Building the Luton Minor

PRACTICAL MECHANICS

1'3

SEPT. 1959

CONTENTS

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"The Cyclist" and "Home Movies" are incorporated

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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

PERSONAL TRANSPORT OF THE FUTURE ?

AS the number of motorists in this country increases and the roads become more and more congested, the prospect of a quick and lasting solution to the problem becomes increasingly remote. So far all attempts to solve the problem have been made at ground level, but perhaps the ultimate answer lies not on the ground at all, but in the air.

This suggestion is prompted by reports received during the last few months relating to three different projects at present under development; two in America and one in Britain. Each of these three projects relates to air travel for the individual, i.e., forms of air transport much cheaper and simpler than the conventional aeroplane.

The first of these is a form of helicopter which is being developed by the U.S. Army. It consists of little more than an engine and rotor fitted to the wearer by means of a harness. The second system, also being perfected by the U.S. Army, is known as the "Buck Rogers," named after an American strip cartoon character. It is essentially a solid propellent rocket motor which is strapped to the back and early versions of it allowed men to run at 35 m.p.h., jump a 20ft. trench or jump 8ft. straight into the air. It is expected that in its perfected form, the Buck Rogers will enable men to "fly" several miles at any height they choose, manœuvre and land safely. The third project being developed is the flying bicycle and although this was considered impossible for several years, a new approach to the problem is being made by Beverley Shenstone, Chief Engineer of B.E.A., in collaboration with Terry Nonweiler, a Belfast University lecturer. A model has been built and from the results of experiments made so far the project is described as promising.

Individually, perhaps, none of these three is the answer to the problem of personal air transport, but they do indicate the direction in which current research and development is tending. Any of the three machines, or any combination of them, would take up less room than the present-day conventional car, so the householder's "hangar" is ready made. Probably the lawn in the back garden would provide sufficient take-off space and if the population of the country "took to the air" in sufficient numbers, office and factory buildings would be designed with flat roofs for landing and parking. Tandem and family vehicles would be the natural follow-up to the solo and incidentally there is a strong probability that an entire new field of sport would be created.

Of course, it may be argued that if everyone takes to the air in their own individual flying machines, the same overcrowding and congestion will inevitably result. It is true that some form of air control would have to be instituted, resulting in aerial roadways and fixed routes from place to place. This would be necessary to avoid the confusion caused by thousands of free-flying pilots, not to mention the new accident problem which would probably come into existence as a direct result of such a "free-for-all." But once order has been installed, it is doubtful whether there would indeed be any overcrowding as the air, instead of being two-dimensional as roads are, is three-dimensional and there is therefore much more room.

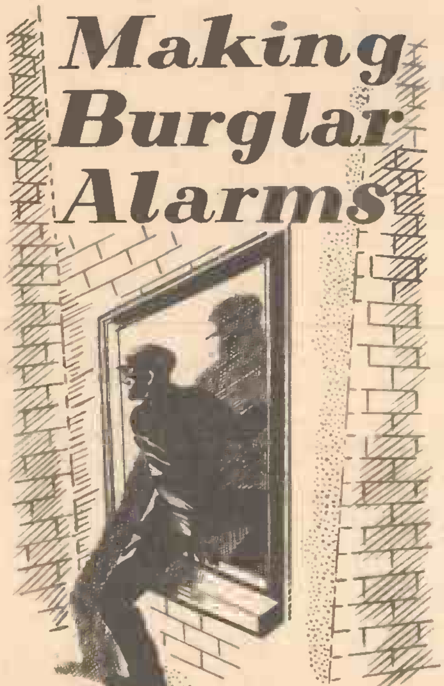
An opportunity to take this discussion further is offered to readers by our "Letters to the Editor" page, and we should be pleased to receive, publish and pay for your views in letter form. Will the roads of the future be in the air? What do you think?

BACK TO NORMAL

The printing dispute which has prevented normal publication of this Journal since the issue dated June has been settled and we shall now be able to publish monthly. The next issue will be published on September 30th.

We greatly regret the inconvenience which our readers have suffered. Nevertheless, we are glad that we are able, once again, to offer all the features that have been so popular with our readers for so long.

The October, 1959, issue will be published on September 30th. Order it now!



Making Burglar Alarms

Part I Commences Construction of the Control Unit

By K. H. Albers

A GOOD burglar alarm must have the following features: It must guard and control all possible places where a burglar could enter. It should further have a compact control unit which gives a continuous alarm when contacts are disturbed, and from which it may be checked that all circuit wiring and all contacts are in order when setting the control unit. This unit should have the least possible number of press-buttons and switches.

Two Systems

There are two systems of wiring for burglar alarms: the closed circuit and the open circuit (see Fig. 2) and with each system a different type of control unit is employed.

The closed circuit consists of a continuous single wire loop through which a low voltage current passes. If this wire is cut—or any of the contacts opened the circuit is broken and the alarm bell rings.

Most manufactured burglar alarm sets operate on a closed circuit. It will be noted from Fig. 2 that in this system the electro magnet is under power the whole time the set is in operation. Therefore, special

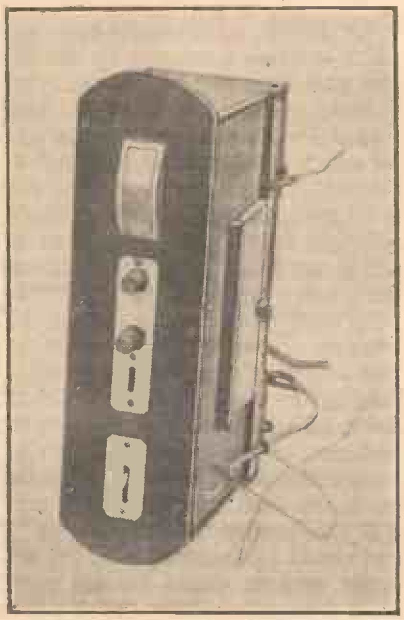


Fig. 1.—Front view of the completed control box.

batteries are required to supply D.C. because on A.C. the magnet will buzz.

To run a closed circuit system off the mains through a transformer and a rectifier is not possible in practice: each power cut will cut out the electro magnet, and the alarm rings as soon as the power comes on again. It is possible to avoid this, but it presents more complications in the form of an automatic switch-over to batteries together with an indicator light to show that the unit is working on emergency power when this happens.

The actual control and guarding of all possible entries which can be doors, windows, rooflights, trapdoors in floors, etc., is done by means of contacts. The contacts can be of the mechanical type, they can also be photo-electric. All the contacts are connected to the circuit wiring, which starts at the control unit, and which in the case of a closed circuit returns to the unit. In an open circuit this is not necessary, but it is of great advantage if the wires also return to the unit.

The Open Circuit

In order to avoid the complications mentioned in connection with the closed circuit, the open circuit system has been chosen for this article.

It is, in a way, the reverse of the closed circuit. Whereas the electro magnet in the closed circuit is constantly under power and thus holds a lever, which drops away or moves away from the magnet only if the magnet has no power—the magnet in the open circuit has no power until an alarm contact is made. Only then will it operate a lever, which in turn will operate the alarm.

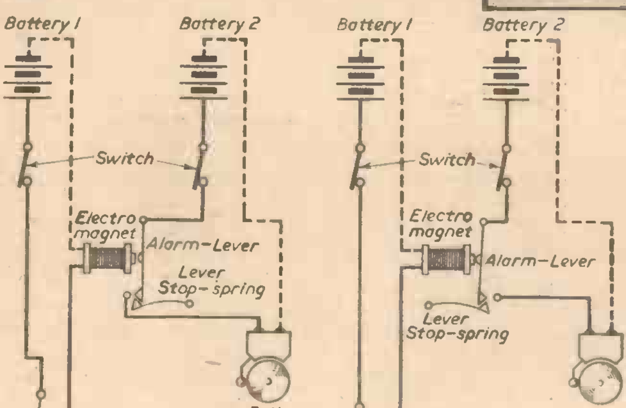


Fig. 2.—The theoretical "open" (left) and "closed" circuits.

In this system all the power needed can come from two 6V batteries. Each battery has a different function and to make the open circuit as effective as possible what can be called the "Three-point System" is used (Fig. 2). When the alarm is set and all contacts are in order, two points at each contact link up the wire which carries the electric current. The third point at each contact is connected to the loop of the neutral wire, and this point only receives electric current when a contact is disturbed.

Comparing the two systems it may be thought that the closed circuit has more advantages. However, there are also advantages which the open circuit has over the closed circuit. For instance: a clever burglar might be able to "bridge" a closed circuit. With the contacts arranged properly in an open circuit, the burglar would have a much more difficult job. In fact, by trying to "bridge" a contact he might connect the live wire to the neutral wire, and ring the alarm bell!

Provided two wires twisted together are

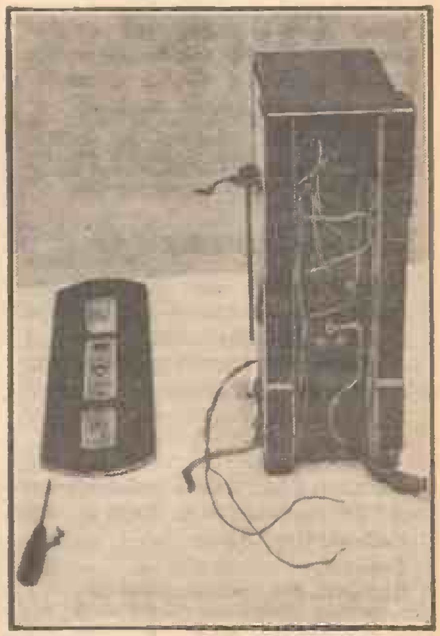


Fig. 3.—A rear view of the control unit.

used for the loop of the open circuit, you will have a sort of fire alarm as well. As soon as the plastic covering has been destroyed by fire the wires will touch at this point and give the alarm. It would take much longer for fire to burn through or melt the metal of the wire, which would be necessary before alarm would sound in a closed circuit.

The greatest advantage of a home-made burglar alarm is, of course, that the system is known only to the constructor, and can have its own secret traps, e.g., a dummy control unit which, when the "off" button is pressed will give the alarm instead.

Wiring should be as unobtrusive as possible.

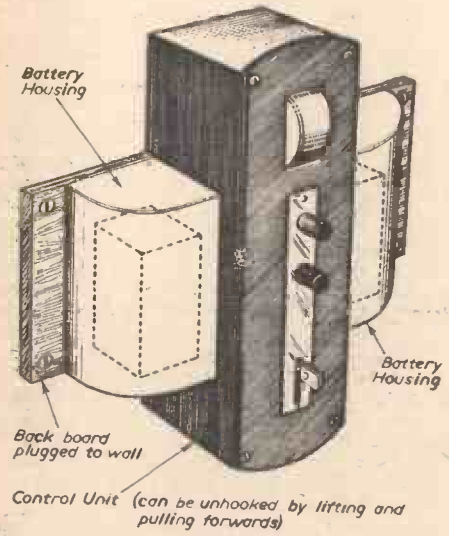


Fig. 4.—The control unit mounted between twin battery housings.

Use proper insulated staples for fixing the wires as metal staples may cut through the plastic cover of the wire and give rise to faults.

The open circuit and the "Three-point System" will be the basis of construction.

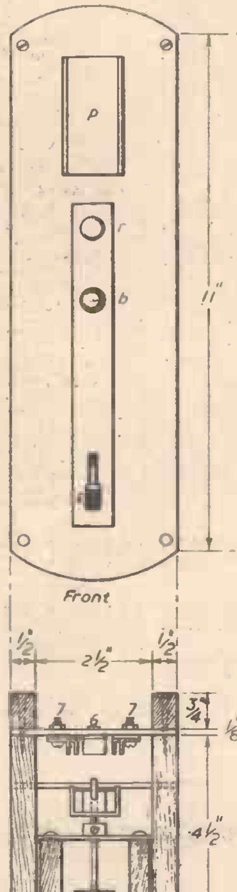
The Control Unit

The control unit is the "brain" of the burglar alarm. Much more than the circuit wiring the control unit can have faults due to careless construction. Figs. 1 and 4 show the appearance of the control unit, which is housed in a wooden box, made to the approximate dimensions in Fig. 5. Looking at the front of the box there can be seen an up-and-down selector switch at the base; above this is a black press-button, then a red press-button, and at the top a curved Perspex indicator window with a green, a blue and a red coloured bulb behind.

The selector switch in the down position provides a "silent" alarm which is indicated by a red light at the control unit and by a buzzer at the side of the bed. If the selector switch is moved to the "up" position, the alarm bell will ring, and in addition to this a 250v. light can be switched on an indicator box outside the premises, a number of bulbs automatically lit up and/or any door locks or door knobs the burglar is likely to touch electrified.

The actual setting of the control unit is done by first pressing the black button, the green light will show in the indicator window when the loop of the first wire of the circuit (and with that all contacts), and also battery No. 1, are in order. The action of the black press-button sets the alarm lever in position over the magnet lever. Next the red button is pressed. The blue light will appear in the neutral loop if the circuit wiring is in order, this also checks the power of battery No. 2. The action of the red button switches the set "on." The selection switch can be moved before or after the set has been switched on.

Whichever type of alarm has been selected it will operate continuously. The fact that a door is quickly shut again does not make the slightest difference to this. To stop the alarm, or to switch off the unit at any desired time, the black button must be pressed again. From the section in Fig. 5 it can be seen that the black and the red buttons are coupled, and that the press-button lever which closes contacts 6 and 7 is moved into the opposite direction by pressing the black button. In theory, to switch the set on again it would only be necessary to press the red button, but to make quite sure that all is in order and that all contacts of the circuit are closed, black is always pressed first before red. There is nothing else to be remembered a fact which alone is of definite advantage. It is not possible to see by the position of the buttons whether or not the set is switched on or off, if this is regarded as a disadvantage, then it will also be a disadvantage to a burglar. If in doubt press black and red again; no harm will be done.



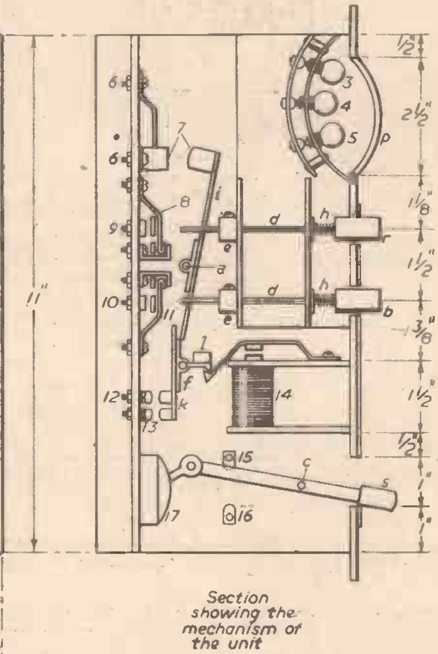
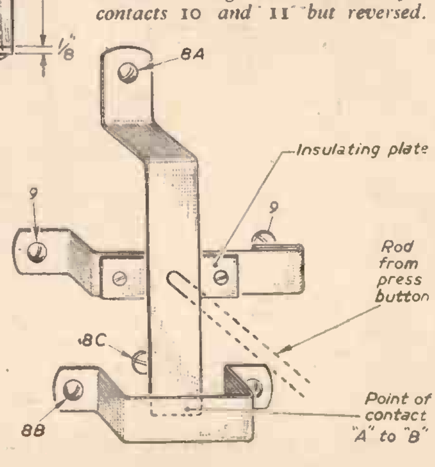


Fig. 5.—Front, plan and side views of the control unit showing the mechanism. (Full details of this mechanism appear next month.)

Fig. 6 (Below).—Combined arrangement of contacts 8 and 9. A similar arrangement is used for contacts 10 and 11 but reversed.



Explaining the Circuit

In order to understand the mechanism fully it is necessary to study the wiring diagrams A, B, C and D of Fig. 7. Of these B is perhaps best suited to show the arrangement of the various contacts.

First of all the key to the wiring diagrams:

1.—Battery No. 1, 6v.
2.—Battery No. 2, 6v.
3.—Flashlight bulb, painted green.
4.—Flashlight bulb, painted blue.
5.—Flashlight bulb, painted red.
6.—"On-off" spring contact, held in "on" position by the contact switch 7.
7.—Prong-like contact switch, "on-off," operated by red and black press-buttons.
8.—A, B, C; a two-way spring contact, operated by the rod of the red press-button.
9.—Spring contact, arranged under contact 8, also operated by the red press-button. (The combined arrangement of contacts 8 and 9—applicable also to contacts 10 and 11—is shown in Fig. 6.)
10.—Spring contact, arranged under contact 11, operated by the rod of the black button.
11.—D, E, F; a two-way spring contact, operated by the rod of the black press-button.
12.—Prong-like contact switch, set by the black button, but released by the action of the electro magnet, the switch controls the buzzer, red light and the bell.
13.—All the same as for switch 12, but better insulated, because this switch controls the 250v. current which passes through the control unit. On no account should any parts of this switch come in contact with others.
14.—Two points for the electro magnet.
15.—Part of the selector switch which controls the buzzer and red light.
16.—Part of the selector switch which controls the bell.
17.—Proper 250v. light switch coupled to the selector switch. At the base of Fig. 7 are five pairs of plug-points, see diagram A: for the buzzer, for the returning circuit, for the outgoing circuit, for the bell and for the 250v. light or current.

In Fig. 7 (A) is shown the complete wiring of the control unit with all contacts open (to avoid confusion). The different parts of the wiring are divided into wires of different "colours," but some of the wiring serves a dual purpose and serves two parts at once. Note that the colours of the wire have nothing to do with the colours of the light bulbs, or with the colours of the press-buttons.

To follow the wiring from a single drawing and to understand how the contacts and wiring of the control unit work is difficult, hence the four stages.

Black Button Pressed

In B is shown the actual position of each contact switch, and of that part of the wiring which transmits current at the time when the black press-button is pressed down. The blue wire which is connected to the positive point of battery 1 carries this current to one point of contact 6 and to the E point of contact 11. Contact 6 is not closed at present so the current ends there, but in contact 11 E is connected to F as long as the black button is pressed down. The current (positive) from battery 1 passes to point F and from here to the current-carrying point of the out-going alarm circuit wiring. From this point it passes through the circuit wire, through all the contacts—if they are in order—and back to the returning circuit point. From this point the current goes to one point of contact 10. This contact is closed while the black button is pressed down. And from contact 10 the current passes on to the green light bulb 3.

The red wire connects the negative points of both batteries, and leads go from it to one of the points of contact 7 and to point D of contact 11. Both these contacts are not closed at present and the current ends at each of the points. The red wire also connects bulbs, 3, 4 and 5. Of these, bulb 3 (green) lights up.

Note that from point F onwards the wire is not blue only, but it is a red-blue dual purpose wire (one single wire, of course, not twin wires).

Black Button Released

On releasing the black press-button both points in contact 10 are disconnected, and in contact 11 F is disconnected from E but is at once connected to point D. At this point the negative current from both batteries (the current has already been traced from the batteries to point D) passes on to point F and goes on over the same alarm circuit wire which has just been checked, back to one point of contact 10, and finishes there.

Red Button Pressed

Pressing the red button as illustrated in C permanently closes contact switch 6 (until the black button is pressed again). The positive current from battery 1 now flows through contact 6 and from here passes to one point of the electro magnet. Contact switch 7 is closed permanently by the action of the red button, and the negative current from both batteries goes to the negative buzzer point and bell point. The positive current from battery 2 is carried by the green wire to contact 12. This wire also branches to point C of contact 8. Points A and C of this contact are connected as long as the red button is pressed down. From point A the current goes to the neutral point of the outgoing alarm circuit. If this circuit wire is in order the current will return to the unit and go on to contact 9. Contact 9, also connected while red is pressed down, passes the current on to bulb 4, blue, and this bulb will now light up.

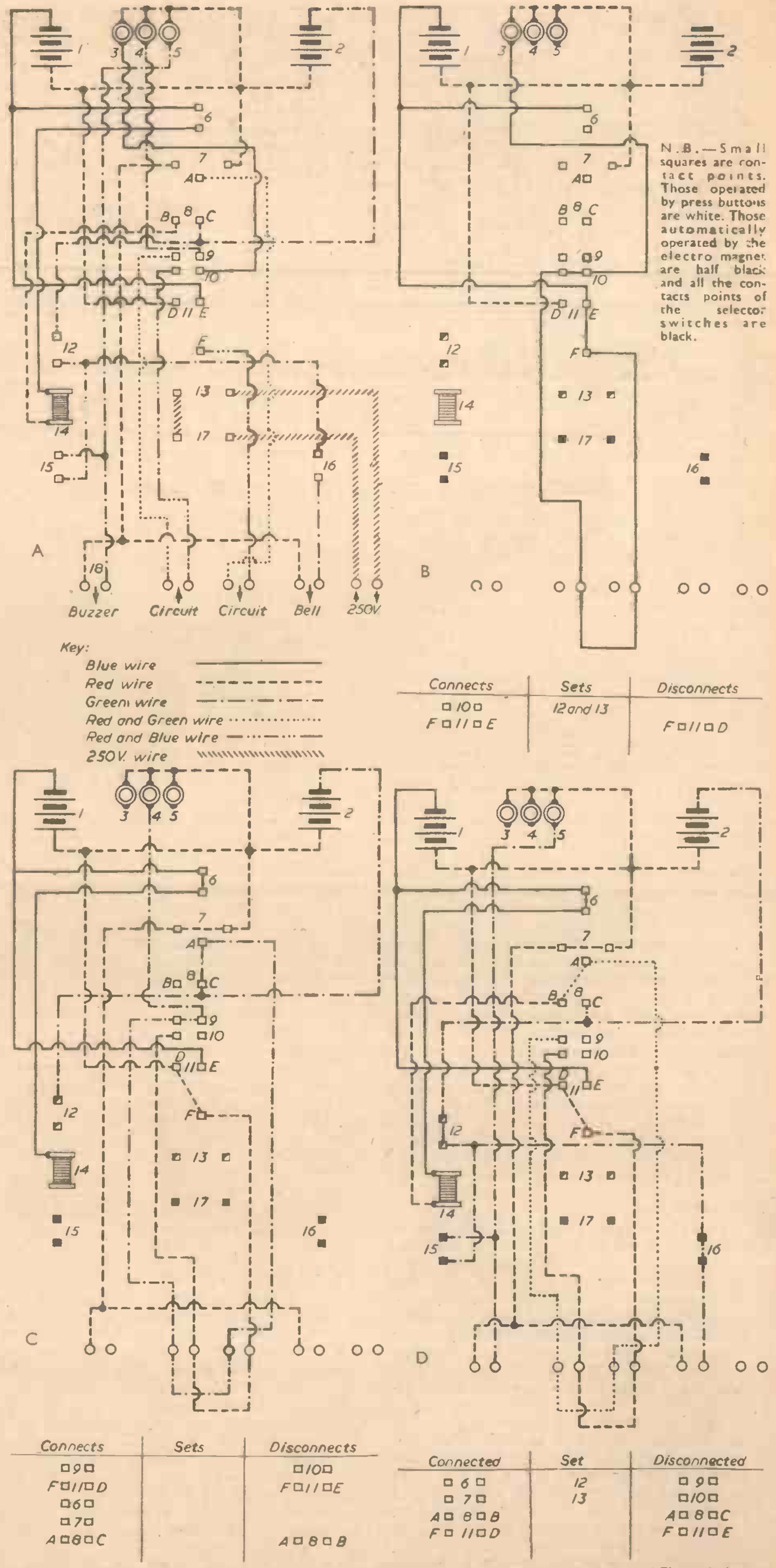
Red Button Released

On releasing the black press-button both 6 and 7 will remain closed. In contact 8 point A is now connected to point B, from B a link is formed to the negative point of the electro magnet. The releasing of the red button has also disconnected the points of contact 9, and thus this wire will carry no current at present. This loop from point A in contact 8 to contact 9 is a dual-purpose wire; it has carried the positive current from battery 2; it is neutral at present (has no current); and it will carry the negative current from both batteries in case of an alarm (Fig. 7C).

The control unit is now set. To check over the contacts quickly: 6 is closed, 7 is closed, in 8 A is connected to B, 9 is disconnected, 10 is disconnected, and in 11, F is connected to D.

In the alarm circuit one wire carries the negative current from both batteries. The other wire is neutral and has no current.

Next month's instalment will show how the alarm works and deal with the mechanical arrangement.



(B)

Connects	Sets	Disconnects
□10□	12 and 13	F□11□D
F□11□E		

(C)

Connects	Sets	Disconnects
□9□		□10□
F□11□D		F□11□E
□6□		
□7□		
A□8□C		A□8□B

(D)

Connected	Set	Disconnected
□6□	12	□9□
□7□	13	□10□
A□8□B		A□8□C
F□11□D		F□11□E

Fig. 7.—(A) complete wiring diagram; (B) black button pressed down; (C) red button pressed down; (D) unit switched on and alarm at set position.

Figs. 1 and 2.—Two methods of repairing a tear by sewing and patching.

Repairing and Reproofing tents

Some Hints for the Camper

By A. M. BROWN

BEFORE starting your camping holiday, a careful inspection of the tent is essential to make sure that it is in a reliable condition. The tent should be unpacked, temporarily assembled and any weak or worn places or slight tears carefully noted.

Tears

Any tears should be prevented from extending further by drawing the edges together with strong carpet thread. The repair is then waterproofed and reinforced by patching both sides with tent canvas, making sure that the patches extend well over the tear and double-stitching them into position (Fig. 1).

Where difficulty is experienced in stitching due to the thickness of the material, the canvas patches may be fixed in position by means of an "impact" adhesive. Draw the tear together by means of stitching with a strong thread, as explained above, and cut out two canvas patches large enough to extend at least 2in. around the tear (Fig. 2). Apply the adhesive to both the patches and the repair and well rub into the fabric. Allow a few minutes for the adhesive to become dry, then apply the patches, pressing firmly in from the centre and slowly working outwards until both the patches have strongly adhered. A light dusting with either french chalk or talcum powder will prevent the patches sticking to other parts of the material when the tent is folded away. Any weak or worn places can be similarly patched, making sure that the patching material is large enough to provide a big overlap.

Eyelet Repair

Trouble is sometimes experienced in the pulling away of eyelets from the surrounding material. A satisfactory repair is to remove the eyelet and apply a 6in. stout canvas patch to both sides of the tent material. This can be secured by double-stitching or adhesive as previously explained. The eyelet is then placed upon the patch and its diameter marked out with a pencil (Fig. 3). A series of diagonal cuts is then made with a razor blade upon the material to correspond with the diameter of the eyelet (Fig. 4). The eyelet is then placed into position, and the cut sections from the inner patch are placed around the eyelet and tucked in between the two patches (Fig. 5). The sections from the outer patch are then brought around and through the ring and on to the inner patch. The sections are then strongly sewn into position. Adhesive can be used if difficulty in stitching is experienced, but wherever possible in effecting tent repairs, it is preferable to use stitching and a strong thread for this purpose.

Reproofing

Tents can be quite successfully and easily reproofed with a special reproofing solution which is available for the purpose. Your local camping stockist will advise about this. Reproofing solutions are supplied colourless, or in a range of colours, the latter being slightly more expensive. Full instructions are supplied and the application is very simple indeed.

Washing

In general, before reproofing the tent, all loose dust, etc., must be removed with a stiff brush (Fig. 6), and if the material is much soiled, a washing with household soap and water is advised, well rinsing with clean water and allowing the material to dry thoroughly before applying the reproofing solution. A fine warm day should be selected when washing the tent, for when erected under these conditions the fabric dries quickly in preparation for reproofing. Where the material is badly grimed, a cleansing solution of hot water and soft soap can be used, brushing well into the fabric with a fairly stiff brush and following this by a thorough rinsing. Detergents can be used for removing obstinate or long-standing stains providing that every precaution is subsequently taken in the removal of all traces with the rinsing water. Detergents left in the material may be detrimental to successful reproofing. To ensure that the rinses are adequate, at least five to six should be given, sponging the last rinse down to remove as much of the water as possible.

Applying the Solution

The reproofing solution should be applied to the tent material when it is dry after washing, by means of a fairly large flat brush, applying it freely so that it is fully absorbed by the fabric. The tent should be left in the open air—making sure that no rain is imminent—until the solution has dried out, which is usually 24 hours or so. In most instances it will be found that one application of solution suffices, but where the tent is in bad condition, it may be necessary to apply two coats of this solution to ensure a satisfactory degree of reproofing. In this instance, the first coat must be dry before applying the second.

A tent should never be packed and stored whilst it is still damp.

Fig. 3.—Marking the position of the eyelet.

Fig. 4.—The series of diagonal cuts.

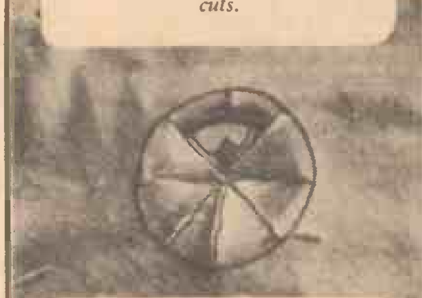


Fig. 5.—Inner patch section goes through the eyelet and between the patches and outer patch section through and on to the inner patch.

Fig. 6.—Use a stiff brush to remove dust, etc., prior to reproofing.

A 35mm. Film Strip Printer

FILM strip consists of a length of positive film on which the negatives are printed in the correct sequence.

By J. BOWICK

THE finished box is shown in Fig. 1, and this should be studied along with Fig. 2 before commencing construction.

The box is constructed from ½in. wood, except for the bottom and lid, which are of ⅛in. ply, and the two partitions of the pressure block compartment which are 1/16in. ply. Of course, thinner than ½in. wood may be used and in this case it is not necessary to alter any of the dimensions of the box since none of these are vital.

Before assembling the box the ¼in. hole for the sprocket axle should be drilled through the side (Fig. 3) and should be continued about half-way through the opposite side.

The whole box may now be assembled, leaving out for the moment the partition carrying the roller mounting. The top edges of the box should be lined with felt to ensure that it is light tight when the lid is closed.

Fig. 1.—The completed film strip printer.

The pressure block is a piece of wood 1¾in. deep resting on a piece of foam rubber. The top edges of the block are rounded and it is covered with felt.

The Lid

An aperture 1⅜in. × 1¼in. is cut out, as shown in Fig. 3. A 35mm. mask is glued (or screwed) over this on the inside of the lid. The two film guides should also be screwed into position. A hole to take the bolt for the clamping washer should also be drilled.

Film Winding Mechanism

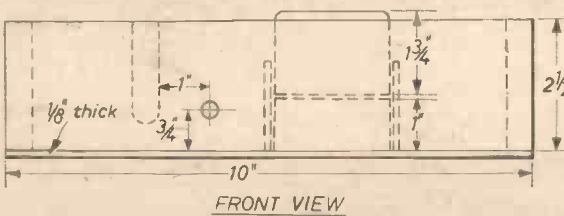
This consists of a sprocket and a guide roller, both of which may be obtained from suppliers of projection equipment or secondhand from your local cinema.

The sprocket is mounted on an axle 3¾in. long and is secured by means of a grub screw (Fig. 2). The hole in the sprocket should be tapped for this purpose. A locking collar (Fig. 2) prevents the axle from riding outwards. The knob may simply be of the type used in wireless, or more ambitious readers may wish to use a ratchet handle which can be seen in Fig. 1. If the handle is made about 2½in. long, one complete sweep of it will drive the film along one frame (nine perforations). The exact length of the handle is best found by trial and error.

The guide roller is mounted, as shown in Fig. 2, and the spring should be such that the roller rests firmly on the sprocket. The roller should be capable of being raised about an inch to allow the film to be threaded (see Fig. 2).

Having fitted the roller, the partition seen in Fig. 2 should now be screwed into place. Notice that the partition is half an inch from the base and is rounded, the edge being lined with felt.

At this stage both the compartments should also be lined with felt to reduce the risk of scratching the film.



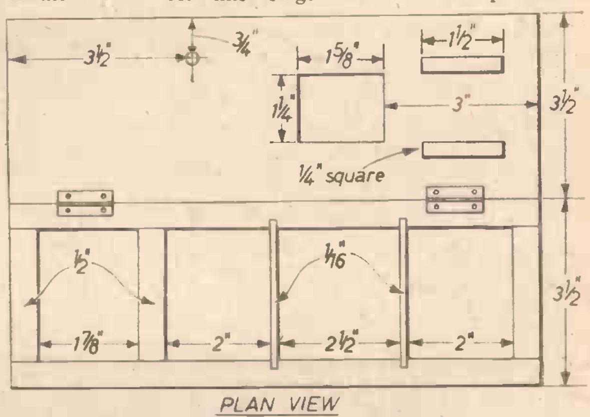


Fig. 3.—Front and plan views of the box giving dimensions.

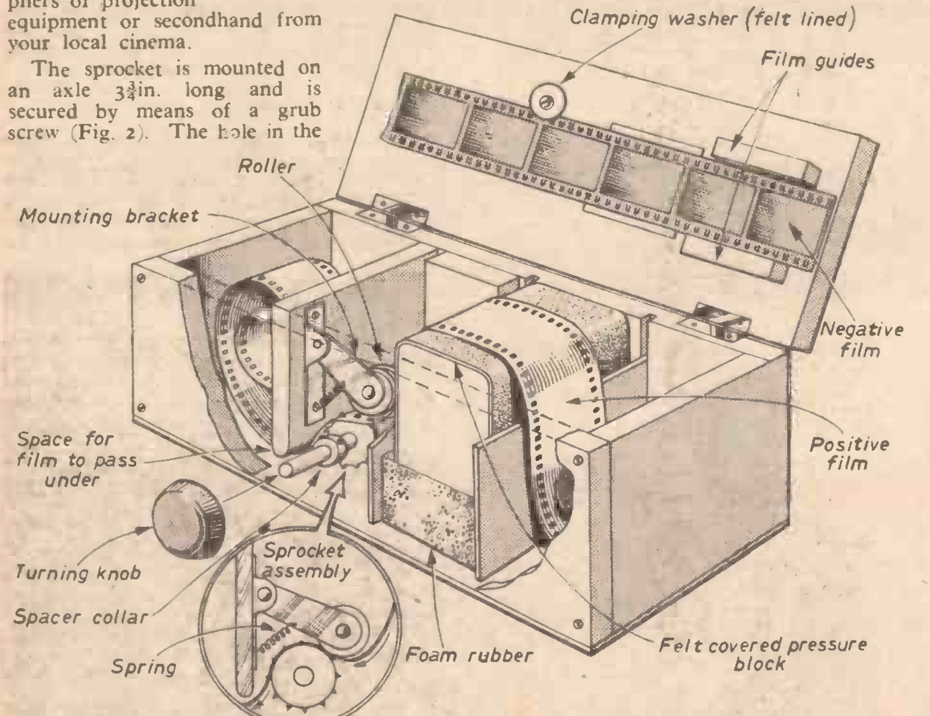


Fig. 2.—General arrangement of the printer, showing method of threading film through.

Using the Box

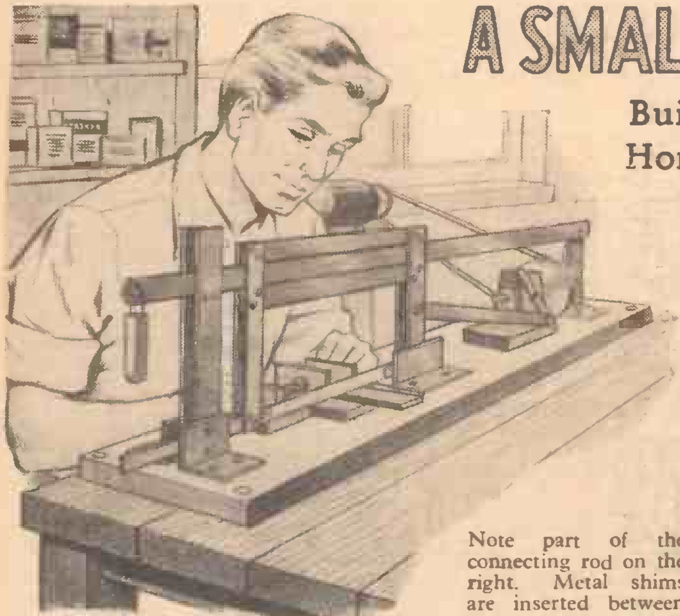
An orange safelight may be used during printing. The bulk roll of positive film is threaded, as in Fig. 2. (Remember the emulsion side should be uppermost.) When one coil of the film has entered the small compartment the first frame can be printed. See that the negative (emulsion side downwards) is correctly placed over the aperture inside the lid and secure it by tightening the wing-nut. Close the lid and keep it firmly pressed down while making the exposure.

The negative should now be changed and the positive film wound on a distance of nine perforations ready for the next exposure.

Developing the Film

This is best carried out in a tank using Johnson's Universol (diluted 1:7). Agitate well during development (1½ to 2 minutes).

When development is complete the film should be given a brief rinse in water, then transferred to fixing bath and left for about 20 minutes. If a hardener is to be used this may be incorporated in the fixing solution. Finally, the film is washed in running water for at least half an hour then allowed to dry in a dust-free atmosphere.



A SMALL POWER HACKSAW

Build This Robust Machine for Your Home Workshop

By Jameson Erroll

THIS machine, of which Fig. 1 gives two views, is referred to as a small power hacksaw for the reason that it employs a 9in. blade instead of the more normal 14in. In all other respects it is a sturdy and powerful machine capable of dealing with work up to 4in. wide and of any reasonable depth.

Operating Principle

In principle, a heavy steel frame which carries the saw slides along a bar by means of a connecting rod fitted to a crank. All moving parts are "steadied" by sliding between angle iron or bracket guides, and the rate at which the saw will cut can be controlled within workable limits by imposing varying weight on the free end of the slide bar along which the frame runs. A stop, Block "B" in Fig. 4, prevents the saw cutting into the base when the work is finished.

Gear Reduction

Unless you possess a slow-speed motor of not less than one-third H.P. some form of reducing gear is the first essential. The saw should make from 70 to 100 strokes per minute, so that with a motor doing 1,425 r.p.m. a reduction of 18 to 20 to 1 is necessary. Suitable reducing gears can often be found advertised in the pages of this magazine, and one of the "worm and wheel" type is perhaps best since it is capable of transmitting high power in proportion to its size. Note that the crank on the reduced shaft (Fig. 4) has a throw of 2in.

Saw Frame

The saw frame should first be made, and Fig. 2 gives constructional details while Fig. 3 is a close-up photograph of the finished frame with a saw blade in position.

Note part of the connecting rod on the right. Metal shims are inserted between the top cross members and the vertical members in order that the slide bar (see Fig. 4) may pass easily but not loosely between them. It is impossible to advise on the thickness of these shims since everything depends on the smoothness and fractional thickness of the various pieces. They are all nominally "quarter-inch," but minute variations not visible to the eye can cause over-tight or over-loose fitting. It is a matter of trial and error, but is well worth taking pains about; the accuracy and clean cut of the saw depend on stability, and lack of vibration depends on well-oiled smoothly working parts. The 8in. bar—bottom left—is a fixture at the lower part of the frame and carries one end of the saw. A slot is cut to receive it and a 3/16in. threaded hole bored to carry a short bolt which will pass through the hole in the saw. It may be necessary to enlarge the holes in the saw very slightly as they are sometimes 3/16in. bare, but they are so near that the drill enlarges them easily in spite of cutting into

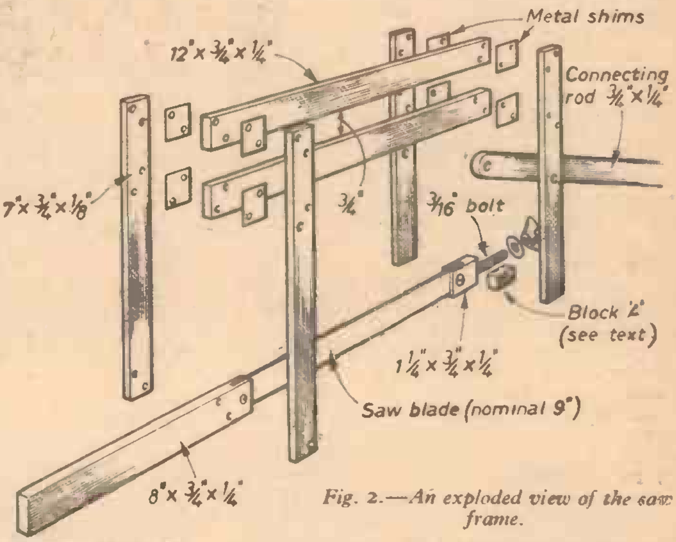
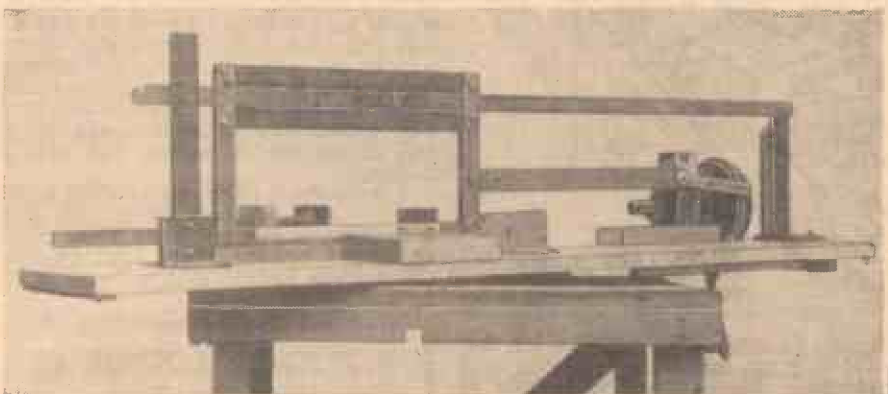


Fig. 2.—An exploded view of the saw frame.

hardened steel. The other end of the saw is held in a short movable block to which, at the rear end, has been sweated or threaded a 3/16in. bolt about 1in. long. A washer and flynut enable the saw to be made taut. The block "A" is ⅜in. × ¼in. × ¼in. and serves to prevent the blade holder working down when the flynut is tightened.

The Bracketed Pillar

The bracketed pillar, at the top of which the slide bar is pivoted (see Fig. 4) must be a really firm job and should not be less than ½in. thick. The length of the slide bar is governed partly by the type of reduction gear used and, of course, the length of the



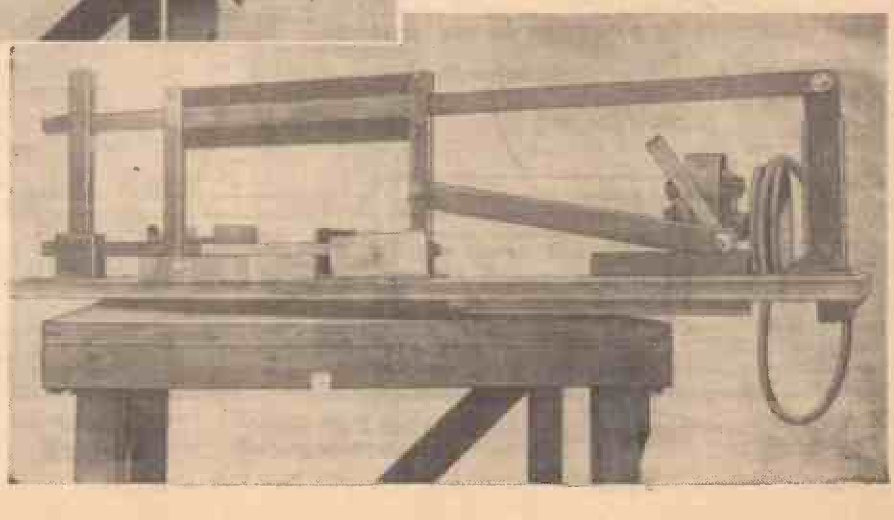


Fig. 1.—Two views of the finished hacksaw.

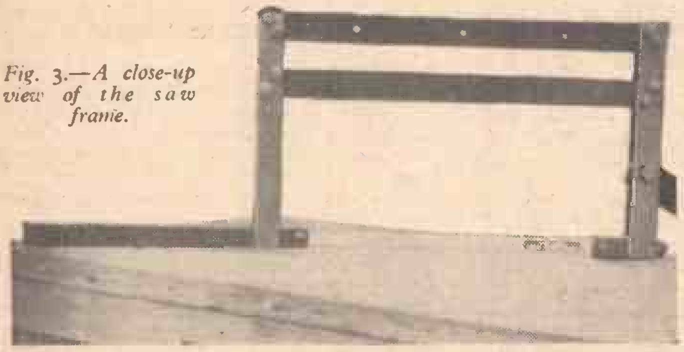


Fig. 3.—A close-up view of the saw frame.

is part of a G cramp cut away as shown in Fig. 7. It will be seen that the female part of the thread and a short length of the adjacent body of the cramp have been incorporated in a metal block 2in. × $1\frac{1}{2}$in. × $\frac{3}{4}$in. A hole and slot are cut in the block as shown on the left of Fig. 6 and the cramp part filed until it is a press fit; it is then pinned in position with two lengths of $\frac{1}{8}$in. silver steel. Note that this hole and slot are cut in the block at a height that will give freedom of movement to the thumbscrew; in this case the centre of the hole was $1\frac{1}{8}$in. from the bottom edge of the block. In the centre of the underside of the block a $\frac{3}{8}$in. metal pin is inserted under pressure. This pin engages in any one of the holes in the cutting board and, while being held fast itself, allows the vice jaw to move forward when the thumbscrew is turned. Although neither the block nor the vice jaw are actually fastened vertically, it will be found that as soon as the jaw engages with the work to be cut, the whole mechanism tightens up and the work is held firmly.

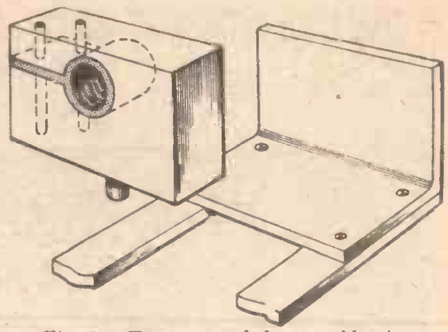


Fig. 6.—Two parts of the movable vice.

connecting rod. It is a mistake to let the latter be too short in an endeavour to economise space; it should be sufficiently long to have a smooth, flowing movement, not a jerky one. At its far end the slide bar runs between two guides as shown, these same guides serving to control lateral movement of the 8in. bar as well. See that these two guides line up with the bracketed pillar so that no "twist" is imparted to the blade. The adjustable end of the saw frame runs between two angle-iron guides as shown, and these, too, should be accurately aligned.

A trial run, first by hand and then by power, may be made at this stage and any tendency to vibration remedied. It will be found that the blade rides about $\frac{3}{8}$in. or $\frac{1}{4}$in. above the baseboard. This is intentional as it is intended to construct a cutting block which will be fastened to the baseboard and on which will be built up the vice for holding the work.

The sketch, Fig. 5, shows the cutting block in perspective; part of the front is cut away to give clearance to the moving saw frame on its return stroke, but that part of the block situated between the vice jaws when fully open is continued to the front edge of the baseboard as an added support for the work being cut. The saw-kerf shown is actually cut by the machine itself after the cutting block is screwed to the baseboard.

Details of the Vice

The fixed jaw of the vice is a 2in. length of 2in. angle-iron screwed to the baseboard adjacent to the edge of the cutting block. The movable jaw, of which Fig. 6 gives further detail, is a 2in. length of $1\frac{1}{2}$in. angle-iron screwed to two parallel runners ($\frac{1}{2}$in. × $\frac{1}{4}$in. mild steel) which run in grooves cut in the cutting-board. Centrally between these grooves and at 1in. intervals a number of $\frac{3}{8}$in. holes are bored through the block but not through the baseboard. The thumbscrew which exerts the pressure on the vice

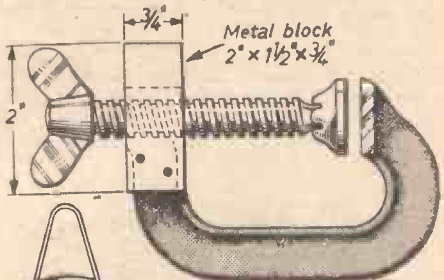


Fig. 7.—How a G-cramp is used to make the movable vice. The shaded portion is cut away.

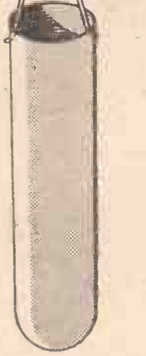


Fig. 8 (Left).—Weights from cigar containers.

Pressure Variation

A glance at Fig. 4 will show that the free end of the slide bar is hooked. This is to enable weights to be hung on it and thus give added pressure to the saw according to the material being cut. These weights

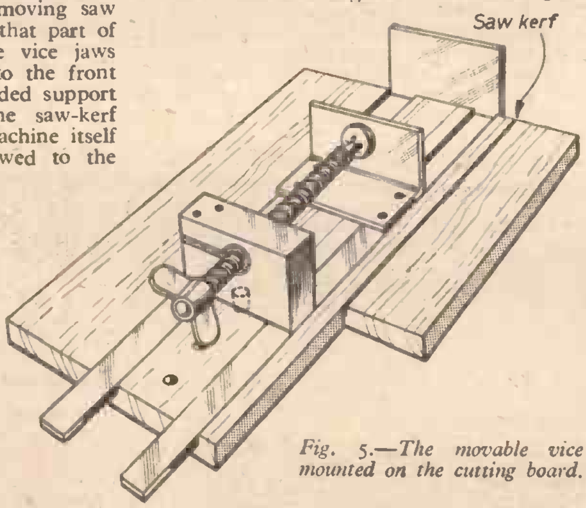


Fig. 5.—The movable vice mounted on the cutting board.

are again a matter of trial and error, but very useful ones can be made from metal cigar containers. These vary considerably in length and a little in diameter, and it is therefore possible to collect quite a number of varying capacities. Fig. 8 shows that wire is bent to form a handle and that the ends pass through holes bored near the top edge of the tube. A dusting of soldering flux is given to that part of the wire handle within the tube and the latter is then filled with molten lead. More than one weight can, of course, be used at one time if necessary.

A professional finish can be given to the machine by painting all non-movable parts with matt grey paint. Oil and grease should be applied liberally where applicable, and the sawblade inserted so that it cuts on the forward stroke.

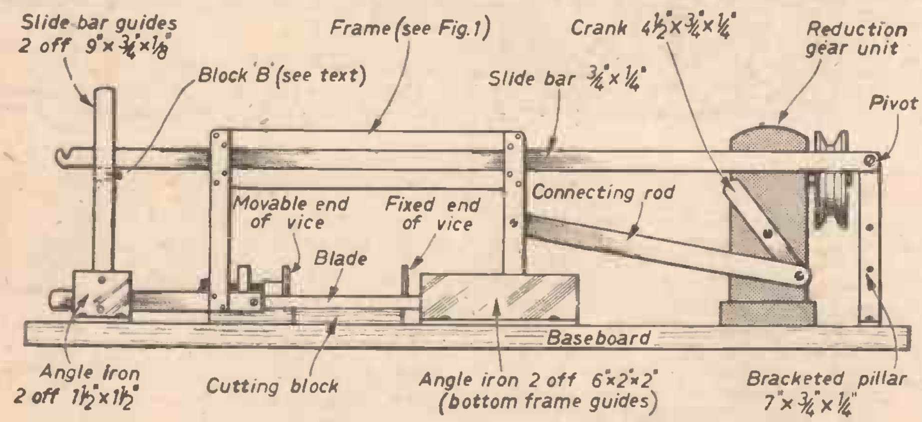


Fig. 4.—A front view of the completed machine.

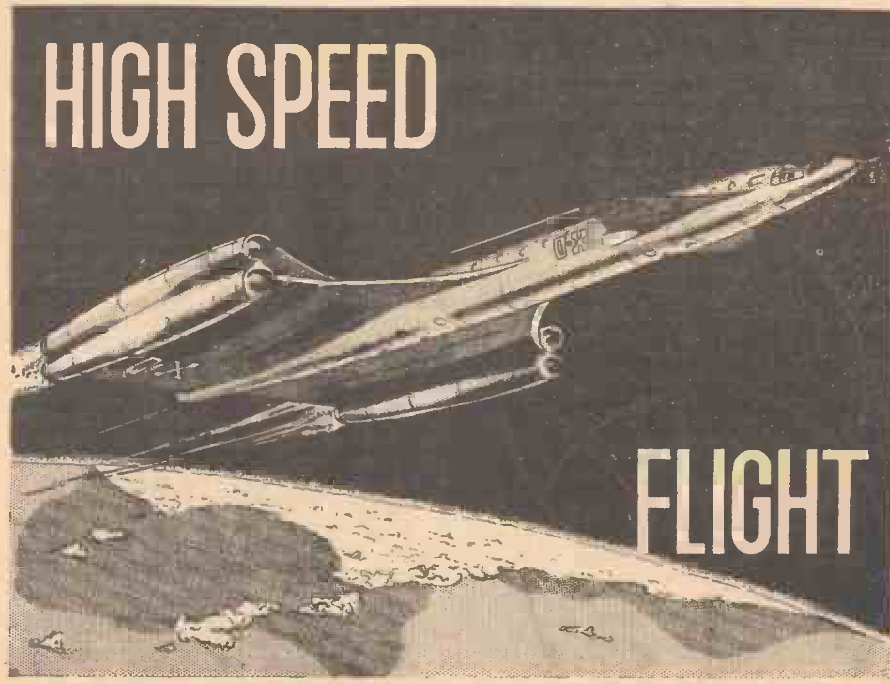


Fig. 1 (Left).—Artist's impression of hypersonic aircraft.

A Modern Problem is Discussed
By William Ellwood

MODERN aircraft, well piloted, are capable of feats which two decades ago would have been ridiculed as fantastic and impossible of achievement. Yet, to-day, it is anticipated that rocket/jet civil aircraft will vault the Atlantic at an altitude of 60 miles at speeds in excess of 3,000 m.p.h., before the year 1970 dawns. This roughly represents a journey from London to New York in less than one hour! (Fig. 1.)

Fallibility of Man and Machine

Aircraft of to-day have proved capable of withstanding great stress at high velocity, and human beings have concurrently proved their ability to contend with the physical difficulties of abnormal acceleration and other related effects of high speed flight. But men flying on busy air routes at transonic (700 to 770 m.p.h.) speeds have one serious shortcoming, which has spelt disaster not infrequently in the past and will no doubt lead to trouble in the future, unless new and stringent air-rules are formulated.

The problem is one of human reaction plus mechanical inertia in mastering the split-second decisions entailed in high speed flight.

Closing Speed

Here are postulated certain circumstances that are typical of those which have arisen often in post-war years. In this manner it is possible to analyse the danger.

Two aircraft are flying on a collision course, that is, directly towards each other. Their individual speeds are 700 m.p.h., thus making the relevant closing speed 1,400 m.p.h., or about .4 miles per second (Fig. 3).

In conditions of good visibility the chances of seeing an approaching aircraft at about 4 miles range are the equivalent of instantly spotting a pin-prick somewhere near the middle of a foolscap sheet. Human focus tends to wander haphazardly over the apparently blank sky ahead, even though the pilot concentrates his vision. Without this concentration he would fail to sight the approaching aircraft until it was miles and seconds too late to avoid a collision.

In the postulated case pilots A and B in their respective aircraft, see each other simultaneously at a distance of 2.5 miles.

The various reactions of pilots and 'planes in the ensuing critical seconds are as follows:

Firstly, the observation or visual impulse to the brain takes about .1 seconds. Secondly, the brain identifies the impulse as the image of a plane: 1.1 seconds elapsed. Thirdly, the decision is made to take avoiding action: 2.6 seconds elapsed. Fourthly, message from brain to muscles, and latter activated: 3.0 seconds elapsed. By this time the machines are separated by 1.3 miles.

Mechanical Time Lag

The controls have been set in motion, but cables must tauten, pulleys turn, and in cases of power-controlled aircraft the pilot's control action must be translated from manual effort to hydraulic boost through servodynes or other actuators, before alteration of the flight control surface is attained to induce a change of direction in the aircraft. This mechanical time lag eats away another two seconds: elapsed time 5 seconds—and the aircraft are separated by a half-mile. Out of an initial time margin of 6.2 seconds, there is left only 1.2 seconds (clearance time) for the machines to alter course. This is inadequate, for at high speed the inertia or sluggishness present in effecting a change of direction is substantial in most aircraft. Clearance time can be anything from 2 to 3 seconds after the flight surfaces (ailerons or elevators) have been reorientated for evasive action.

In the foregoing case disaster would almost be inevitable.

Which Way?

Even if the speed/distance factor is suitable for a successful evasive movement, there

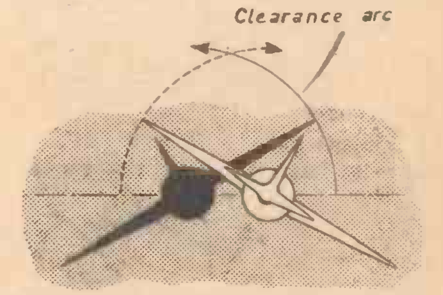


Fig. 4.—The port wing must roll through a large angle to avoid wing scything.

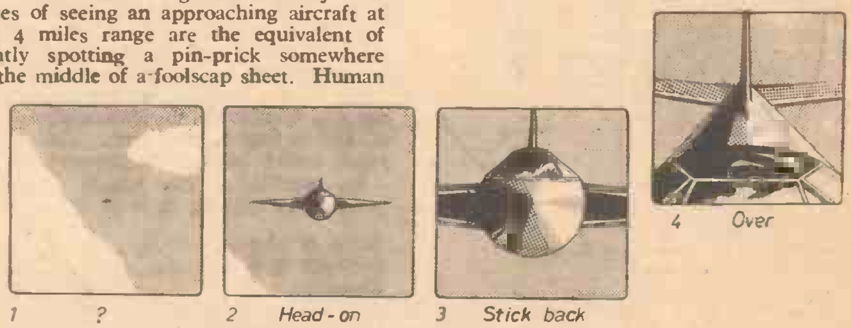


Fig. 3.—Reaction test sequence.

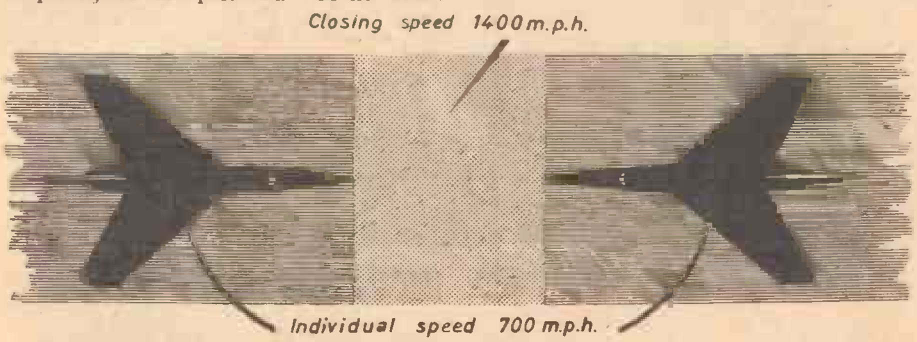


Fig. 2.—The interval in which evasive action can be taken is governed by the closing speed.

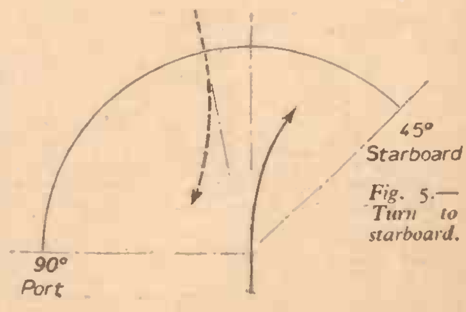


Fig. 5.—Turn to starboard.

still remains the dilemma of what to do—which way to go? One may bank to starboard as is at present laid down, or dive or shoot over the top. For the two pilots concerned to dive or climb simultaneously, the result would obviously be fatal. To bank or roll to starboard in the time allowed, is in the majority of cases asking too much of aircraft at great speed; as will be shown shortly.

The Test

To give an approximate simulation of the crucial approach period, Fig. 2 is included so that you may test your reactions.

Firstly, a sheet of paper should be placed over the drawings. Then, with the aid of a friend using a stop-watch, the four pictures should be uncovered at the starting moment (it makes little difference even if they have been looked at previously as a pilot in action tries to anticipate such an encounter) and the person under test should look deliberately at the first picture, gathering its import and making his decision, before switching his glance to the second sketch and so on through the sequence. He must be outstandingly alert and decisive to do the test fairly within the specified time. (See end of article after the test.)

An Obsolete Rule

It is an international rule that two air-

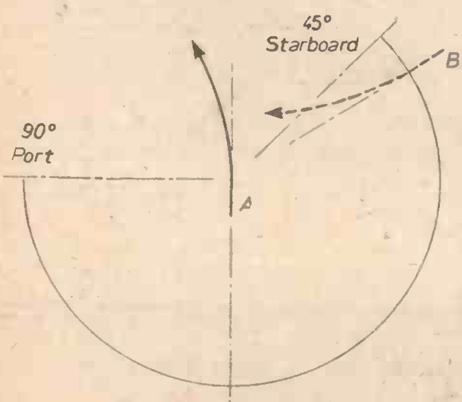


Fig. 6.—Turn to port.

craft on a collision course should each turn to starboard. If, as is generally accepted, the minimum clearance time is 2.5 seconds, the principal overall dimensions of an aircraft become of great importance.

Adhering to this rule, the pilot must roll the 'plane quickly enough to clear the wing of the approaching aircraft. As the fuselage centre/wing tip dimension is the largest lateral measurement where angular movement is the criterion; the present rule increases the risk of wing-scything (Fig. 4).

Horizontal Approach

A new proposal is that an aircraft on an approach course with another should: (1) turn to starboard if the other aircraft appears on a bearing within a segment bounded by 90 deg. port and 45 deg. starboard (Fig. 5), or (2) turn to port if the other aircraft appears on a bearing between 45 deg. starboard, through stern, to 90 deg. port (Fig. 6). It will be noticed in the latter case that the left or port turn is only applicable to aircraft A, as aircraft B initially observes A dead ahead and, therefore, turns to starboard. If aircraft B is much faster than A, it is conceivable that it could intersect A at the latter swings to port.

This two-part rule is reasonable only in a theoretical sense, where the speeds of the two aircraft are identical, or where the machines are slow flying. It also fails to take into account the various directions the two aircraft may be pursuing relative to each other. In high speed flight one has very little time to consider whether the plane on an opposing course is converging or passing

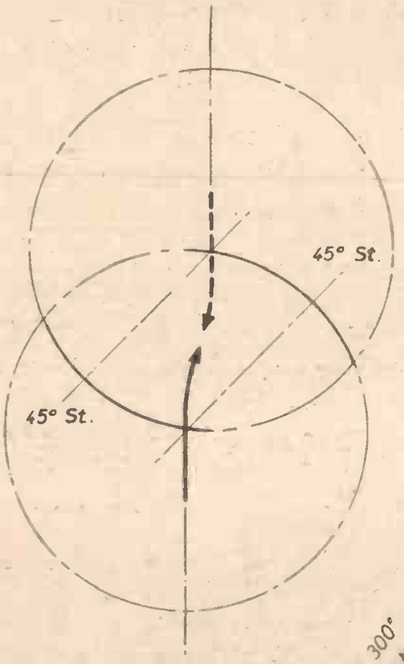


Fig. 7.—The dangerous sector—both aircraft swing to starboard.

in close parallel. In this two-part rule there is in reality a dangerous sector bounded by the arc 0 deg. to 45 deg. starboard (Fig. 7). Here it is seen that two high speed aircraft sighting each other respectively within this arc on initially parallel courses, would be simultaneously obliged to turn to starboard. The result could be very unpleasant.

In considering the speeds of present-day aircraft, it is of little

Fig. 8.—An emergency dial based on compass characteristics and affording a constant illuminated instruction for the pilot.

use formulating air-rules which basically incorporate lateral evasive actions.

Vertical Evasion

Irrespective of all regulations, either proposed or already existing; when a pilot is confronted with an aircraft at close quarters and closing at enormous speed, his first reaction—virtually a reflex action—is to pull the joystick or control column back and go over the top. It is a natural defensive movement, much like one throwing their hands up to protect their face when an object is hurled toward them. Provided that one pilot makes this move before the other attempts it, the chance of avoiding a collision is better than if attempting to roll clear, for the clearance dimension (fuselage centre to rudder tip) in the vertical plane is much less than the clearance dimension (fuselage centre to wing tip) in the lateral plane. The salient point here is that both pilots may climb simultaneously. If some definite and preconceived instruction was available for each pilot to climb or remain level or descend in such emergency, the risk of collision in the air would be greatly reduced.

The Emergency Dial

It is suggested, therefore, that a dial based on compass characteristics and universally installed in aircraft, could provide the essential and definite instruction in cases of emergency (Fig. 8). If, say, the set course was to some point in the arc 240 deg. to 360 deg. the illuminated instruction DOWN would be showing on the dial. For courses set to points within the arcs 120 deg. to 240 deg. or 120 deg. to 360 deg. (anti-

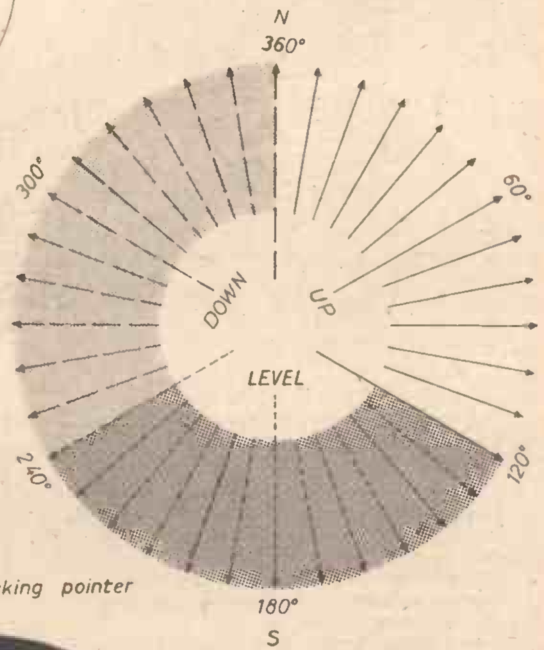


Fig. 9.—Theoretical basis of the proposed emergency dial.

clockwise), the dial would be registering respectively LEVEL or UP. The preknowledge and constant reference that this dial would afford the pilot cannot be overestimated. It conditions his mind to the action which must be taken in an emergency.

Along the demarcation courses 120 deg., 240 deg., 360 deg., it is true that the dial could register one of two instructions, but scrutiny of the theoretical diagram (Fig. 9) will show that an aircraft coming from the opposite direction would perforce have to obey the remaining third instruction.

It would be interesting to know the views of P.M. readers on this vital subject.

Your Reaction

The test simulates the meeting of two aircraft at a closing speed of 1,400 m.p.h., mutually observed at a range of three miles.

A period of 7.5 seconds would be the maximum permissible to avoid a collision. Any reader taking more than 10 seconds for the test is advised to fly as a passenger only.

AN ELECTRICAL WIND DIRECTION INDICATOR

See the Wind Direction from the Comfort of Your Armchair

By S. K. Harble

THE electrical wind direction indicator consists of two main parts: an outdoor wind vane with contacts, and the indoor indicator box, together with 9 connecting wires between the two.

These are the materials you will need for the wind vane and contacts:

One piece of resin-bonded plywood, hardboard, or tinplate, 8in. × 8in., cut to shape as shown in Fig. 1.

One 1in. × 1in. batten, 27in. long, in this cut a slot, and shape as shown in Fig. 1.

One ¼in. dia. 4in. long bolt, if possible with a long thread and three nuts.

Four washers with a 5/16in. dia. hole.

One short metal tube (sleeve), ⅞in. long, inside diameter 5/16in. or ⅜in.

One contact spring, shaped as shown in Fig. 1, made from tinplate.

Eight contact plates, shaped as shown and made from tinplate.

One bottom end of a 9in. dia. tin, cut this to leave an upstanding edge (sides) of 2½in. to 3in. high.

One 1½in. thick, 8in. dia. circular block of wood (contact block).

Three metal brackets (or four) to fasten the contact block to the top of a pole.

Construction

Secure the tailfin to the arrow of the vane by means of two small bolts. The tailfin fits into the slot. Drill a hole ⅜in. dia. through the centre of the batten which forms the arrow. Put on to the batten two triangular pieces to form the arrow head.

The contact spring is made from tinplate (cocoa tin). Drill a ⅜in. dia. hole where indicated in Fig. 1 and two smaller holes for the screws.

Make the eight contact plates from tinplate and drill the necessary holes for the screws.

Drill a ⅜in. dia. hole into the exact centre of the bottom part of the 9in. dia. tin, and smaller clearance holes for the screws which are to secure the contact spring to the underside of the arrow.

Screw the 9in. dia. tin which is to serve as a cover for the contacts and contact block, to the underside of the arrow, and also screw the contact spring into position.

The complete wind vane and the outside of the cover can now be painted.

A 5/16in. hole is drilled into the exact centre of the 8in. dia. contact block. Where indicated a slot, or a ½in. dia. hole is made for the wires to pass through. Screw the metal contact plates on to the wooden contact block as shown in Fig. 1. One screw in each contact plate has a washer under which the ends of the different wires are fixed.

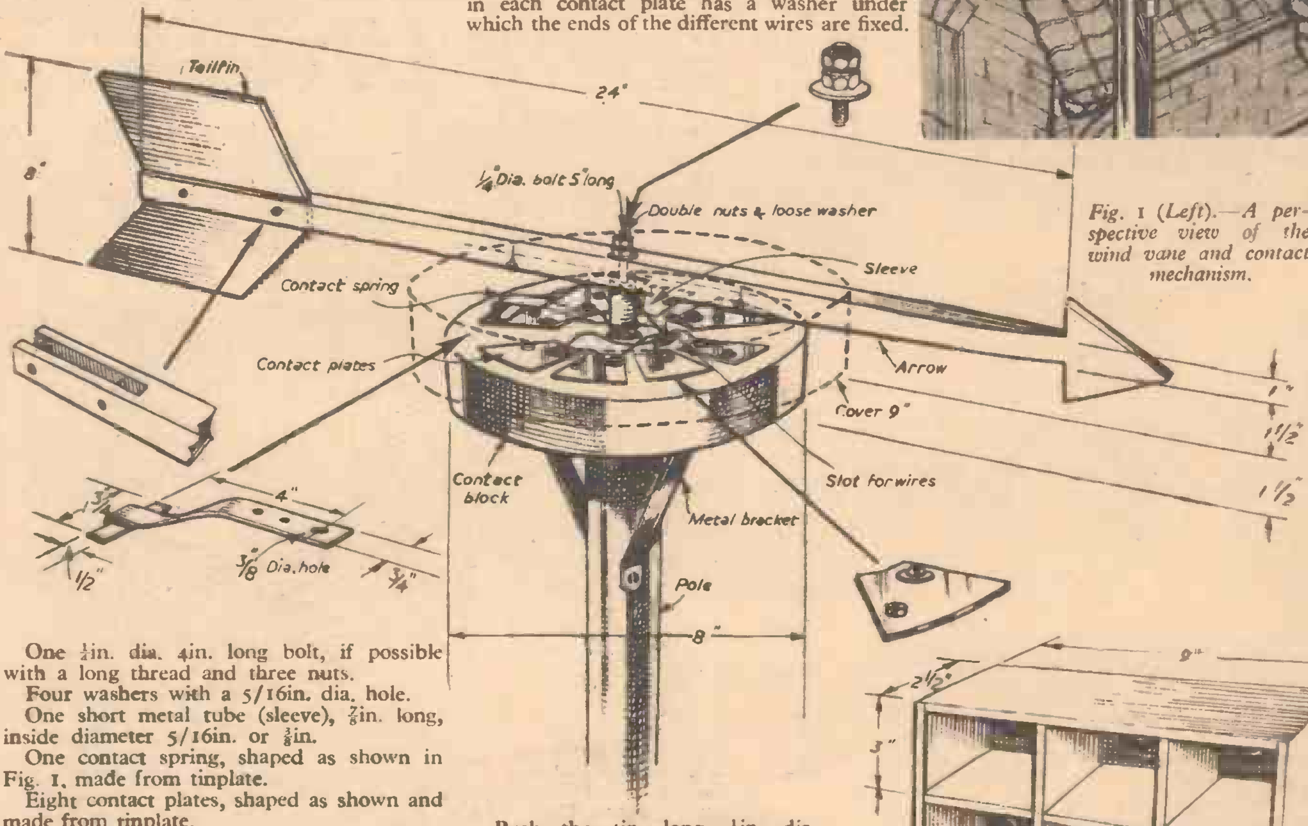


Fig. 1 (*Left*).—*A perspective view of the wind vane and contact mechanism.*

Push the 4in. long, ¼in. dia. bolt up through the centre hole in the contact block, from the bottom, place a washer on to the bolt over the block and screw down the first nut. The wire from the battery is fastened under this nut and washer. At the point where the wire comes in contact with the bolt it should be cleaned up. The same applies where the cover and the contact spring touch the bolt.

Place another washer on top of the nut. Put the metal sleeve over the bolt and again place a washer over the sleeve. At this point a drop of oil may be required

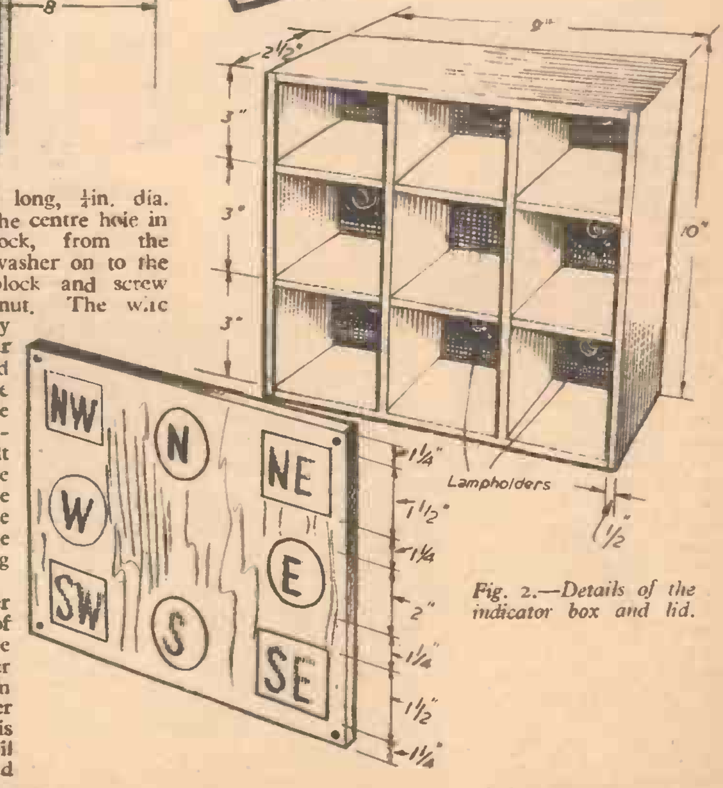


Fig. 2.—Details of the indicator box and lid.

in order that the wind vane may turn freely on the bolt. A light coating of oil on contact spring and contact plates will help to keep rust away.

Before the wind vane and the cover are placed on to the bolt, all the contact plates and the centre bolt must be wired up, the wires having been passed through the slot, or hole, made for this purpose.

Note here that the connection for the "north" wire is at the opposite end of the direction to which the arrow points, the same applies to all the other directions, remember this when wiring up to the indicator box.

Finally, the cover and wind vane are placed over the bolt. A washer is put on top, a nut screwed down far enough to allow for the movement of the wind vane, a locking nut is put on and the two nuts are turned tight together.

Fastening to the top of a pole can be by means of metal brackets, as shown in Fig. 1. An open position should be selected, where the indicator can be reached by winds from every direction.

Materials for the Indicator Box

Two pieces of plywood, 10in. × 10in. × ¼in. or 3/16in. thick.

Two side pieces, ½in. × 2½in. × 10in. long.

Two top and bottom pieces, ½in. × 2½in., 9in. long.

Two plywood strips, 2½in. wide × 9in. long.

Eight small bulb holders.

Eight flashlight bulbs.

Circular and square holes are cut into the front piece in the positions shown in Fig. 2. Glue a piece of white paper to the back of the front piece, mark "N," "NE," "E," "SE," "S," etc., in black Indian ink on to the paper from the back in reversed characters. Thus the letter will only show up when the respective panel is lit up from inside.

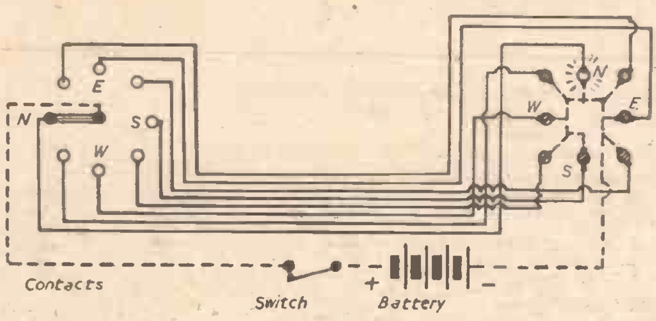


Fig. 3.—The electrical circuit.

Make the sides and the back of the indicator box and assemble as shown in Fig. 2. Cut a hole into the bottom for the wires to pass through. Fix the small bulb holders to the back of the box. Slots are made into the plywood strips to fit them into each other and the plywood partitions are fitted into the box. It may be found more convenient if the bulbs are wired up before these partitions are fitted in.

The front of the indicator box is fixed by means of four screws, one at each corner.

Wiring

Fig. 3 shows the wiring diagram for the connections between the contacts and the indicator box, incorporating the battery and a switch. If possible use a different coloured wire (bell wire) for each contact. Failing this, secure the wind vane on each contact while the respective wire is connected to the corresponding bulb in the indicator box. The wiring is not complicated at all, merely being straight connections from the "N," "NE," "E," etc., contacts to the bulbs which indicate these directions.

By making the indicator box larger it would be possible to accommodate a battery and the switch in the centre portion.

Fig. 1.—A view of the remote control release and camera.

A Remote Control Camera Release

Described and Illustrated By W. Gardner

THIS simply made remote-control release (Figs. 1 and 3) is suitable for most cameras with push-button release on the top. It can also, with the addition of a simple clip accommodate a cable release for other types of camera (Fig. 4).

The basis is a 12-volt solenoid purchased from Messrs. Proops of Tottenham Court Road, London, for 2s. 6d. The long arm is taken off and reversed, with the short length cut away. A fresh hole is drilled for the bush and pin for attaching to the solenoid plunger. The arm is cut to length to suit the camera. The solenoid before and after modification can be seen in Fig. 5.

A bracket is made with one end which will slide under the tripod bush screw and in the other end a 2 B.A. clearance hole is drilled to attach to the solenoid (see Fig. 2). Twin wires are soldered on to extend the solenoid wires which protrude at the top of solenoid and are connected to a push-button switch and a battery.

Excellent results have been obtained using 20ft. of twin bell wire. Care should be taken that the solenoid arm travels down to its full extent without the release button reaching the end of its travel, so as to avoid camera shake. Packing under the solenoid will adjust this. The tension spring at the pivot point of the arm can be retained in position to give extra thrust to releases which need more pressure.

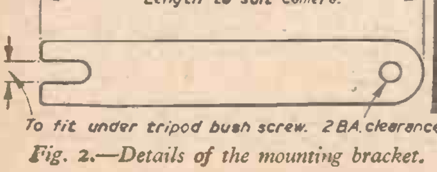


Fig. 2.—Details of the mounting bracket.

Fig. 3.—A further view of the release ready for use.

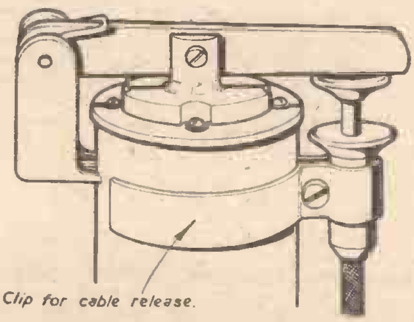


Fig. 4.—Using the solenoid in conjunction with a cable release.

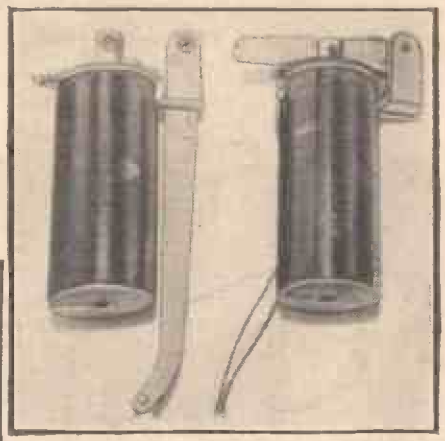


Fig. 5.—The solenoid before and after modification.

A Dual-Purpose Tuning Meter

For Both Radio-controlled Transmitter and Receiver

By D. J. Cameron

AS the purchase of two meters, a 5mA one for tuning the receiver, and a 50mA one for setting up the transmitter, is rather expensive, the meter described below serves both purposes, being at the same time light and compact.

Construction

It was desired that the meter should fit into the transmitter during actual control operations, so any additions to the existing casing had to conform with its cylindrical shape. A 5mA f.s.d., square meter with screwed rod terminals was therefore bought, and a framework was fitted over, and secured to these terminals, this mode of building being considered safer than attempting to drill the plastic casing, with possible damage to the internal mechanism. Thus the framework is entirely external, and does not require the dismantling of any part of the original meter. The terminals must, of course, be electrically separate from one another, so a construction of tinplate and Paxolin was adopted, the latter for insulation.

First of all two strips of tinplate are cut to the measurements given in Fig. 1. In each strip two holes are drilled to clear the meter terminals, and three are drilled 8 B.A. clearance (or preferably tapped 8 B.A.). The V cuts at the top and side of each frame are to clear the two-pin battery plug (which is added later), and the range switch. The strips are bent up into an open box shape, as in Fig. 2. The best method of making the last two bends is to cut a piece of stripwood to the internal dimensions of the finished frame, then clamp this firmly in a vice, and use a mallet to bend the tinplate round it (Fig. 3). Be sure to position the V cuts so that when the frames are finally assembled the cuts face each other (Fig. 2). When both frames have been completed, they should be fitted over the terminals and secured with nuts.

Two panels are now cut from 1/16in. Paxolin sheet as in Fig. 4. (The measurements here may differ with various types of meter, but those used on the original are given.) Panel "A" has four 8 B.A. clearance holes to match with those in the frames; and also a ½in. diameter hole to take a single-pole, on-off, wafer-type switch. Panel "B" also has four 8 B.A. clearance holes, two for fixing to the frames, and two to attach the previously mentioned two-pin battery plug. Holes for the plug's pins are drilled as shown, then the plug is placed in position and holes are drilled in it using the fixing holes in panel "B" as a template. Panel "B" is made 13/16in. wide so as to butt joint the two panels, as shown in Fig. 5.

Assembly

Panel "A" is now bolted to the frames (¼in. 8 B.A. bolts are used throughout) and the switch, with its terminals upwards, is adjusted by using two nuts, so that the toggle does not project beyond the edge of the meter (Fig. 5). The wiring should now be carried out, having first ensured that panel "B" will fit, but without bolting it in position, as if this is done access is rather

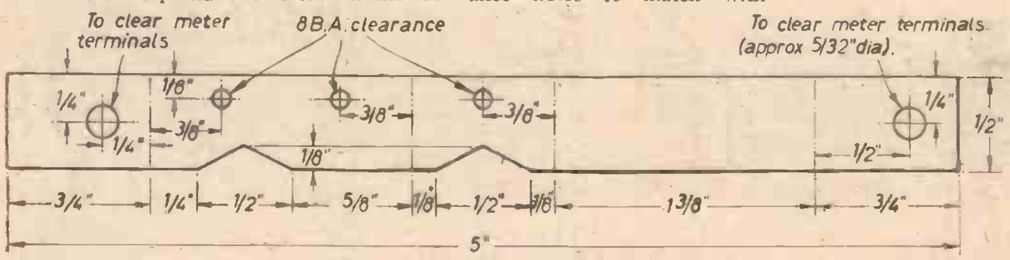


Fig. 1.—Dimensions of the frames.

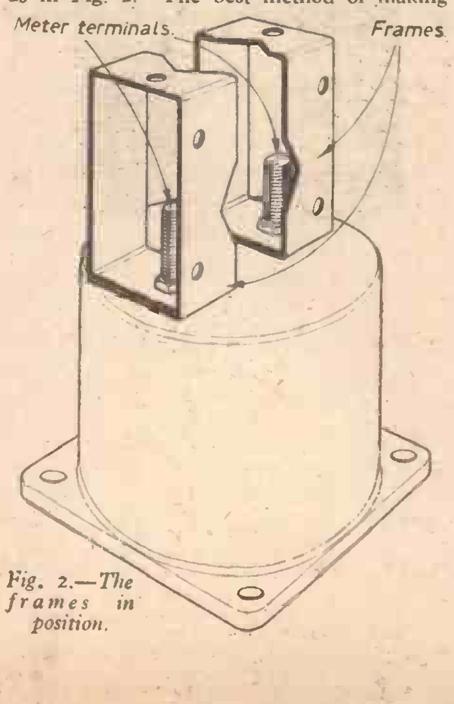


Fig. 2.—The frames in position.

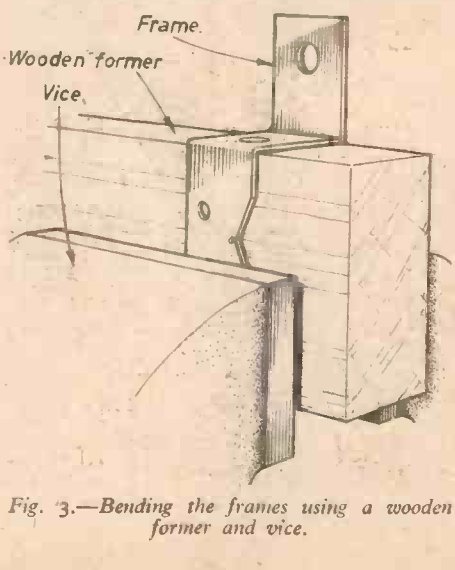


Fig. 3.—Bending the frames using a wooden former and vice.

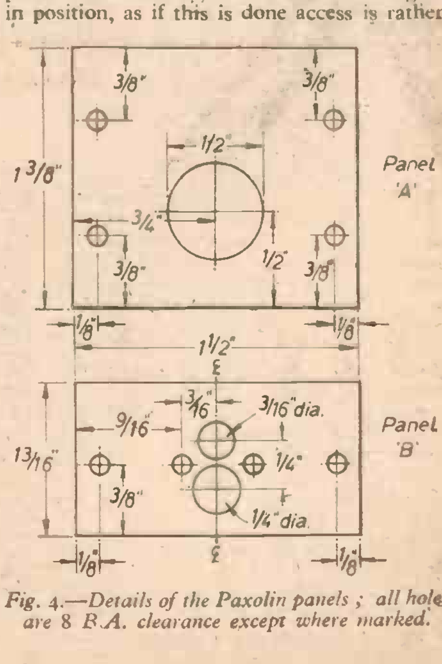


Fig. 4.—Details of the Paxolin panels; all holes are 8 B.A. clearance except where marked.

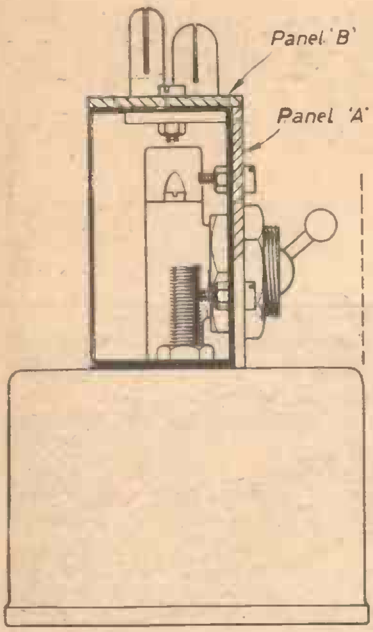
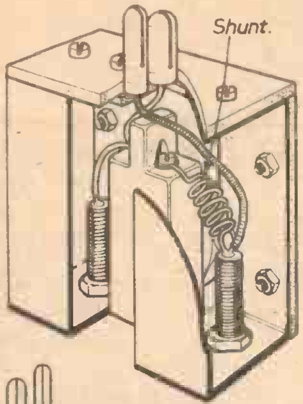


Fig. 5 (Above). — Side view showing adjustment of switch. Wiring is omitted for clarity.



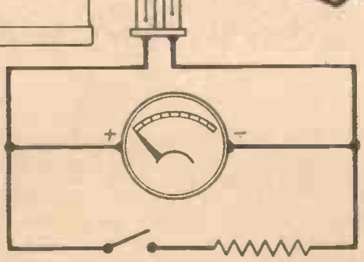


Fig. 6 (Right). — (Top) wiring details. (Bottom) circuit diagram.

difficult. Circuit and wiring diagrams are shown in Fig. 6. The value of the shunt (approx. ½ an ohm) which converts the f.s.d. from 5mA to 50mA is roughly found by calculation from the resistance of the meter; and finally adjusted by using a standard 50mA meter in series. The thick pin on the plug should be connected to the positive terminal of the meter.

Having finished the wiring, panel "B" is bolted to the frame, and the construction is complete. Some indication of the range selected should be marked on the switch panel to avoid confusion. In the writer's case, the back and sides were left open, but they could easily be covered with Paxolin panels by adding small brackets for the sides.

Method of Installation

Because the meter has to be removed from the transmitter case each time the receiver is tuned, the normal nut and bolt method is obviously too slow. Four "bolt action" collar studs (see inset Fig. 7) were bought cheaply from a well-known multi-department store and the bases were fitted into the case as in Fig. 7. Holes are drilled to clear the necks, the marking being done with the meter in position, and pieces of tinplate are bent and fixed as shown, while small "collars" of copper tubing are slid over the necks so that the ends are flush with the top of the meter when it is in position. The meter fixing holes will probably have to be drilled out to a larger size for this. The meter can now be removed and replaced at will simply by unfastening the studs.

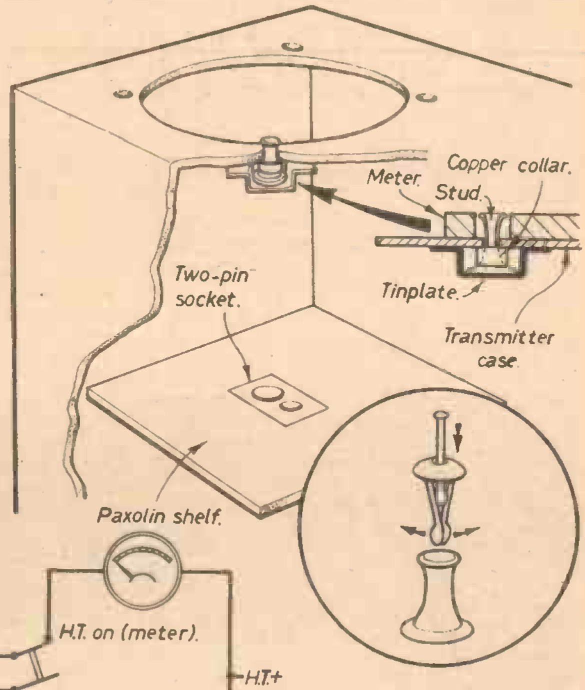


Fig. 7 (Right). —Method of fixing meter, with (inset) action of stud.

The socket for the two-pin plug is secured to a small Paxolin shelf inside the transmitter case. The position may best be found by trial and error.

Instead of using a shorting plug or switch when the meter is out of the transmitter, the writer uses a modified two-pole, on-off toggle, which can also be used for testing when the control-box is unplugged from the closed-circuit jack. The connections are shown in Fig. 8, the two positions being marked "H.T. On" and "H.T. On (Meter),"

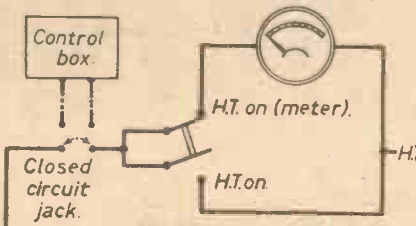


Fig. 8.—Wiring of H.T. switch.

from which it may be seen that when the meter is out the toggle serves as an on-off or keying switch.

Thus the complete tuning procedure is as follows: Switch on transmitter; H.T. switch to "On (Meter)"; set up transmitter. H.T. switch to "On"; remove meter; range switch to 5mA; plug into receiver; key transmitter with H.T. switch while tuning receiver; range switch to 50mA and replace meter in transmitter.

A HANDY GAS LIGHTER

Useful For the Kitchen and Workshop

By R. R. Hutchison

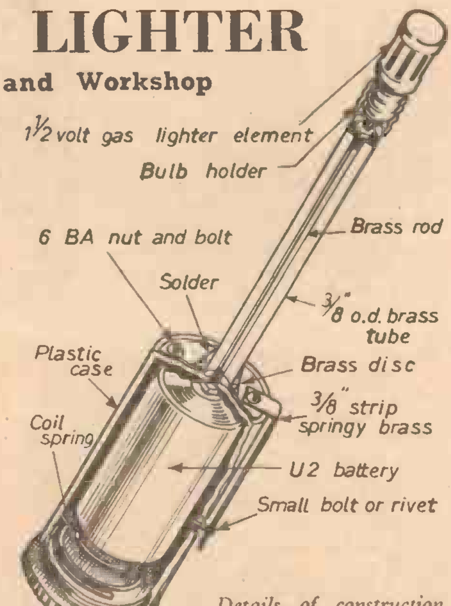
A USEFUL and easily constructed gas lighter is shown here built on an empty plastic shaving stick case.

Construction

First, cut a stiff disc of brass slightly less in diameter than the end of the plastic case, which should be big enough to house a U2 battery with ½in. to spare. Drill a ⅜in. hole in the centre of this disc and solder a short length of ⅜in. o.d. brass tubing so that the tubing is flush with the disc. It is advisable, if ordinary soft solder is used, to build up a heavy shoulder of solder to give strength in case of an accidental fall.

The Bulb Holder

At the other end of this tube solder a screw type bulb holder of the solid brass type if available. Remove the centre contact from the insulated washer and replace with either a length of 6 B.A. screwed brass rod, or a piece of plain brass rod which has been screwed 6 B.A. at both ends.



Details of construction and materials used.

The plastic case (or its screw-on lid) is now drilled to take two 6 B.A. bolts for fixing on the brass disc which has been similarly drilled and a central hole is drilled clearance 6 B.A. to take the other end of the screwed brass rod which passes down the centre and clear of the brass tube.

A nut should be screwed to each end of the rod so that the rod ends are just flush with both nuts. Under the head of one of the fixing bolts is clamped a short length of springy brass about ⅜in. wide which is bent down the side of the casing and a small bolt or rivet soldered near its free end, which, in turn, is able to pass through a hole drilled in the side of the case to contact the bare metal side of the U2 battery.

Fitting the Battery

A 1½ volt gas lighter element is screwed into the holder and a U2 cell is kept in contact with the central nut by a spiral spring. The circuit is completed by depressing the rivet contact on the springy brass arm.

The battery lasts about a year with normal use.

LANDSCAPE PHOTOGRAPHY

Walter Hunnisett Discusses the Part Played by Different Types of Light and Shadows

THE sun is blazing from a clear blue sky and surely a sunny day is the best time to take a photograph. We take great pains to select a beautiful view and release the shutter, feeling certain that we have captured a masterpiece. Then we produce a print and return to earth. Somehow it makes us doubt if the sun really was so strong. The sky is a blank expanse and the whole scene looks lifeless. What can have gone wrong?

The answer is that we have not understood one of the main purposes of a photographic light source, namely to cast shadows which help to explain the shape of the subject.

Use Shadows

When we look at a subject it may stand out from its background very well, but that is quite often because of a difference in colour. In black and white photography, which is what we are concerned with at the moment, the colour of the object of main interest and that of the background may convert to similar shades of grey. The use of shadows will put this right; but to move a shadow calls for an alteration in the relative positions of light and subject. Unless time is no object, this is not possible with natural lighting and immovable subjects. The alternatives which remain are either returning at a different time or walking around and tackling the problem from another angle.

Fig. 1.—Lerwick, Shetland, 1/50 sec. at f5/6 with a Rolleiflex camera and an Agfacolour negative.

Fig. 2.—The early morning sun lifting the clouds from the hills at Langdale. Taken with an Agifold camera on an HP3 film. 1/25 sec. at f/8.

Lighting

"Keep the sun off the lens" is sound advice but unfortunately, to make completely sure, it was often given as "Keep your back to the sun." If the sun is scorching the back of your neck, shadows will be hidden, with the exception of your own which will spoil the foreground. Frontal lighting is not very useful except for cloud formations, which can be photographed with just a narrow strip of earth to complete the bottom of the picture. If a distant view is hazy, thus giving depth to the scene, and cloud shadows are chasing each other across undulating ground, then this lighting still deserves consideration. Unless the subject has good tonal contrasts, think twice before exposing with frontal lighting.

Side lighting is generally more reliable. The main danger here is encountered with a broken foreground, particularly when using a wide-angle lens. A recollection of some panorama photographs taken on a sunny day will be useful. They provide extreme examples but the point is easier to see. Suppose we are looking at a picture covering 180 deg. One side has the light in front of the camera, with the resultant deep shadows, whereas the other extremity shows no shadows at all. If the light is at right-angles to the camera we get an effect similar to almost the middle third of the panorama. Unlike the camera, which records all details at once, our eyes take in each item of a view separately, and will ignore such faults unless they are trained otherwise. Viewfinders are often too small to show up this effect, so should not be relied on too much in that respect.

Slightly in front of or behind the right-angle is often to be preferred. If shadows are being cast slightly away from the camera, the conditions are ideal for showing up the texture of solid objects such as mountain faces or buildings. Side lighting with a slight tendency towards the front is very effective for giving sparkle to foliage and the shadow patterns are interesting.

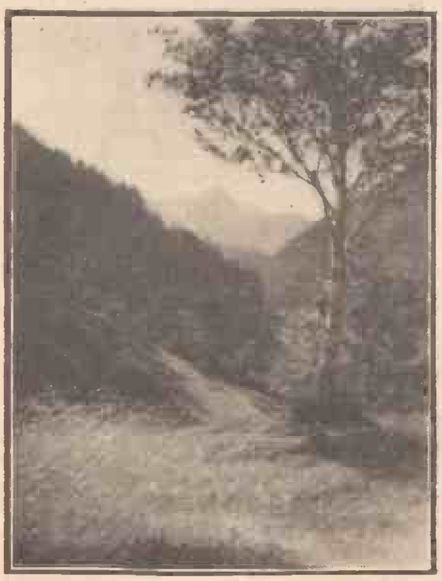


Fig. 3.—Long, soft shadows, cast by the low evening sun. This photograph was taken in the Austrian Tyrol with an Agifold camera. 1/100 sec. at f/16 on HP3.

Fig. 4.—This photograph gives no indication of the heat or brilliance of the sun. It was taken at noon, in midsummer in the Austrian Tyrol with an Agifold camera on HP3 film.

Against the Light

Photographing right towards the sun is a tricky business, particularly if the sun is low. The sky will need little exposure and the shadows will need considerably more if the result is not to be a silhouette. A high viewpoint, leaving out the sky altogether, reduces the contrast range, and at the same time makes better use of the long shadows. Used carefully, this lighting can provide excellent results, especially if you can capture the sparkle on water. The haloes which are a feature of against-the-light photographs make objects stand out well, but adequate exposure is essential to get detail in the shadows.

Clouds

It is possible to have too much sun, as with brilliant lighting it is far too easy to get "soot and whitewash" effects. The sky is likely to be devoid of cloud interest, the negatives are difficult to use and the resulting prints are rarely satisfactory. Clouds in the right place can be of immense value in composing a picture, but their usefulness goes further than that.

Outdoor pictures have the sun as the sole light source (discounting flash, which can only have a local effect). If there is no cloud, the light is similar in effect to a spotlight and the shadows are hard and lacking in detail. Clouds act as reflectors and help to keep the contrast of the subject within printable range.

Fig. 5.—Scafell from Lingmell. This photograph was taken 15 minutes after Fig. 8, with an Agifold camera, 1/50 sec. at f/16 with a 2 x yellow filter on HP3 film.

Fig. 6—Towards Keswick from Grain Gill. Cloud shadows provide the separation of planes. This was taken with an Agifold camera on HP3 film.

For most of the year the sun never gets really high in this country. This means that if it puts in an appearance any time between autumn and spring it is possible that a potentially good subject is waiting for you. ("Autumn and spring" is a rather vague term, but there is no sharp dividing line between correct and incorrect lighting.) During the remainder of the year only about 2-4 hours at midday need be written off as providing lighting which is too high to give the best results.

Fig. 7.—The Jaws of Borrowdale taken with a Rolleiflex camera. 1/100 sec. at f/8, on an HP3 film.

Scenes taken early or late in the day have a quality of their own. It is a quality which cannot be faked as can "moonlight" photographs. The only way to record that quality is to be there at the right time. The soft shadows cast by a low sun often make it easier to capture a "mood" picture. The effort required to get up early is well worth while—occasionally!

Dull Days

So far we've been blessed with sunshine almost unlimited. What about those days when the sun has a hard job in penetrating the clouds?

Three of the most precious requisites of a successful landscape photographer are patience, anticipation and, most of all, luck. These are particularly valuable on "hopeless" days. A shaft of sunlight breaking through from any direction can give life to an otherwise sombre scene. You may have enough patience to wait all day in the hope of seeing one break through. You may anticipate the approximate direction of the beam and position yourself accordingly; but the deciding factor will always be whether you are lucky enough to see the light falling on the right spot.

Fig. 8.—Flat lighting does not show rock to best advantage. The photograph shows Scafell taken with an Agifold camera. 1/50 sec. at f/16 with a 2 x yellow filter on HP3 film.

THE P.M. 6in. ASTRONOMICAL REFLECTING TELESCOPE

CARE AND ADJUSTMENT

Some Valuable Advice for the Amateur

By F. W. Cousins, A.M.I.E.E., A.C.I.P.A., F.R.A.S.

A REFLECTING telescope does not perform well if it is taken from a warm room into a cool garden. It is much to be preferred that the telescope should be kept out of doors ready for use. If you have made the portable Seller's mounting, keep the instrument in such a place that it is close to the temperature of the ambient conditions at the position where it is to be used. If you have made the equatorial cradle type mounting then this, by its very nature it not portable and you will need to protect the mounting and the telescope from the weather. The writer favours a run-off shed for this gives the tyro a full view of the night sky. A dome looks very impressive but it can be a great nuisance to one not familiar with the heavens. A simple run-off shed (Fig. 1) moving on a concrete apron with a slight water shed is very satisfactory. The writer has used such an arrangement to cover a larger instrument than the one proposed here for the past nine years and it has given excellent protection.

It must be made abundantly clear that the mirror surfaces are either top silvered or top aluminised and these surfaces—especially the silver—will deteriorate rapidly if they are not provided with close fitting covers to be kept on at all times when the telescope is not in use.

It is more usual nowadays to utilise the aluminium surface. Most optical workers making flats and the main paraboloidal mirrors for Newtonian telescopes send their finished work to be aluminised in special vacuum plant. The mirror is placed in a container facing a coil charged with aluminium. A high vacuum is then generated within the container and the coil heated electrically to a temperature sufficient to fuse the aluminium charge and evaporate it. The aluminium molecules are propagated in substantially straight lines across the evacuated space to strike the mirror surface condensing upon it to form a metallic reflecting film.

The reflectivity of the aluminium surface is not so high as that for silver (Al. 90 per cent., Ag. 97 per cent.), but the aluminium is much to be preferred in that it forms a full oxide coat quickly (aluminium oxide or hydroxide) and this is transparent. In contradistinction to this the silver coat forms a sulphide which is opaque and black by reflection.

The aluminium surface is usually free from minute scratches for it requires no burnishing. Its behaviour in the ultra-violet region of the electro-magnetic spectrum is good and this is useful for photographic and photoelectric observations.

It is said that the aluminium surfaces can be cleaned by careful washing. One uses a pad of cotton wool, a little good quality soap and *running* water, but as little cleaning as possible is best. Do not be too fussy about the spotlessness of the main mirror surface, it will function quite well even with several minor blemishes. When it is unsatisfactory have it re-aluminised. With close fitting covers the mirrors if aluminised should last for something near to three years.

Uncovering the Mirrors

The following procedure will save much damage to the instrument. Never take the cover off the main mirror until you have uncovered the optical flat. Always replace the cover on the main mirror before replacing the cover on the optical flat. Then if you drop the flat's cover you will not damage the main mirror's surface.

Orientation of the Cradle Mounting

The cradle mounting is an equatorial mounting. Once the telescope is trained on to a star, movement of the cradle will allow the telescope to follow the rising and setting motion of that particular star.

It has already been pointed out that the angle of the cradle to the horizontal is equal to the latitude of the position at which it is set up. Now we must consider the positioning of the mounting on to the meridian so that the long axis of the cradle extended passes through the North and South celestial poles. (See Fig. 2.)

The meridian is most readily found with a Gnomon. Set up a pole of six or more feet in height; set it up vertically at the site for the mounting. To do this use two plumb bobs at right angles to each other. See Fig. 3. On the top of the pole fix a needle and a bead (Fig. 3). On a clear, sunny day observe the position of the shadow of the bead at, say, nine hours. Mark the position X_1. With an old knife blade and a radial string describe a circle through X_1, the circle having the pole as its centre. Some hours later, after noon, observe when the shadow of the bead once again is on the circle you have described. Let us suppose this is position X_2. Draw the line X_1 X_2 and bisect it at Z, the line ZO extended is the meridian. The observations should be made on the same day. A mounting for any telescope should be very rigid.

Some constructors may care to make a concrete mounting. One design for the pillars is shown in Fig. 4.

Adjustment of the Finished Equatorial Mounting

This should only be attempted when the optical parts of the telescope have been set.

For those who wish to use their telescope for photography and

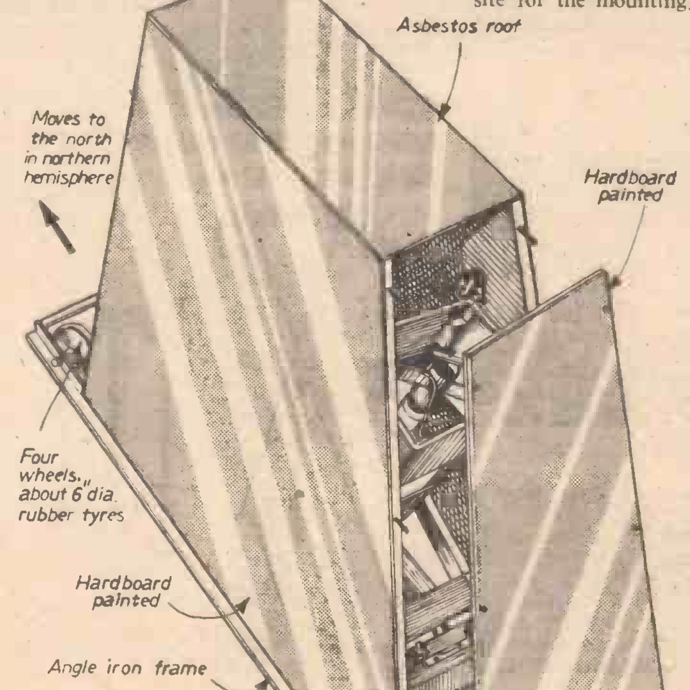


Fig. 1.—A simple run-off shed to protect the cradle-mounted telescope.

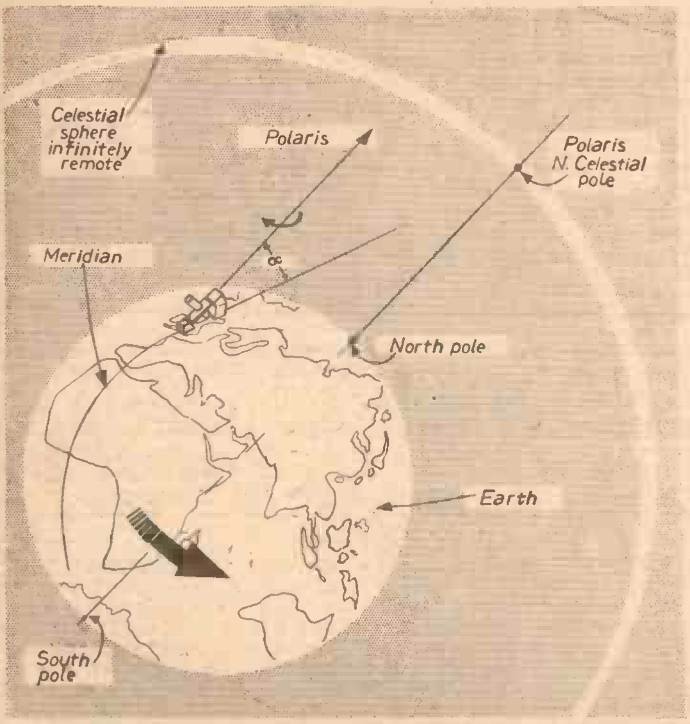


Fig. 2.—How the telescope is placed on the meridian.

fit a clock drive the adjustments are critical. For those who wish to observe by eye alone and guide by hand, final adjustments of the kind now discussed are largely unnecessary. Point the telescope at a star near to the pole and view its out of focus disc against cross wires (suitable eyepieces are available). Observe the star for, say, 12 minutes of time and if it remains centrally placed in the eyepiece field, then the mounting is in good adjustment. If the star trails away from the centre of the eyepiece field then the following adjustment of the mounting is necessary.

1. If star trails up, the polar axis is pointing west of the celestial pole.
2. If star trails down, the polar axis is pointing east of the celestial pole.
3. If star trails to the right, the polar axis is pointing above the celestial pole.
4. If star trails to the left, the polar axis is pointing below the celestial pole.

Eyepieces

The main mirror collects light from a given star and to be effective all of this light must enter the eye. At night the iris opening of the eye is very nearly eight millimetres. Somehow light collected by the mirror must be squeezed into this eight millimetres and in order to be brought to focus on the retina it must be nearly parallel light on entering the eye. A reflecting telescope can readily meet these requirements.

The eyepiece receives rays of light sent to it from the paraboidal mirror and as a separate optical system forms an image of the mirror, small compared with the mirror *per se*. If the focal length of the eyepiece is 24 mm. and the mirror f8, the image of the mirror formed by the eyepiece is a disc 3 mm. in diameter. If we focus the eyepiece to produce a parallel pencil of rays these can, in this case, enter the eye.

The useful range of eyepieces in use with a given mirror is limited at one end by the size of the opening of the eye and at the other by either atmospheric turbulence or the spreading out of the available light under higher power. Since the eye at night is never open more than 8 mm. (say, $\frac{1}{3}$in.) the lowest magnifying power is three times the aperture in inches (on a 6in. mirror 18 magnifications). A useful upper limit may be taken as 50 times the aperture in inches. With a 6in. telescope a power of 300 is near the maximum.

The linear field in the focal plane corresponding to an angle θ on the celestial sphere given by a telescope is $\theta = \frac{30^\circ}{m}$ approx., where "m" is the magnifying power. In practice this can be found from the time which an object in or near the celestial equator takes in passing centrally through the field; any star having but little declination will answer; favourites are γ Virginis and δ Orionis; the Moon or a planet in a correspondingly favourable position will do. Several trials are made and the mean result in minutes and seconds of time multiplied by 15 will give the diameter of the field in minutes and seconds of arc on the celestial equator.

It will be seen that the angular field of view becomes smaller with increase in power. With a 6in. telescope f8 using a 1in. focal length eyepiece the magnification is 48. The approximate field of view is $\frac{30^\circ}{48}$, a little over 37 minutes of arc.

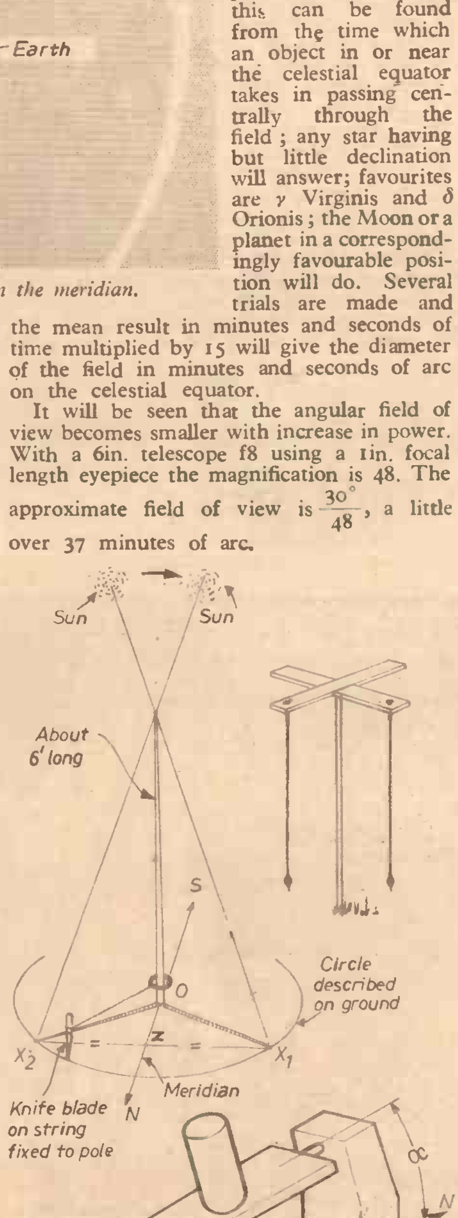


Fig. 3.—Finding the meridian.

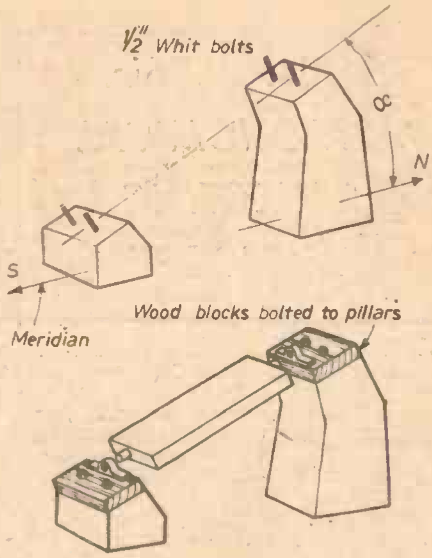


Fig. 4.—Suggested design for a rigid concrete mounting for the cradle.

As a guide one should recall that the full Moon subtends about half a degree—that is 30 minutes of arc.

Recommended Eyepieces for Beginners

These are shown in Fig. 5.

It is a great fallacy to over-stress magnifying power. Schröter and Webb long ago warned observers against this natural desire which is apt to lead beginners into mistakes. A certain proportion of light-to-size in the image is essential to distinctness. Although a higher power can be employed to enlarge the size the light cannot be increased so long as the diameter of the mirror (the aperture) is unchanged. Hence the picture becomes dim and indistinct beyond a certain power and the imperfections of the atmosphere and the telescope more visible. A very high power has further disadvantages in the general difficulty of finding the object and keeping it in view—the contraction of the field, the rapid motion of the image (the motion of the earth) all conspire to make observing very difficult. Reserve high powers for very special objects under the best seeing conditions. Too low a power is apt to show bright objects surrounded with glare. Experience alone is the only sure guide.

At the start use a low power. The following eyepieces are suggested:

A Kellner, an orthoscopic or an Erfle eyepiece of 1in. focal length for general use. Any of these will give a good field of view, even without a finder one should have little trouble in sighting along the tube and finding the object in the field of view.

For planetary and lunar studies a useful eyepiece to have is a $\frac{1}{2}$in. orthoscopic or a $\frac{1}{2}$in. Tolles.

For even higher powers a $\frac{1}{4}$in. Tolles or $\frac{1}{4}$in. monocentric is a most satisfactory ocular, especially for planetary work.

With a Barlow lens this equipment should be sufficient for most needs.

The Barlow Lens

A Barlow lens is a negative lens used to increase the focal length of the telescope and consequently its power without recourse to very short focal length eyepieces. If, as shown in Fig. 6, a negative lens is placed at distance P inside the Newtonian focus of the mirror the negative lens diverges the beam to a distance Q. This new focus is observed with your standard eyepieces in the usual manner. The Barlow negative lens is thus mounted in the eyepiece tube and it is easy to get quite high powers with only one eyepiece. Mr. Hargreaves, one of the leading

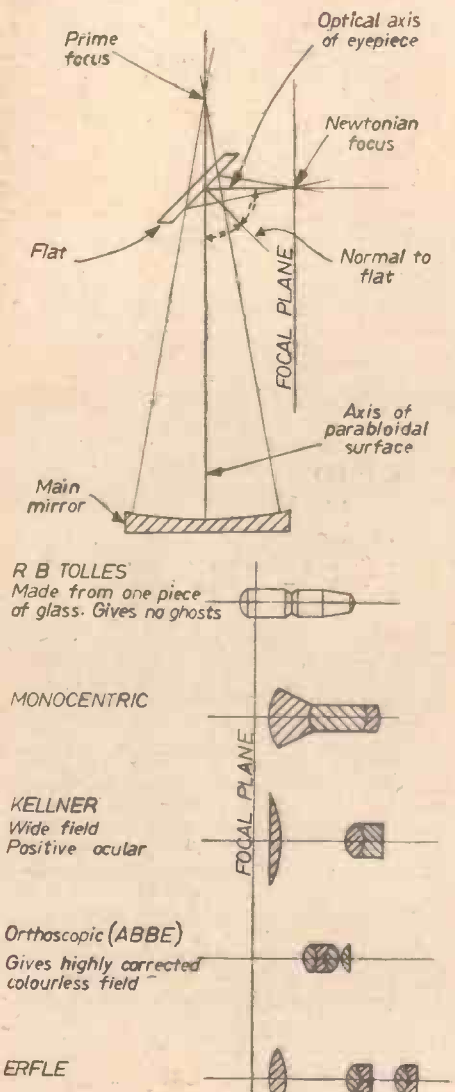


Fig. 5.—Details of the optical train and suitable eyepieces.

optical workers, has reminded us that these lenses exist in the form of telenegative lenses and that they were designed and made for photographers not astronomers. They have become obsolete in photography, having been replaced by fixed-focus telephoto lenses. It may still be possible to obtain from second-hand photographic dealers a Goerz, Zeiss or Dallmeyer telenegative lens. The Goerz lens, according to Hargreaves, is superb. For some years he has used one of focal length 2¾in. with his reflector of focal ratio 5.5.

It is, however, possible today to purchase first-grade Barlow lenses from amateur optical workers at a very reasonable price. (Addresses available from PRACTICAL MECHANICS.)

Final Adjustments of the Telescope's Optical Parts

When the preferred design was considered, reference was made to the provision of "squaring on" screws, which could be manipulated by the observer when his eye was applied to the eye tube. Now the full force of these words will be apparent—for a Newtonian reflector cannot perform well if its optical parts are not "squared on" or collimated.

Two criteria must be fulfilled.

1. The optical axis of the eyepiece and the axis of the paraboloidal surface of the main mirror must intersect in the centre of the reflecting surface of the flat mirror.
2. These two axes must make equal angles with the normal to the reflecting surface of the flat mirror at the said point of intersection.

This can be readily seen from Fig. 5.

Remove the eyepiece from the eye tube and place over it a cardboard cap with a small spy-hole—sometimes one of the eyepiece caps will do this job excellently. Remove the cap from off the flat and then remove the main mirror cover. Point the telescope at the day-time sky. A brightly illuminated disc will be seen with a dark spot upon it. The view may well be something like that of Fig. 7A. Everything is wrong; compare with Fig. 7B, which shows how things should be for good order.

Proceed in this way:

i. Make the outline of the flat (F) concentric with the eye tube rim (E), Fig. 7C. Do this by moving the flat in its holder (Fig. 7, May issue). Check that the flat and the spider are in the centre of the tube (Fig. 7D).

ii. Now consider circles F and M. The circle M is the reflection in the flat of the main mirror. If the black dot, the reflection of the flat (FR) is objectionable eliminate it by placing a white paper circle exactly covering the main mirror. Circles F and M can be made concentric by moving the flat within its holder, using the screws provided. It can also be rotated on its axis.

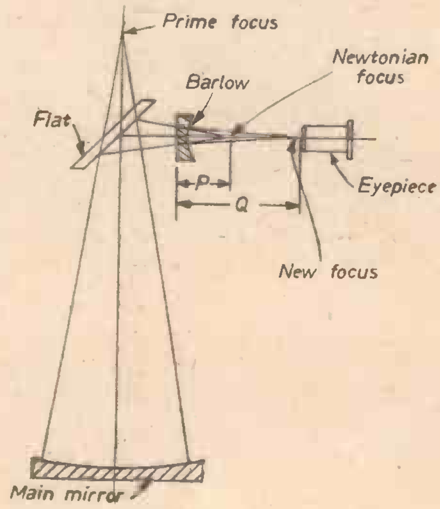


Fig. 6.—The Barlow lens.

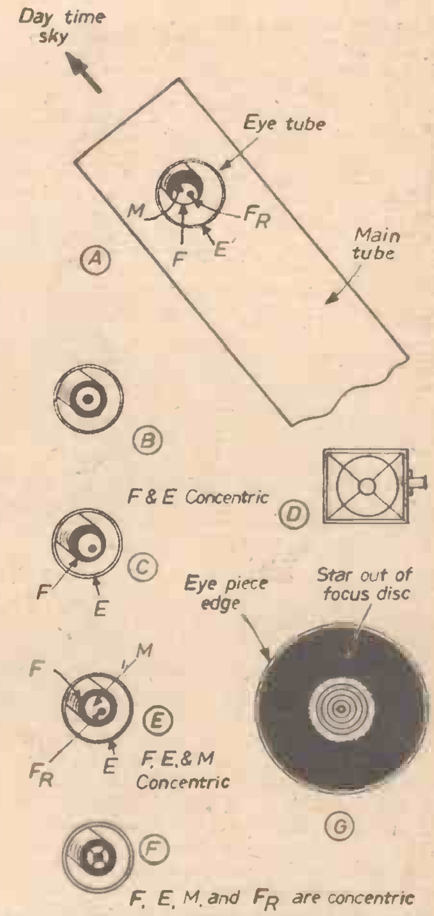
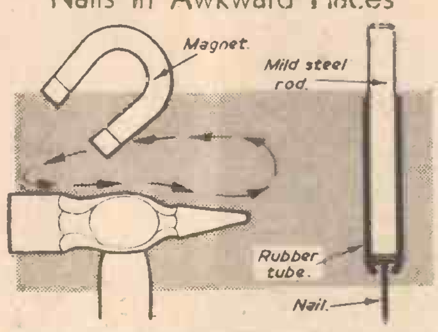


Fig. 7.—The optical adjustment of the Newtonian reflector.

iii. Remove the paper circle off the main mirror. You should see something similar to Fig. 7E. Only the black dot FR is assymetrically placed. This adjustment is most important; it is perfected by using the screws which tilt the main mirror cell. It is often found difficult to judge when the black spot FR is centrally placed of the mirror. Two crossed strings in the tube will give the intersection point. This is shown in Fig. 7F.

When all the adjustments have been made with care test the telescope on a brightish star. The out of focus image of the star should be a system of rings concentric one with the other, having a dark spot in the centre (Fig. 7C).

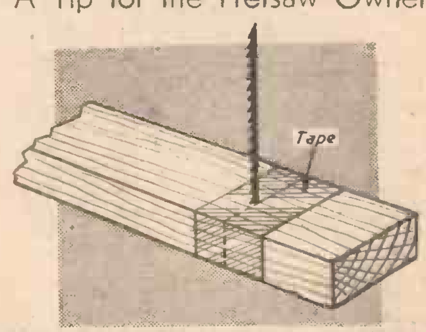
Nails in Awkward Places



ONE way of accomplishing this feat is to use a magnetic hammer. Any hammer can be magnetised, using an ordinary permanent magnet and dragging it along the hammer-head as shown in the sketch above.

A simple tool for this job is shown above right. It can be easily made by anyone from an old piece of rubber tube and a short length of mild steel rod. In use the tool is held in one hand and struck with the hammer held in the other.

A Tip for the Fretsaw Owner



TO prevent splitting when sawing through small strips of wood on the fretmachine, simply wrap a piece of transparent adhesive tape round the strip at the point of the cut.

BUILDING THE LUTON MINOR

The First Article of a Series Describing an Aeroplane that is Simple and Cheap to Build, is Easy to Fly, and Can be Towed Behind a Car and Kept in the Garage

THE prototype of this aeroplane first flew in 1937. It has been modernised and is the first post-war all-British aircraft which can be built and flown by amateurs. The Ministry of Transport and Civil Aviation has approved the Minor for operation under a "Permit to Fly," thus dispensing with the need for a Certificate of Airworthiness.

Aircraft construction is by no means difficult to master and it is quite within the capabilities of the average amateur who is reasonably good at metalwork and carpentry.

The Luton Minor was specifically designed for the amateur builder and pilot, thus simplicity and straightforwardness of construction coupled with maximum flight safety have been the overriding design consideration throughout.

Originally designed by Luton Aircraft Limited in 1936 as a safe, practical, personal aeroplane which was cheap to operate, many examples were built and flown in all parts of the world before the war by enthusiasts and today a number of these pre-war Minors are still flying!

Before the war PRACTICAL MECHANICS published a series of articles dealing with the construction of the Minor. The popularity of these articles was proved by the world-wide reception they were given which resulted in Minors being built in many countries.

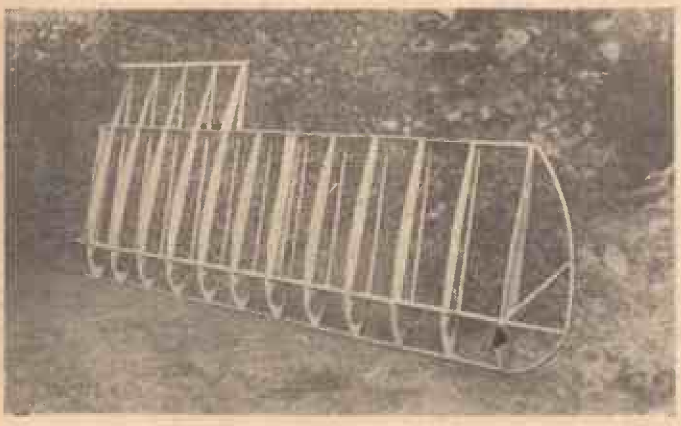
Phoenix Aircraft Ltd., which has taken over the designs of Luton Aircraft Ltd., has modernised the Minor to bring it into line with present-day standards. Heading the design team is Mr. C. H. Latimer-Needham, the designer of the original Minor and many other successful light aircraft. The new Minor—the L.A.4a—is already being built in numbers by enthusiasts in Great Britain and such far away places as Australia.

The L.A.4a Minor is designed to be powered by the 37 h.p. Aeronca J.A.P. J.99 horizontally-opposed, twin-cylinder, air-cooled engine, although any engine up to 42 h.p. may be fitted with only small modification. With the J.A.P. engine, which uses only two and a half gallons of petrol an hour, fuel costs are only 2d. per air mile, with a cruising speed of 70-75 m.p.h.

By removing the wings and tail and fixing them to the sides of the fuselage, the entire aircraft can be towed on its own wheels along the road behind a 7 h.p. car. This enables the Minor to be housed in a shed or garage, thereby avoiding the cost of hangarage at an aerodrome.

The Minor will take-off in 80 yards, may be operated safely from a 200-yard long field and can climb at 450 feet per minute. The stalling speed is about equal to bicycling speed.

Phoenix Aircraft Ltd., in conjunction with the Popular Flying Association, operates an inspection and advisory service and will, upon request, send a qualified representative to give advice and even practical help to the constructor. The amateur, by availing himself of this service, can be certain of completing a perfectly airworthy aeroplane of his own for which he will be granted a Ministry of Transport and Civil Aviation "Permit to Fly."



A partly constructed wing, photographed in the garden of an amateur builder of the Luton Minor.

PRACTICAL MECHANICS has obtained exclusive rights to publish the construction details of this delightful little personal aeroplane. However, since it would be impossible to reproduce the drawings to any useful scale, it has been agreed that we shall provide in this series of articles an illustrated and detailed step-by-step account of the construction. Readers who wish to build the Minor are advised to obtain the full set of plans from Phoenix Aircraft Ltd., whose registered address is Cranleigh Common, Surrey. They will then receive the full set of large scale, black-on-white drawings, which are fully detailed with most of the metal fittings drawn full size. The set of plans costs £11 10s., which is inclusive of a licence to build one Minor and one year's subscription to the Popular Flying Association the founding and representative body in the United Kingdom of amateur constructors and operators of ultra-light aircraft.

This arrangement allows Phoenix Aircraft Ltd., to maintain a watching brief over constructors, so as to avoid unnecessary deviations and mistakes, and to give the benefit of their experience. It is advisable that every constructor should be given the facilities of this advisory service so that he may receive copies of memoranda, issued from time to time, together with copies of any modifications and recommendations as issued by them.

SPECIFICATION

SPAN	25 ft.
LENGTH	20 ft. 9 in.
WING AREA	125 sq. ft.
MAX. SPEED	85 m.p.h.
CRUISING SPEED	75 m.p.h.
STALLING SPEED	28 m.p.h.
INITIAL RATE OF CLIMB	450 ft./min.
TAKE-OFF RUN	80 yds.
LANDING RUN	40 yds.

OPERATING COSTS

Description

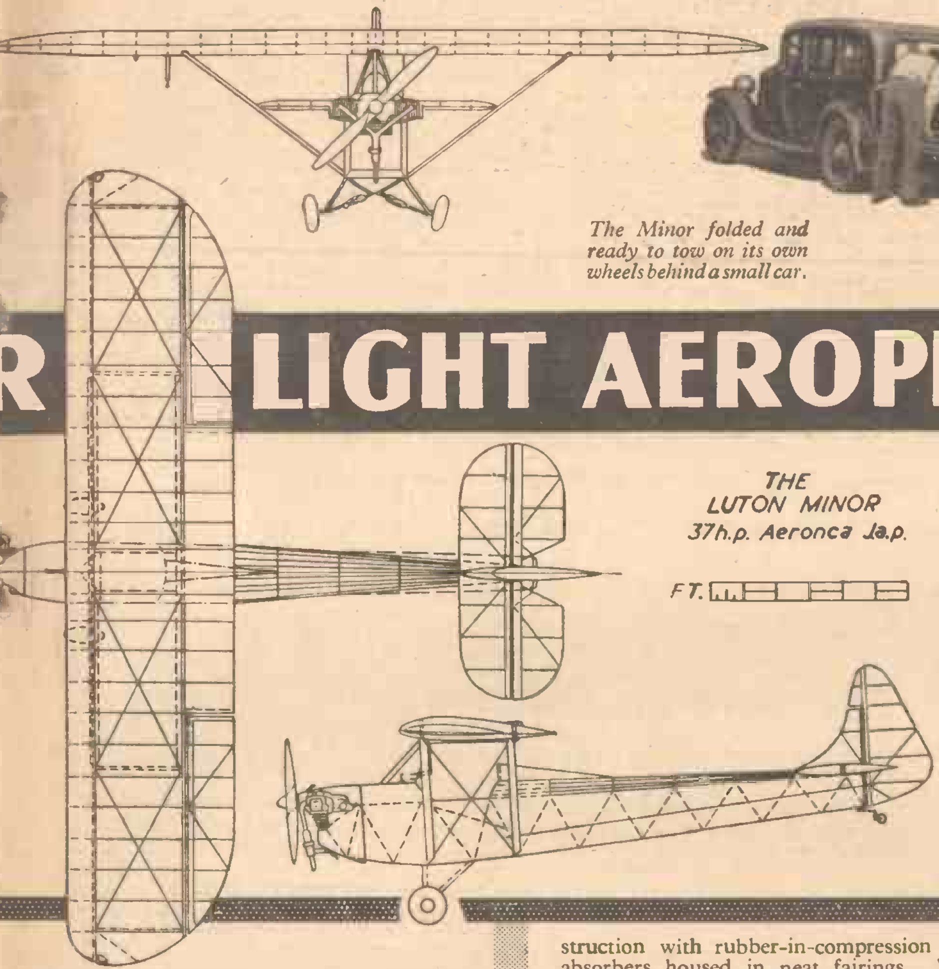
The Luton Minor is a single-seat, all-wood parasol monoplane designed specifically for the amateur constructor who has little or no previous aircraft experience. It is an extremely simple aircraft to build and requires no special tools or workshop equipment.

The parasol wing layout has been chosen for its inherent pendulum-type stability, coupled with excellent view in flight, safe ground handling and also the simplest wing structure. There is no complicated cantilever main spar—the wing is in two separate 12ft. 6in. pieces, which bolt to tubular steel pylon struts above the cockpit.

The designers have steadfastly avoided all fabrications and assemblies which require

The Minor folded and ready to tow on its own wheels behind a small car.

R LIGHT AEROPLANE



WEIGHT (EMPTY)	-	390 lb.
PILOT	-	170 lb.
PETROL	-	47 lb.
OIL	-	10 lb.
LUGGAGE	-	10 lb.
GROSS WEIGHT	-	627 lb.
FUEL CAPACITY	-	$6\frac{1}{2}$ gall.
FUEL CONSUMPTION	-	2.5 gall./hr.
RANGE (STILL AIR)	-	180 miles
	-	2d. per mile

the use of expensive tools or large workshop spaces. The structure of the Minor can be built in a large room or garage. Welding and brazing have been kept to a minimum and, if the amateur has no facilities for this, Phoenix Aircraft Ltd., undertake either to supply such metal parts ready made, or to weld up parts sent to them by amateurs.

Construction

The fuselage is of box construction with spruce longerons and bracing, with a covering of plywood. Aft of the roomy cockpit, the top decking is fabric covered, the fabric being supported on light spruce stringers and plywood formers. The fuel tank, holding $6\frac{1}{2}$ gallons of petrol is mounted on the top longerons in front of the cockpit. The pilot's seat is hinged so that it tips forward to give access to the luggage compartment which has ample space for week-end baggage.

The undercarriage is of steel tube construction with rubber-in-compression shock absorbers housed in neat fairings. Wheel brakes may be incorporated if desired and a fully-castoring tailwheel is fitted. Metal fittings are all simple bent-up fabrications of mild steel sheet.

The wings have two spars each, comprising top and bottom spruce booms and a plywood shear web. The large-chord ailerons hinge directly on to the rear spar. Each wing is built in one piece, complete with the aileron, which is cut off after completion. This ensures perfect alignment without the need for a special aileron jig. The wing ribs are nearly all the same and are of open girder layout. Plywood sheet covers the leading edge and tips for durability and also to improve the airflow over the wing. The remainder is fabric-covered and cellulose doped. Attachment to the fuselage is by two centre-section pylons and two sets of parallel lift struts made of streamlined steel tubing.

Tailplane and elevators are also built in one piece and cut apart after completion. Construction is very simple and follows that of the wings. The fin and rudder are likewise simple wooden assemblies covered in fabric.

A partly constructed tailplane outside the garage where it was built.

The pilot's controls are light and effective. The majority of the control cable runs are internal, examination being facilitated by inspection hatches. The cockpit is of ample size—the tallest and most well-built pilot will find all the controls within comfortable and easy reach.

Normally, the minimum of aircraft instruments are fitted, but for the sporting pilot, an artificial horizon and directional gyro can be incorporated.

The engine is attached to a simple cradle of steel tubing which is bolted to the front of the fuselage. Cowlings are of aluminium sheet and are all of single curvature thus dispensing with difficult shaping which can only be executed effectively with a wheeling machine.

Among those engines suitable, apart from the Aeronca J.A.P., is the Agusta G.A./40, the 40 h.p. Continental, the 32 h.p. Bristol Cherub and the converted 32 h.p. Volkswagen.

Costs

The airframe of the Minor, excluding the engine, can be made for approximately £125. Aeronca J.A.P. engines are available for about £100 complete, plus £20 for the propeller. The total cost of the aircraft should not exceed £250 with the J.A.P. engine.

This is much less than the cost of buying a small car having the same fuel consumption. Phoenix Aircraft Ltd. will supply the Minor, ready to fly, for £698 and can supply all parts, fittings and materials to order.

Materials

All spruce and plywood used in the Minor should be of aircraft quality. Mild steel should be to specification S.510 or nearest equivalent (this is normal 28 tons/sq. in. steel). Steel tube must be of the aircraft specification stated on the plans. Brass aircraft gimp pins or brads are to be used for nailing. All wood-screws used are to be brass or cadmium-plated brass. On no account should steel brads, nails or screws be used—the moisture content of the wood will cause them to rust.

The glues used are of the synthetic resin type and the two recommended in the construction of ultra-light aircraft are Aerolite 300 (or 306) and Aerodux 185. Both are two-parts adhesives and the choice of which one to use is left to the constructor.

Fabrics and dopes will be dealt with later.

Sequence of Construction

It is recommended that the amateur should begin by building the tail unit. This will provide him with good practice and, should he make a mistake, it will not be too costly to rectify. As he gains proficiency so may he gain confidence and proceed to the mainplanes and fuselage.

It cannot be too highly stressed that the constructor should always use aircraft quality materials where specified (though not necessarily A.I.D. released) and must not resort to commercial materials for the sake of saving a few shillings, unless it is definitely stated on the drawings that such materials may be used for certain parts.

The essence of good work is quality rather than speed. The builder must take time over each part and aim to produce good work. By keeping in touch with a Phoenix Aircraft Ltd. representative, or a Popular Flying Association inspector, he can receive guidance, help and assurance that his work is satisfactory. If he is unable to avail himself of such assistance, he should seek the advice of a local licensed aircraft ground engineer who will usually be pleased to make helpful suggestions and give the benefit of his practical experience.

Tools and the Workshop

The constructor will require a dry workroom or garage in which to work. A firm bench with a woodworking vice and a metalwork vice is essential. An electric drill with a small circular saw attachment will save a lot of time and hard work. A steel-backed sanding disc, used in place of the circular saw, is useful for shaping blocks and general sanding off.

Ordinary carpenter's hand tools are sufficient for the woodwork involved. Make sure that the smoothing plane has a good sharp blade—if it is curved or chipped, buy a replacement. The plane is a most important tool in aircraft work—you will be doing some fine work with it—so protect the cutting edge when it is not in use. Cultivate the habit of laying the plane on its side on the bench.

This Luton Minor was built by an R.A.F. officer for his own personal use and is shown here compared with a much larger aircraft.

Metalworking tools comprise a scriber, pair of dividers, centre punch, ½in. cold chisel, pair of tin snips (two are preferable—one large and one small), a 12in. metal rule graduated in fractions and decimal inches, one or two steel squares (4in. or 6in.), a hacksaw, a good set of sharp twist drills up to ¼in. diameter and an assortment of hand files.

A small hand-operated guillotine, capable of handling up to 14 s.w.g. steel sheet, is a worthwhile, although not vital extra. You will also require an office hand stapling machine and a good supply of staples.

Other essential items include a 3ft. straightedge (wood or metal) and a level. A builder's level would do if it is accurate, but a rigid straight plank of wood and a spirit level are much more useful. Two or three rigid trestles or saw horses will be needed—large wooden boxes may be used here.

Three lead plumb-bobs and a large angle square (a wooden "T" square will suffice) are required for truing up fuselage and wings.

Some planks of good straight commercial deal and a sheet of ¼in. or ⅛in. commercial plywood will come in useful for the few jigs and fixtures which are required.

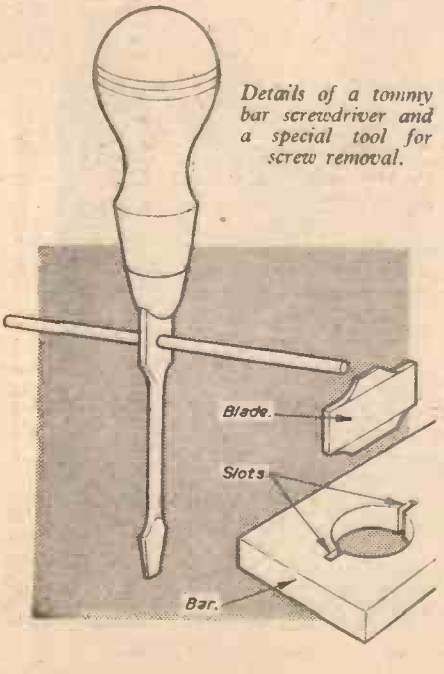
The Plans

A good deal of time—and often money—can be saved by carefully working through the plans before actually starting work. If you have a sound understanding as to how the aeroplane goes together beforehand it all becomes a logical sequence of events, and this period of familiarisation is certainly not time wasted.

Lay the plans out on the floor or a large table. Follow each part through to final assembly. See where the various details go. This way you are also learning about the aeroplane you are about to start building and will eventually fly.

Workshop Hints and Tips

Sent in by L. T. Sydney

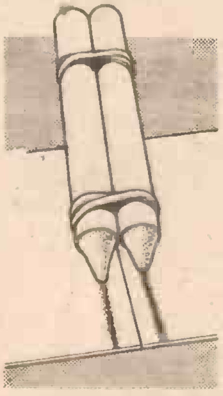


Details of a tommy bar screwdriver and a special tool for screw removal.

Two Ways of Moving Stubborn Screws

QUITE frequently the handyman comes across a screw that just refuses to be moved by normal methods. One way of tackling such problems is to use a screwdriver with a tommy-bar. Simply drill a hole in your screwdriver, as shown in sketch, and use a piece of steel rod about 9in. long as a tommy-bar. The extra leverage should move the screw.

Failing this a special tool can be made fairly easily for the job. A hole approximately ¾in. dia. is drilled in a piece of mild steel bar near one end and the two slots made as shown with two hacksaw blades together in the same frame. The blade (see sketch) was conveniently made from a piece of an old machine hacksaw blade ground to shape on a grindstone. To make the tool really versatile it can be made with a double-sided blade at each end of four sizes of screw.



Enclosing the joint with wax crayon lines.

To Prevent Solder Running

THOSE of us who have attempted repair jobs with solder know how often it runs beyond the area of the joint. This can be prevented by drawing a line round the joint with a wax crayon.

A useful method for long seams is to tie two crayons together with elastic bands as shown in the sketch.

We Will Pay 10/6 for Useful Tips

Home Made Musical Instruments

6th and Final Article By F. Hook

The Tympani

These are Sometimes Known as Kettle Drums

The completed tympani on simple bamboo stands.

NO percussion section is complete without the bass part comprising the tympani (Fig. 1). No doubt with younger players this will be a most attractive section. The tympani are the real kettle drums. The latter name is often incorrectly given to the side drum. The shell of the drum is made from preserving pans.

In general the orchestra has a pair of these instruments and they are mostly tuned to the tonic and dominant notes of the key in which the music is being played. Thus for many pieces played by the pipes already described these notes would be D and A, or for pieces in the key of C they would be tuned to C and G. Thus this type of drum will plainly indicate the importance of drum tuning, a feature which is overlooked by the novice. The art of tuning is not easy at first and has to be learned by practice. The straining nuts are tightened a little at a time and the skin flicked with the finger in proximity to the tuning nut. The nuts are tightened one at a time and the aim is to arrive at the same pitch for the six areas. Having arrived at the conclusion of what note is being played further adjustments can then be made in a systematic way to arrive at the precise note required.

Materials Required (for a pair of drums)

One each of aluminium preserving pans of 18in. and 15in. diameter approx.

Two strips of resin bonded plywood $\frac{1}{4}$in. thickness × 60in. × $1\frac{1}{2}$in.

Two pieces of parchment for the heads.

3ft. of mild steel, $\frac{1}{8}$in. × $\frac{1}{2}$in.

2ft. $\frac{1}{2}$in. × 20 gauge (approx.) brass strip.

One dozen 3in. × $\frac{1}{4}$in. coach bolts with wing nuts and washers.

Four dozen $\frac{3}{8}$in. × 4B.A. countersunk head screws with nuts and washers.

Construction

The familiar hemispherical shape of the kettle drum is normally made of copper. The shell is usually "raised" from a flat sheet of metal. It is not suggested that the reader should employ this process in its entirety as it is a lengthy and laborious process.

Excellent results may be obtained quite quickly by purchasing aluminium preserving pans of suitable dimensions and adapting these for the purpose. The handles of the pans may be cut off close to the base as will be observed in the illustrations. On the other hand the rivets holding on the handles may be filed down and punched out to set free the handles and then used to fill up the holes by riveting over neatly. No harm would, of course, be done by leaving the handles on.

When purchased the pans will have flat bottoms although the sides curve smoothly into the base. The first stage in shaping is to hammer out the bottom from the inside whilst resting the bowl, at the point of contact of the mallet, upon a small sack filled with fine sand.

The handle of the mallet should be on the short side, and one of hard rubber, such as used by panel beaters is useful, but a round-ended boxwood mallet is also satisfactory. The process is shown in Fig. 2. This process of hollowing is commenced from the centre of the bottom and proceeded with in ever-widening concentric circles.

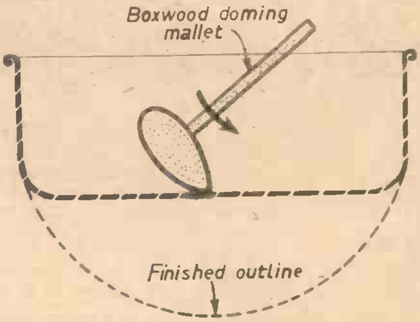


Fig. 2 (Right).—First stage in hollowing the bowl.

After a short time the aluminium will become hardened by the hammering and, if the process were to be continued indefinitely, a crack would soon appear in the metal. To obviate this the metal is annealed from time to time.

Annealing

To anneal aluminium gradually heat the surface of the pan

Fig. 1.—The completed tympani or kettle drum and a pair of sticks.

with the flame of a blow lamp or a pressure stove of some kind. Move the flame about over the whole surface and on no account let it remain stationary for a long period in one place. Test the surface of the bowl with a matchstick. When you can "write" on the heated surface the correct temperature has been reached. The bowl may then be quenched in water or allowed to cool slowly.

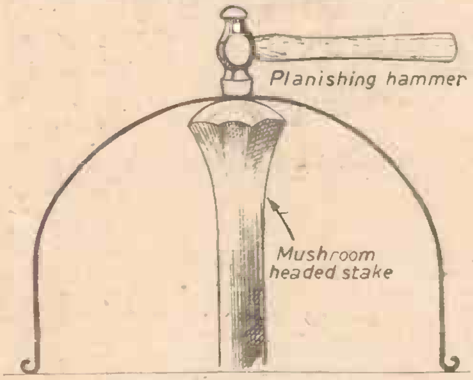


Fig. 3.—Planishing the shell.

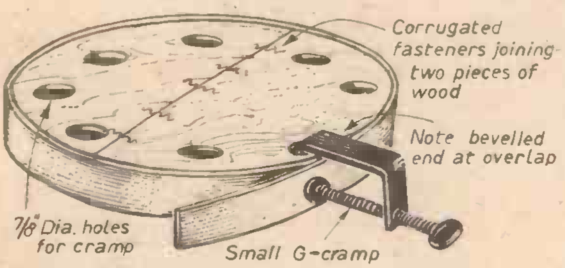


Fig. 4.—Cramping the hoop strip around the former.

Another method sometimes used to indicate the correct temperature is to rub over the surface of the bowl with common soap. As the heat is applied and the correct temperature reached the soap will go a brown colour whereupon the metal may be quenched.

It is suggested that before starting work upon a new preserving pan the beginner to this work should experiment upon a piece of aluminium sheet or an old aluminium saucepan (not a cast saucepan).

The hollowing and annealing process will have to be repeated a number of times until the hemispherical shape is produced. By using a cardboard template of the correct contour the finished shape can be tested quite easily.

Planishing

When the correct shape has been achieved, the final process of planishing may be commenced. This is a somewhat slow and tedious process designed to get a smooth finish to the bowl. If the reader does not mind the dented effect of the hollowed bowl then this stage may be left out.

If planishing is to be proceeded with, the surface must be well cleaned first of all by washing in a solution of soda. Wash well in water only to remove the soda solution. Dry the bowl. It is then inverted on a domed-head stake, Fig. 3. Starting at the centre and working outwards in ever-increasing circles light blows are struck with a planishing hammer, striving to get each succeeding blow just overlapping the previous one. The greatest care should be taken that the sharp edge of the hammer does not strike the bowl, or else a mark will be made which is extremely difficult to erase.

When the planishing process is completed the outside of the bowl must be finished off finally by cleaning and polishing. A dull matt surface may be produced by washing

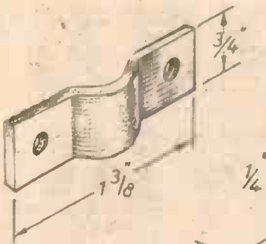


Fig. 5.—(Left) Strainer clips.

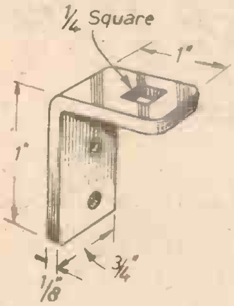


Fig 6.—(Right) Details of straining brackets.

over with a solution of caustic soda and then rinsing in a dilute solution of acid with a view to neutralising the caustic solution.

Making the Hoops

Next the hoops may be made. For this purpose a former is required of diameter a trifle over that of the outer diameter of the top rim of the bowl. This former may be made up quite simply by joining together some 1in. × 6in. deal with corrugated

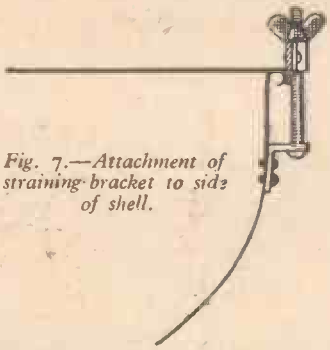


Fig. 7.—Attachment of straining bracket to side of shell.

fasteners. There is no need to glue the joints. Mark out a circle ½in. larger than that of the outer diameter of the rim of the bowl. Cut to the line with a bow saw and smooth up with a spokeshave.

Around the circumference of the former

bore some ⅞in. dia. holes with a centre bit in the same way as described for the former of the side drum, see Fig. 4.

The strip of resin bonded plywood for the hoops is soaked in water and bent around the former and held in place until the moisture has dried out of the wood. Remember to plane the slope on one end for the overlap. Apply Aerolite glue to the overlap and cramp together again until dry.

When the glue is dry saw off the overlap of the ply not required and finish off with a plane or spokeshave. Then saw off the

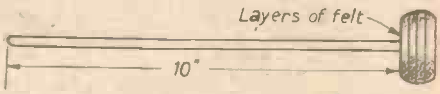


Fig. 8.—Details of sticks.

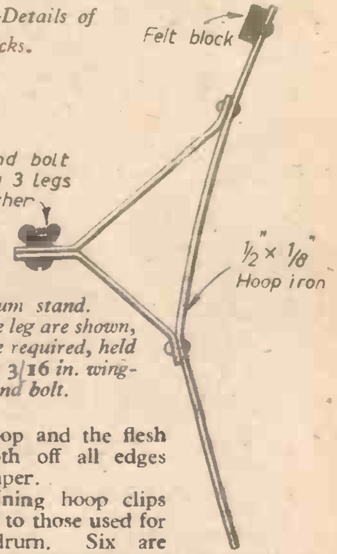


Fig. 9.—Drum stand. Details of one leg are shown, but three are required, held together by a 3/16 in. wing-nut and bolt.

straining hoop and the flesh hoop, smooth off all edges with glasspaper.

The straining hoop clips are identical to those used for the side drum. Six are needed. The straining rods, however, are different and are made from six 3in. × ¼in. coach bolts.

Six strainer brackets are needed, made as indicated in Fig. 6. The part with two holes is to secure the bracket to the side of the bowl (Fig. 7). The holes on the other sides are drilled ¼in. in dia. and then filed out so that the shank of the coach bolts will fit into them snugly. This will prevent the bolt turning when the wing nuts are tightened up.

The bolts and brackets are painted as well as the hoops. The flesh hoop has the parchment tucked on now or it may be sent to a firm for covering.

The drum may now be assembled and tested.

The Sticks

The sticks are made of ¼in. dia. birch dowel rod, Fig. 8. Alternatively, some thin pieces of cane may be used. The knobs on the ends are made of some circles of felt lightly glued together.

A stand of suitable height for the player is required for each drum. When on the stand, the head of the drum should be the same height above ground level as the elbow of the player holding his arm to the side. A very simple stand can be made (see heading photograph), comprising three lengths of bamboo secured with a length of cord at the centre, another loop being used to prevent the legs from splaying out. A more ambitious stand can be made of metal, as shown in Fig. 9. In this case some felt pads are attached to the top ends of the metal legs to prevent the iron from scratching the shell of the drum. Finally, the ironwork can be painted an appropriate colour.

A 3/16in. diameter hole is drilled in the centre of the bottom of the bowl to relieve the pressure inside the drum.

RADIO NAVIGATION

R. N. Hadden Describes the Consol and Decca Navigation Systems

WITHIN the last few years the science of radio navigation has taken tremendous steps forward, and it is now possible to fly an aeroplane from one country to another, and to bring it down within yards of the place intended on the runway, without the pilot ever having seen the ground.

The Consol System

One of the recent radio aids to navigation is the Consol system, which is the easiest of all to use. The navigator needs only a simple wireless set to locate his position to within less than one mile anywhere in the British Isles, or on the surrounding seas.

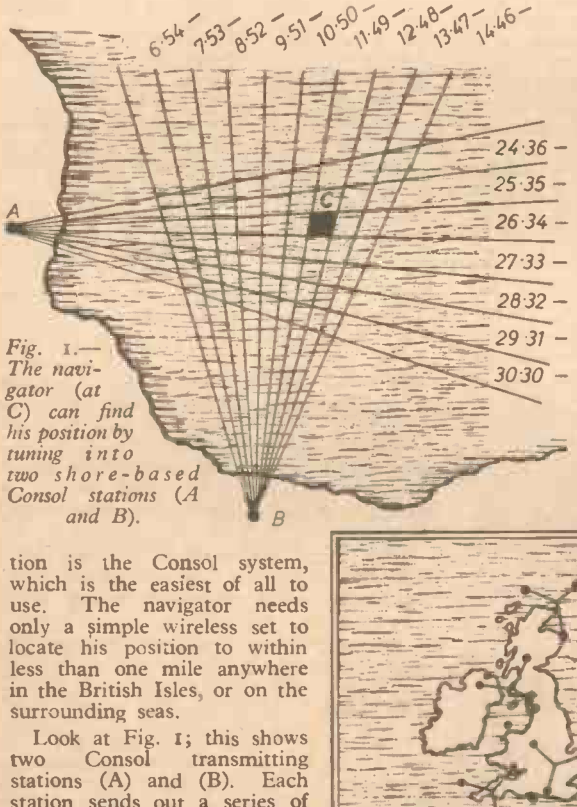


Fig. 1.—The navigator (at C) can find his position by tuning into two shore-based Consol stations (A and B).

Look at Fig. 1; this shows two Consol transmitting stations (A) and (B). Each station sends out a series of very narrow beamed signals, the signals being identified by different numbers of dots and dashes. Suppose the radio navigator is located at (C) and that first of all he tunes into station (A).

On tuning into station (A) he will hear the call sign, and then a series of dots followed by a series of dashes. For example, he may hear 26 dots followed by 34 dashes, from which he knows that he is somewhere along that particular beamed signal. If he now tunes into station (B) he may hear, say, 12 dots and 48 dashes, so that again he knows which band he lies on. His position is where these two beams cross.

It is possible for anyone with an ordinary radio set to tune into a Consol station. Bushmills Consol transmitter in Northern Ireland works on a frequency of 266 kc/s (1,128 m). The signal is sent out on an unmodulated carrier wave, so that an ordinary wireless will receive the signals as a hissing sound. However, it is quite easy to count the number of dots and dashes in each signal. With a ship's radio it is possible to switch over to the morse reception, so that the signal is very clearly heard.

Now count the number of dots and the number of dashes. In any signal the total of the two should add up to 60. You will probably miss a few at the point where they change from dots to dashes. Suppose the total of the count is 56, this means that 4 dots or dashes have been missed at the change over point, or 2 dots and 2 dashes. So if these are added to the ones actually counted the correct figures will be obtained. The next thing is to look up a Consol chart and identify the band with the same number of dots and dashes as have been counted. This will locate one band or position line.

Fig. 2.—Map showing position of Decca Navigator transmitters (tripod symbols) and Consol stations (shown as blobs).

Now get a cross bearing from Stavanger in Norway which works on 310 kc/s (940 m). This will give your exact position. If a Consol chart is not available tables may be purchased from H.M. Stationery Office, or may be sent to you by one of the better known makers of marine radio.

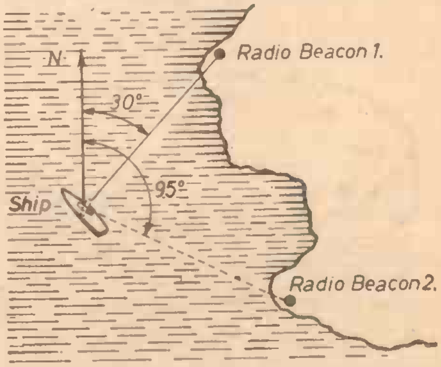


Fig. 3.—How a "fix" can be obtained from two shore-based radio beacons.

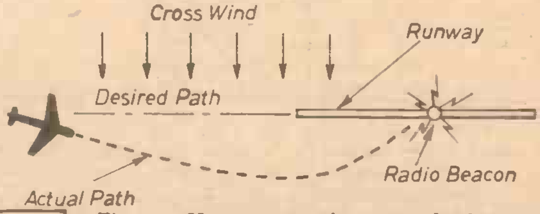


Fig. 4.—How an aeroplane may land at an angle to the runway if the pilot "homes" on a radio beacon when a cross wind is blowing.

Fig. 2 shows where the European Consol stations are located, and also shows where the Decca Navigator stations are situated. The Decca Navigator will be described later. Consol is very useful for navigation where an error of a mile or two does not matter, and as its range is about 1,500 miles it is greatly used as a long range navigator.

Direction Finding

Where the Consol error could lead to danger it is better to change over to short range navigation, and for this purpose direction finding is used. Radio direction finding depends on the fact that a wireless fitted with a loop aerial does not receive signals equally strongly from all directions. Thus when a loop signal is pointed directly towards a station the signal is strongest, and when it is broadside to a station no signal is received. The "minimum" signal position is much more strongly defined than the "maximum" signal. For this reason the minimum signal position is always used for bearing purposes. To get a radio bearing on a station the receiving set is tuned in, and the aerial is rotated until the signal is reduced to zero. In this position the loop is exactly at right angles to the direction of the station.

Fig. 3 shows a ship taking bearings from two shore stations, one station is 30 deg. East of North and the other is 95 deg. East of North. These two bearings can be plotted on a chart, and the position of the ship is where the lines cross. Aeroplanes can also use direction finding in the same manner as ships, or they can "home" to an airfield by flying in the direction of the airfield marker beacon. However, the pilot must use this homing signal with caution if there is a strong side wind blowing, as is shown in Fig. 4. If he had relied on the homing signal to bring him in line with the runway he would be bound to crash.

Safe Lane System

Because homing on a radio beacon can sometimes be dangerous another system has been developed to overcome this difficulty. Suppose there is a harbour as shown in Fig. 5, which has a narrow channel approaching the breakwaters, with rocks on either side. To enter this harbour in fog could be very dangerous if it were not for radio navigation aids.

The navigation problem is solved by placing a transmitter at (T). This transmitter sends out two signals, one a series of dots, and the other a series of dashes. The two signals overlap slightly to give a very narrow band where both dots and dashes can be received. To get into the harbour safely all the captain has to do is to sail along the band where he can receive both dots and dashes.

System for Aircraft Landing

A similar sysem is also used by aeroplanes, and all major airports are equipped by such aids. In the case of the airports the narrow central band is exactly in line with the runway. However, as aeroplanes move very much more quickly than ships, and as the pilot has a lot of other things to do as well, the signals are usually shown on an instrument, which indicates when the plane is on course. In addition, there is also an audible warning which sounds when the plane gets off course. Fig. 6 shows an airport in which the guiding signal is being used to bring in planes on runway (C).

However, unlike a ship, an aeroplane has in addition to keeping on course, got to keep to its correct altitude, at all stages of the descent. This is done by having another transmitter to one side of the runway which also sends out a narrow band of signals. This narrow band is the same as the lateral guidance transmitter, but is in a horizontal plane. A plane following this band will be brought down from its approach altitude on to the level of the runway. The band is known as the "glide path."

Imagine then an aeroplane coming in to land in bad weather, as shown in Fig. 7. It has been navigated to within the airport control area by one of the long range navigation systems and is now ready to land. First of all the pilot will circle the airport until he picks up the runway direction signal. He will then turn and fly along the narrow band towards the airfield. He flies at a constant height of, say, 1500ft., until he meets the glide path signal, at which point he begins to loose height. The pilot now has two instruments to watch. He must keep his approach instrument indicating "on course" and his glide path instrument zeroed.

The pilot flies on, keeping both his instruments exactly zeroed. This will bring him down low over the runway when he will be able to land. At two points on his glide path there are marker beacons, which serve as a check on his distance from the runway, and also his height, as he knows what his altitude should be at these points. These beacons are known as fan markers as they resemble a fan, they are very wide but not very thick.

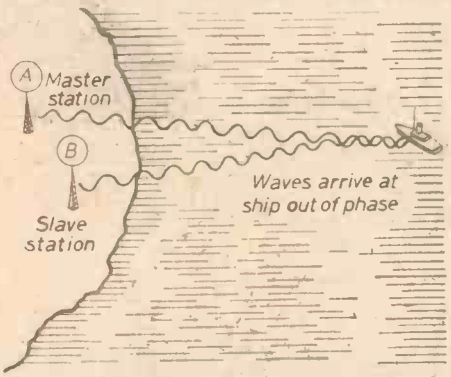


Fig. 8.—Waves from station B arrive sooner than from station A, as B is nearer. This means that the waves are out of phase.

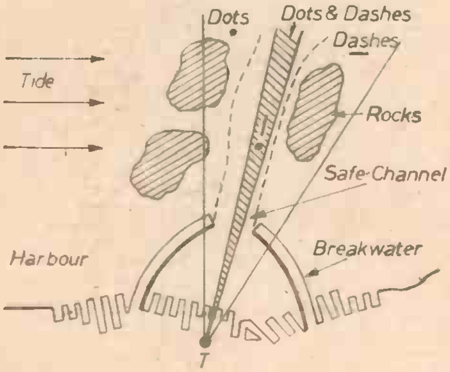


Fig. 5.—Entering a dangerous harbour by following the narrow path where both dots and dashes are audible.

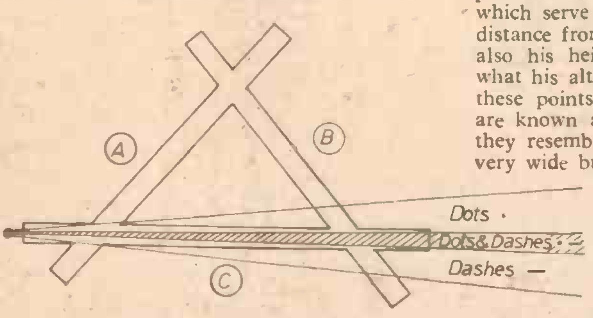


Fig. 6 (Left).—How aircraft can be guided down exactly in line with the runway.

Fig. 10 (Right).—How a Decca fix is obtained.

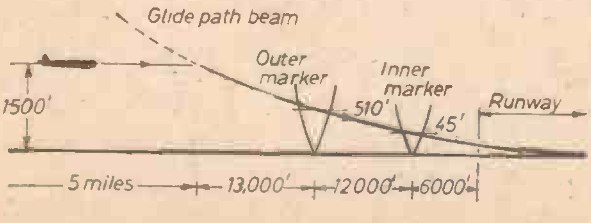


Fig. 7 (Left).—How a landing aircraft flies on to intercept the Glide Path beam and follows it down to the runway.

The Decca Navigator

There is another system of radio navigation which has been developed recently, and is far more accurate than any previous system. This system is known as the Decca Navigator and is accurate to a few yards.

Imagine two transmitters, as shown in Fig. 8, both working on the same frequency. If these signals are received by a ship, it will be found that the signal from station (B) arrives slightly sooner than from station (A). This means that they are slightly out of phase. This can be seen from the drawing. The Decca receiver on the ship is able to measure how much the signals are out of phase, and to indicate it on a dial. As the ship moves the amount that the signals are out of phase changes. Thus the degree that the signals are out of phase is a measure of the ship's position.

Thus on a map lines can be drawn to show where the two signals are out of phase by the same amount. These curves are actually mathematical hyperbolae drawn with the two transmitting stations as loci. This is shown in Fig. 9.

In the Decca system the transmitters consist of one master station and three slave stations. To obtain a fix it is necessary to obtain two intersecting position lines, and actually only the master and two of the slave stations need be used. For example, suppose a ship wanted to find its position it might find that the difference in the phase between the master and No. 1 slave station was, say, half cycle, and between the master and No. 2 slave station was, say, quarter cycle. Then the ship's position would be as shown Fig. 10.

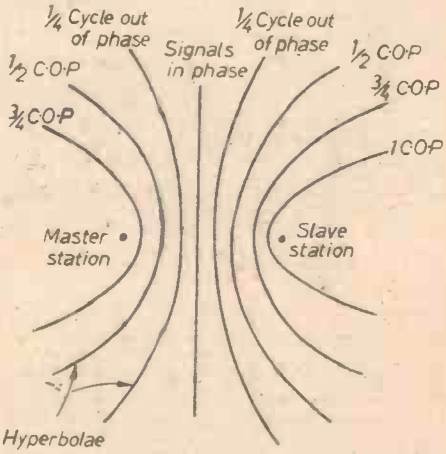
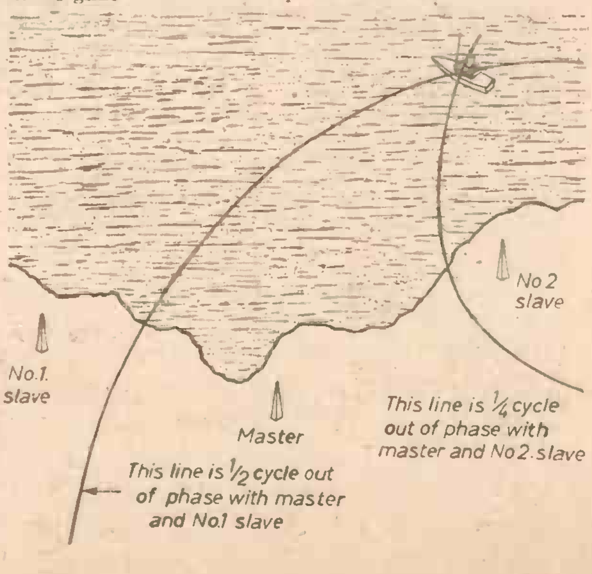


Fig. 9.—Two stations transmitting on the same frequency form lines where the degrees of out-of-phase is the same.



Additions to the P.M. Junior Lathe

These Will Greatly Add to Its Scope

By

J. Rodger

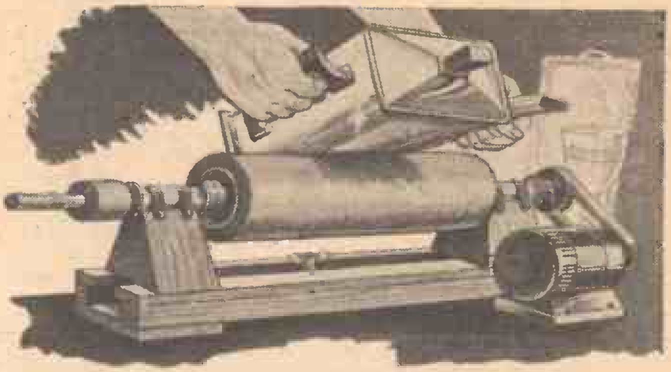


Fig. 4.—The buffing machine set up for polishing household cutlery, etc.

THE simple lathe described in the May, 1957, issue of PRACTICAL MECHANICS has been made with a few modifications and works very well. Two cycle rear hubs were used for the headstock and tailstock and the lathe is powered by an ex-Government converted Gen-motor, Ref. AM 10k/22, type 29. The motor is better than 1/6 h.p. and gives 2,800 r.p.m.

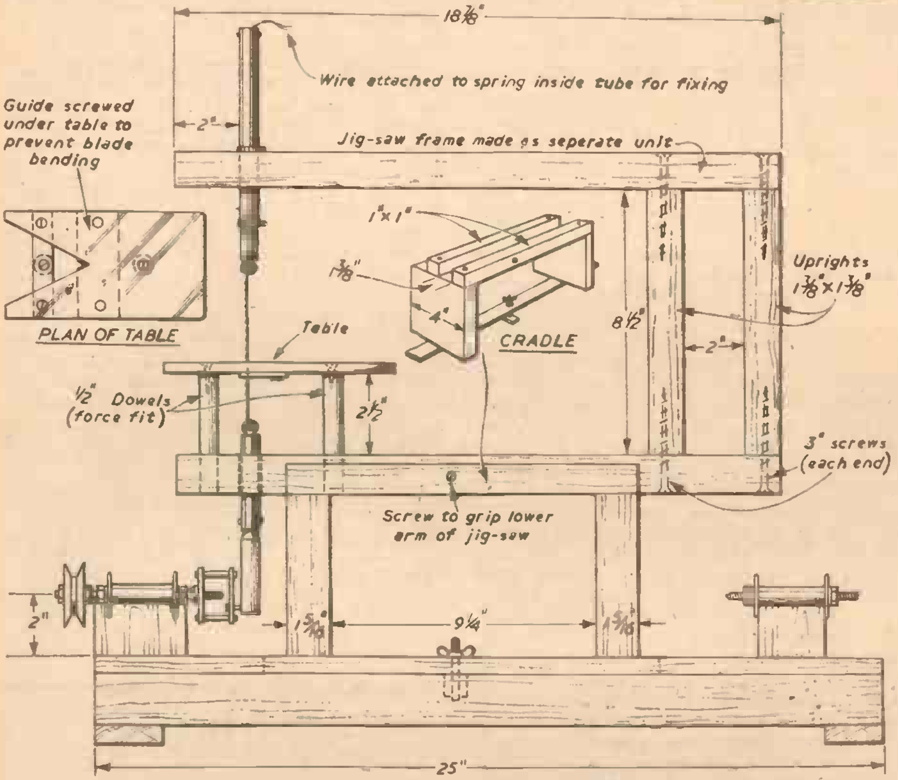


Fig. 1.—General arrangement of the jig-saw and details of the modified lathe.

The Jig-saw

To work with the lathe a jig-saw was constructed, the design of which was based on another article in P.M. The general arrangement is shown in Fig. 1, in which details of the modified lathe can also be seen. The jig-saw table is made to fit snugly in the bed of the lathe. On top are mounted two guides of 1in. square wood, between which is clamped the jig-saw frame which is made separately.

The eccentric device is shown in Fig. 2. It is made from a disc of steel ⅛in. thick × 2in. dia. × ⅜in. bore and a piece of iron plate, drilled as shown. The disc and plate are spaced by means of nuts, bolts, spacers, etc., and a rear cycle spindle cone is soldered on for fitting to the headstock spindle. The eccentric pin is positioned the distance required for the throw away from the centre of the metal plate.

The "head" and "toe" of the jig-saw are shown separately in Fig. 3. The table was an old Hobbies fretsaw table and was fitted using dowels, as shown.

Buffing Machine

The materials required for this include a discarded lamb's-wool distemper roller, two discarded thread bobbins with the flanges removed on the lathe and a 4in. length of ⅜in. dowel. The two bobbins are mounted on the dowel and the projecting part of the dowel and the bobbins covered with lamb's-wool from an old glove. The distemper roller is mounted between the headstock and tailstock as shown for polishing large flat surfaces; the combined bobbins and dowel are fixed on the back of the tailstock and used for polishing eggcup bowls, spouts and handles of silverware, the insides of candle-

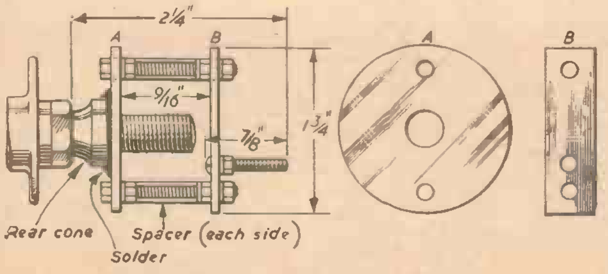


Fig. 2.—Details of the eccentric device.

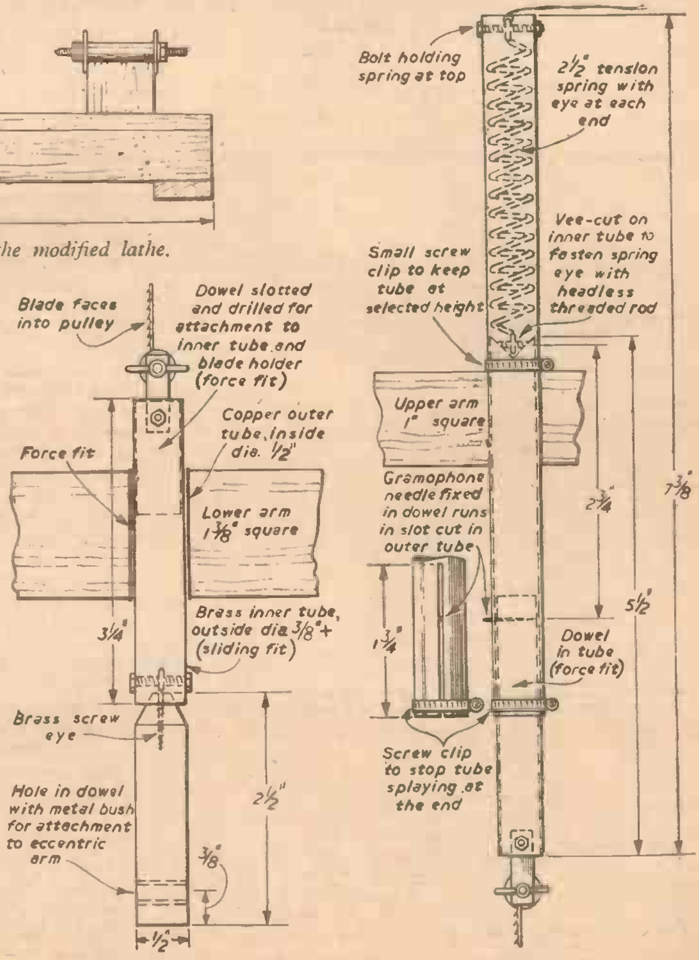


Fig. 3.—Full details of the head and toe of the jig-saw.

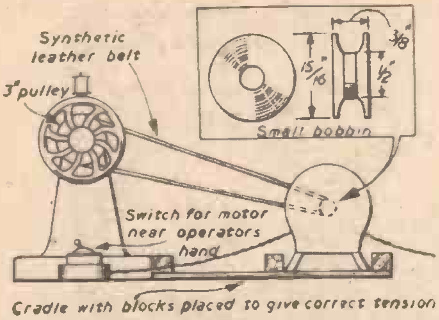


Fig. 5.—Details of the sewing machine electrification.

sticks, etc. The device, which is shown set up in Fig. 4, takes most of the tedium out of polishing the household cutlery.

Sewing Machine Electrification

For this the actual lathe is not used, except to turn up a small bobbin to the dimensions shown in Fig. 5. It can be made from a discarded thread bobbin. The pulley is fitted to the motor and coupling to the sewing machine pulley is by means of a Singer synthetic belt, which costs 5s. 9d. This had to be cut to shorten it and was rejoined with the metal clip. A cradle was made as shown so that the tension on the pulley is correctly maintained.

A Screw Centre

This is made by using one of the long cones for use in spacing on a rear cycle spindle when a derailleur gear is fitted. A 1½in. woodscrew is soldered into the end of the cone with the right-angled face, while the other end of the cone is screwed on to the headstock spindle. The lathe is then stood on end and supported with the screw centre standing vertically as shown in Fig. 6. A piece of plywood is either held or clamped tightly to the tool rest and jammed down on to the woodscrew point. Heat is then applied till the solder melts, thus allowing the woodscrew to be pushed down until it contacts the tip of the headstock spindle. The pulley wheel is then turned by hand, until the screw is centred. Let the solder set hard, and then resolder the screw shank to the right-angle face of the double cone. A heavy soldering iron will be required as the smaller types designed for radio work cannot convey either degree or duration of heat necessary. Use plumbers' solder.

A Faceplate

A 4in. dia. sheet steel disc must be obtained first of all; the prototype was obtained from a marine engineer. Find the centre of the disc and scribe a line through it right across the disc and then another through the same centre point at right angles to the first. Holes are drilled along this line in all four directions from the centre, so that woodscrews can be passed through into varying sizes of wood block. The centre is drilled ⅛in. and the metal round the hole scraped clean. Finally, a cycle cone is soldered on, using the method shown in Fig. 7.

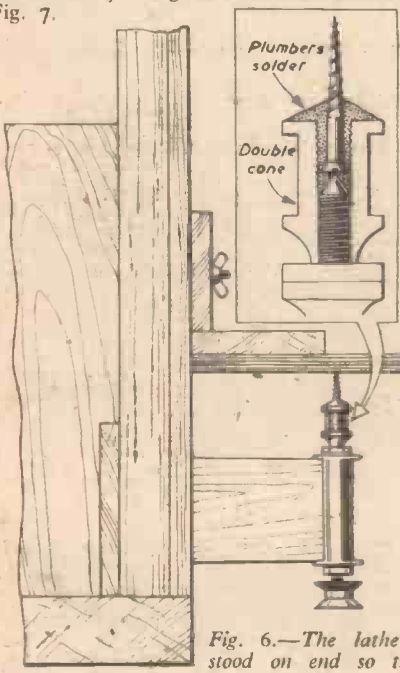


Fig. 6.—The lathe is stood on end so that the screw centre is vertical.

Calico Buff and Grindstone

These are mounted on the lathe as shown in Fig. 8. The calico buff is fitted on the tailstock spindle and a cycle backstep fitted on the headstock spindle. These cycle backsteps, though not now made, can sometimes be obtained from an old-established cycle dealer or from an old bicycle. The backstep is used to drive the calico buff by means of a rubber grommet which provides a friction drive. The tailstock and headstock spindles should not meet inside the backstep. The grindstone is mounted on the back of the tailstock as shown.

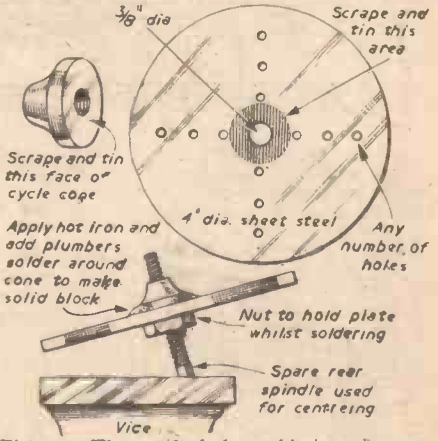


Fig. 7.—The method for soldering the cycle cone to the faceplate.

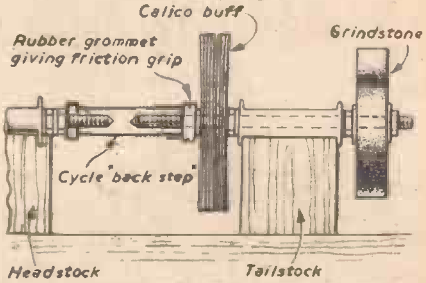


Fig. 8.—Calico buff and grindstone mounted on the lathe.

PUZZLE CORNER

1.—Sent in by W. G. Smith: Fractions

If 2 is 2/3 of 3, what fraction of 3 is 2/3 of 2?

2.—Sent in by Jameson Erroll: Silver Problem

What is the largest sum of money in silver you can have in your pocket and yet be unable to change a ten-shilling note?

3.—Railway Trains

Two railways trains, one 400ft. long and the other 200ft. long, run on parallel rails. When they travel in opposite directions they pass each other in five seconds; when running in the same direction the faster train passes the other in 15 seconds. What is the speed in miles per hour of each train?

4.—From A. C. Airey: Sweet Tooth

A mother tells her daughter on her birthday that she may buy as many ounces of sweets as she is years old, and the daughter returns from the shops with 2s. 5¾d. change out of 10s. How old is she?

5.—From D. Dalton: The Orchard

A man is setting out an orchard, and he decides he would like six rows of trees each having four trees. He orders 24 trees but is only able to obtain half this number. This does not disappoint him because with a little thought he realizes that he can still have his way. How?

6.—Simple Calculus

Most people who have done sufficient calculus will agree that $\log e^x = \int \frac{dx}{x}$ (1)

Now if we take the right-hand side and integrate by parts using the formula: $\int v\,du = uv - \int u\,dv$ we get

$$\text{R.H.S.} = \int \frac{dx}{x} = \frac{1}{x} \times x + \int x \frac{dx}{x^2} = 1 + \int \frac{dx}{x}$$

but from (1) $\log e^x = \int \frac{dx}{x} = 1 + \log e^x$

but L H S = $\log e^x$

but L H S = R H S $\therefore 1 = 0$??

Answers

1.—2/3 of 2 = 2 × 2/3 = 4/3 and 4/3 as a fraction of 3 = 4/3 × 1/3 = 4/9, i.e., 4/9 of 3 = 4/3.

2.—Fifteen shillings and nine pence. (Four florins, three half-crowns and a silver three-penny bit.)

3.—In five seconds both trains (together) go 600ft. or 81 and 9/11 m.p.h. In 15 seconds the faster train gains 600ft. or 27 and 3/11 m.p.h. Thus 54 and 6/11 m.p.h. is the speed of the faster train and 27 and 3/11 m.p.h. that of the slower one.

4.—She is 19 years of age. She spends 7s. 6¼d. which equals 361 farthings. The square root (and only factors) of 361 = 19. Therefore, she is 19 and buys 19 ounces of sweets.

5.—He arranges the trees in the shape of a six-sided star. If you try this you will find he has his six rows of four trees.

6.—The fault comes in first line:

$C + \log e^x = \int \frac{dx}{x}$ where C is a constant.

Letters to the Editor

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

CYCLING IN SCHOOLS

SIR,—I would like to offer my congratulations regarding the May edition of THE CYCLIST. I have never before seen an article expressing so many facts and yet so interesting. I was especially interested in the item regarding cycling in schools. I heartily agree that cycling should join other sports and be taught in school. I am secretary of St. Augustine's Secondary School Cycling Club. This I have discovered to my horror is the only cycling club organised by a school in Glasgow and possibly Scotland.

There are, however, many well-known cyclists who have offered to help me in my aim of promoting school cycling. This year I am promoting my first school championship. It will be over a distance of 40 miles and will have two primes. I had hoped to have an inter-school race in Glasgow. Although this may not occur this year I am sure that 1960 will see the first Glasgow Schools Championship.

I was disappointed to read that it was a cycling club, Kentish Wheelers, that first organised schoolboy cycling. I would have hoped that schools would have promoted such races in conjunction with the school sports.

I am sure in the next five years cycling will become part of the school curriculum. I hope the two pages in PRACTICAL MECHANICS devoted to cycling will maintain their high standard.—OWEN J. J. BRADY (Glasgow, E.3).

Make Your Own Ukulele—A Criticism

SIR,—In the article, "Make Your Own Ukulele," in the May issue, the fret spacings cannot possibly be right, because from Fig. 4 it can be seen that they do not decrease in size regularly from the nut towards the bridge.

Below is a table of figures accurate to three places of decimals, and the same figures corrected to the nearest 1/32 of an inch.

The biggest error in this table is .019in., whereas the figures given in the article have errors as large as .09in., more than four times as great.

Nut	Spacing inch	To nearest 1/32 inch
1st fret	0.715	23/32
2nd ,,	0.685	11/16
3rd ,,	0.643	5/8
4th ,,	0.603	19/32
5th ,,	0.570	9/16
6th ,,	0.536	17/32
7th ,,	0.507	1/2
8th ,,	0.478	15/32
9th ,,	0.450	7/16
10th ,,	0.426	13/32
11th ,,	0.400	13/32
12th ,,	0.379	3/8

—G. E. MANVILLE (Northumberland).

Author's Comments

SIR,—I have the following comments to make on Mr. Manville's criticism:

Before submitting the ukulele article to you I took the finished instrument to a piano tuner to check the tuning and tone. He passed it as being A.1, on both counts.

If, however, the tuning does not satisfy readers they have only to remove the finger-board, which is secured by two screws, and replace it with one made to their own measurements.—

A. B. ORR.

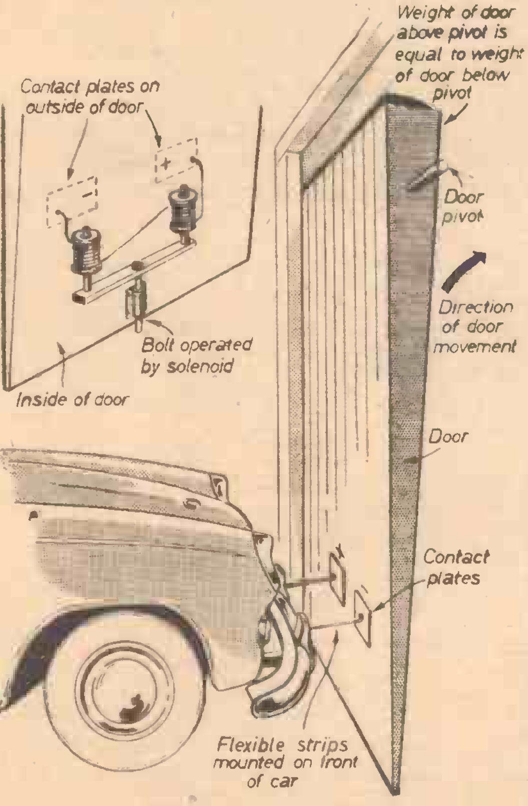
ANONYMOUS LETTERS

We regret that we cannot publish readers' letters from which the full name and address have been omitted.

Automatically Operated Garage Doors

SIR,—With reference to Mr. R. Watson's query in the April issue, the idea set out below might be of interest.

As can be seen from the sketch, the door is wedge-shaped in section and is pivoted



The automatic doors in use

near the top, this being so that the minimum power is required to open it. In actual fact, when the door is released, it swings into a horizontal position, allowing the car to enter underneath.

The door is held in the closed position by a bolt at the bottom, engaging in a slot in the floor. Two arms are attached to this on which are mounted solenoids. These solenoids are connected to contact plates on the front of the door.

The source of power is the car battery and leads from this are connected to two feelers which project beyond the front bumper of the car. The car is driven up to the doors so that the feelers touch the contact plates. The circuit is completed, the solenoids operate and withdraw the bolt. The door swings open, operated by its own weight, brushing past the contact feelers on the car. These are flexible for this reason. The door must be closed by hand.—J. P. SCERRI (Malta).

Definition

SIR,—Mr. W. A. Patience in February's issue, poses the question, "Is the human mind capable of defining 'nothing'?" Mr. K. E. Langner, in April's issue, says yes. I agree with Mr. Langner, but not with the premises he uses.

The fundamental factor in any argument is the necessity of understanding the precise meaning or connotation of every term used in the premises from which is derived the conclusion. Without a clear understanding of this preciseness the conclusions are more often than not erroneous. Furthermore, its neglect leads to misunderstanding, for one person may use one term, which normally conveys one sense to one person, and which may convey or may be interpreted in a totally different sense by another.

I contend that every word was invented, i.e., in the mind to explain or convey some idea, e.g., the word "chair." In the English language everyone understands and knows what it means, and the majority of people could give a reasonably good definition of it: because they have contact with the concrete object chair. It is something tangible. But the word "nothing." Who or what comes into contact with "nothing"? No one. Does that mean it doesn't exist as something concrete? Yes. But, it exists in the abstract sense. This brings us into a different realm or state—viz., the state of mental conception. But it is very difficult to conceive, i.e., to think of some thing or word that does not exist in the concrete. Hence to define "nothing" we must attack its meaning from a totally different viewpoint. If I say "Do not touch anything," it is equivalent surely to "touch nothing," which means, i.e., the complete sentence to refrain from doing some act or acts: that implies restraint or negation or a want or an absence of some act or deed. Five minutes after the order has been given, if all the things (concrete) in the room have not

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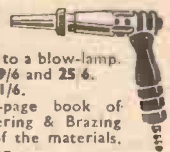

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PHOTOGRAPHY

GLASGOW. If buying, selling or exchanging modern Cameras, Enlargers, Equipment, Tape Recorders, etc., for the best deal, call or write to Victor Morris, 406, Argyle St., Glasgow, C.2. (Central 8958.)

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been touched, it implies and means a sort of want or absence of some thing (act or deed performed) whether the concrete things desire or feel or do not desire or feel this absence is a different question. Accordingly I conclude that nothing is the absence of something, i.e., anything, just as light is the absence of darkness. Here I am willing to concede that light is not properly defined, because it may be defined as a physical element. But how may one define darkness then? It seems to me that to do so one must of necessity define it thus—darkness is the absence of light. Other examples are "Fear is the absence of courage." Here I do not use the word "afraid" because one may be intensely afraid and yet perform some courageous act. Hunger is the absence of food. Pride is the absence of humility, etc. etc.

And apart from what I have inferred above Mr. Langner's definition that "By nothing is meant nothing to the power absolute," is false because in defining any term one cannot use in the definition the term or word they are defining, e.g., one cannot say, "A triangle is a triangular figure," nor "An aeroplane is an aeroplane with wings and it flies," nor "A circle is a circular line running round an equidistant central point," etc.

Re his explanation of creation. What does he mean by "creation"? Does he mean something, i.e. anything made out of nothing; or something, i.e., anything made out of something else? It is the differentiation between these two definitions that explains creation. By that I mean the ability to conceive of the difference between something (anything), i.e., concrete and nothing, i.e., abstract.

If Mr. Patience and Mr. Langner arrive at the mental point or attitude where they can conceive this differentiation, it ought to be quite easy for them to arrive at a definition of creation. I should like to make it clear that this will not explain creation, anymore than defining that light is the absence of darkness will explain light, for defining and explaining are too distinct words or terms, with vastly different connotations, defining that X^n is some number won't explain X^n.

In the February issue Mr. Waterhouse states that you cannot create anything from nothing and infers conclusions from this statement. Perhaps Mr. Waterhouse would explain the difference between:

There is nothing to make anything from; and, there is nothing to create anything from; or, there is nothing to make anything with; and, there is nothing to create anything with.

Finally "You (assuming this 'You' to mean a human being) cannot create anything from nothing," does not mean it can't be done. For this is particularising, and for any such statement to be true the term "You" must include all possible "You's." "You can't walk" may be true with respect to *thousands* but it is not true with respect to *all*, i.e., *all* who are *potentially* capable of walking. No statement or definition is true unless it includes in its terms all possible kinds or types of the particular term to which it refers.—MICHAEL M. A. COPPINS (Co. Cork).

Theory of Gravitation

SIR,—This letter describes my new theory of gravitation in more detail than the one printed in the August, 1958, issue. In my opinion, space is filled with very minute particles of atomic dust, which are constantly being created by atomic explosions on all the suns that exist in space. This dust is the medium that transmits the enormous power from these explosions in the form of very high-frequency shock waves. To try to measure the strength of this enormous power, which is flashing through space in all directions, would be impossible because we have nothing to stop it in its entirety; even our earth itself can't stop it all, simply because it is not solidily locked.

If we could produce a block of lead one cubic mile in size, I don't think it would stop and absorb one-thousandth part of the energy passing through it. For this reason I cannot accept the theory that one body has a gravitational pull on another. My explanation for this is that each offers some resistance to the waves and therefore the area between them is of a slightly lower pressure.

An electro-magnet appears to us to pull a piece of iron towards its poles, but it does nothing of the kind; what actually happens is that we have artificially produced shock waves which neutralise the waves from space of a similar frequency between the poles of the magnet, thereby creating an area of lower pressure and the iron is just pushed into it.

All bodies in space are more or less composed of the same substance, the main differences are size, density and temperature. Why some are suns can easily be explained by the simple fact that they offer a more solid front to these powerful shock waves. The size and density govern the temperature of any body in space. Planets like our earth with a cold crust are not big enough and dense enough to offer sufficient resistance to these waves of pressure to create a very high temperature needed to make them suns.—J. CLAYTON (Wednesfield).

Metallising Children's Shoes

SIR,—In reply to W. J. Mullins' query re the above. The shoes should be thoroughly cleansed from all dirt and grease. Smooth all rough spots with fine glasspaper. Apply two thin coats of "dove grey" paint (flat) as a base for "silver" lacquer (applied with a camel-hair brush). A similar process using "yellow chrome" or "yellow ochre" as a base for "gold" lacquer. But allow sufficient drying and hardening time in each case between applications.—R. B. GARNISH (Ilfracombe).

SCIENCE notes

Driverless Trucks

ABOUT a year ago, E.M.I. Electronics Ltd., of Hayes, Middlesex, produced the driverless trolley system known as the Robotug, which the Western Region of British Railways are at present experimenting with in association with their battery-electric platform trucks. The basic electronic driving system operates by a trolley following a single wire laid beneath the flooring, having an alternating current about ½ amp. of specified frequency passed through it.

New Heat Resistant Polystyrenes

BRITISH RESIN PRODUCTS LIMITED, of London, W.1, have recently introduced on to the market two new heat resistant polystyrenes, Styron 700 and Styron 440. Styron 700, a general purpose grade, has the exceptional heat distortion temperature of 106° C. and is available in crystal and a wide range of colours. Styron 440, like Styron 700, has also been developed to provide superior heat resistance (98°C.). It is a high impact grade but the inherent properties of general purpose polystyrene, such as chemical resistance, dimensional stability, specific gravity and electrical properties, have been largely retained.

Reduction of Noise

NOISE in industry is a serious matter and to combat this The Marley Group, of Sevenoaks, Kent, manufacture an acoustic pyramid. It is a functional absorber, formed from rigid P.V.C., perforated and filled with mineral wool. The base of each pyramid is 22in. square, including a ½in. flange; the depth is 8½in. When sound reaches the pyramid, a large proportion of it is absorbed, and unwanted reflection is eliminated.

Safety Code for Radioactive Device

THE Ministry of Labour and National Service have recently published a booklet entitled "Radioactive Markers in Go-devils; Safety Precautions." "Go-devils" consist of tightly fitted rubber washer, scraper vanes or wire brushes mounted on a central core which are pushed through pipelines by means of water or compressed air, to detect obstructions. They occasionally get jammed against these obstructions and location of the stoppage can be an expensive procedure. The inclusion of a radioactive marker in the central core, which is exposed on contact with an obstruction, overcomes this, because the gamma rays given off by the radioactive material can be traced above ground. A Code of Practice for persons engaged in such operations is set out in this publication.

BOOKS Received

Basic Electricity (In Five Parts) and Basic Electronics (In Six Parts). Basic Electricity cost 12s. 6d. net per part, and 55s. net per complete set of five parts. Basic Electronics costs 12s. 6d. net per part, and 66s. net per complete set of six parts. Both published by The Technical Press Ltd., of 1, Justice Walk, London, S.W.3.

IN this new series of training manuals lies the core of a Standard Course of Technician Training developed for the United States Navy. The British edition was prepared, with War Office approval, by a special Electronics Training Investigation Team. The approach throughout the manuals is strictly non-mathematical. Only the essential facts about each new concept or piece of equipment are used and each is illustrated by a cartoon-type drawing.

Basic Electricity deals with D.C. circuits; A.C. circuits and D.C. machines. Some of the principal subject matter appearing in *Basic Electronics* is: power supplies and rectifiers; amplifiers and oscillators; transmitters and receivers; frequency modulation and transistors.

Films For Industry, issued by the Central Office of Information, Hercules Road, Westminster Bridge Road, London, S.E.1. 151 pages. Price 2s. 6d.

THIS is the 1959-60 edition of this catalogue and it is divided into two parts. The first part contains classified lists of films, the second of filmstrips. Each title is accompanied by a short description. There are also several photographs.

Decorative Flower and Leaf Making, by Frederick T. Day. 102 pages. Price 8s. 6d. net. Published by C. Arthur Pearson Ltd., Tower House, Southampton Street, London, W.C.2.

THIS book describes how authentic flowers and leaves in three dimensions may be made from coloured paper for decorating the home or schoolroom. The craft may also be carried to the professional stage for display work in shops and theatres. There are 61 drawings and photographs and some attractive colour plates.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

Petrol Outboard Motors

THERE are three Perkins petrol marine outboard motors, each has 2-cylinder, 2-stroke power heads and develops maximum power at 4,500 r.p.m. They use petrol-oil 2-stroke mixture fuel.

The outboard motor.

The engines have forward, neutral and reverse gears, and are fitted with built-in recoil hand starters, although the 16 h.p. and the 35 h.p. engines are available also with 12-volt electric starting.

The 6 h.p. engine, with a cubic capacity of 154 c.c. (9.42 cu. in.), weighs 50lb. and has an 8in. × 6½in. twin-blade propeller. The 16 h.p. outboard has a 2½in. bore, 2 1/32in. stroke and 325 c.c. (19.94 cu. in.) capacity. A 9in. × 10½in. two-blade propeller is fitted and total weight is 75lb. The 35 h.p. engine has a capacity of 690 c.c. (42.35 cu. in.) and weighs 127lb. It has a 3 1/16in. bore and 2⅞in. stroke, and is fitted with a 10in. × 13in. three-blade propeller. Further details and prices from Perkins, Ltd., Peterborough.

Bench Spot Welder

THIS bench spot welder is a high-class unit that will automatically produce precision spot welds on foils as thin as .003in. The 7.5 KVA bench spot welder on steel sheet up to 16 s.w.g. × 2 and wire up to 6 s.w.g. × 2, when used by untrained labour and on a production basis. It is a completely self-contained unit and includes electronic timing, six heat stages and a built-in water circulatory pump to save the necessity of water mains connection. The price is £108, carriage free. Models available are 200/250v. and 380/440v. types. Literature is available from the makers, Triangle Products, Limited, Hyde, Cheshire.

The 7.5 KVA bench spot welder.

AMATEUR PAINT SPRAY OUTFIT

THE Tuffy paint spraying outfit that has just been introduced by the Aerograph-DeVilbiss Co. Ltd., 47, Holborn Viaduct, London, E.C.1, is designed for the amateur or small-scale painter. The outfit consists of an air compressor that plugs into an ordinary lamp fitting and weighs only 34lb. so that it can be easily carried around, 12ft. of air hose and a CGA low air consumption spray gun which will apply all commonly used painting materials. Tuffy is safe to use in any surroundings—the compressor has no exposed belts, pulleys or flywheels and there is an air pressure control and safety valve built in. The retail price is £44 10s. complete and the outfit may be obtained from paint merchants.

(Right)—The Tuffy paint spraying outfit.

THE SMALL STANLEY SHAPER

The small Stanley Shaper.

THE Stanley shaper-junior is designed for work in awkward corners, or on more delicate work, where a larger tool is inconvenient. It can be used with one hand, leaving the other free to hold the work. The 5¼in. long blade of the shaper-junior has exactly the same tooth form as the big Stanley shapers, and is attached to a strong, comfortably gripped, red plastic handle. It costs 7s. 6d., and replacement blades are available at 2s. 6d. The manufacturers are Stanley Works (G.B.) Limited, Rutland Road, Sheffield, 3.

SELECTA SCRAPER-SANDER

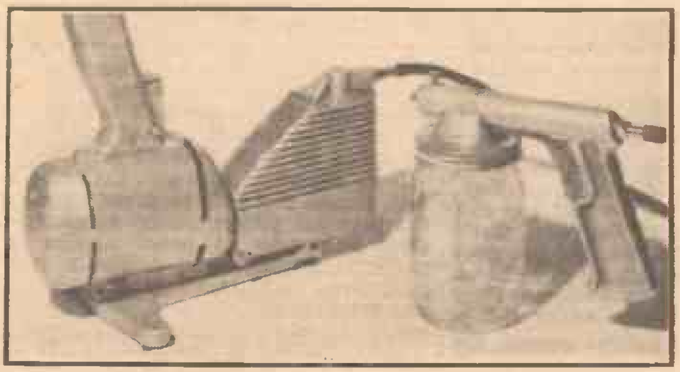
SELECTA POWER TOOLS have recently introduced a power operated scraper-sander which can be fitted to any popular ¼in. drill. It scrapes and sands wallpaper, woodwork, paint and polish, performing in a tenth of the time what was formerly a tedious hand operation. The scraper-sander with its adjustable blade works perfectly on old wallpaper, old paintwork, French polish and many difficult surfaces that require renewing. Fit the blade and you have a scraper, change the blade and you have an effective sander. The price is £4 16s. 6d. and the makers are Selecta Power Tools Ltd., Hampton Road West, Hanworth, Feltham, Middlesex.

A new unit for the home decorator.

The scraper-sander fitted to the Selecta drill and with the scraper blade in position.

NEW BRIDGES ATTACHMENTS

DESIGNED by S. N. Bridges & Co. Ltd., London, for use with the Bridges Neonic Drill, their new spray attachment consists of two units, a powerful lightweight air compressor developing a pressure of 100lb. per sq. in. and a trigger controlled spray gun. The unit will handle paints, distempers, stains and wood preservatives, insecticides and fungicides. The complete spray gun attachment costs £6 6s.



The new spray gun attachment.

The home decorator and enthusiastic gardener will find this attachment of immense use.

Also produced by S. N. Bridges is a mixing attachment which is basically a long centre spindle with a flat "thread" wound spirally along it. It will mix small quantities of cement, mortar, paint, distemper, cement paint, concrete, etc., in an ordinary pail — no special container is necessary. The price of this attachment is 19s. 9d.

This model farm cost less than 2/6

It was made from a half-crown tin of Sankey's PYRUMA—farmhouse, barn, implement shed, walls and gate—and there was still plenty of this grand modelling material left to build many more farm features, by simple methods described in the Instruction Book (see Coupon below).

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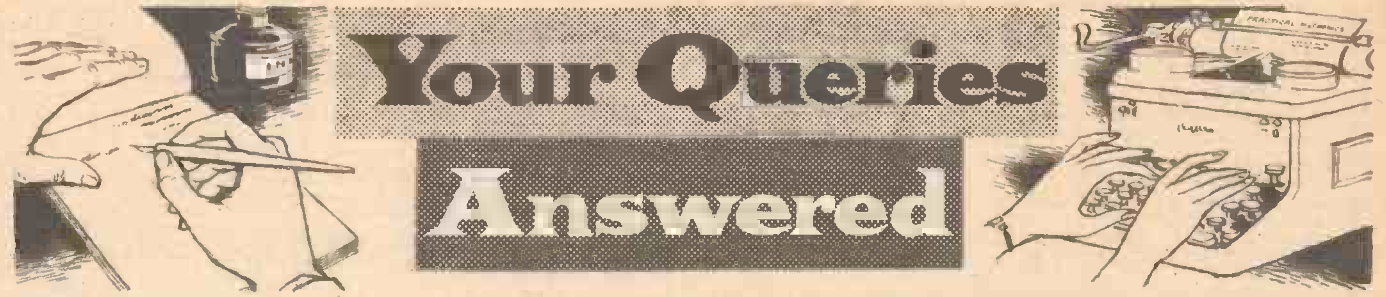


FIRE EFFECT

WE are presenting a comedy sketch concerning a TV Studio. At a certain time in the sketch one of the "cameras" is supposed to catch fire. How can we fire the "camera" at a set time? The camera is made from sheet metal; the flame must not be too fierce as the "operator's" face will be quite close.—D. D. Taylor (Suffolk).

IT would probably be a simple matter to arrange for one of the performers, or an assistant, to ignite a strip of magnesium electrically at the appropriate time by remote control. The simplest and most reliable method would be to use a narrow strip of magnesium as a fuse below the main charge, current from a car battery being switched through this strip at the correct instant. Some experiment would be needed to determine the narrowest strip which will fuse to ignite the charge.

CANDLES FOR FOG DISPERSAL

I HAVE heard that lighted candles in a room help to disperse fog; can you explain this? What effect would an old-fashioned oil stove have?—W. E. Goodchild (S.E.1).

BOTH fog droplets and tobacco smoke are aerosols—and these aerosol particles are electrically charged. The ions liberated by the free flame of a candle precipitate these charged particles of aerosols.

In South Germany and Austria they burn candles of the slow-burning type, that is to say, of large diameter similar to a night-light but of normal candle height.

An open fire dispels by draughting fog or tobacco smoke up the chimney. An oil stove would emit some ions, but these might become discharged by the metal of the stove and relatively would not be as effective as a multitude of naked flames.

THE DISTILLATION OF SAWDUST

I HAVE a considerable quantity of sawdust at my disposal and am rather anxious to put it to commercial use. Please inform me if it is possible to obtain a useful product by distillation.—James. J. Cullen (Limerick).

WHEN wood is heated in retorts, the moisture is driven out but no decomposition occurs until temperature approaches 160 deg. C. Between 160 and 275 deg. C. a thin watery distillate, known as "pyroligneous acid" is chiefly formed; above 275 deg. C. the yield of gaseous products become marked and up to 450 deg. C. liquid and solid hydrocarbons are extensively formed. Above this temperature little change takes place and charcoal, containing mineral ash, remains in the retort. The acid liquor contains methyl alcohol and acetic acid, together with acetone, methyl acetate, allyl alcohols, phenols and many other substances. The most valuable product, however, is the creosote oil which it contains.

RULES.

Our Panel of Experts will answer your Query only if the Rules given below are complied with.

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

To do this work properly you would have to set up a small-scale distillation plant but your local gasworks manager would advise you of the lay-out.

IMITATION OPAL GLASS

I WANT to attempt making imitation opal glass, I know that barium sulphate is one of the chemicals used, could you name the others, or have you a formula that could do the job?—A. E. Woodyer (London, N.19).

THE essential materials for glass making are silica, an alkali and lime or lead, but if a mixture of soda and potash is used as the alkali a more fusible glass is obtained.

To make "opal" glass add cryolite or fluorite, with felspar to the batch for common glass. These substances crystallise in the glass when the melt is kept near its fusion point for some time, and thus cause the opalescence.

LAYING RUBBER TILES

I HAVE some second-hand rubber tiles and wish to lay them on my floor. Would you please advise me of the best method of cleaning off the old solution and what solution to use in laying them. The floor it not level. Would you also suggest a way of levelling. It consists of 9in. boards.—W. Nelson (Co. Down).

TO clean off the old solution from your rubber tiles rub over with rag soaked in carbon tetrachloride. This must be done cautiously for any solvent used will also affect the rubber tile itself if used too freely. Use a scrubbing action over the hardened deposit itself with the rag, avoiding as far as possible the tile surface.

A good adhesive can be obtained from: Dunlop Special Products Ltd., Fort Dunlop, Erdington, Birmingham. Their product S.81 or S.480 is suggested.

Your floor can be levelled up by use of a screeding compound. A leaflet is obtainable from: Tile Floors (Industrial) Ltd., Yeoman Street, London, S.E.8.

P.M. ASTRONOMICAL TELESCOPE

WOULD you please let me know the approximate cost of the astronomical telescope with lens, which appears in your blueprint list and also the size of the telescope when completed.—L. Cottam (Birmingham).

THE most expensive item in the telescope is the object glass. This is obtainable from Broadhurst, Clarkson and Co., Ltd., of 63, Farringdon Road, London, E.C.1 for £8 10s., with or without a cell. In the PRACTICAL MECHANICS telescope a metal cell will not be needed. Each pair of eyepiece lenses will cost about 10s. For the woodwork much will depend upon whether you can do the turning yourself. There is a wooden cell for the O.G., a breech piece for the eyepiece to slide in and two spindles all to be turned in the lathe; these may cost about £1 if the work has to be put out, or say three or four shillings for the beech wood if you can do them yourself. The rest of the wood in deal, for the stand, etc. It may be bought for about 7s. 6d., and the hinges, bolts, etc., for about 2s. 6d.

As you see, much depends upon how much you can do yourself, but at the outside the cost should not exceed a sum of £11-£12.

GREEN SOFT SOAP

IN the manufacture of green soft soap I am having some difficulty as regards to keeping qualities. The soap keeps for two or three weeks but after that it seems to lose colour and go rancid.

Could you please let me know where I am going wrong and if possible let me have a formula so that I can compare it with my own?—W. A. Ross-Lonergan (Kent).

WE think you must have been using the "cold process" of soap making which consists essentially of combining carefully calculated quantities of caustic potash and fat. Coconut oil, linseed, castor, cotton or other seed and fish oils are melted and run into a mixing tank heated by steam. Then a definite quantity of potash lye (strong) 32-36°Be, is added and the mixture well stirred for a few minutes. The heat of reaction is enough to carry it on when once started. After saponification is under way the stirring is stopped and the mixture run into frames where it is allowed to stand for some days to complete reaction and cool. This leaves the glycerine and excess lye in the soap, but it is apt to discolour and go rancid after two or three weeks.

The better plan is to use a "boiling" process. Details, which are too intricate to give here, can be obtained from "Thorpe's Industrial Chemistry," which can be seen in most Reference Libraries.

ASTRO TELESCOPE

I AM thinking of building an Astro telescope with a magnification of 200x and an achromatic O.G. but am wondering whether it would be cheaper to make the reflector type. On what does the degree of magnification depend?—R. R. Pierce (Kidderminster).

IF an achromatic telescope of 3in. aperature has an object glass of standard focal length, 40in., it would require, in order to give a power of 200x, an eyepiece having an equivalent focus of 1/5in. A 3in. O.T. costs with cell, £8 10s. A 4in. O.G. has a focus of 60in. and a ¼in. f eyepiece on this would give 240x. The cost of such an O.G. with cell is £40 approximately. It would be cheaper to build a reflector and make the aperture somewhat larger than the refractor, say, 6in., with a focus on the parabolic mirror of 60in. A mirror is quite achromatic and automatically brings all the chromatic light rays to a common focus.

Higher magnification is partly dependent on the focal length of the O.G. and partly on the eyepiece f. The longer the O.G. f and the shorter the eyepiece f the greater the power. Write to Messrs. Broadhurst, Clarkson & Co., Ltd., 63, Farringdon Road, London, E.C.1, for prices of both O.G.s and mirrors.

TEMPERING TOOLS

IS there a tool made, or a paint, that will register the temperature for tempering tools such as chisels, screwdrivers, etc., after sharpening?—J. G. Huggins (Eire).

WE do not know of any such paint. Any engineering handbook will give you the colours of the oxide which indicate the correct temperature for tempering.

You first heat to cherry red and plunge into an oil bath to cool. Then clean off scale to a fine polish with emery cloth; re-heat until desired colour of the oxide is attained and plunge into water.

Yellow straw, 450°F, surgical tools.
Light straw, 510°F, chisels.
Dark straw, 560°F, hammers.

Thermindex Temperature Indicating Paints are supplied by: Messrs. Synthetic and Industrial Finishes Ltd., Imperial Works, Balmoral Road, Watford, Herts.

BURNISHING PICTURE FRAMES

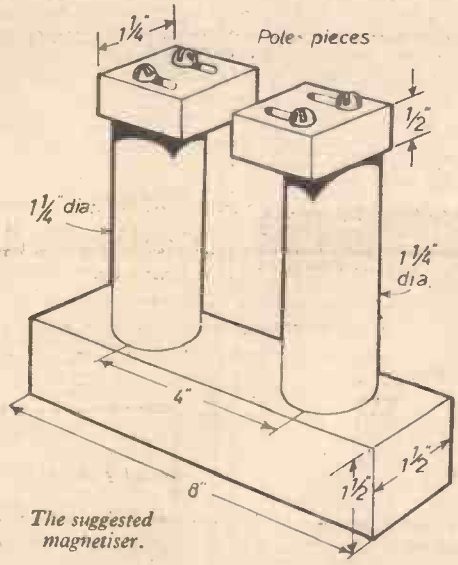
I WISH to manufacture picture frames which are finished in a rough surface (similar to very fine "stucco") and the edges outside and inside are finished with a gilding process and then burnished. The burnishing presents the difficulty A product called "Bolo-D'Armenia" can be used prior to applying the gold, and this is evidently the secret of successful burnishing with an agate burnisher. Can you tell me how to make this product?—T. W. Harker (South Africa).

WE have never heard of "Bolo-D'Armenia" nor do we know of any special compound. The only way in which we have seen burnishing done, and it can be done on any surface if it is hard enough and the gold adhesive is likewise hard, is this: The plaster or plastic moulded base must be given several coats of a water size made by boiling parchment in water until you get a strong solution like thin glue. The final coat of this is allowed to dry thoroughly, when gilding can be commenced. The gold leaf should be cut up into strips of the required width. Now, commencing at one corner, breathe upon the size to slightly moisten it and at once lay the piece of gold leaf. By the time that you reach the end of the frame the first leaf will be dry and this can be burnished. Burnishers of various shapes are obtainable but two only will be needed: one straight and one hook-shaped. Both are of agate.

A MAGNETISER

I WISH to make a number of permanent magnets from ¼in. dia. hardened silver steel. I have been told that magnetisation can be carried out by the use of some sort of coil and battery. Could you please give me details of such a method?—W. Parker (Devon).

A POWERFUL magnetiser could be constructed as shown in the sketch, the parts being made of soft iron or mild steel



The suggested magnetiser.

screwed together. The pole pieces could be secured by means of screws through slots, if required, so that the distance between the pole pieces can be made slightly less than the length of the rods to be magnetised. Each pole could be wound with about 3½lb. of 16 s.w.g. D.C.C. copper wire, the two coils being connected in parallel with each other for use from a 6-volt car accumulator. Care must be taken to connect the coils so that the two poles have opposite polarity. The rods are then placed across the pole pieces and the current switched on and off a few times. For storage the rods should be laid side by side with opposite polarity poles in contact. For maximum retention of magnetism the magnetic circuit of the magnetised rods should be kept closed if possible.

ESTIMATING ALCOHOL CONTENT

PLEASE tell me how to test for the alcohol content in home-made wines, and how to make any apparatus required. — L. Flinn (Watford).

YOU would have to sacrifice one pint or more by distilling off the alcohol from your mixture, and condensing the alcohol distillate in a receiving vessel. Since a certain amount of water vapour would also be carried over, you would probably have to re-distil the condensate three or four times to estimate the percentage of alcohol accurately.

A hydrometer.

You had in mind, we expect, the use of a hydrometer, a floating instrument with a narrow stem and graduations on it. See illustration. It consists of a hollow metal cylinder with conical ends, terminated at its upper end by a thin rod carrying a scale pan and carrying at its other end another pan loaded with lead. It thus floats vertically. We suggest that you load such an instrument so that it floats at a certain mark when your brew is fresh and that as fermentation proceeds and your alcohol content gets richer you make further marks on the stem, for it will float at a different level. This would give you an arbitrary indication of alcohol increase.

LENS CALCULATIONS

WHAT is the formula for finding the curvature of a lens from focal length and refractive index, for both diverging and converging lenses?—E. Beresford (R.A.F. Singapore).

FOR a simple lens, i.e., a lens composed of one piece of glass, the focus is in direct relation to, and equal to the radius of curvature but if the lens is radiused on one side only, i.e., a plano-convex, the focus will equal twice that of a double convex (curved on both faces). The curvature of any lens is a portion of a sphere and, in the case of a double convex, the focus point is at the centre of the sphere. A plano-convex will have its focal point on the opposite side of the sphere so, although the radius of both lenses is the same the focus of a plano-convex is, for the same kind of glass, just twice the length of that of a double convex.

The foregoing may be taken as a broad rule, applying to crown glass and would vary slightly with the many different proportions in the chemical compositions of the glass. For diverging lenses: plano-concave and double concave, exactly the same rule applies, the sphere in this case being an inside radius instead of an outside.

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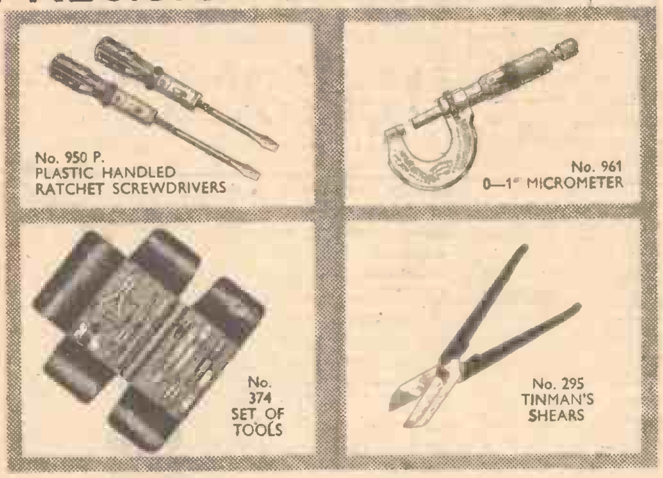

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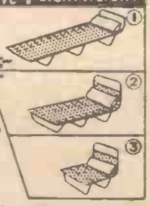

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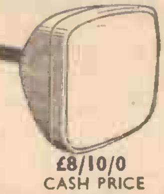

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Vol. XXVII No. 444

COMMENTS OF THE MONTH

THE CLUB MAGAZINE

THE Club "Mag." can be one of the greatest influences in club life giving news to members, past members and non-active supporters of the club and providing a vehicle for views and criticisms and a means of disseminating information. Nearly every well-established club has a magazine at some time in its existence, but the length of its life depends usually upon how long the editor is prepared to devote his time and energy to running it and—in the majority of cases—writing it and printing it too.

Running the club magazine is a worth while job and usually gives a lot of satisfaction to the enterprising member who makes himself responsible for its production. This satisfaction may last for a few months or perhaps as long as a year; it just depends upon how long his support from the rest of the club lasts. Usually there are one or two people in the club, people already holding jobs, i.e., the racing secretary or social secretary who become regular and reliable contributors, but no magazine will remain interesting if the whole of it is regularly written by only one or two people. It requires a contribution from every member of the club to attain the essential variety of matter to make it worth reading. Results of club events and time-tables announcing future social events are necessary parts of the magazine, but without the club wit or cartoonist's contribution, without the club vegetarian's controversial views on diet or the champion tall story-teller's contribution, the magazine might just as well be tabulated and pinned on the club notice board.

Members who are known to be able to produce interesting features may when approached by the editor have no contribution to offer, but it is much easier for them individually to think up some small items than it is for the editor to fill the whole magazine on his own. It is usually the editor's chief grouse that members are much more eager to buy each issue as soon as it appears than they are to do his share towards writing it.

However, in spite of the trials and tribulations of being an editor, the effort of producing a magazine is well worth while. What form the magazine takes is not important. It may only be a loose leaf binder containing typewritten pages, illustrated with drawings and photographs which is passed from hand to hand. These single copy "mags" have this definite advantage that they can easily contain photographs and drawings.

A slightly more ambitious format is one where the articles and features are typed on to stencils and duplicated; here the only form of illustration can be rough sketches cut into a stencil. The covers of this type of magazine, however, can be enhanced by having them printed, the costs being defrayed by advertisements on the inside and back covers paid for by local cycle dealers, etc.

Finally, those clubs with large membership and greater resources will have their magazines professionally printed, but the average club will find that this costs far more than they are prepared to spend.

The club mag. in addition to giving pleasure to its members by seeing their names and activities in print enables those interested in but not closely associated with the club to keep in touch with events. The perusal of a lively, factual, chatty and humorous club journal has persuaded many a cyclist to become an enthusiastic clubman.

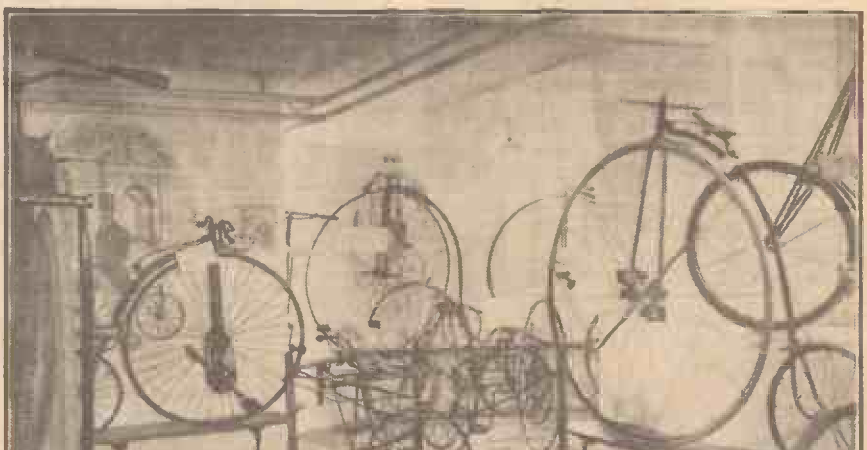
CYCLING JARGON

If you were discussing a time-trial with a fellow cyclist and he said to you, "I did a flier to the turn but then had trouble with my double clanger, took a packet and barely managed evens, finally doing a 2," you would understand him perfectly, but have you ever considered the dilemma of a non-cyclist overhearing this conversation? What do words like bonk bag, sprints and tubs, honking, breakaway, minute-man, sag-wagon, hunger knock, bit-and-bit and prime mean to the non-cyclist? Nothing at all. During the war, when talking to an R.A.F. man, the ordinary man in the street needed an interpreter and this tendency is creeping into cycling, particularly since the increase in mass-start events and the consequent influx of Continental words like peloton, grimpeur, musette, coureur and repêchage. Very soon at the rate we are progressing, translation will indeed become a necessity!

METAL STUDS DISCOURAGED

We were pleased to note recently that local authorities are being officially discouraged from using metal studs and plates for road marking, especially near the kerb or on a steep camber. This type of marking has been a source of great danger to cyclists for many years, adding quite unnecessarily to the existing hazards in wet weather.

This is an improvement which will be welcomed by cyclists everywhere.



A selection of old time bicycles on show in the pantry of Palace House, Beaulieu, Hants, the home of Lord Montagu. This is part of the Motor Museum which houses a large collection of vintage cars, motor cycles, bicycles and tricycles. Visitors can also visit Palace House and Beaulieu Abbey.

From the Following Instructions You Can Do Your Own

WHEEL BUILDING

THE standard number of spokes in cycle wheels is 32 in the front wheel and 40 in the rear and with the hubs and rims to hand, the builder's first problem is to calculate the spoke length. This cannot be done by straight measurement as cycle wheels are tangent spoked, i.e., the spokes do not go radially from hub to rim, but, as can be seen from Fig. 1, are set at an angle. The procedure is, therefore, to measure the diameter across the rim, using the bottom of the well where the rim tape fits. Next measure between spoke hole centres on opposite sides of one flange of the hub. Divide these measurements by two to obtain the radii, then square each one and subtract the squared hub radius from the squared rim radius. The square root of the answer will be the spoke length required.

The gauge used for most cycle wheels is 14 but heavier wheels and tandem wheels employ 12g. or 13g. Lightweight wheels are spoked with double-butted spokes.

Spoking the Front Wheel

The first step is to thread two spokes into the hub leaving six empty spoke holes between them and making sure that they are threaded through in opposite directions (see Fig. 1). Now look at the rim and you will see that the spoke holes are drilled at an angle both from side to side and fore and aft. Select two holes with one empty one between which slope in the appropriate direction from the edge to the centre of the rim. Push the threaded ends of the spokes through and screw nipples half way down the thread. Now take the next two holes in the hub below those already occupied on either side of the hub and thread through spokes 3 and 4, making sure they go through the opposite ways to their neighbours, and take them to the opposite side of the rim as in Fig. 1, counting the spoke holes if necessary to make sure that they are exactly opposite.

Now take spoke 1 and in the next but one hole in a clockwise direction insert a spoke in the same direction. This is spoke 5 and it is fastened in the fourth hole in a clockwise direction from spoke 1. Spoke 6 goes in the next but one hole in the hub in a clockwise direction, and four holes farther round the rim. This procedure is repeated until all the spokes in the same tangential direction on that side of the hub are in.

Take spoke 2 and insert another spoke in the next but one hole in an anti-clockwise direction round the hub. This is spoke 11 and it is positioned in the fourth hole round the rim in an anti-clockwise direction from 2. Spoke 12 is positioned in the next but one hole round the hub in an anti-clockwise direction and threaded through to the hole in the rim four round from spoke 11. This procedure is followed until all the spokes in this flange of the hub are in position.

Where spokes cross some 2in. or 3in. from the hub flange, they must be laced. i.e., bent under or over so that they cross tightly (see Fig. 2).

The Opposite Flange

Remove one of the spokes and sight through the hole in the hub along the barrel

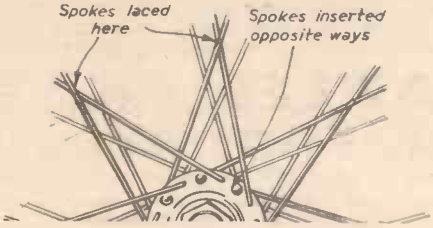


Fig. 2.—How spokes are laced

of the spindle to the opposite flange, where it will be seen that it lines up with a space between two holes on the other side. Thread a spoke through a hole, say, on the right of the one you are sighting through on the opposite flange and then replace the one removed. Carry the threaded end of the spoke to the rim, lining it up with one of the other side just replaced, but taking it to the hole in the rim immediately on its right. Now, calling this spoke 1, insert spokes 2, 3 and 4, and repeat the procedure exactly as for the other side of the wheel.

The Rear Wheel

The method of spoking the rear wheel is exactly the same as for the front wheel except that eight empty holes are left between the first pair instead of six as in the 32-spoke wheel. One side of the completely spoked wheel is shown in Fig. 3, and the spokes numbered in the order in which they are inserted. A further check can be imposed. Note that spokes adjacent at the hub end cross on opposite sides of the hub flange. Two spokes that cross in this way are, in a 40-spoke wheel, spaced at the rim by 13 holes. This spacing on a 32-spoke wheel is nine holes.

Check finally that spoke heads in the hub face opposite directions.

All the spokes must now be tautened and this process must be approximately equal on every side. One method of doing this is to tighten every nipple until its end is level with the end of the thread and then ensure all future tightening is equal by counting the turns of the spoke key.

Truing the Wheel

When the slackness has been taken out of the spokes equally all round the wheel, truing can commence, and to do this the wheel is mounted in the forks of the cycle. Spin the wheel and look first for bumps, i.e., deviations from the round, and eliminate them by tightening the appropriate spokes. Then go round the rim tightening or loosening spokes a half a turn at a time to eliminate sideways deviations from truth. Do not over-tighten the wheel by using a tightening action to eliminate every eccentricity.

When the wheel is true, inspect the nipple heads in the well of rim to see if any spoke ends are protruding. If they are, file them flush with a narrow file.

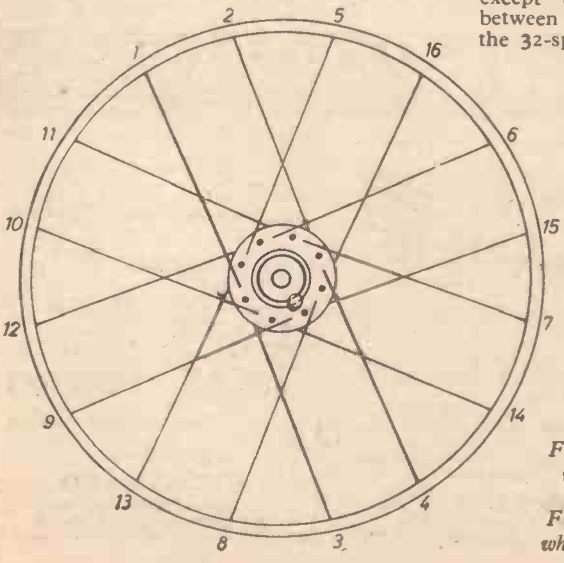


Fig. 1.—(Left) Front wheel spoking one side only.

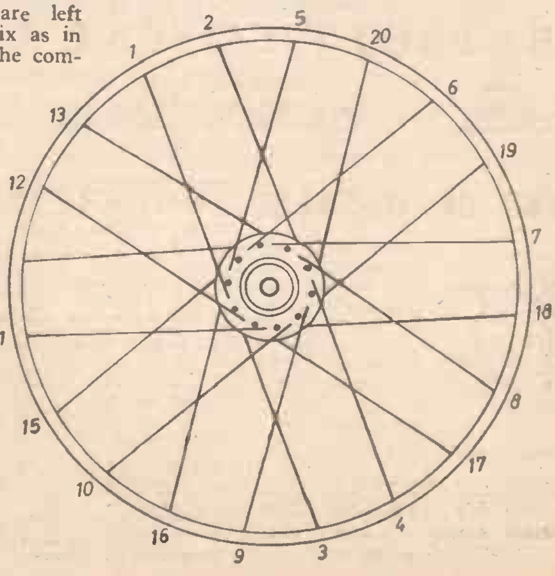


Fig. 3.—(Right) Rear wheel spoking one side only.

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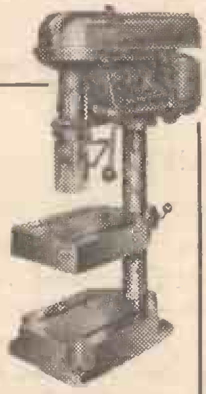

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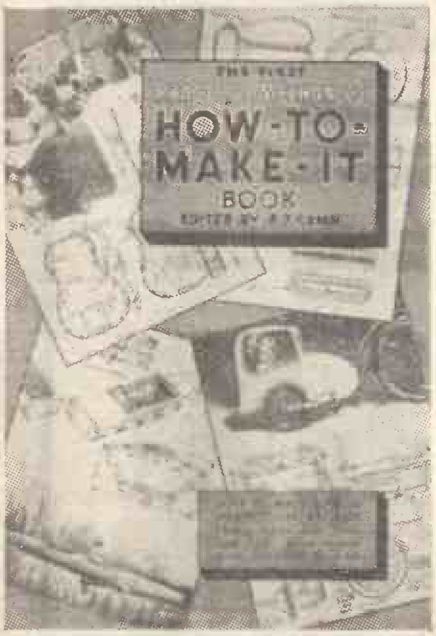

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