring fitted allows the cam to rotate or the shaft will be bent. The motor had plenty of spare power to compress a really powerful spring. That shown is of about 20g steel wire. To fit a new spring a small screw situated to the right of the push rod actuating lever and in line with the push rod is loosened and the push rod may be unscrewed from "Q" or "R" in Fig. 77. A new spring is then fitted, the push rod screwed in place and the locking screw tightened.

All working parts should be covered in light grease. One tappet lever was not used and was left in place, but may be removed and kept as a spare.

A warning lamp fitted across the motor terminals will inform the user that "a bolt is moving." The lamp would go out once the bolt had moved either fully in or out.

Faulty tappet adjustment will result in bent cam shafts. Never tighten more than is necessary to click over the micro switches. Automatic locking as the door is closed can be arranged as shown in Fig. 80. A method of attaching flexible curtain spring to the push rod was shown in Fig. 70, alternatively the rod may be tapped and a screw-on bush fitted. Operation by light control, etc., is represented in Fig. 76b.

How it Works

The motor works very well off four large 4½V. batteries in series or the 24V. supply and does not take much current. Imagine the door is bolted and the leads are connected. Micro switch "Y" is held off by tappet and cam and no current flows. If the toggle of Fig. 77 is thrown over it shunts "Y" and the motor starts, the bolt is withdrawn and pushed back three times (about 15 sec.) and finally is withdrawn as micro switch "X" is depressed and the motor stops. If the toggle is now thrown over it shunts "X" and the motor again starts and in about 2 sec. the bolt is in, micro switch "Y" is depressed and the motor stops. This is the starting position.

Fig. 79.—Secret system cam-operated.

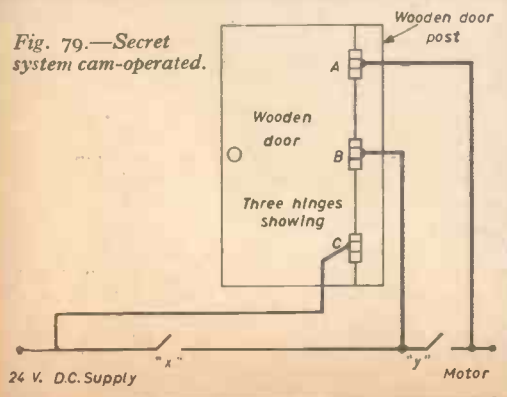
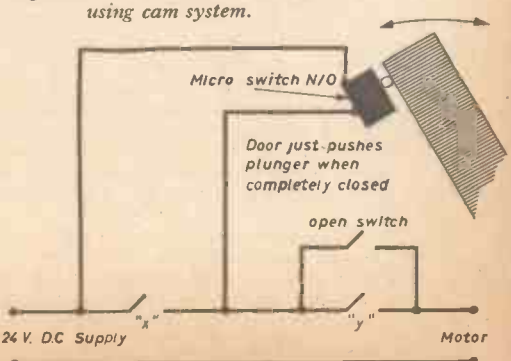


Fig. 80.—Automatic "locking" using cam system.



F. G. Rayer describes a

Model Control Transmitter Autoswitch

which will save the enthusiast a lot of time and trouble

WHEN adjusting a radio controlled model receiver and relay, it is necessary to switch the transmitter on and off repeatedly, so that proper operation of the receiver and equipment can be checked. If no helper is available, this is very troublesome, when the receiver is at some distance from the transmitter. To avoid any difficulties in this direction, an automatic switching device for the transmitter is extremely useful. Such a device should switch the transmitter on and off repeatedly, at intervals of a few seconds. The receiver and model can then be moved farther and farther away, and adjustments made for both the " no signal " and " carrier on " conditions.

The Circuit

When a high resistance relay of the type used in model control receivers is available, an automatic switching device can easily be made, using the circuit in Fig. 1. Normally, the relay armature rests against contact A. This completes the battery circuit to the relay, so that the armature is drawn over, breaking contact with A. At the same time, the 1,000 μF condenser has become charged, and this charge holds the armature against contact B, until the condenser is nearly discharged through the relay windings. The armature is then released, touching contact A and thus repeating the cycle. If the circuit is taken directly to the battery, the condenser charges immediately, so that the armature only rests against A momentarily. To avoid this, which would give a very brief interval with the transmitter off, a variable resistor is added in one lead.

Adjusting

To adjust the autoswitch, the resistor is set near minimum value. Relay armature tension, distance from magnet poles, and contact settings are then adjusted in the usual way until the relay operates regularly and firmly at intervals of some 10-15 seconds or so. The variable resistor is then adjusted slowly towards a higher value, until the time the armature is in contact with A approximately equals that in contact with B. Exactly equal intervals are not necessary. Bringing too much resistance into circuit will prevent the armature being drawn down at all. A 4½V battery is sufficient.

The circuit to the transmitter is completed through the armature and contact B. The circuit which is interrupted is of no importance, provided the voltage or current does not exceed the rating of the relay contacts.

To adjust a receiver, the autoswitch and transmitter are connected together and switched on. The breaks in the transmitter carrier are particularly useful for adjusting the " no signal " tension and setting of the receiver relay. With the carrier present, receiver tuning and the other setting of the relay can be adjusted. Initial adjustments can be made with the receiver fairly near the transmitter. The receiver can then be carried away to an increased distance. Each time this is done, receiver tuning, and particularly relay adjustment, will become more critical. Eventually, a distance will be reached when even very careful attention to the receiver tuning and receiver relay tension will not allow reliable working to be achieved. This indicates that the maximum working range of the equipment has been exceeded, and the actual model must not be allowed to reach such a distance.

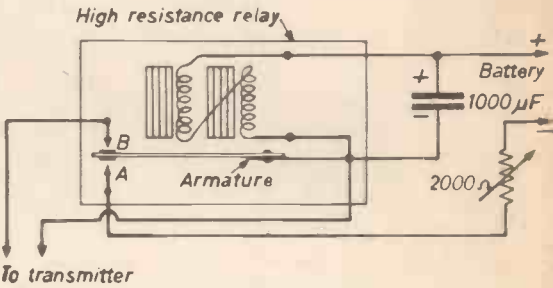


Fig. 1.—Transmitter autoswitch circuit.

1. Pipe Dream?

A MAN decides he is spending too much on tobacco so buys a cheaper brand of tobacco at 3s. 10d. per oz. and mixes 20z. of it with 10z. of the brand he normally buys which costs 4s. 1d. per oz. He finds that 6 pipes of the new mixture only last him as long as did 5 pipes of his old brand. Assuming that he smokes the same amount as before, has he in reality effected an economy?

2. Seven and —?

Seven and another number are such that twice the difference of their squares is 48. Find the other number.

Answers

1. Yes, he has. Since he smokes the same amount of tobacco in both cases, it is unnecessary to take into consideration their lasting properties. And since the mixture costs him less, it is therefore more economical.
2. Their difference of squares must be 24. Thus the other number must be $\sqrt{(49 - 24)} = 5$.

home-made CHEMICAL LABORATORY APPARATUS

Part 3

By K. Given

Making retort stands and clamps, gas jars, deflagrating spoons, cork borers and spatulas

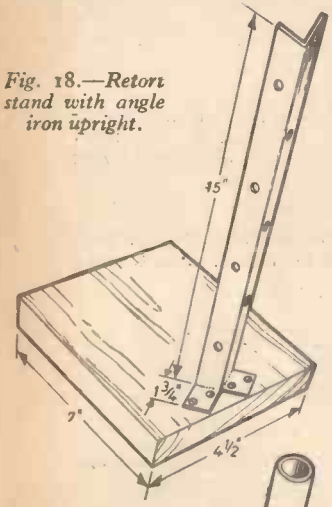


Fig. 18.—Retort stand with angle iron upright.

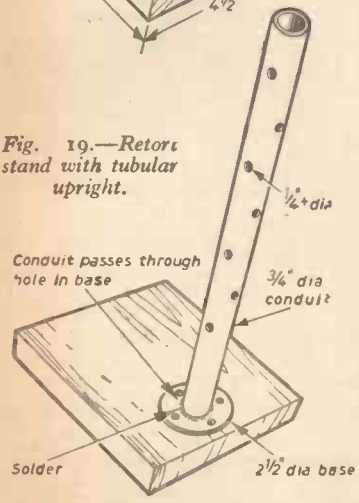


Fig. 19.—Retort stand with tubular upright.

IN a home-made retort stand there are three parts—the upright and base, the clamp and the ring.

Upright and Base

A base made of wood was used by the author, but it may be made of steel, the extra weight being an advantage. Dimensions are given in Fig. 18; any thickness over ¼in. will suit.

The upright is best made of angle iron. A piece about 17in. long is cut with a slot down one end, heated in the fire or domestic boiler until red hot and the ends bent over with a hammer (Fig. 18). Two holes are drilled in each flange. The flanges are then screwed or bolted to the base.

If the rivet holes in the iron are insufficient for use more may be drilled down both sides as shown. These holes must be large enough to take the ¼in. fencing strainer used for the clamp. An alternative stand may be made using a tubular upright (see Fig. 19).

The Clamp

You require for each clamp: one ¼in. wire fencing strainer, two washers and wing nuts. Some strainers are not standard thread so when buying be careful or you will not get wing nuts to suit. One $\frac{5}{16}$ B.S.F. (Whit. would do) bolt about 1in. long threaded at least half-way down with a washer and wing nut to suit. Obtain a piece of mild steel ¼in. thick, some small bore rubber tubing about ¼in. dia. and 7in. long, one bolt and wing nut 1¼in. long × ⅜in., preferably B.S.F. thread.

The clamp is divided into three parts. The wire strainer, which is fixed to the stand. The fixed prong which is attached to the strainer by a "yoke." The moving prongs which are both on one assembly (see Figs. 20 and 21).

The Wire Strainer

On purchase make sure the loop on the end has been properly welded and file or drill the hole to clear the short $\frac{5}{16}$ in. bolt. The wing-nuts should travel freely over the thread.

The Fixed Prong

The piece of M.S. strip is cut and filed to the shape shown in Fig. 21B, centre popped, bent to shape and then drilled as shown. The small piece shown in Fig. 21C is then cut and filed to shape, and bent. It is held up to the long piece in the position shown in Fig. 21B and the position of the two rivet holes marked with a scriber, pencil or drill. It is then drilled and riveted in place using iron rivets. Brazing or welding would of course be quite satisfactory.

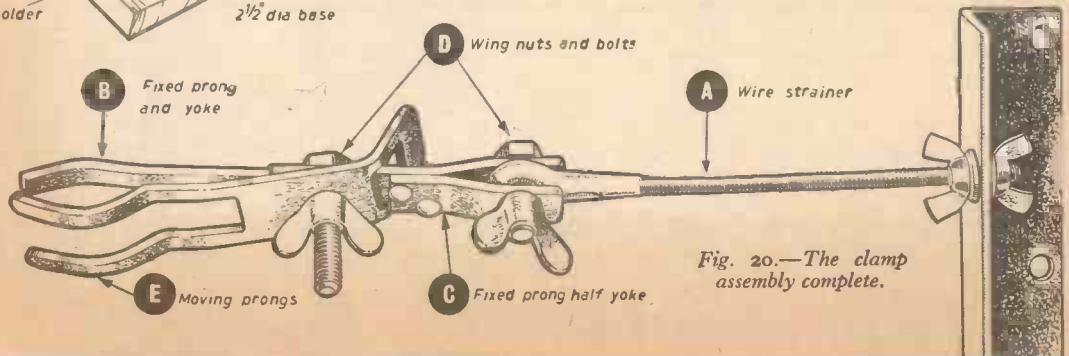


Fig. 20.—The clamp assembly complete.

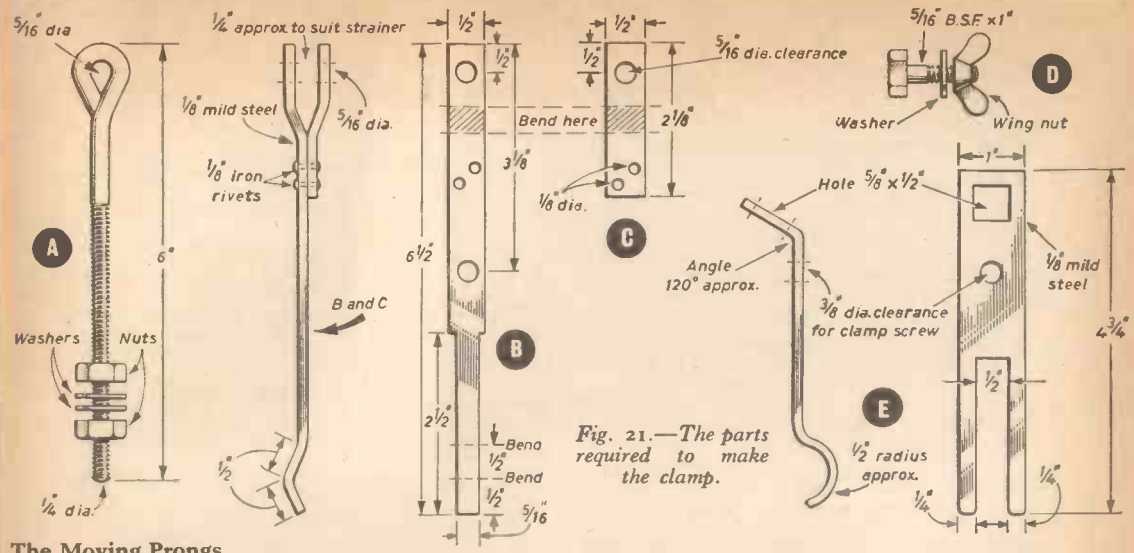


Fig. 21.—The parts required to make the clamp.

The Moving Prongs

Cut out and file the piece of M.S. strip to the rectangular shape of Fig. 21E. Cut out the small rectangular hole first by drilling a hole in each corner and then a whole series (about $\frac{1}{4}$in. dia.) round the perimeter. A sharp knock with a punch with the sides supported will knock the inside out. File the rough ends away. Verify that the long fixed prong will indeed pass easily through this hole. Now drill the $\frac{3}{8}$in. clearance hole. Lastly, cut down the prongs with a hacksaw and file to shape. The prongs are rather fragile and should always be filed up last. Bend round an iron pipe to the radius shown, and in the vice to the angle shown in Fig. 21E.

Method of Use

The clamp is now put together as in Fig. 20. It may be moved out or in on the stand by using the two wing nuts on thread A as adjusters. It may be moved through any vertical angle by using the $\frac{5}{16}$in. wing nut "C" and the clamp will hold anything with a diameter of $\frac{1}{16}$in. to 4in. Most flasks have a neck diameter of about $1\frac{1}{2}$in. and the clamp has optimum efficiency at this diameter. When used on glass vessels never tighten too much and let any weight be supported by the external rim of the vessel and not through frictional grip of the prongs. It is usual to fit rubber tubes over the prongs for such use.

Where a clamp is likely to be overheated it should have the prongs bound with asbestos string. This will stop glass from breaking from moderate overtightening and will prevent the metal from getting hot (never let it approach a red heat or the prongs will bend). The model will stand rather more heat than the dural models available commercially.

A smart appearance may be given by coating with heat resistant metallic paint taking care not to get it on the threads of bolts or wing nuts.

While burette stands may be made quite easily, and one will be described later, two clamps may be used, one above the other in the same stand. The burette, even if 3ft. long, will be quite safe and firm. A filter funnel may also be held in the clamp by the glass tube, but since it is easy to make the common retort stand rings it is not worth while making dc.

Ring for Filter Funnels, Etc.

This is made of $\frac{1}{4}$in. Whit. studding, obtainable cheaply from some ironmongers or Messrs. Whistons. It is fitted with two wing nuts and washers and fixes to the retort stand in the same way as the clamp (see Fig. 22).

The studding is heated to a bright red heat in the coal fire and bent round a large diameter pipe or can.

A suitable size for home use is 3in. dia. but other sizes could be made, the largest practicable one of this type being about 5in. dia.

The ring will accommodate funnels for filtering operations, but may also be used for holding a round-bottomed flask (to be made from electric lamp bulbs) or any vessel such as a beaker or flat flask with either a sand bath or wire gauze on top.

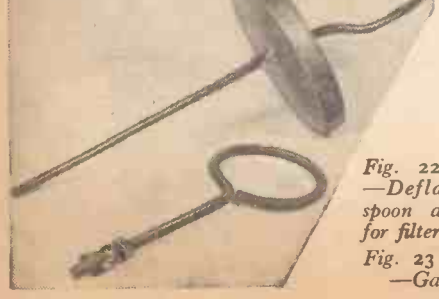


Fig. 22 (Left). —Deflagrating spoon and ring for filter funnels.

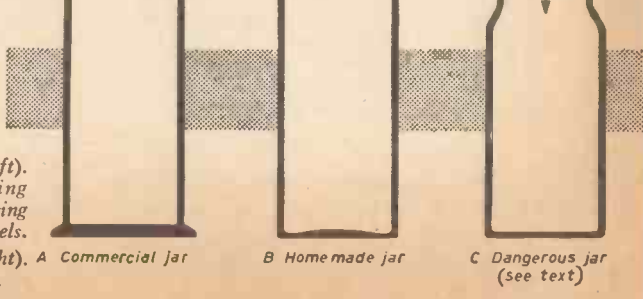


Fig. 23 (Right). —Gas jars.

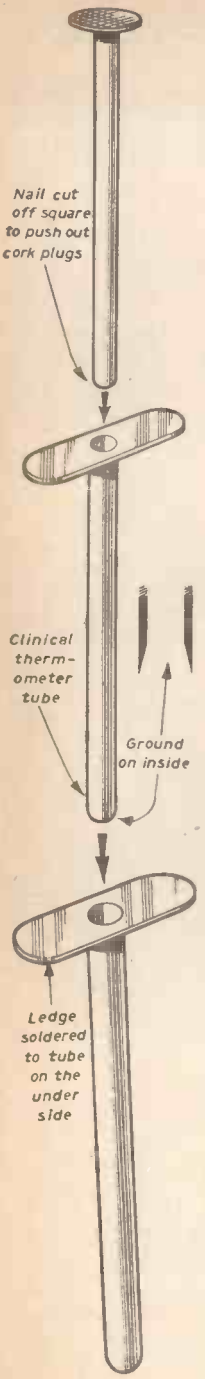


Fig. 24. — Cork borers and nail for clearing cork.

Gas Jars and Covers

These are easily made at home provided suitable bottles or jars are to hand. A section of a commercial gas jar is shown in Fig. 23 together with a section of a home made one and also of a jar which is *not suitable*. A restricted opening makes the bottle liable to explode during some experiments.

A good round glass bottle is cut off just before the top starts converging and the rough cut ground down on a glass sheet with emery powder and water. Give it a finishing grind on a piece of plate which has not been used very much to obtain a dead flat gas-tight joint. It is more essential in the home-made one to have a good surface as it has no wide flange. In the interests of safety it would be unwise to make a jar of this type longer than about 6in. Experimenters are urged to wear protective goggles whenever dealing with explosive or unfamiliar substances.

Cycle lamp glasses make good covers when lightly smeared with motor grease or vaseline. They are improved by grinding on the flat glass plate with emery powder, holding the glass with a motor type suction valve grinding tool. Even when ground it is advisable to grease the surface.

It is not easy to cut glass in circles and the author finds that small squares of glass similarly treated work just as well.

Deflagrating Spoons

When experimenting with gases such as Oxygen, Nitrous Oxide, or even Carbon Dioxide some safe and convenient method of introducing dangerous substances for combustion tests is required.

In Fig. 22 will be seen a suitable spoon made from " studding " (Messrs. Whistons). Once made this will last a lifetime and although the initial heating of the spoon in a bunsen may take longer it will not be burnt away in any experiment known to the author.

A tin lid a little larger than the gas jars is drilled with a hole to take the studding and a couple of wing nuts are fitted. The end of the studding is heated in the fire to a bright red heat and bent as shown while still very hot. When cold a nut is screwed on the bent end and another screwed on for only about $\frac{3}{16}$in. The first nut is then tightened on to the other to act as a lock nut. The hole in the projecting nut is now drilled as large as possible without fracturing the hexagonal sides (say $\frac{7}{16}$in. approximately). This cavity is the " spoon." Should the spoon become badly burnt another nut is fitted and drilled.

Cork Borers

While the use of rubber bungs is advisable in most cases, good airtight joints can be made with ordinary bark corks if they are " drilled " carefully to the correct diameter for the tube to be fitted and then soaked in water.

Holes may be made with a little practice by using a red hot bradawl or similar instrument. The disadvantages are the smell produced, the blackening of the cork and the certain skill necessary to burn the correct sized hole perfectly round. Where many experiments are to be performed it is well worth while to make a set of cork borers.

Fig. 24 shows a selection of cork borers; the diameter of the tube may be as required but the metal of which the tube is made should not be thicker than $\frac{1}{16}$in. Brass is best to use as when wet corks are cut, steel will tend to rust. A suitable key with which to turn the tube is shown, the hole in the top just takes the tube, which is soldered in with ordinary tinman's solder. The free end of the brass tube is sharpened very slightly with a grindstone, file or emery cloth. Brass tube may be purchased in assorted bundles from Messrs. Whistons, but a good " general purpose " borer may be made using the casing of an ordinary clinical thermometer. These are made of chromed brass and will not rust.

Spatulas for Handling Chemicals

A good brass spatula may be made from about 18g brass sheet or strip, cut to the approximate shape and size of Fig. 25. The " spoon " end may be carefully hammered out using a ball peine hammer, this is a tricky operation and readers not used to metal hammering might decide to leave the spatula flat. The spatula should be thin enough to pass along a $\frac{1}{2}$in. tube and long enough to reach almost to the bottom.

Perspex $\frac{1}{16}$in. thick and similar materials may also be used. Cut to shape with a fret or coping saw, clean up with a file and shape the spoon under almost boiling water. Amyl acetate and similar solvents must be kept away from such spatulas.

The apparatus described so far in this series will enable oxygen to be prepared at home using only home-made equipment. The apparatus should be used in conjunction with a text book on inorganic chemistry. Also in such a textbook would be found further chemicals which would give off oxygen and a list of substances to be burnt in oxygen to form a series of experiments.

(*To be continued*)

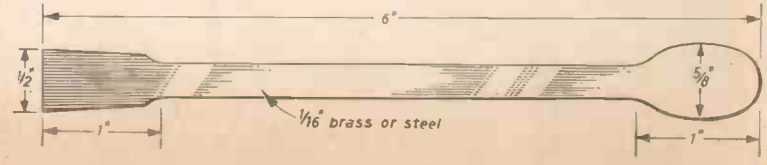


Fig. 25 (Right).—Home-made spatula.

A Bedside Teamaker

(*Continued from page* 81)

lamp will stay lit when the teapot is removed the wire from the lamp to the n/o contact of S3 is shortened and soldered to the vacant tag on the " a " side of S4; it can be seen in Fig. 4. Also from the same tag on S4 1in. of wire connects to the centre tag of the " b " side of the switch (S4) and from these goes on to the n/o contact of S3.

Connect up and put switches on with S4a set to " Heater." Heater should get hot. Pressure on the pad should bring on the lamp. Put S4 over to " Mute " (Fig. 10) and the bedside lamp should now remain on, even when the pressure is released from the pad.

At the same time the heater should now cool down. Check that it still does so. The wiring is now as in Fig. 7g.

Modifying the Kettle

Obtain from the local garage about 15in. of $\frac{5}{16}$in. or similar copper pipe and a petrol pump union as shown in Fig. 13. Take one of the flange nuts " D " and solder to it a strong piece of galvanised wire about 8in. long as shown in Fig. 13, but leave the wire long for now.

Heat the copper pipe to a bright red heat and then plunge it in cold water. Bend it to the shape shown round a dowel or can, if the copper hardens during this bending process anneal it again. Tin both the copper tube and the nipple " E." Solder the copper pipe inside " E." Slide the flange nut over and having wetted the bent pipe, slide suitable polythene tubing over the whole length of the pipe and leave about 3in. of tubing projecting (according to the height of the teapot used).

Drill out the hole to the right of " A " in the union body (Fig. 13) to take the other piece of copper pipe. This must be long enough to reach to $\frac{1}{4}$in. from the bottom of the kettle. It must not touch the bottom, and if too high will not deliver enough water. Solder the pipe in place.

Drill a $\frac{5}{32}$in. or $\frac{1}{16}$in. expansion hole *just beneath* the inside of the union in the copper pipe.

Now fix the assembly in the top of the kettle by drilling a hole carefully (it is thin metal) and threading the extra flange nut inside the stopper hole using the wire. Plumber's hemp and paint (not lead paint) will make a watertight seal easily as the pressure is very low. Do up tight. Fit the copper pipe on top.

Fill the kettle with water. Blow into the stopper until water ceases to come over. Check that at least half a cupful is still inside the kettle. Cut the galvanised wire short (Fig. 13).

Trying Out the Circuit of Fig. 10g

The unit is already wired. Place the teapot on the pressure stand and take the polythene pipe through the teapot lid (enlarge the hole to a loose fit). Put S1 on, set S2 to any time required, put S4 to " Heater " and the kettle of cold water on the stand. About 14 to 20 minutes later it will boil and the water will slowly be forced over into the teapot. When full enough the lamp will come on and the heater will go off. Before removing the pot put S4 to " Mute " to cut out the heater and leave the lamp on. If the wrong amount of water is delivered on test take out the internal pipe and adjust length.

Wiring in the Electric Bell and Transformer

Wire the bell directly to the low volts side of the transformer (5V. will suit) and test by connecting the primary of the transformer directly to the mains.

Wire the main side of transformer to S1 (Fig. 4) and other lead from transformer to spare tag on " b " side of S4. Note which tag it is in Fig. 4. One tag of this switch is never used.

Join one side of the secondary (low volts) to earth tag on left of Fig. 4. If an earth connection to the laminations is possible, earth these too. Take a lead from the 5V. terminal to the bell. Connect the other bell terminal to earth (or as in Fig. 4, to the earthed side of the transformer).

The circuit is now as in Fig. 7h and most of the wires are seen in Fig. 4. Test the whole lot out. When S4 is set to " Heater " pressure on the pad should put on the light *and* ring the bell. Putting S4 to " Mute " should silence the bell, but leave the lamp on.

Wiring in the Thermal Switch

The thermal switch S6 has been fitted into the pressure pad and previously tested for correct time lag. Remove wire from 5V. connection to transformer and bell. Connect bell to thermostat instead, and other side of thermostat to the 5V. side of the transformer. The circuit will now be as in Figs. 7j, 2g and 4.

The apparatus should now function as above and in addition if a teapot of hot water is placed on the pressure pad, the bell will not ring for about 3 minutes (brewing period).

Earthing

If it has not already been done earth all metal parts which might be touched on top. The earth wires are clearly marked in Fig. 4.

Final Heater Test

Switch heater on without any water on it. Leave it for 15 minutes. Make sure no scorching of wood, etc., occurs. If it does the heater is too powerful, not made correctly, the holding bolts are not as long as stated or insulated with asbestos (Fig. 11). A bottom piece the same shape as the top is required or the unit may be screwed down to a bedside table.

Other Circuits

The constructional remarks have been confined to the circuit of Fig. 2g, but other more complicated and simpler ones are possible. Fig. 2a to h gives some ideas about possibilities. Where the thermal switch S6 is connected to mains direct it must be *thoroughly insulated*.

Circuit " a " is very simple, but S2 must be put off before the teapot is lifted or the kettle will commence to boil again; " b " suffers from the same defect, but an alarm bell operates at mains voltage.

Circuit " c " makes tea, rings bell and lights the lamp. No brewing up period is allowed for in this circuit. Circuit " d " will permit the bedside lamp to be used at all times in addition to its function as a photo alarm.

Circuit " e " is a good one, it is simple and effective. The bell is low voltage, the wiring is simple and S2 must be put off before removing teapot. Circuit " f " does not light the lamp until after the brewing up time, but additional insulation is required on the thermostat (S6).

Circuit " h " shows how it is possible to have all the automatic features already mentioned with a lamp usable at all times and an alarm system ringing in other rooms with a master bell muting switch S4b and a minor one at S7. One for use in the external bell circuit can be fitted if desired.

An All-metal Version

This makes the tea at a preset time, puts on a bedside lamp automatically and rings a bell when the tea has brewed. The bedside lamp may be used at all times independently of the " teamaker." The model is shown photographically on page 81, the circuit is that of Fig. 2j and construction is shown in Figs. 14-17.

The universal chassis 6in. × 10in. × 2in. sold by Home Radio (Mitcham) Ltd. or similar would suit and is priced at 7s. 2d. It can be made from 18g soft aluminium sheet as shown in Fig. 17, but small individual holes are not shown and will have to suit the actual components used. A bottom plate will be necessary if the unit is likely to be picked up while plugged in, or it may be screwed down to a stand or bedside table top.

The Heater

The same unit as already detailed is used. No heat sink is necessary as the chassis will dissipate surplus heat, especially if it is painted black.

The Pressure Pad

The top of the pad is shown in Fig. 15 and the underside in Fig. 16. The relief spring is not situated centrally as before, but is to one side away from the hinges on which this pad rests. There is less friction and more positive action as long as the hinges are free and properly lubricated. The pad is of about 18g aluminium sheet and the spring is the same as in the other version, but has five complete turns and is soldered to a nut to fix it in position. The aluminium is hinged on small right angle brackets bolted to the chassis as shown in Figs. 15 and 16. A $\frac{3}{16}$in. Whit. bolt with the head cut off and a screwdriver slot cut in it is fitted with two nuts, one each side of the aluminium sheet to form the adjustable tappet to work the micro-switch plunger (S3).

A $\frac{3}{8}$in. cork mat is laid on top of the aluminium sheet and is fixed down with bend-over paper clips or nuts and bolts countersunk in the cork. The thermostat is mounted as in the other model, in an inset in the cork, but it is essential in this model to place about four layers of cellulose tape under the thermostat on the aluminium sheet to stop the wires or soldering tags connecting directly to the aluminium. The wires pass out through holes in the aluminium: if grommets are fitted countersink the cork above to take them.

The Thermal Switch

Mounting and wiring has been referred to above. In the prototype the component shown in Fig. 3a was used. It was obtained from Messrs. Electronics Ltd., 44 Windmill Hill, Ruislip, Middlesex for 5s. 6d. and requires slight modification, as shown in Fig. 3a. Remove the bimetal strip by undoing bolt " a." File off the rivet head fixing in the platinum contact. Gently punch out the contact. File *both* sides of the bimetal down a little where the rivet went through. Put the contact back in the reverse position as shown. The contact will be adjacent to the grey metal of the strip, and the rivet will project a little on the brass side since the bimetal was filed somewhat thinner. It is gently knocked over with a small ball peine hammer.

Fix the bimetal back the reverse way round so that contact now touches the fixed " point " when heated. Slight bending of the strip may be necessary. Adjustment is also possible as the " point " is on an adjustable screw thread. Slight heating with a match should now bring the contacts together. When cold they must be only about $\frac{1}{32}$in. apart. The thermal switch in the wooden version will also suit, but is not quite so robust.

Overtravel stops, consisting of two $\frac{3}{16}$in. × 1in. Whit. bolts with two nuts on each as shown in Fig. 16 are required.

Mounting the Components

A suitable layout is shown in Fig. 14. In this version the chassis is properly earthed and only one fuse is fitted. Bulgin F55 or F155 will suit with 3A. fuses to fit.

S1, S2 (time clock), S4a and b, S3 and S6 are all as previously listed while the additional switch S5 to give independent control of the bedside lamp is another 2-pole 2-way switch which may be as specified for S4a and b. In the prototype a surplus one of unknown make is seen fitted.

In the prototype the bell transformer is replaced with an ordinary speaker transformer (speaker windings to the bell, valve anode windings to the mains). The micro-switch is mounted as before and all earth connections will have to be made to solder tags bolted to the chassis.

If the bell is of all metal construction then it will have to be *completely insulated* from the chassis. This can be done by putting grommets in the fixing down holes, a layer of paxolin or card under the bell and fixing with nuts and washers above the grommets on top of the chassis. Before connecting verify with a flash lamp and battery that the metal of the bell is, in fact, insulated from chassis.

A separate table or bedside lamp is used to suit the user.

Wiring

This is shown in Figs. 14 and 2j. It is best to test each part, and basically the same method may be used as was described for the wooden version. Experienced readers may, however, build the unit up as in Fig. 14 in one go without the testing described.

Testing and Adjustment

The same kettle and teapot is used as for the wooden version. The remarks about initial adjustment to get the right amount of water in the teapot and time lag for the alarm bell apply. Do not use the unit until it has been thoroughly tested and always have a good earth connection.

SALES AND WANTS

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

FOR SALE

AIR COMPRESSORS, single cylinder, two stage, 2¼ cu. ft. min. at up to 450 p.s.i.; suitable for spraying, etc.; condition as new but slightly store soiled; cost over £10; bargain at £2 0s. 0d. each. Air Lines, 40ft., new, 30s.—Cooper, 10 Fowler Street. Nechells. Birmingham, 8.

SPARES, VALVES, TUBES. 1930-1960 Guaranteed perfect, set tested, ex-working equipment. LOTs from £1. FOTs, Osc. Tr. Def. Coils, etc. cheap. TUBES guaranteed 6 months, FITTED FREE, Picture shown to callers. 9in., 30/-. 12in., 40/-. 14in., 60/-. 17in., 70/-. VALVES. 3,000 types stocked. EF50, SP61 . . . 1/-. EF91, EB91, 6H6 . . . 2/-. EF80, UF42, 6F1, 20D1 . . . 3/-. 10F1, 6V6, B36, KT61 . . . 4/-. PCC84, PCF80, PL81, PL82, PY81, ECL80, PCL83, 6K25 . . . 5/-. KT33c, 10P14, 10C1, UCH42 . . . 6/-. EL38, KT36, U22, U35, U281 . . . 7/6. PL38, PZ30, U24, 20P1, U25, 185BT . . . 10/-. U801, 20P4, 27SU, U37 . . . 12/6. Pre-war 4, 5 and 7 Pin, 5/- each. Postage 6d. "Constructor's Parcel." 3lb. assorted res. cond., etc. from modern TVs, 7/6. Postage 2/6. Send S.A.E. for list or with enquiries.
"ST. JOHN'S RADIO,"
156 St. John's Hill, S.W.11. Bat. 9838.

2,000 COMPONENT BOXES each with 10 adjustable compartments, 2 × 1½ × 1¼ and press on lid. Ideal for nuts, screws, etc. 3/11 each, 6 for £1, post free.—Jervis, 16 Manor Road, Brampton, Chesterfield.

"ON TIME"
AUTOMATIC PARKING LIGHT SWITCH
ON AT DUSK—OFF AT DAWN
Transistorised amplifier operated by sensitive photo-electric cell. **Kit of Parts, 42/6. Ready for use, 47/6.**
Parking Light, 7/6 extra.
Major model to operate side and rear lights **17/6** extra.
State voltage, 6 or 12 v. Photo cells. **20/-** each.
HUGGETT'S LIMITED,
2/4 Pawsons Road, West Croydon

ELECTRIC FURNACES, muffle type chambers, 7" × 4" × 3" 240 v; 900°C., 39/6; 1,000° C1 or 1½ kW., 59/6.—"Paytox," 57 New Road, Rubery, Birmingham.

FOR SALE (*Continued*)

ASTRO TELESCOPE MAKING. — Standard Ramsden Push-in Eyepieces, ¼in., ⅛in., ⅛in., focus, 35/-, with R.A.S. thread, 42/6 ea. S.A.E. list, Object Glasses, Newtonian Mirrors, Diagonal Mounts, Focusing Mounts, Tripods, Mountings and Terrestrial Telescopes.—W. Burnet, Grand Sluice, Boston, Lincs.

GREAT BARGAIN OFFER. Stainless Steel Split Pins, about ½ list. 3" × 5/32", 30/-, 2½" × 1/8", 15/-, 1¼" × 5/32", 6/- (1" × 1/8", 1" × 5/64", 1" × 5/32") all 3/- per 100 box. Assortment of each 20/-. Also Stainless Steel Worm Drive Hose Clips, most sizes 2/6 each.—L. Brooks & Co., 48 Church Road, St. Annes on Sea.

BRAND NEW
HYPODERMIC SYRINGES 5/1
WITH 2 SPARE NEEDLES
excellent for precision oiling, etc.
SIMA Serum Glass 2 c.c.
Wonderful value. Each 5/1.
Per doz. 54/-.
SIMA Needles, Stainless Steel.
Sizes 12, 17 or 18. Per doz. 4/-.
All Orders Post Free.
G. ROGER-SMITH
(Dept. 7), *Syringe Supplies*,
38 OLD FARM RD., LIVERPOOL, 23

EASIBUILD "WITCH" RUN-ABOUT, Fast 12ft. glass hull, ready moulded. Precision cut timber, wheel steering, screen, Attwood fittings, screws, glue, varnish, etc., all in.—Lund Finney Boats, Morda, Oswestry.

CYTRINGAN Welders 180 amp., £35. Brochure from Pickhill Engineers, Thirsk, Yorks. Sinderby 234.

Elliptical Speakers, 15/9. Brand New, 8" x 3" and 7" x 4". Ideal for record player cabinets. The present any one would like. P. & P. 2/9.
8" P.M. Speakers, 5/9. Slight cone fault that is repaired, not affecting the quality. 2-5 ohms. P. & P. on 1, 2/6; on 2, 3/6.
P.P. COMPONENTS LTD.
219 Ilford Lane, Ilford, Essex.
Mail order only. FREE Catalogue.

NEW AND USED light machinery. Engineers and woodworking equipment.—Tom Mallaby, 223, Lakk Road, Portsmouth, Hants. Phone 21917.

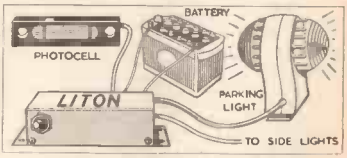
FOR SALE (*Continued*)

COMPRESSORS
Twin Cylinder 2¼ cu. ft. per min. 150 lbs. pressure, base mounting complete with vee driving wheel, £2 C.F.
S.A.E. for list of Motors, gauges. Safety Valves, Air Line, etc.
Dept. P.M.3,
WHEELHOUSE
13 BELL ROAD, HOUNSLOW
Phone: HOU. 350

MISCELLANEOUS

AQUALUNG and Compressor Equipment, Ballraces and Miscellaneous items. Lists 3d.—Pryce, 157 Malden Road, Cheam.

"LITON" AUTOMATIC PARKING LIGHT SWITCH



Controlled by a photocell, will turn your light on at dusk, off at sunrise automatically. Easy to build and fit. Kit of parts, **52/6.** Built and Tested, **57/6.** Mains **PHOTOELECTRIC GARAGE DOOR OPENER, BURGLAR ALARM,** etc. Kit: **£4.12.6.** Built: **£5/10/0.** Battery model: Kit: **65/-.** Built: **72/6.**
Photocells only **7/6, 12/6** and **25/-.** Circuit and details of any project, 6d. stamp please.
"ST. JOHN'S RADIO" 156 St. John's Hill, LONDON, S.W.11 BATtersea 9838

RADIO

LEARN-AS-YOU-BUILD PRACTICAL RADIO COURSE. Home study teaches you basic radio, electronics and electrical theory with practical training. Build your own 4-valve TRF and 5-valve superhet radio receiver; Signal Generator and High-quality Multi-tester. Moderate fees include all books and equipment.—Write for FREE Prospectus to I.C.S., Intertext House, Parkgate Road (Dept. 521A), London, S.W.11.

PHOTOGRAPHY

BELLOWS, Camera, Enlarger, Process. Industrial Collapsible Machine Guards.—Beers, 4 St. Cuthbert's Road, Derby. (Tel. 41263.)

PROJECTORS. Home Assembly Kits from £5 17s. 6d. Fan Base Kit £3 7s. 6d. Opticals: Screens. S.a.e. Marshall Smith Ltd., 64 Norwich Avenue, Bournemouth.

EXPOSURE METERS.—Build your own universal double-range incident light exposure meter with 50 × 37 mm. photocell, f/1·4 to f/32. 1/1,000th to 60 sec. film speed 19 to 37 deg. B.S. complete component kit, 45/-; all size selenium photocells in stock. S.a.e. details.—G. R. Products, 22 Runnymead Avenue, Bristol, 4.

Continued overleaf

STEEL SHELVING

RIGID AND SELF-SUPPORTING

55/- 72" high × 24" wide × 12" deep **65/-** 72" high × 34" wide × 12" deep

GROSVENOR INDUSTRIES LTD.
77 GROSVENOR ROAD LONDON, S.W.1. *Victoria 4375*

SITUATIONS VACANT

A.M.I.Mech.E., A.M.Brit.I.R.E., City and Guilds, G.C.E., etc., bring high pay and security. "No pass—no fee" terms. Over 95% successes. For details of exams and courses in all branches of Engineering, Building, Electronics, etc., Write for 148-page handbook—free—B.I.E.T. (Dept. 9G78), London, W 8.

CITY and COUNTY of BRISTOL EDUCATION COMMITTEE

GREENWAY SECONDARY BOYS' SCHOOL Doncaster Road, Southmead, Bristol

This well-equipped Comprehensive School of 810 boys has a vacancy for a Metalwork Master in January. Craftsmen holding Higher National Certificate or Diploma or Full Technological Certificate are eligible for the appointment, with qualified teacher status.

Salary in accordance with Burnham Scale—£520-£1,000 per annum. Approved industrial experience will be taken into account in assessing commencing rate.

Application by letter to Headmaster immediately, giving details of experience and qualifications, and enclosing copy testimonials.

ENGINEERING COURSES by post. A.M.I.Mech.E., City & Guilds, etc., and many practical training courses in Mechanical, Motor and Electrical work. No books to buy.—Write for FREE prospectus stating subject to I.C.S., Intertext House, Parkgate Road (Dept. 521), London, S.W.11.

JOBS ON SHIPS.—At last a book giving details of jobs, opportunities and entry into sea-going employment. 4/-.—P. J. S. Dept. PM, 21 Warwick Street, Oxford.

EDUCATIONAL

"HOW AND WHY" of Radio and Electronics made easy by a new, non-maths. practical way. Postal instructions based on hosts of experiments and equipment building carried out at home. New courses bring enjoyment as well as knowledge of this fascinating subject. Free brochure from: Dept. 12.P.M., Radiostructor, 40 Russell Street, Reading, Berks.

NEW!

LEARN

RADIO & T/V SERVICING and ELECTRONICS

and how to make and build your own equipment—using an exciting new practical apparatus course. Ideal for starting your own business or as a fascinating hobby.

FREE Brochure, without obligation

FROM **RADIOSTRUCTOR** *Dept. G 80*

READING · BERKS

Britain's leading radio training organisation

HOBBIES

CIRCULAR GLASS DISCS. Edged and bevelled, 6" × 1", 35/- per pair with abrasives, polish, etc., £2/15; 8" × 1", £3/5 per pair, with abrasives, polish, etc., £4/10. All post paid. Cash refund guarantee.—H. Gibbs, 75 Portmanmoor Road, Cardiff, S. Wales.

HOBBIES (*Continued*)

NEWTONIAN TELESCOPE MAKING. Glass Blanks and Tools. Grinding Kits. Optical Flats. Ramsden Eyepieces. S.a.e. for lists. L. J. Mays, 20 Clover Road, Timperley, Altrincham, Cheshire.

GILMOUR-VALE GAS TORCHES for CALOR GAS

We offer a powerful torch to all Calor Gas users, 33/6, and a Safety Coupling Valve, 15/6. Complete outfit: Torch, Valve, 6 ft. H.P. Hose with Hose Clips, assembled ready for use, 58/-. Ask for illustrated list of torches for town and bottled gas, with prices of all the materials for metal jointing. 3d. stamp please.

G. M. VALE & Co., 55 Park Road Wellingborough, Northants.

CATALOGUE NO. 14 Government Surplus and Model Radio Control, over 500 illustrated items. 2s. (refunded on purchase). P/P. 6d.—Arthur Sallis Radio Control Ltd., 93(B), North Road, Brighton.

SEREN ASTRONOMICAL SUPPLIES

Warehouse Road
Stebbing, Dunmow, Essex

EQUIPMENT for ASTRONOMERS

Mirrors, eyepieces, focusing mounts, spiders, etc. Do-It-Yourself kits.

S.A.E. for free details.

JEWELLERY

JEWELLERY Simply Made. Catalogue Free. Brooches, Earclips, Rings, Marcassite. — Webbs Handicrafts, 46 Burnway, Hornchurch, Essex.

(*Continued on page 99*)

IBM UNITED KINGDOM LIMITED

CUSTOMER ENGINEERING

Due to continued expansion, International Business Machines, the largest company of its kind in the world, requires approximately 185 additional Customer Engineers to be responsible for the installation, maintenance and efficient working of IBM'S whole range of Data Processing equipment, including computers, calculators and electro-mechanical accounting machines. Applications are invited to fill following vacancies:

1. COMPUTER ENGINEER Applicants (age 21 to 30) should be of H.N.C. (Electronics) standard or have a sound background in general electronics; with emphasis on pulse circuitry. A knowledge of computer or calculator techniques would be an advantage but is not essential. Computer Engineers selected for the IBM 700 series machines must be prepared to spend a training period of 5/6 months in France, or the United States. For the IBM 650 and RAMAC systems, training given in the United Kingdom or Germany. Excellent starting salaries are offered based on qualifications and experience.

2. ACCOUNTING MACHINE AND CALCULATOR ENGINEER Applicants (age 21 to 30) should have the ability to handle complex electro-mechanical machines and have a sound background in electronics obtained by study for a National or City and Guilds certificate or through practical experience in Industry or the Armed Forces. Starting salaries are between £600 and £750 per annum. Salary increases are awarded solely on ability and performance. Promotion prospects to computers or to supervisory/managerial appointments are excellent.

Preliminary Interviews will be conducted at the IBM offices which are located throughout the United Kingdom.

Applications should be made in writing to the

Personnel Manager,

IBM UNITED KINGDOM LIMITED,

101 Wigmore Street, London, W.1.

or any IBM Branch quoting reference CE/60/144

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

The Tectool

THE TECTOOL MFG. CO. of Rainham Road South, Dagenham, Essex, now market a tool for making grooves for sliding doors, etc., it is called the Tectool. It works both forwards and backwards, cuts nicely into the wood to a variety of depths, controlled by the angle the engaged cutter makes with the work. It can also be used to groove across the grain first scoring the edges of the groove. Price 19s. 6d.

Grooving with the Tectool.

Three-way Adaptor

GRELCO LTD., of Minehead, Somerset, have produced a new design in three-way adaptors. Two 13A. three-pin and one fused 5A. three-pin, all safety shuttered are all on one face and a quick change 5A. fuse carrier enables the fuse to be changed quickly without dismantling any part of the adaptor. The fuse is a standard 5A. cartridge type to B.S. 646A. Overall protrusion is 1¼in. The list no. is K.135 and adaptors are available either in brown at 10s. 9d. each, or white 12s. 3d. each.

(Right) The new design in adaptors.

(Below) The power - tool chest.

Portable Power-Tool Chest

A COMPLETELY portable power-tool chest comes from Black and Decker, containing the new Power Driver, a unit specially developed to drive all attachments included in a new line of quality tool chests. The contents also include a jig-saw attachment, portable saw attachment with two blades, a finishing sander and the right-angle speed changer which also allows drilling, sanding and polishing in awkward places with ease. A full range of minor accessories, such as the wire cup brush, moulded rubber pad and grinding wheel, are also included in this comprehensive kit. The chest itself is made of oak. Price £36 15s.

Soldering Iron Stand

A NEW soldering iron stand is announced by Antex Ltd., and is suitable for bench mounting as well as for wall mounting. A reel of solder can be accommodated on the back. The stand retails at 12s. 6d. Antex Ltd., 7/8 Idol Lane, London, E.C.3.

(Right) The Antex soldering iron stand.

Electronics Construction Outfit

A NEW "do-it-yourself" electronics constructional outfit has been produced by Clarke-Smith Manufacturing Co. Ltd., and Griffin and George Ltd. The Griffin-Clarke-Smith "Mechtronics" apparatus enables pupils to assemble for themselves a large number of experiments and demonstrations illustrating many of the fundamental principles of electronics. The complete set, type 97-100, contains valves, transistors, a photo-electric device, transformer, relay loudspeaker, circuit board, neon tube, crystal diode and potentiometers, bulbs, holders, switch parts, special connectors, wires, valve holders, resistors and capacitors and other standard components. For further details write to Griffin and George Ltd., Ealing Road, Alperton, Wembley, Middlesex.

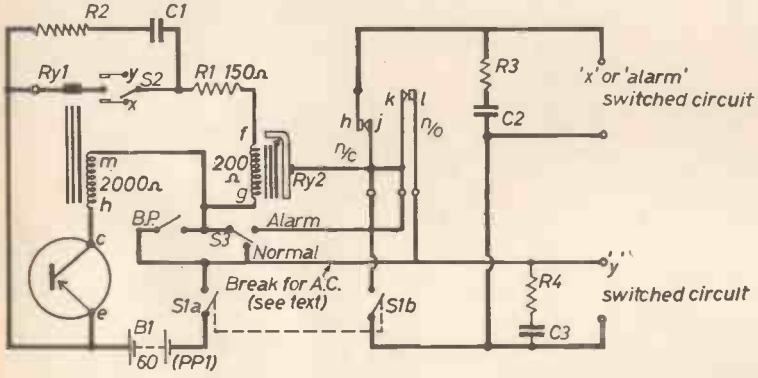
(Below) The "Mechtronics" kit.

LETTERS TO *The Editor*

The Editor does not necessarily agree with the opinions expressed by correspondents

Combined Photo-switch and Burglar Alarm

SIR,—The following details of a combined photo-switch and burglar alarm might interest your readers. It is on the same lines as that described by E. V. King in his excellent series of articles on photo-transistors (November 1958-April 1959). The circuit is almost identical with that of his photo-switch (December 1958 issue). However, a simple piece of switching enables this circuit to play a dual role with only one extra switch and a bell-push.



Mr. Taylor's circuit.

By means of S3 it can be determined whether the unit is to be used as a photo-switch or alarm. For the former, S3 is put to "Normal," which completes the battery circuit when S1 is closed. If the unit is normally illuminated, S2 is switched to the circuit n/o, i.e., which will be closed on interrupting the beam. If normally dark, vice versa.

For use as an alarm, a bell or buzzer, etc., is connected to terminal box x, in series with a suitable battery (for A.C. work omit R3 and C2). Switch S3 to "Alarm" and S2 to x. While pushing the bell-push B.P., close S1 when both relays should click over, if the unit is being illuminated. Nothing should happen when the B.P. is now released. When the beam is interrupted, the alarm should go and the unit can be reset by pushing the bell-push or be turned off with S1. The overwhelming advantages of the bell push method over the mechanical reset button are ease of operation and access and simplified mechanical construction of the unit. When the unit is being used as a photo-switch, circuit Y should not be used directly on A.C. mains unless the lead marked "break for A.C." can be interrupted, either by a switch or by disconnecting it, to safeguard against faulty insulation or switches.—P. F. TAYLOR (Bristol).

The P.M. Printing Press

SIR,—Below is a photograph of my printing press which I made shortly after the constructional articles by J. Rodgers appeared in the November 1959 issue. As can be seen my printing press is much the same as J. Rodgers but I used strong ½in. plywood instead of ⅞in. thick.

I found after using the press several times, that the forme slipped about on the glass each time the type was inked. I made provision for wedging this, to keep it in one position during printing.

Notepaper heading is one of the many different things I have printed. I have found from experience that I cannot satisfactorily print the address and telephone number on this at the same time, but that notepaper has to be printed twice. Cards and tickets however can be printed at one time. I thank PRACTICAL MECHANICS and Mr. J. Rodger for this printing press.—J. M. DAVIDSON (Edinburgh 10).

This press was made from ½in. plywood.

HANDICRAFTS

TROPICAL SHELLS. All sizes for handicrafts, jewellery, aquariums, ornament. Catalogue, 6d. Mixture, 6s. 11d. lb. Post free.—Chapman, 14 Moreton Close, Tottenham, N.15.

NOW. MUSICAL BALLERINA MOVEMENTS ONLY 19/11 COMPLETE. Ordinary movements from 11/6. Large selection of ready to assemble kits. Call at your dealer now, or send for our free illustrated catalogue. Please send stamp.

SWISSCROSS LTD. Dept. V,
202 Tulse Hill, London, S.W.2

WATCHMAKERS

LEARN to be a Watch and Clock Repairer in your spare time and earn extra money at home. We can supply everything you need at unbeatable prices, including instructional books. Swiss watchmakers' tools, watches, watch and clock movements, lathes, cleaning machines, all spare parts for watches and clocks, etc. We also have a fine selection of musical box movements and kits. Send 9d. P.O. for bumper bargain catalogue.—The Watchmakers Supply Company (Dept. P.M.), Carterton, Oxford.

BOOKS for Watch / Clockmakers, Collectors. New, Out of print, Antique. Free list.—T. & S. Hyde, Scotgate, Stamford.

WATCH PARTS

For all makes of watches, tools, instructional books, etc. Special Kits for beginners. Send 6d. for "Super Bargain Catalogue." T. G. LOADER (Dept. B.), Watchmakers Mail Order Service, Milestone Road, Carterton, Oxford.

THE SALE OF THE YEAR. Mainsprings separately packeted, 6/6 gross assorted. Buttons 12/- gross. Gents Watches. Special bargain line 79/6 each. Free Lists.—J. J. Lawson, 10 Victor Road, Bradford, 9. (Tele: 47377).

WATCH REPAIR SERVICE, unrivalled for reliability and speed, coupled with reasonable charges. Part jobs welcomed. Material supplied.—Hereford Watch Co., 13 St. Owen Street, Hereford.

HOME BOAT BUILDING

EASY TO FOLLOW KITS to build a Boat at home—for Cabin Cruisers, Runabouts, Canoes, Prams, Dinghies and Enterprise Sailing Dinghies. Brochure from: Wyvern Boats (Wessex) Ltd., Milborne Port, Sherborne.

BUILD YOUR OWN BOAT. Send 3/- for copy of "Home Boat Building." This contains 13 designs for amateur construction.—Bell Woodworking Co. Ltd., Narborough Road South, Leicester.

PATENTS

PATENTING SERVICES. — Advice. Qualified agent.—C. L. Browne, 114 Greenhayes Ave., Banstead, Surrey.

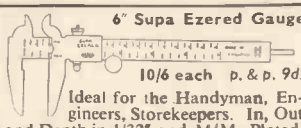
WOODWORKING

SAWBENCHES.—Cast Iron. Rise and Fall. 6 in., £6/19/6. 8 in., £10/10/-. Carriage extra.—Drysdale, 58 Commerce Road, Wood Green, London, N.22.

TOOLS

SELECTA BCU28 Benchmaster Workshops. Brand new. List price £19/17/6. Our price £14 or £19/17/6 with brand new Black & Decker D500 electric drill thrown in. Drysdale, 58, Commerce Road, London, N.22.

SUPER SIXTY HAND TOOL KIT OFFER
60 Assorted Hand Tools in 3-Tray Cantilever Steel Tool Chest.
Bargain £9.19.6 lot. *Carriage 5/-*
DRYSDALE
58, Commerce Road, London, N.22
BOWes Park 7221



6" Supa Ezered Gauge
10/6 each p. & p. 9d.
Ideal for the Handyman, Engineers, Storekeepers. In, Out and Depth in 1/32" and M/M. Plated. Buy direct from makers. S. J. PARKER & CO., 140/1 Longden Coleham. SHREWSBURY.

WOLF ¼ in. Electric Drill with 10 genuine Wolf accessories including saw attachment. Everything brand new. Bargain 160/- the lot, carriage 3/6. Drysdale, 58, Commerce Road, London, N.22.

BLACK & DECKER
D.500 ½in.
ELECTRIC DRILL
Plus 10 attachments, everything new. Full maker's guarantee.
BARGAIN £7 8s. 6d. LOT.
DRYSDALE
58, Commerce Road, London, N.22
BOWes Park 7221

CAPSTAN SCREW DRIVER. For speedy work, high torsion lock and quick release. For details apply—Butcher Eng. Co., 4 Cross Street, Darwen, Lancs.

SELECTA 2 SPEED DRILL
plus 13 attachments. Everything new. Full maker's guarantee.
£12 19s. 6d the lot. *Carriage 3/6.*
DRYSDALE
58, Commerce Road, London, N 22
BOWes Park 7221

TOP TWENTY BASIC TOOL KIT OFFER
20 Top Quality Hand Tools.
Bargain £6 19s. 6d. lot. *Carriage 3/-.*
DRYSDALE
58, Commerce Road, London, N.22
BOWes Park 7221

TOOLS (*Continued*)

FANTASTIC SOCKET SET OFFER
Genuine Hand Forged Chrome Vanadium 27 Piece Socket Set in fitted steel carrying case.
BARGAIN £5 18s. 6d. LOT
DRYSDALE
58, Commerce Road, London, N.22
BOWes Park 7221

ELECTRICAL

SELF starting synchronous mtrs., 200/250 v. 50 cycles complete with detachable geared mechanisms. 10s. each. —James S. Graham, 73 Acre Road, Kingston-on-Thames, Surrey.

BUILD YOUR OWN WELDER.—Full set of working drawings and instructions to build 50 amp. (6s.), 100 amp. (8s.), 180 amp. (12s.). Every assistance given. C.W.O.—Plans Service Co., 7 Gilpin Road, Urmston, Lancs.

LET US INTRODUCE YOU
to an old thrill revived. Early experimenters derived much pleasure from simple radio circuits. Transistors enable you to recapture the old thrill. Radios can be made simply and cheaply using these devices. The only power is a small flashlamp battery lasting weeks. Our "Notes on Transistors" show you how. Send 8d. stamps to
MORCO EXPERIMENTAL SUPPLIES
(MOORES (SHEFFIELD) LTD.)
8-10 Granville Street, Sheffield, 2

BRAND NEW BROOK ELECTRIC MOTORS

Single Phase.	¼ h.p. 1,500 r.p.m.	£7.10.0
	½ h.p. 1,500 r.p.m.	£10. 2.6
H.P. TERMS	¾ h.p. 3,000 r.p.m.	£10. 2.6
AVAILABLE.	¾ h.p. 1,500 r.p.m.	£11.11.0
	1 h.p. 3,000 r.p.m.	£11.11.0

Fully guaranteed by makers, approval against cash. Carriage paid mainland. State voltage.
P. BLOOD & CO.
ARCH STREET, RUGELEY, STAFFS.

ALL TYPES OF ELECTRICAL GOODS at extremely competitive prices, e.g., 5 amp. Twin Cable, 35s. 100 yards; Lampholders, 7s. doz.; 5ft. Battens, 49s.; quality and immediate despatch guaranteed. Request list.—Jaylow Supplies, 93 Fairholt Road, London, N.16. (Telephone: Stamford Hill 4384.)

CABLES: 3/029 and 7/029 P.V.C. cable twin and E., 9d. and 1/3 yd. 5% and 10% discount for 50 and 100 yds. respectively, 1/- extra packing, c.w.o. Brit. Stand. spec.—Lewis Electrical, 62 The Broadway, Mill Hill, N.W.7. MIL. 6741.

95,000 PIANISTS

have learned to play the piano beautifully with the aid of my POSTAL lessons.
Everything is so clearly explained that, even if you do not know a note, you will, with only half an hour's practice each day, become a proficient pianist in 9-12 months. Ordinary music: no freakish methods. I have taugh over 95,275 pupils in over 45 years and I CAN TEACH YOU. Free Book and advice Say if Beginner, Moderate or Advanced pianist.
Mr. H. BECKER, 159, The Hall, Centurion Road, Brighton, Sussex.

YOUR *Queries* ANSWERED

Treating Ebonite

CAN you please give me details for polishing and for removing the slight discoloration which appears on polished ebonite? My flute, which is made of this material, shows signs of a green discoloration.—J. Turner (Exeter).

DISCOLORATION of ebonite is largely due to exposure. To remedy the defect a film must be removed from the surface with fine emery powder lubricated with paraffin, to which can be added a little lampblack. Apply with a soft cloth. From time to time rinse down with paraffin and dry to see the effect. Be cautious of the effect of abrasive powder on the metal parts of the instrument as the plating of these items could easily be spoilt.

When ebonite tube is bought, unless polished tubing is asked for, the tubing will have a matt finish. Commercially the tubing is buffed up to a polished surface with abrasive powder on a power-operated polishing mop. The amateur can manage small quantities of tubing by hand. Start rubbing down with course grades of emery cloth and work down to fine grades. Use paraffin as a lubricant.

P.V.C. Pressings

I AM using open plaster moulds for small articles pressed from a P.V.C. paste and cured in an oven at 150 deg. - 170 deg. centigrade. However, I get a very pitted and rough surface on the cured article, although the top surface (outside mould) is quite satisfactory. I have also tried using a lacquer to seal the mould, this produces a clean moulding but it is practically impossible to remove the P.V.C. article from the mould owing to the heat softening and making sticky, the applied lacquer during the cure. Would you please advise me on this matter? —L. Corder (Croydon).

SUBSTITUTE Araldite plus hardener for the preliminary surface dressing to your plaster mould. (Araldite D plus 951) obtained from CIBA Ltd., Duxford, Cambs.

Then as a releasing agent smear the dressed surface —after it has been cured at the appropriate temperature; i.e. room temp. for 4 hours or 2 hours at 80 deg. —with a preparation known as " Mold-wiz."

RULES

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

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

Setting Prisms and Lenses

I HAVE recently taken my binoculars to pieces to clean the prisms and lens but after assembly I get double vision. Also there is a slight difference in the tone, i.e. whilst looking at a yellow object one eye piece showed yellow the other more orange. Is there any way I can set these correctly again?—E. Smith (London, N.W.5).

THE double vision may be caused by any lens or prism not being on its true optical centre. If careful examination, and checking each component in turn, does not show where the fault lies, a repairer such as Wallace Heaton Ltd., 127 New Bond Street, W.1, would doubtless service them.

If optical surfaces were bloomed, and the cleaning removed some of this, the two parts of the binocular could give images of different tone. If this has happened, re-blooming would be the best cure. However, in some cases a slight difference in tone may be caused by the viewer's eyes, especially if each is subjected to dissimilar colours or light reaching the eye from outside the binocular field. This can be checked by turning the binoculars upside-down.

Shellac

I BOUGHT some white shellac, broke it up into small pieces and let it dry for some months. I put some of the fine shellac in a bottle of methylated spirits and shook the bottle to help

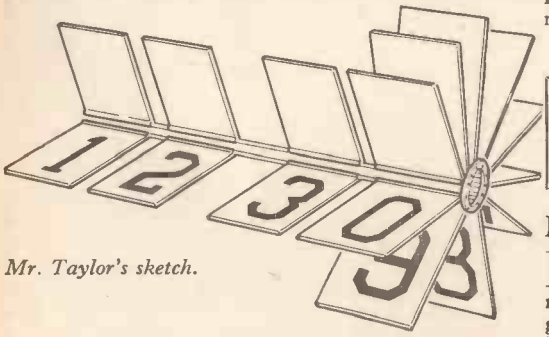
dissolve the contents. I now find that the shellac has become soft but is not mixing to form a polish. Is the method I used correct?—E. Martin (County Down).

THE mistake you made was to let it dry for so long. What happened was the organic molecule polymerised and become insoluble. Try again with fresh shellac and you will be successful. You must discard the present gel and start again.

A Digital Clock

COULD you please supply any information on the mechanism of a type of clock which uses a digital (rather than an analogue) display? I remember seeing a clock of this type which used a system of leaves which turned over to display the time (see sketch). And information of this type of system (whether applied to clocks or advertising displays) would be welcome.—A. Taylor (Oldham).

THE simplest mechanism of this kind uses drums or discs numbered from 1 to 0, or as necessary, with a toothed wheel having the same number of teeth as numbers. The previous number spindle (e.g. units) carries a single tooth, so that one complete revolution turns the next number spindle (e.g. tens) one tooth. This method will be found in vehicle mileage meters, etc. For a clock, you would need



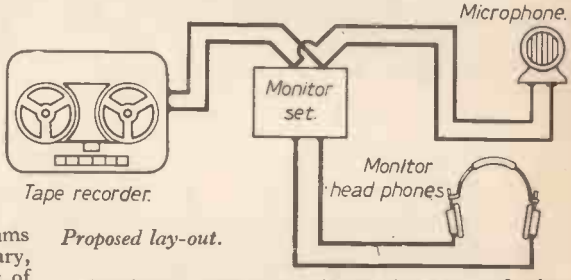
Mr. Taylor's sketch.

10 : 1 ratio from units to ten of minutes, and 6 : 1 from tens of minutes to hours, with 10 : 1 between hours, but the tens of hours repeating 1 and blank, for a 12 hour clock. To obtain larger numbers an arrangement like that you sketch may be used, or each set of numbers may be on an endless belt.

Improving a Tape Recorder

I HAVE a tape recorder which has no monitoring facilities. I should like to add this feature if possible. The illustration shows an idea I have in mind. The input from the microphone to the monitor and recorder to be in parallel. I should like your advice on this and also a circuit-diagram if you consider it a possibility. Perhaps you may have an idea that I could adopt.—A. W. Jones (Glos.).

WHETHER or not your monitor set would work depends on what it consists of. If the monitor headphones are connected across the microphone leads, you would get nothing, as a microphone output is fairly small. However, if you intend placing a small amplifier in the monitor set, so that part of the microphone signal could be taken, amplified and then fed to the monitor 'phones, your system would work. It would be far better if you could take your headphone leads from some point in the record amplifier. We cannot give you the circuit diagram of the recorder you mention, but it should be possible to tap off some of the signal somewhere along the line and take it to the monitor headphones. If you consider this a little difficult to undertake, we expect any radio dealer who specialises in repairs would do it for you.



Proposed lay-out.

Another method of monitoring is to use a further head and amplifier so that while recording, one can listen to the signal as it is actually on the tape. It is rather involved because of the need for a further amplifier, but if your recorder has separate record and replay amplifiers you could use the replay unit to monitor while you record.

INFORMATION SOUGHT

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

Master Contactor

I OWN a "Master Contactor." This is of the clockwork type having six small coils at the rear, a heating element and a small dial graduated in 75 divisions (12 volt). What is this instrument used for?—T. G. Gully (Glam.)

Weaving Problem

CAN you please suggest a method of sending a shuttle on a hand loom across the shuttle race, from side to side, other than by using a manual picking stick? Preferably by some kind of lever or automatic method.—T. Booth (Manchester).

An Etching Machine

I WISH to make an etching machine in which nitric acid is used, for making line blocks for printing. I intend using an ordinary bread bin in which to house the aluminium paddles driven by a motor (500 r.p.m.). What I should like to know is how to construct the bearings for the paddle spindle placed on either side of the bread bin, as they must provide a seal against the acid. The true bearings for the spindle will of course be placed outside the bin.—J. Gale (Luton).

Published about the 30th of each month by GEORGE NEWNES LIMITED. Tower House. Southampton Street, London, W.C.2, and Printed in England by The Garden City Press Limited, Letchworth, Hertfordshire. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia), Ltd. Sole Agents for South Africa and Rhodesia—Central New Agency Ltd. Subscription Rate (including postage): For one year, Inland 22s., Overseas 20s. 6d., Canada 19s. Registered for transmission by Canadian Magazine Post

Free Guide — SUCCESS IN ENGINEERING

132-PAGE BOOK FREE!

SEND FOR YOUR COPY

One of the following Courses taken quietly at home in your spare time can be the means of securing substantial well-paid promotion in your present calling, or entry into a more congenial career with better prospects.

ENGINEERING, RADIO, AERO, ETC.

Aero. Draughtsmanship
Jig & Tool Design
Press Tool & Die Design
Sheet Metalwork
Automobile Repairs
Garage Management
Works M'gmnt. & Admin.
Practical Foremanship
Ratefixing & Estimating
Time & Motion Study
Engineering Inspection
Metallurgy
Refrigeration
Welding (all branches)
Maintenance Engineering
Steam Engine Technology
I.C. Engine Technology
Diesel Engine Technology
Elec. Draughtsmanship
Machine "
Automobile "
Structural "
R/F Concrete "
Structural Engineering
Mathematics (all stages)
Radio Technology
Telecommunications
Wiring & Installation
Television
Radio Servicing
Gen. Elec. Engineering
Generators & Motors
Generation & Supply
Aircraft Mainten. Licences
Aerodynamics
Electrical Design
Ordnance Survey Dr'ship

BUILDING AND STRUCTURAL

L.I.O.B. A.I.A.S. A.R.S.H. M.R.S.H.
A.M.I.P.H.E. A.A.L.P.A. A.F.S. A.R.I.C.S.
Building Construction
Costs & Accounts
Surveying & Levelling
Clerk of Works
Quantity Surveying
Builders' Quantities
Carpentry & Joinery
Building Inspector
Building Draughtsmanship
Heating and Ventilating

GENERAL, LOCAL GOVERNMENT, ETC.

Gen. Cert of Education
Book-keeping (all stages)
College of Preceptors
Woodwork Teacher
Metalwork Teacher
Housing Manager (A.I.Hsg.)
Common. Prelim. Exam.
A.C.I.S., A.C.C.S.
A.C.W.A. (Costing)
School Attendance Officer
Health Inspector
Civil Service Exams.

BECOME A DRAUGHTSMAN — LEARN AT HOME AND EARN BIG MONEY

Men and Youths urgently wanted for well paid positions as Draughtsmen, Inspectors, etc., in Aero, Jig and Tool, Press Tool, Electrical, Mechanical and other Branches of Engineering. Practical experience is unnecessary for those who are willing to learn—our Guaranteed "Home Study" courses will get you in. Those already engaged in the General Drawing Office should study some specialised Branch such as Jig and Tool or Press Tool Work and so considerably increase their scope and earning capacity.

★ OVER SEVENTY YEARS OF CONTINUOUS SUCCESS ★

NATIONAL INSTITUTE OF ENGINEERING

(In association with CHAMBERS COLLEGE—Founded 1885)

(Dept. 29)

148, HOLBORN, LONDON, E.C.1

SOUTH AFRICA: E.C.S.A., P.O. BOX NO. 8417, JOHANNESBURG
AUSTRALIA: P.O. BOX NO. 4570, MELBOURNE

FOUNDED 1885 - FOREMOST TODAY

This remarkable FREE GUIDE explains:

★ Openings, prospects, salaries, etc., in Draughtsmanship and in all other branches of Engineering and Building.

★ How to obtain money-making technical qualifications through special RAPID FULLY-GUARANTEED COURSES.

MANY INTERESTING COURSES TO SELECT FROM!

A.M.I.Mech.E., A.M.I.M.I.,
A.M.Brit.I.R.E., A.M.I.P.E.,
A.M.I.C.E., A.M.I.Struct.E.,
A.M.I.Mun.E., M.R.S.H.,
A.M.I.E.D., A.F.R.Ae.S.,
London B.Sc., Degrees.

Fully guaranteed postal courses for all the above and many other examinations and careers. Fully described in the New Free Guide.

THE ACID TEST OF TUTORIAL EFFICIENCY

SUCCESS—OR NO FEE

We definitely guarantee that if you fail to pass the examination for which you are preparing under our guidance, or if you are not satisfied in every way with our tutorial service—**then your Tuition Fee will be returned in full and without question.** This is surely the acid test of tutorial efficiency.

If you have ambition you must investigate the Tutorial and Employment services we offer. Founded in 1885, our success record is unapproachable.

ALL TEXTBOOKS ARE SUPPLIED FREE
PROMPT TUTORIAL SERVICE GUARANTEED
NO AGENTS OR TRAVELLERS EMPLOYED

Free Coupon

To: NATIONAL INSTITUTE OF ENGINEERING (Dept. 29), 148-150, Holborn, London, E.C.1.

Please Forward your Free Guide to
NAME .....
ADDRESS .....
.....
.....

My general interest is in: (1) ENGINEERING (2) AERO (3) RADIO (4) BUILDING (5) MUNICIPAL WORK

(Place a cross against the branches in which you are interested.)

The subject of examination in which I am especially interested is

.....

To be filled in where you already have a special preference.
(2d. stamp only required if unsealed envelope used.)

SEND OFF THIS COUPON NOW AND BE ALL SET FOR SUCCESS