★ Making a Camping Trailer ★

NEWNES

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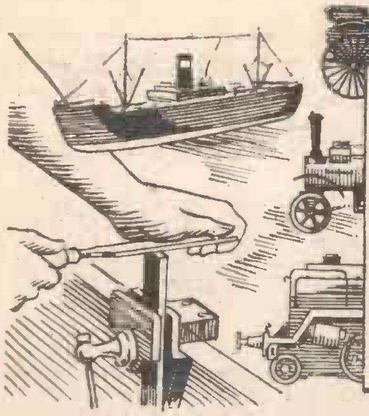
PRACTICAL MECHANICS

EDITOR: F. J. CAMM

JANUARY 1957



Practical Mechanics

Vol. XXIV. No. 275 JANUARY, 1957

"The Cyclist" and "Home Movies" are temporarily incorporated

FAIR COMMENT *by the Editor*

Petrol Rationing—Will Steam Power Return ?

ELEVEN years after the war petrol rationing has been reimposed, since it was abolished in June, 1950. During the war many methods were adopted to keep vehicles running. Cars were adapted for running on town gas, producer gas, methane, and other gases. Then, as now, suggestions were made that someone should produce a steam car. But the plain fact is that although experimental models have been produced, no design has reached the stage where it could be marketed. This is surprising when we recollect that the White, Stanley and other cars were marketed and run successfully on the roads years before the internal combustion engine caused interest in steam to wane. A steam car is a fascinating vehicle to drive, since it does not need a gear-box, and in many respects is superior to the I.C. engine. This is a topic which should be ventilated, and I invite comments from my readers on the subject.

"Practical Wireless" Film Show

READERS who wish to see the radio film show at the Caxton Hall, Caxton Street (off Victoria Street), S.W.1, on Thursday, February 21st, should make application for tickets at once. There is accommodation for 500 people and applications will be dealt with in strict rotation. There is no entrance fee. The film will start promptly at 8 p.m., and there will be an interval for refreshments. We are all aware of the part the electronic valve has played in the development of television and radio. The transistor, however, has now entered the field, and bids fair eventually to replace the valve in certain parts of TV and radio circuits. These films have been specially produced by the well-known manufacturers of valves and TV tubes, Mullard, Ltd., and I am grateful to them for their co-operation in making them available for showing to readers of this journal and my associated journals, *Practical Wireless* and *Practical Television*.

I shall be in the chair, and readers wishing to attend should send in their requests for free tickets immediately to "Film Show," PRACTICAL MECHANICS, address as on this page. I have seen the films and I was so impressed that I thought they should be shown to as many readers of my journals as can be packed into the Caxton Hall.

"Practical Mechanics" Self Binders

WILL readers please note that when ordering self binders for this journal they should state the volume number they require blocked on the spine. If you intend to have previous volumes bound in this way, you should state the numbers of those volumes. Full details of the binders, which cost 11s., post free, from the offices of this journal, appear on page 216 of this issue.

Indexes, of course, cost 1s. 3d. extra.

Perpetual Motion

THERE was a time when you could obtain a patent for perpetual motion and many dozens of such patents are on file at the Patent Office. The Patent Office, however, now has the power to reject any application for a patent which, in the opinion of the Comptroller, opposes natural laws. This places in his hands rather sweeping powers, for who is to say that perpetual motion *is* impossible ? Mr. S. Bramley-Moore, an engineer and scientist of international repute, described in our last issue how he has obtained power from permanent magnets, and I have witnessed a demonstration of his machine. He has proved that certain basic scientific concepts are not true and that his successful tests break the law of the conservation of energy, which is a prelude to perpetual motion. He has, of course, patented his principle and methods, so there is no reason to suppose that the Comptroller will capriciously exercise his powers. Things we thought impossible 25 years ago, such as television for example, have come to pass and there is no reason to suppose that some day perpetual motion will not be part of our everyday life. It may come from that mysterious force known as magnetism or it may derive as an offshoot from developments in atomic power. Bramley-Moore's experiments and ideas cannot be lightly brushed aside.

The mere mention of the word perpetual motion is likely to be met with a smirk and the individual is likely to be classed with those inventors who, year by year, advance the idea of the unbalanced wheel, the dynamo which drives the motor whilst the motor drives the dynamo, the band of sponges half immersed in a liquid, and similar devices which have been suggested through the ages.

Perhaps the best-known suggestion was the Orphyrus wheel which is supposed to have run for a few days until the inventor smashed it up in disgust at the suspicions of his critics that it was a fake. What little details are known about it (see PRACTICAL MECHANICS, dated October, 1946), will tend to support the view that the inventor was a charlatan, and we must regard his demonstration as a hoax and his destruction of the device his means of destroying evidence of the hoax.—F. J. C.

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An Electric Convector Heater

THIS convector is simple and efficient and intrinsically safe. The heat is produced by coils operating at a "black" heat which eliminates fire risk and the coils themselves are doubly insulated from the casing, which, in turn, is earthed.

It consists of an outer casing, the design of which can be varied to the user's taste, containing an "element carrier" which carries the heating coils. A switch is provided on the casing to give three degrees of heating and a small amber-coloured bulb, in conjunction with a sheet of glass, gives a pleasing effect and visual indication that the heater is connected to the main supply.

A Black Heat Unit, Providing Three Degrees of Heat

By G. H. DOWSETT

The Casing

The author's convector was made using the case of a discarded oil convector and the dimensions of this are given in Fig. 1. It is a simple matter to make up such a case from tinned iron. The seams must, however, be secured by self-tapping screws or nuts and bolts, as obviously soldering is not a suitable method of seaming in an appliance that becomes hot in use. The dimensions must not be smaller than those given, but can be slightly larger. The element carrier must be fitted so that it is clear of the casing at all points by at least 1in., and if this clearance is unduly increased there will be a loss of efficiency. The size of the element carrier and the case are therefore related.

In the top of the case there is an aperture 8in. × 5in. If preferred this can be made along the top edge of the front of the casing, as in the commercially made product, but the aperture should have an area of 40 sq. in. If the aperture is made in the top it is essential to make it in the form of louvres or to fix a piece of substantial wire netting underneath it to prevent the possibility of anything falling through on to the elements inside.

The back of the casing does not reach to the bottom, but a gap of 4in. is left. As the casing is 14in. wide this gives an area of 56 sq. in. for air to enter. If desired the back can be made to cover completely the rear of the casing, in which case it will be necessary to mount the whole casing on legs so that there is not less than 2in. clearance between the bottom of the case and the floor.

Provided these points are observed the design of the casing can be to the taste of the maker. The rectangular opening in the front of the casing can be any shape desired, and the design can range from a simple "hole" to a fretted galleon in full sail according to the patience and whim of the individual. In either case it is backed up by a piece of muffled glass. The best effect will be obtained by selecting a design of glass that consists of a number of closely packed "stars," which have a prismatic effect on the light reaching them from the lamp within and give a most cheerful glow.

The Switch

That used is an "Arrow" single-pole, four-position, three-heat switch, Catalogue No. 9977-GEY, fitted with knob "B" or "Self-indicating bakelite dial pattern W," and is secured by two 2BA screws. It can be fitted in the front of the casing or at the side if preferred and a ⅝in. hole, with rubber or ebonite grommet to suit, should be provided adjacent to it to accommodate the three-core heater cable from the mains socket from which the convector will be fed. See that the switch is positioned so that the terminals appear as shown in Fig. 4.

It is essential that any portable electrical appliance of this nature should be efficiently earthed. This has been provided for in the design, but will not be effective if the plug-socket feeding it is not properly installed. This plug socket must be three-pin 15- (or 13-) ampere type and must have been properly installed with the socket for the earth pin properly earthed. The large type of socket is necessary because this convector has a maximum rating of 2 kilowatts, and this requires between 9 and 10 amps. at normal supply voltages (200/250).

The muffled glass mentioned above is fixed inside the casing by means of the triangular corner fixings for mirrors. The "Arrow" switch can be obtained from a local electrical contractor as it is a standard replacement switch for many types of electric cookers and if not in stock can be readily obtained. The same shop will be able to supply the amber pygmy lamp and a moulded batten holder to carry it, as well as the asbestos-covered wire for the internal connections.

The heating elements are arranged on an "element carrier" which is made up from ¾in. × 1/16in. mild steel strip and are insulated from the carrier by means of ceramic split bushes. A perspective view of the carrier is given in Fig. 2 and dimensioned drawings in Fig. 6. The carrier is fixed to two longitudinal strips by means of ceramic split bushes and these strips are bolted to angles on the inside of the casing. The element carrier and the casing must be of such dimensions that when the carrier is fixed inside the casing there is a clearance of not less than 1in. all round the carrier. If the dimensions of the case are modified, then the carrier size must also be altered. It will be noted that the elements are insulated from the carrier by means of the split bushes and that the carrier is similarly insulated from its mounting in the casing. This double insulation is essential for safety.

Carrier Construction

To make the carrier, two strips of ¾in. × 1/16in. strip are cut, each being 19in. in length. These are marked off into three sections, measuring 6in., 7in. and 6in. and in the central 7in. section are drilled two ⅜in. holes for the split bushes. The remaining two sections are drilled with 2BA clearance holes for fixing the side bars and the split bush bearers. The strips are then bent to form the ends of the carrier (Fig. 6).

Four pieces of strip are now cut, each being 11in. in length and drilled 2BA clearance ⅜in. from each end. These pieces form the side bars.

A further four pieces of strip must now be cut, these being for the split bush bearers and each 8½in. in length. Again it will be

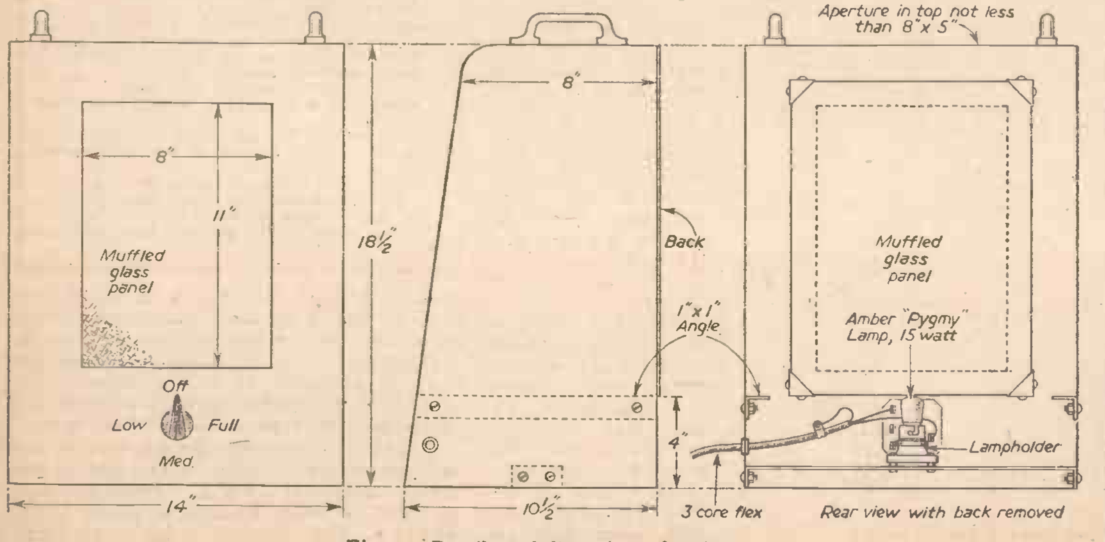


Fig. 1.—Details and dimensions of casing.

necessary to drill a 2BA clearance hole centrally ⅜in. from each end and also make a right angle bend ¾in. from each end. You will now have a strip turned down at each end and having a section 7in. long in the middle. This section is drilled with ⅜in. diameter holes in accordance with Fig. 3.

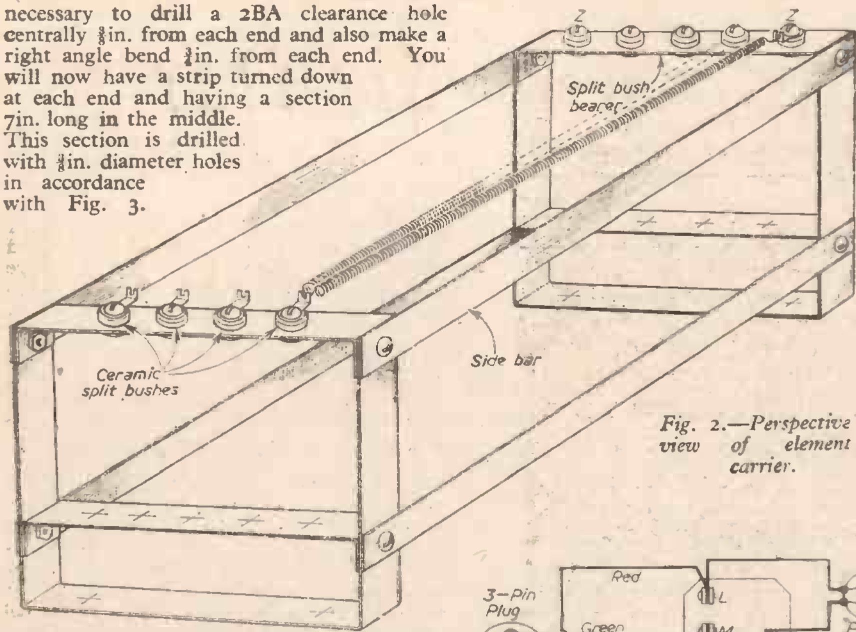


Fig. 2.—Perspective view of element carrier.

Two of these split bush bearers are drilled with five holes and the remaining two with four holes. It is important that the relative positions of the holes are as shown in Fig. 3. The carrier can now be assembled, using 2BA bolts with washers and nuts. The excess of bolt protruding through the nut when all is tight should be cut off and the end riveted over. This will prevent any chance of the element carrier becoming loose due to the heating and cooling to which it will be subject in use. Fig. 2 shows the element carrier as it appears when assembled. At this stage it should be fitted in the case and the necessary holes drilled to fix it in place, using the angles provided inside the casing. It is then possible to check that the element carrier clears the casing properly and that there will be no difficulty in fitting the bolts to secure it. If these checks are not carried out now it may be difficult to fit the carrier later when the elements are in position.

Assembling the Elements

The next stage is to make up 14 wire hooks as shown in Figs. 3 and 5. Ordinary galvanised wire of 18 s.w.g. such as is common for odd jobs in the garden can be used; this is easy to bend and satisfactory in use. In Fig. 2 another type of hook is shown.

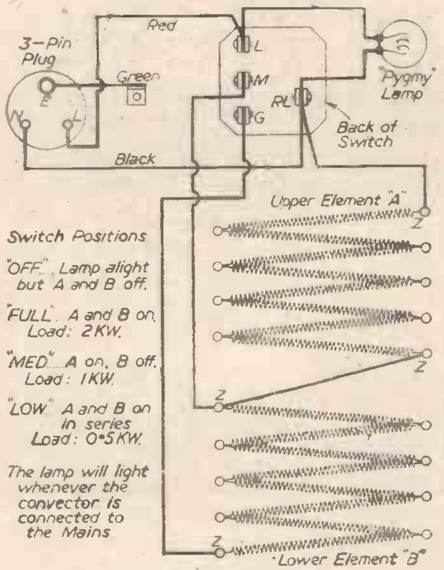


Fig. 4.—Wiring diagram.

After removing the element carrier from the casing the fitting of the elements can be commenced. Have the ceramic split bushes, 2BA bolts, washers, nuts and the wire hooks laid out to hand. Starting with the split bush bearers having five holes, assemble split bushes, hooks, etc., as shown at (a) in Fig. 5 only in the middle three holes. The outer holes have their bushes fitted later, and do not have wire hooks. In the same way, assemble split bushes in the bearers having four holes; in all four holes this time. The bolts and nuts should be screwed up finger tight. If a spanner is used the ceramic bush may be fractured.

The outer holes in the two bearers having five holes can now have their split bushes assembled, leaving the nuts very slack for the moment. The assembly here is different and a 2BA bolt 1¼in. long is used with extra nuts and washers, the order of assembly being shown at (b) in Fig. 5.

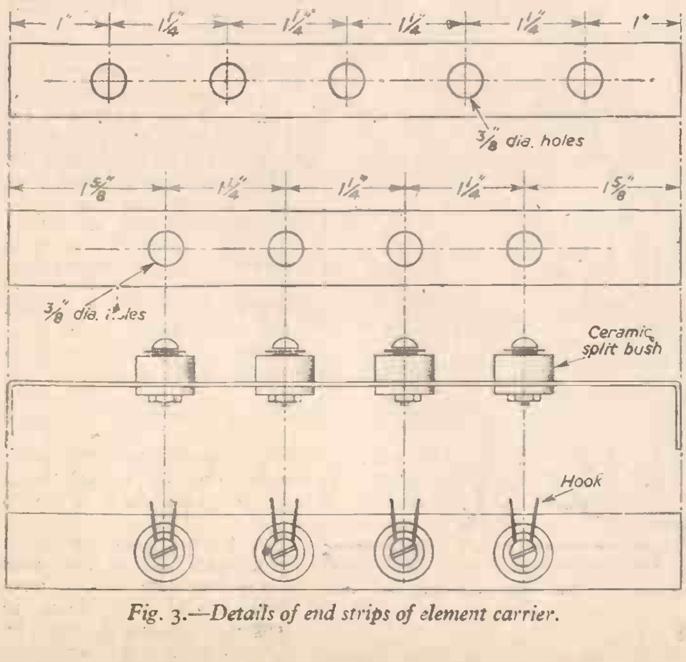


Fig. 3.—Details of end strips of element carrier.

The elements will be found to consist of a tightly wound spiral about 24in. in length. This spiral has to be divided into eight equal parts and this can be done by measuring off and pulling one turn out at each division as shown in Fig. 6. Two turns at each end of the element should be straightened out to make the end connection under and between the washers as indicated at (b in Fig. 5.

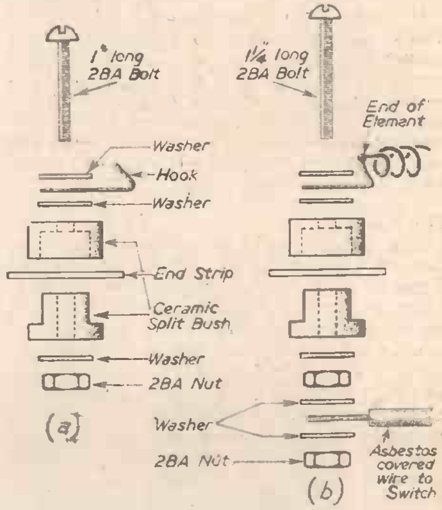


Fig. 5.—Assembly of split bushes, etc. (a) Those not carrying connections; (b) Those carrying connections, i.e., outer ones of groups of five (marked Z in Fig. 2).

Start fitting the elements by winding the end twice round the bolt at the outer bush of the five in the lower bank (Fig. 6). Stretch the first section to reach the hook on the first split bush of the four at the opposite end. Continue thus, back and forward, finally fixing the free end of the element by taking two turns of wire round the bolt securing the other outer bush of the five. Reference to the wiring diagram (Fig. 4) clearly shows how the element zigzags between the split bushes. The upper bank now has its element fitted in exactly the same manner and it will be noticed that the five split bushes come at the opposite end. This simplifies connection and also increases the contact between the column of air passing upwards through the casing and the elements that are heating it.

A length of asbestos-covered wire is cut and connection is made to the end of the upper element by looping it round the bolt between the lower washers as shown at (b) in Fig. 5. The other end of this wire is taken

MATERIALS REQUIRED

Sheet iron, 18 or 16 gauge, for the casing.
Bolts and nuts or self-tapping screws for assembling the casing.
Muffled glass of suitable size (13in.×10in., for the casing shown).
20ft. bright mild steel, ⅜in.×1/16in.
2ft. 1in.×1in. angle iron.
2 metal (not plastic) drawer handles with 4 nuts and bolts for fixing.
12 2BA R.H. bolts, length ½in.
18 2BA R.H. bolts, length 1in.
4 2BA R.H. bolts, length 1¼in.
24 ceramic split bushes, for 2 BA. (From the Technical Services Co., Shrubland Works, Banstead, Surrey.)
2 1,000-watt black heat spirals to suit local mains voltage, which must be stated when ordering. (From the Technical Services Co., Shrubland Works, Banstead, Surrey.)
*1 batten-holder for standard B.C. lamp.
*1 pygmy sign lamp, 15 watts, 28·mm. sprayed red or amber.
*1 "Arrow" three-heat cooker switch, Cat. No. 9977-GEY with knob "B" or self-indicating dial type "W."
*Length of 3-core heavy heater flexible cable.
*3ft. asbestos-covered connecting wire as used for the internal wiring of electric fires.

* These items can be obtained from the local electrical contractor.

to the end of the lower element. Another length of asbestos-covered wire is cut long enough to reach from the end of the lower element to the switch when the carrier is in its case. This and the wire from the upper element are secured between the washers of the split bush at the end of the lower element. A similar connection is made with an asbestos wire of suitable length from the other end of the upper element to the switch and another wire from the other end of the lower element to the switch. It will be noticed that the connection is made between two nuts so that this connection can be really tight without straining the ceramic split bush.

The carrier can now be fitted in the case and the loose connecting wires fitted to the switch. It is assumed that the three-core flex will have already been fitted. Check that

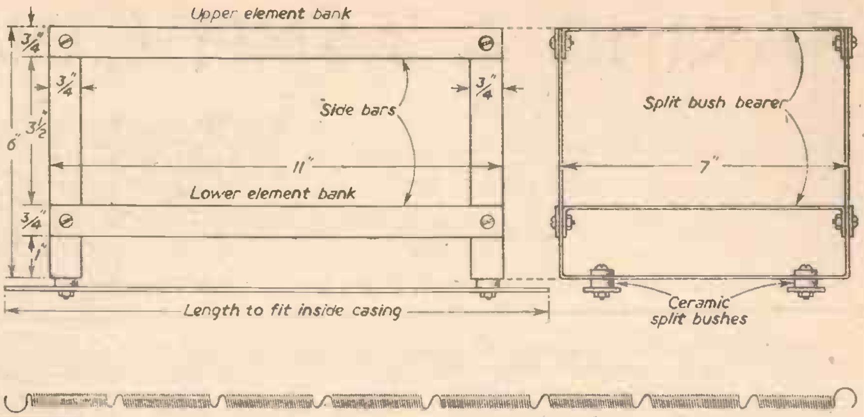


Fig. 6.—Dimensions of element carrier and element ready for fitting.

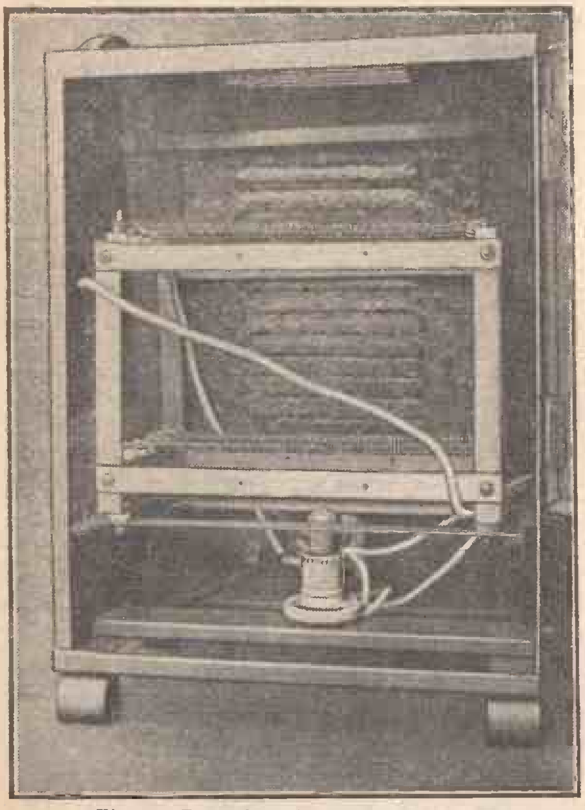


Fig. 7.—Rear view with back removed.

the green wire of the three-core flex makes a good solid contact with the casing and thus effectively "earths" it. See also that the flex itself is secured by means of a clip or small saddle so that the connections to the switch are not strained if the flex is pulled. It will be necessary to remove the outer braiding of the flex for 3in. or 4in. in order to make the connections and when this is done three packing and "anti-kinking" strings will be found. These strings can be used to anchor the flex by tying them to some convenient point on the casing, thus taking any strain from the wires of the flex themselves. In some cables a number of strands will be found instead which can be plaited together to achieve the same result.

The switch has four terminal plates labelled "L," "M," "G" and "RL," the letters being moulded in the porcelain switch base close to the terminal plates. The wires from the pygmy lampholder are connected to "L" and "RL." The red wire of the flex is also connected to "L" and the black wire of the flex to "RL." The lamp will thus light up whenever the main electricity supply is connected to the heater even though the heater switch is in the "off" position.

Returning now to the wires connected to the elements, the wire that is connected to both elements is now connected to the "M" terminal of the switch. The wire from the other end of the lower element is connected to the terminal of the switch which is marked "G" and the remaining wire from the upper element is connected to the "RL" terminal of the switch. This terminal thus carries three wires in all, but the bolt provided is long enough for these wires to be accommodated between the terminal plates securely. All connections must be properly made and screwed up tight with no odd ends of wire sticking out.

Having secured the element carrier in the casing and made the necessary connections, the back of the casing should be fixed in position and the heater tried out. Fig. 7 shows a rear view with the back removed.

Testing

Insert the plug in a convenient power socket without switching on. Turn the switch on the heater to the 12 o'clock position (off) and switch on at the socket. The lamp should light, but the heater should not become warm. If it remains cold the switch can be turned anti-clockwise to the 9 o'clock position (low) and almost at once hot air should rise from the opening in the top of the casing. Turn the switch next to the 6 o'clock position and the temperature of the air should at once increase. Turning the switch to the remaining 3 o'clock position (full) should again produce a rapid rise in the temperature of the air leaving the heater. It is necessary to test the wiring in this order as it will be impossible to determine if the elements are being correctly switched if one starts from hot instead of cold. The elements will not glow, but run at a "black" heat and are, therefore, very safe.

Painting

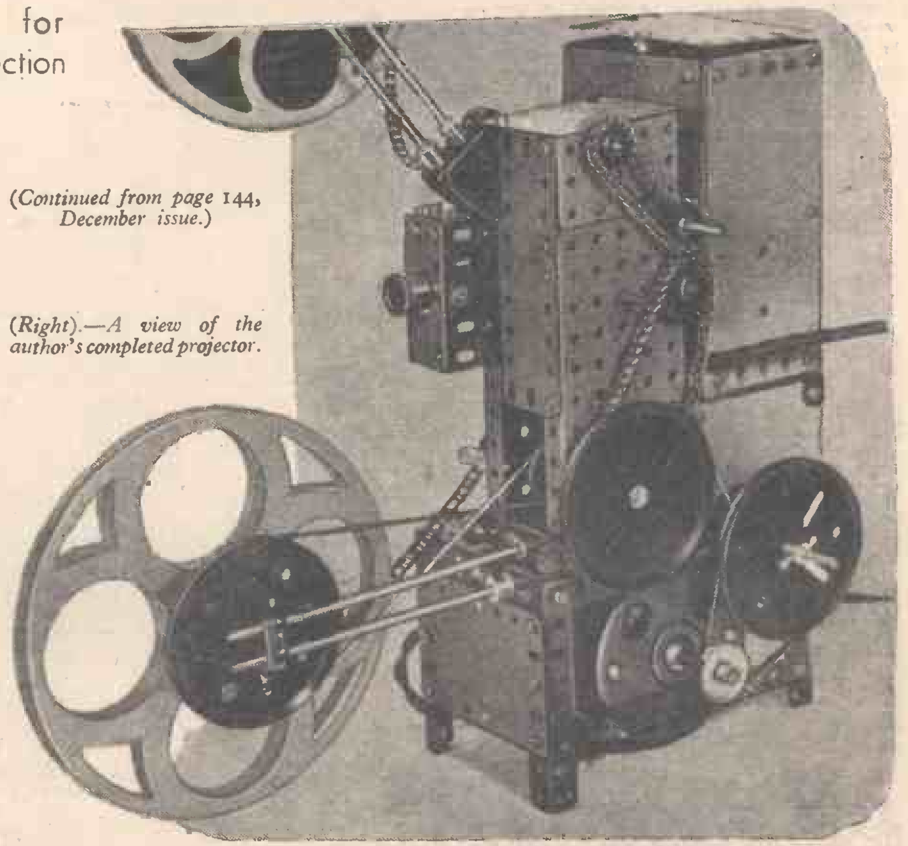
Switch off the heater and remove the plug from the mains socket and clean down the case prior to painting. Any of the special gold, silver or bronze paints intended for painting radiators, hot water pipes, etc., can be used as they are heat resisting. Attractive designs can be produced by combinations of bronze and silver, particularly by spraying. If spraying is out of the question, then the old dodge of spattering with an old toothbrush can be utilised. It is worth while spending some time and trouble on the external appearance as such a heater will be found useful not only for heating halls, lobbies, etc., but for use in drying and airing clothes indoors in bad weather. It is also a most effective workshop heater and does not produce water vapour and fumes, which are so damaging to tools.

MAKING A 9.5MM. CINÉ PROJECTOR

Full Constructional Details for Making Apparatus for the Projection of 9.5mm. Silent Films

By L. COGSWELL

(*Continued from page 144, December issue.*)



(*Right*).—*A view of the author's completed projector.*

MOUNT the gate and buffer brackets in the positions shown in Fig. 10. Place the compression springs on the buffer pins and mount the backplate to the sockets. Bring the gate bracket up to the backplate until the pads locate in the guide under slight pressure from the springs. The bracket should be only lightly fastened at this stage as this may not necessarily be the final position of the assembly.

The Intermittent Mechanism

As a general rule film does not travel continuously through the guide of the projector: the film is pulled through intermittently, each successive picture of the projected film being made to rest for a regular split-second period at the gate aperture. There are other arrangements, such as optical compensating devices, synchronised with continuously moving film, but with the machine described the constructor need only be concerned with the conventional mechanism.

Silent film is photographed at 16 pictures or frames per second (16 f.p.s.): thus, if 16 individual exposures a second were recorded in sequence by the camera on the original sensitised film, then 16 f.p.s. of the resultant printed or processed film must be projected in similar sequence to reproduce the original photographed movement. Perceived by the eye of the viewer, the constituent variations of the subject printed on each successive frame of the film, and projected intermittently at the rate of 16 f.p.s., appear as a continuously moving image. This illusion is known as the "persistence of vision."

Ciné film perforations are employed for transporting the film continuously through cameras and projectors alike; they are also used for displacing the film by intermittent mechanisms. In conventional projectors a continuously rotating take-off sprocket, the teeth of which engage in the film perforations, feeds the film at constant speed from the take-off spool into the guide, whilst a continuously rotating take-up sprocket feeds the film on to the take-up spool.

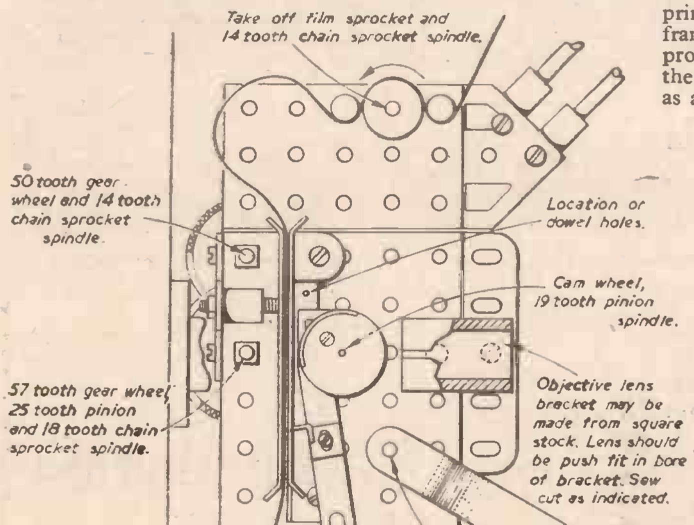


Fig. 10.—Gate bracket, pull-down movement and film sprocket positions.

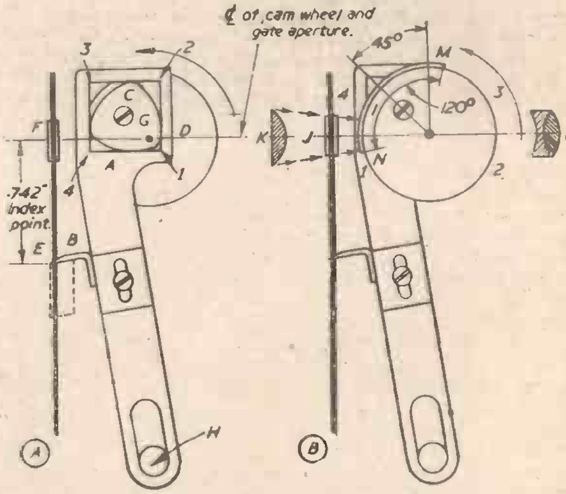
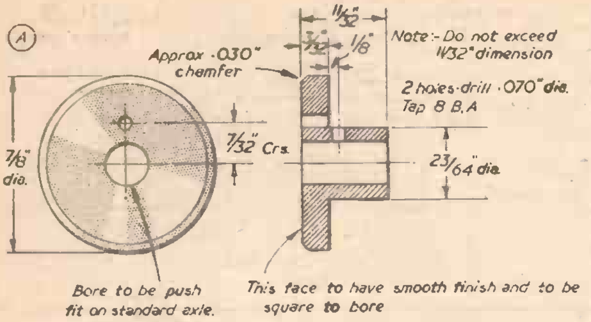


Fig. 11.—(A) The pull-down movement. (B) The pull-down movement with shutter in position.

Whereas the function of the continuously rotating sprockets is to supply at constant speed the film to the guide and take-up spool, the intermittent mechanism performs a more critical function in indexing accurately each successive frame of film at the gate aperture in rapid sequence. Various ingenious devices are employed to perform this critical function, including modern versions of the obsolescent dog paddle, the ubiquitous Maltese Cross of pioneer cinematography and the contemporary pneumatic pull-down. A widely



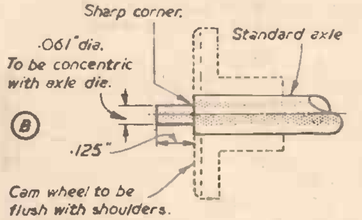


Fig. 12.—(A) The cam wheel which is turned up from ⅞in. dia. brass bar. (B) Cam wheel spindle, made from a standard axle.

used device in sub-standard machines is the Trezel cam and shuttle, and a variant of this latter movement is employed here.

At A in Fig. 11 is shown the principal components and the function of this pull-down mechanism is illustrated. The shuttle type follower A, to which a claw B is attached, operates on the periphery of the cam C, which is spigoted to the concentric cam wheel D. One frame of the film E, the elevation of which is sectioned to show the film perforations, is at rest in the gate aperture F.

Assuming now that a short length of film is in the guide, positioned so that a frame of the film is squarely at rest in the aperture (no portion of a perforation visible at either top or bottom of the aperture), the film will be required to be displaced downwards a distance of 7.54 mm. to bring the successive frames to rest squarely in the aperture, as there is one perforation per frame and 7.54 mm. is the pitch of the perforations (see Fig. 2, December).

The diagram shows a vertex G of the cam at rest in the corner of the square follower track at position 1. As the cam wheel commences to rotate continuously in the direction of the arrow, the follower, the arm of which is pivoted at H, transmits a vertical downwards movement to the claw until the cam vertex, formerly at position 1 of the square follower track, has reached position 2. A horizontal linear movement is imparted to the claw as it is withdrawn from the film, which has been displaced one frame, until the cam vertex reaches position 3 of the follower track. The claw is then guided by the follower upwards in a perpendicular path until the cam vertex reaches position 4, where a forward linear movement of 9 deg. to the horizontal is transmitted to the claw until the cam vertex reaches its original point at 1 of the follower track. The rotary input of the cam wheel is thus transformed to linear output, describing the rectangular claw trace shown at the dotted lines. The frame of film dwelling in the gate aperture is supplanted by the successive frame as the cycle is repeated. In operation, this "pull-down and dwell" cycle is repeated at 16 f.p.s.

The movement may at first appear to the home constructor as a rather formidable piece of work to tackle on the domestic workbench, especially as dimensional accuracy is necessary. The cam wheel and spindle are, of course, lathe jobs (if the constructor does not himself possess a metal turning lathe, he could probably enlist the aid of a friend who has one), but, apart from these components, all other items can be hand made from mild steel plate, and the fabrication of the complete movement should be quite within the capacity of the interested constructor. A small surface plate, a height gauge and box plate would be useful tools to borrow for marking off the components. Although by no means essential facilities for hardening the follower track, pivot slot and cam would be advantageous.

Turn the cam wheel to the dimensions shown at A in Fig. 12, ensuring that the 11/32in. overall dimension is not exceeded, as this will affect the position of the claw relative to the claw slot. The bore of the wheel should be reamed to a push fit on a standard axle. As it is important that the outside face of the wheel is square with the bore, it would be advisable to finish face the flange with the workpiece set on a true running mandrel in the lathe. The position of the two 8 B.A. holes in relation to each other is unimportant. The cam wheel spindle can be made by turning a .061in. diameter "pip" at the end of a 3in. standard axle, as indicated at B in Fig. 12.

The throw of the cam is determined by the required displacement at the frame advance, and the size of the cam is governed by the lengths of the offsets relative to the wheel centre. The pitch between 9.5 mm. film perforations is 7.54 mm. (.297in.); the cam must, therefore, give a .297in. throw. The minor offset of the cam in this case is .067in. and as:

Throw = Major offset − Minor offset

and

Major offset = Minor offset + Throw,

The Major offset is .364in.

A greater minor offset than .067in. would produce a larger cam, which is not desirable due to the proximity of the gate bracket to the square follower and shutter when fitted. A lesser minor offset than, say, .062in. may weaken the cam at the vertex positioned at the cam wheel centre.

From 17 B.G. mild steel plate, or a thicker gauge plate faced to not less than .058in. thick, mark off the cam shown at A in Fig. 13 by drawing an equilateral triangle, the sides of which are .297in. long. Scribe a .067in. radius at each vertex of the triangle and blend a .364in. radius struck from each vertex into the respective .067in. radii. To obtain the correct throw it is essential that all the cam dimensions are accurately marked off.

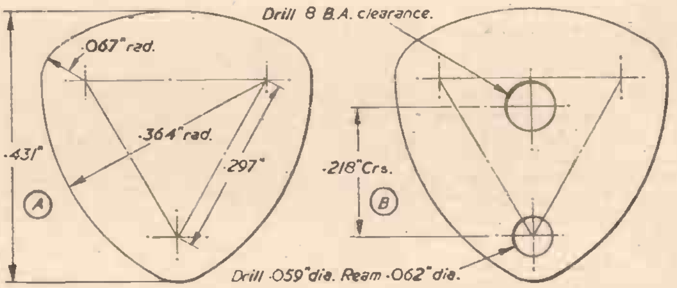


Fig. 13.—The cam, made from 17 B.W.G. (.058in. thick) M.S. (A)—Construction. (B)—Positions of holes.

Mark off the position of the two holes shown at B in Fig. 13, ensuring that their positions are correct in relation to the basic triangle drawn in the construction of the cam. Drill both holes, ream the .062in. diameter hole and cut out the cam, leaving sufficient metal all round to enable the cam periphery to be brought to its final size with a smooth file. The periphery should be square to the cam face and micrometer readings taken periodically across the periphery to ensure that the cam does not become undersized. The periphery surface should be finished smoothly, free from pits or file scratches.

The follower illustrated at A and B in Fig. 14 may be marked off from 17 s.w.g. mild steel plate. A thicker gauge plate, faced down to .056in. may be used, but the thickness of the finished component should not exceed .057in. The 9 deg. follower arm is to be pivoted 2in. below and on the vertical centre line of the cam wheel. The intersection point from the vertical cam wheel centre line position to the follower arm centre line (B in Fig. 14) should thus be .316in. (i.e., Tan θ2.0in.), the length of the arm between the intersection and pivot points 2.024in. (i.e., .316in. ÷ Sin θ) and the width of the arm .307in. (i.e., Cos θ .312in.).

As the index point is 2½ frames (.742in.) below the horizontal centre line of the gate aperture and the length of the claw (to be fitted later) .375in. from the claw tip to the follower arm centre line, the 8 B.A. tapped hole should be situated .692in. (plus .187in. to centre of claw slot) from the

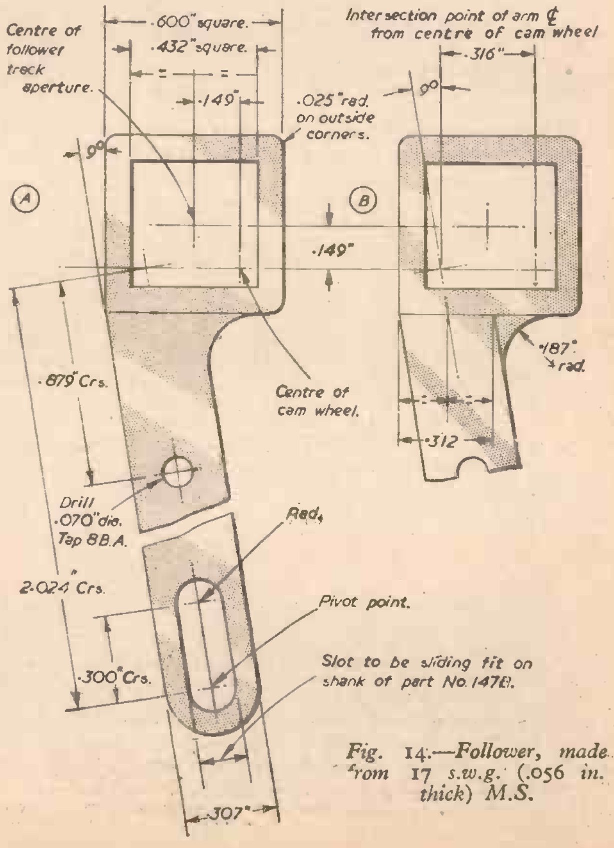


Fig. 14.—Follower, made from 17 s.w.g. (.056 in. thick) M.S.

intersection point of the follower arm, i.e.:

$$\frac{.375\text{in.}}{\text{Sin }\theta} = .742\text{in.};$$

$$\text{then } .187\text{in.} + \left(\frac{.375\text{in.}}{\text{Tan }\theta} - \frac{1.655\text{in.}}{\text{Cos }\theta}\right)$$

The dimensions shown at A in Fig. 14 were drawn using the position of the cam wheel centre as a datum point. The actual follower may be marked off in the same way with the material clamped to an angle plate which could be inclined to an angle of 9 deg. to mark off the follower arm. If desired by the constructor, the component may be marked off from the horizontal and vertical centre lines of the follower track aperture. Whichever method is employed the point to observe is the dimensional relationship of the follower track and the pivot point of the follower arm to the cam wheel centre.

Drill a 13/32in. diameter hole at the centre of the aperture and the two holes from which the pivot slot will later be formed. Drill and tap the 8 B.A. hole and cut out the follower to the dimensions at A in Fig. 14. The .432in. square follower track should be brought to its final shape and size from the 13/32in. diameter hole previously bored. Periodic Vernier caliper readings should be taken to ensure that the square track does not become oversized and that the relevant facets of the track are square and parallel to each other. The finished track should be smooth and free from tool marks. Form the pivot slot by removing the metal between the two holes previously drilled, leaving sufficient metal to enable the slot surfaces to be smoothly finished.

At B in Fig. 11 is shown the pulldown movement in an identical position to that shown at A, but with the shutter in position. The purpose of the shutter is to cut off the light beam at each frame advance, thus eliminating "ghosting" or the longitudinal streaking effect that appears on the image if a shutter is not employed.

This streaking effect, especially noticeable on a contrasting image (i.e., high lights on a dark background) is immediately apparent if the light beam reaches the screen whilst the film is in motion in the gate aperture. The film should be completely at rest in the aperture before the light beam is allowed to reach the screen and the shutter phased so that the aperture is completely obscured before the pulldown commences.

Shutter and Pulldown Sequence

The diagram at B in Fig. 11 shows the claw commencing the pulldown: the shutter blade I, shown in elevation, is at rest in front of the gate aperture; thus, were a beam of light J directed through the gate aperture from a source K and aiming at the objective lens L, the beam would be cut off by the shutter blade and light would not reach the objective. As the claw commences its downward movement the shutter blade rotates continuously and at the same speed as the cam wheel to which it is spigoted, obscuring the light beam until the claw terminates its downward movement and is drawn from the film. The successive frame of film will now be at rest in the aperture and the shutter will have turned through 120 deg. The blade edge M of the shutter will now be at position 1 previously occupied by the blade edge N, permitting the light beam to fall on the lens. The beam will again be intercepted as the blade edge N of the continuously rotating shutter reaches position 2 on the beam path and the light will be completely obliterated when position 3 has been reached by the blade edge N. When position 3 has been reached by the blade edge M the beam will be permitted to fall on the lens until the edge N reaches position 4. The light beam will then be cut off progressively as the blade edge N reaches its original position at 1, where the cycle is repeated.

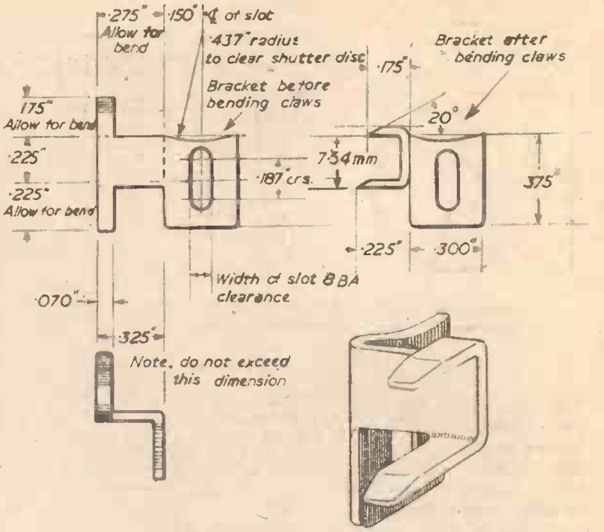


Fig. 17.—Stages in making up a double claw from 18 s.w.g. (0.48in. thick) M.S.

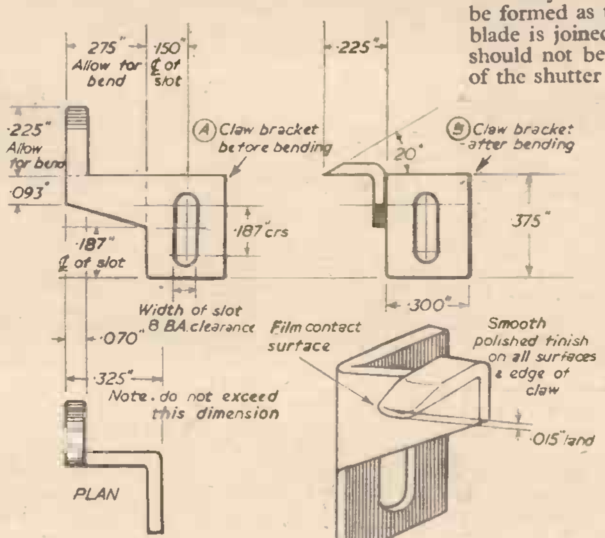
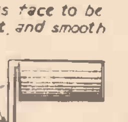


Fig. 16.—The claw bracket made from 18 s.w.g. (.048in. thick) M.S. (A)—Before bending. (B)—After bending.

Therefore, in the arrangement described above, the light is cut off at both the frame advance and the frame rest. The purpose of this additional light cut off whilst the film is at rest is to minimise the flicker. If the light were to be cut off only at frame advances (i.e., 16 c.p.s.) a pronounced slow flicker on the image would be perceptible to the viewer. By increasing the shutter frequency to 32 c.p.s. the flicker effect, although not eliminated, is reduced to a level tolerable to the viewer.



The Shutter

Mark off the shutter shown in Fig. 15 from 25 s.w.g. brass. The blade length should be .917in. (i.e., $\frac{\pi D}{3}$) before bending. Drill and cut out the component and ream the centre hole .062in. diameter. Bend the blade at right angles to the disc and form the blade to a 7/16in. radius, as indicated at B in Fig. 15, using a ⅞in. bar as a former.

It may be found that a true radius cannot be formed as the curve will flatten where the blade is joined to the disc at the neck: this should not be detrimental to the functioning of the shutter so long as the flattened portion does not exceed 1/16in. in width. The outside face of the disc should be flat and smooth, as this face retains the follower in position.

The Claw

Make the claw bracket, shown in Fig. 16, from 18 s.w.g. mild steel. The .325in. overall dimension from the mounting face to the outer edge of the claw should be maintained to ensure correct alignment of the claw and slot. To prevent inaccuracies in the bending operation the item could first be cut out, leaving approximately 1/16in. on the relevant dimensions for finishing to size after bending.

To avoid fracturing the film perforations the underneath surface of the claw tip only contacts the film (see perspective view of claw). The 20 deg. relief on the top face of the claw permits the claw to pass through the perforations to .025in. without the top face contacting the film and the .070in. width allows an approximate clearance of .012in. each side of the perforations. Bring the claw tip to a .015in.-.020in. land and radius the corners as in the perspective (Fig. 16).

Although a double claw is often used in sub-standard machines, the additional claw is by no means essential. Films with occasional tears at the perforations can be transported through the guide with the duplicate claw whereas, with a single claw, film in this condition may stop in the guide and the claw skid on the film.

Double claws, shown in Fig. 17, may be made if desired and can be adapted to the machine without modification to the claw slot of the gate bracket. The additional claw should be set at 7.54 mm. above the position occupied by the single claw already described, and set back so that in operation both claws engage in the perforations simultaneously.

(*To be continued*).

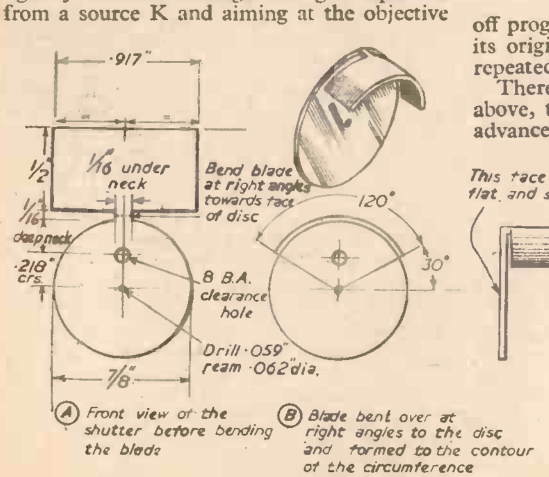


Fig. 15.—The shutter made from 25 s.w.g. (.020in. thick) brass. (A)—Front view of shutter before bending blade. (B)—Blade bent over at right angles to the disc and formed to the contour of the circumference.

An Electronic METRONOME

A Simple Audible Timer Using a Neon-tube Relay Circuit

By V. W. SCOTT

A NOVEL application of the well-known neon oscillator principle can successfully replace certain types of mechanically controlled timers such as the metronome.

The circuit consists essentially of a battery, delay circuit (R3 C1), a low voltage neon tube (V1), with a high-speed relay in the cathode circuit. When the neon fires the relay operates and connects a voltage across a 50 Ω telephone receiver, giving an appreciable "click." The theoretical circuit is shown in Fig. 1.

Absolute valves depend upon the time range required and will have to be selected to suit the discharge tube employed. A detailed explanation may assist in the solution of this problem.

The neon employed is a standard 70v voltage stabiliser (QS 70/20 or equivalent). Although the *striking* voltages of these neons vary from one to another, being anywhere within the range 85-100v, the important fact is that the specific firing voltage of one neon remains reasonably constant. (This must not be confused with the stabilising voltage.)

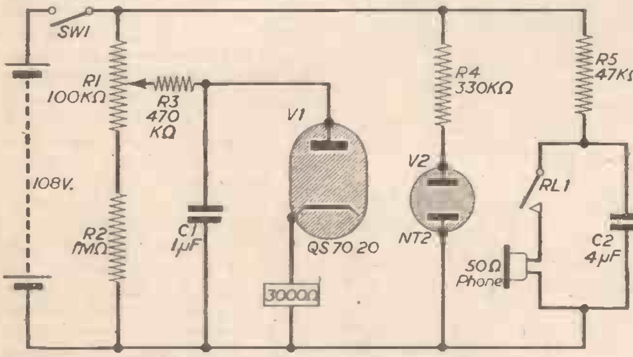


Fig. 1.—The theoretical circuit.

V1 was found to have a striking voltage of about 90v, so the battery supply voltage needed was only 108v. As the total current drain in this type of circuit is just over one milliamp, the small hearing-aid type of battery is adequate and enables the apparatus to be quite compact.

On closing the switch SW1, the supply voltage is applied to the potentiometer, R1 R2, and the selected voltage is fed to the neon via the delay circuit (R3 C1). After the initial charging time the repetition rate is determined by the time taken for the voltage across C1 to build up from the extinguishing level of V1 (below 70v) to the striking voltage (90v).

It is possible to calculate the value of the potentiometer (R1) required to cover the desired range of time variations, but this involves a rather tedious exercise in exponential functions. It is suggested that the reader uses the values given as a practical guide bearing in mind that the lowest voltage (i.e., the voltage across R2) must obviously be in excess of the neon striking voltage. The circuit given has a frequency range of approximately 70-140 beats per minute.

When the neon tube strikes the pulse of current is quite large, being drawn entirely from C1, but with the receiver connected in the cathode circuit the discharge is barely audible. However, the current is sufficient to operate a small 3,000 Ω relay. The contacts (normally open) close momentarily and connect C2 across the receiver, giving effective indication.

The value of R5 should be high enough to limit the amount of current drawn by the receiver, but enabling C2 to charge up to the supply voltage during the time intervals.

With regard to calibration of the apparatus, although non-linear, it is quite a simple matter to mark the dial at required speeds (e.g., 90, 120, etc.) over the period of one minute.

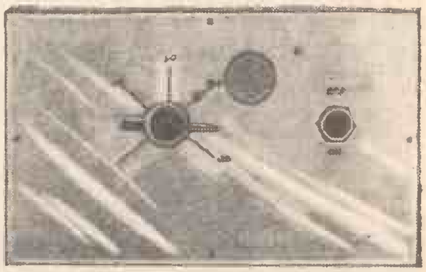


Fig. 2.—The author's completed metronome.

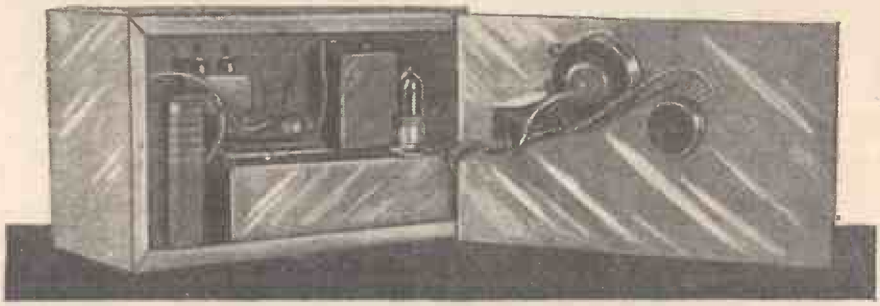


Fig. 3.—The interior layout of the author's instrument.

Finally, a certain amount of stability is required and it may be of interest to mention the fact that some discharge tubes, when in *complete* darkness, have considerable time lags before striking.

This irregularity may be overcome by placing a small neon, V2 (N.T.2), against the main neon, where it will provide sufficient illumination with negligible current drain. When switching on V2 strikes instantaneously and remains ignited throughout the operating period.

Arrangements for casing the instrument and layout are left to the individual constructor but Figs. 2 and 3, which show the author's metronome, may serve as a guide.

The Use of Dowels

DOWELS are those short pieces of round rod which are glued into two pieces of woodwork to hold it together. In the olden days dowelling was considered bad workmanship, and craftsmen only admitted a mortise and tenon and a satisfactory joint. Now, however, a great deal of furniture, cabinet work, etc., is held together by dowels and the amateur carpenter is also able to use them on a number of occasions.

Woodwork shops usually stock several sizes specially rounded and suitably prepared. A 3ft. length will, of course, do several jobs as dowels are not more than 2in. long for the largest work. For small jobs 1in. dowels are sufficient.

The size of the work determines how many dowels are required, whilst the thickness of the rails will give the diameter of the rod. If the dowel is half the thickness of the wood it should make a good joint. The work is held in a vice, so the brace and bit are used horizontally and not vertically. Sink the dowel hole half the length of the dowel into each portion of the work, dip the dowel in glue and then force home. Test with a square in boring and in fitting to ensure accuracy.

A Plate Back for a Roll Film Camera

A Useful Adaptor for Single Exposures

By P. WILDON

THIS "plate back" enables the user to take a photograph on a sensitive plate and process it immediately, instead of waiting for the end of the film.

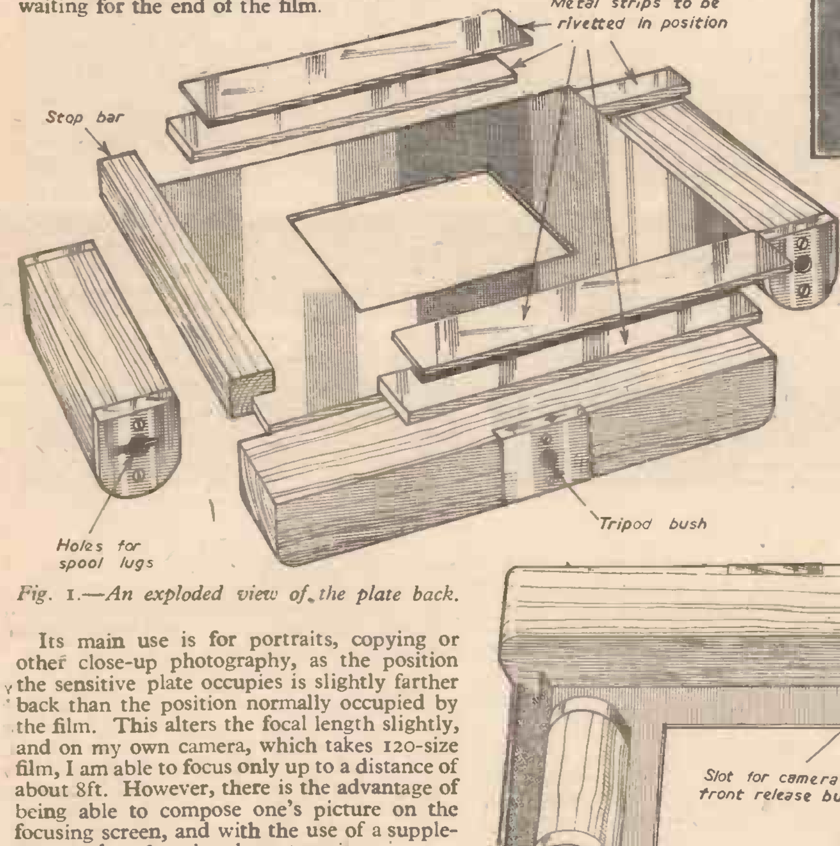


Fig. 1.—An exploded view of the plate back.

Its main use is for portraits, copying or other close-up photography, as the position the sensitive plate occupies is slightly farther back than the position normally occupied by the film. This alters the focal length slightly, and on my own camera, which takes 120-size film, I am able to focus only up to a distance of about 8ft. However, there is the advantage of being able to compose one's picture on the focusing screen, and with the use of a supplementary lens focusing down to 12in.

The first step is to obtain a focusing screen and slides, and the best plan is to purchase an old ¼in. plate camera complete with these from either a photographic dealer or a second-hand shop. I bought one for 30s. The focusing screen and slides are used with the "plate back," while the plate camera itself is used in an enlarger, details of which will appear later.

Construction begins with a small sheet of rigid metal, the length being the same as the back of the roll film camera. The width is determined by the width of the focusing screen and slides.

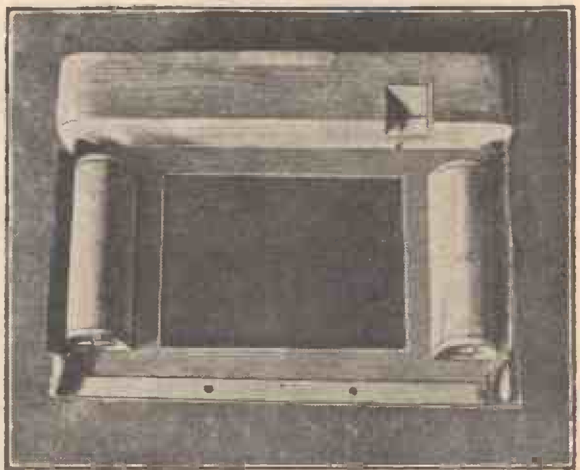


Fig. 4.—The author's plate back from the camera side.

Fig. 3.—Camera side of adaptor with shaped blocks in position.

It should be approximately ½in. wider at each side to allow for the metal strips which are riveted on for the screen and slides to fit into.

The picture aperture is then marked and cut out, a hole being drilled at each corner and sawn along with a hacksaw, after which the rough edges are smoothed off with a file.

The metal strips mentioned previously are now cut to size and riveted in position. There are two of these on both sides and one on the underside. The top strip is slightly wider than the one beneath it so as to prevent the slides from dropping out (see Fig. 1). The strip on the underside is for the edge of the camera to fit against, and so help to prevent any light seeping in.

A stopbar made of either wood or metal is then screwed across the end of the sheet. This is rebated underneath to allow a slide to fit under it. Two pieces of wood, semicircular in section, are then made to fit in the film spool chambers. These are faced with metal and have the correctly shaped holes cut in the ends, into which the film spool lugs fit (see Fig. 2). They are now screwed to the underside of the sheet, making sure that the strip of metal will fit snugly against the side of the camera when doing so. Care must also be taken to ensure that the sheet lies flush on the back of the camera when these are fitted, otherwise light is apt to creep in.

The half-finished plate back is now fitted in position in the camera and the position marked for a bar of wood to be attached underneath on the opposite side to the metal strip. This acts mainly as a support for the camera and also as a light trap.

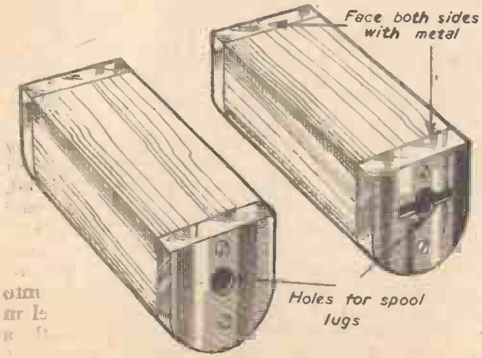


Fig. 2.—Shaped blocks to fit film spool chambers.

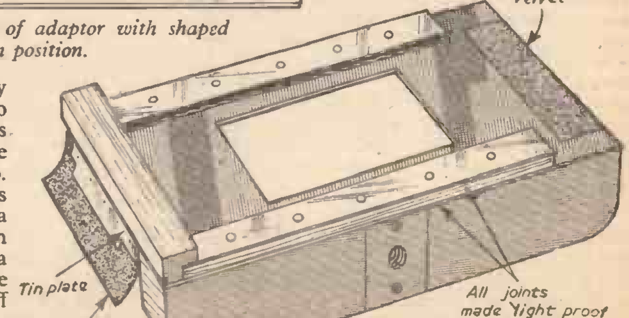


Fig. 5.—Method of light trapping.

A piece of metal which has been drilled and tapped is let into the side and screwed in position. This takes the place of the camera tripod bush. A slot is now cut across one corner to allow access to the press button which releases the drop front (see Figs. 3 and 4).

With the bar screwed in position, all that remains is to make the "plate back" absolutely lightproof.

A piece of velvet is glued on to the face to provide a light trap for the slides, and pieces of rexine or felt are tacked on to the outside of the semicircular blocks with correctly shaped pieces of tinplate covering them (see Figs. 5 and 6).

Any other apertures are carefully covered and all joints checked for opacity. Fig. 7 shows the adaptor in position and Fig. 8 shows it with focusing screen.

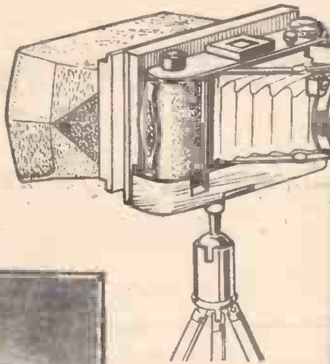


Fig. 8 (Above).—The plate back with focusing hood in position.

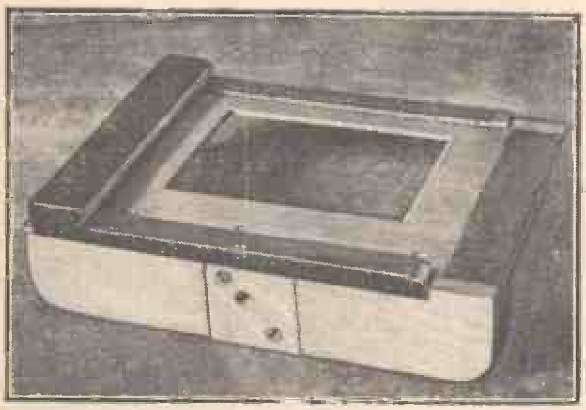


Fig. 6 (Left).—The plate side of the adaptor.

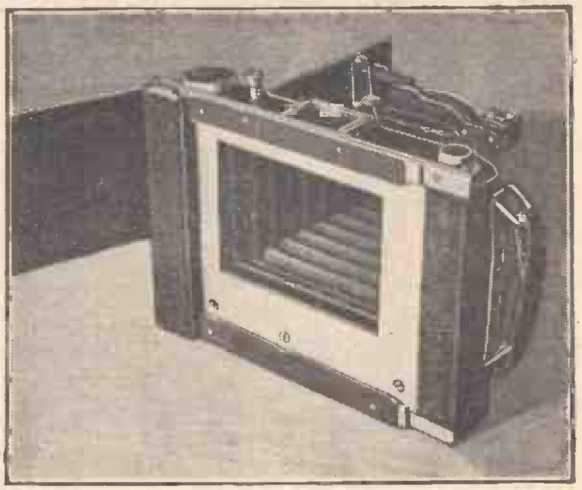


Fig. 7 (Right).—The plate back in position.

GAMMA RAYS

By FRANK W. COUSINS, A.M.I.E.E., A.C.I.P.A.

ELECTRO-MAGNETIC waves constitute radiant energy. All the waves travel at the very high velocity of 30×10^9 centimetres/second *in vacuo*. We are familiar with visible light waves and radio waves, which are a small part of the electro-magnetic spectrum shown in Fig. 1. The difference between the various waves of the spectrum is their wavelength. For example, the waves of light (visible light) have wavelengths between 4,000 and 8,000 Angstrom units (an Angstrom unit = 10^{-8} cms.). Radio waves, however, have wavelengths between 3×10^{14} and 4×10^6 Angstrom units.

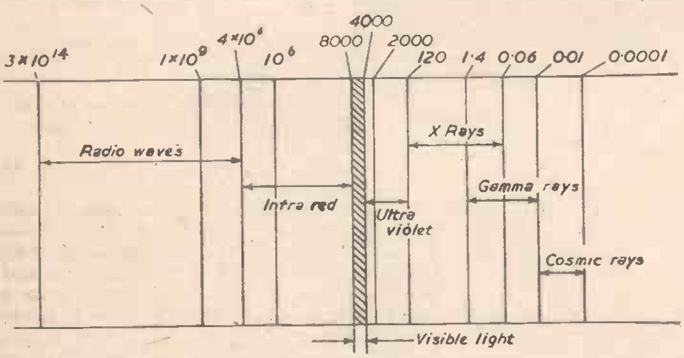


Fig. 1 (Left).—Electro-magnetic spectrum.

X-rays and gamma-rays are a form of radiant energy in the electro-magnetic spectrum distinguished by their extremely *short* wavelength (1.4 to 0.01 Angstroms). It is this characteristic that is responsible for the X-rays' and gamma-rays' ability to penetrate materials which absorb or reflect ordinary light.

Gamma-rays have even shorter wavelength than have X-rays. They are emitted during the disintegration of radio-active substances such as radium. It will be remembered that other well known types of radiation from radio-active substances are alpha-rays and beta-rays. Alpha-rays have been found to be helium nuclei and beta-rays electrons hurled out of the nucleus at speeds of 75,000 to 150,000 miles/second. Alpha-rays and beta-rays are particles, but gamma-rays are true electro-magnetic radiation. The gamma-ray radiation does not indicate a change in nuclear structure; it indicates merely a settling down of a nucleus from a higher energy state into a lower, or more stable, state. It usually follows some other reaction and is accompanied by no chemical change of the substance.

Not only radium but thorium, polonium and actinium emit gamma-rays. To-day it is possible to generate X-rays both longer and shorter than gamma-rays, the gamma-ray spectrum can be considered a portion of the X-ray spectrum. We have shown it so in Fig. 1. The nuclear significance of gamma-rays lies in their revelation of nuclear energy states analogous to those of the electron shells in the outer atomic structure.

In 1932 Anderson discovered a new particle of the nucleus—the *positron*—it is like the beta particle—or an electron—in every respect except for charge and life span. The positron is a positively charged electron that seldom exists longer than a fraction of a second. Positrons are very common in the field of artificial radioactivity; their existence, however, is transitory, for they unite readily with negative electrons in the creation of gamma radiation.

X-rays and gamma-rays are used extensively in non-destructive testing and inspection. The best known applications of this radiography have been with castings and welds that must stand up to high service pressures and temperatures. By means of radiography the foundryman can locate and identify internal defects and use radiographs as guides in improving his art. The method of radiography is derived from the fact that gamma- and X-rays darken a photographic film in the same way as visible light. The high penetrating power of the gamma-rays enables them to penetrate material opaque to visible light. A metal object containing internal cracks, gas cavities or inclusions of sand or slag is inspected by having the rays pass through it and form a radiograph (actually a shadowgraph) on a photographic film placed behind the object. Simple techniques of the kind mentioned above are shown in Fig. 2.

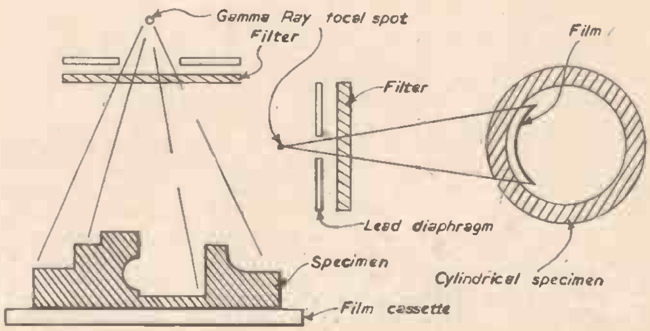
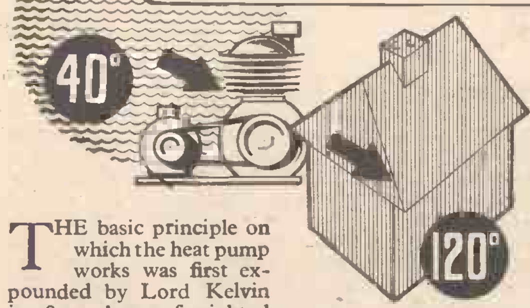


Fig. 2 (Right).—Principles of gamma ray radiography in industry.

THE HEAT PUMP FOR DOMESTIC HEATING



By ROLT HAMMOND, A.C.G.I., A.M.I.C.E.

How it Works : Type of Heating System to Use : Results from a Special Test Bungalow

THE basic principle on which the heat pump works was first expounded by Lord Kelvin in 1852. A very farsighted man, as well as an extremely able scientist, Lord Kelvin considered that in his day the heat pump would probably not be developed owing to the cheapness and availability of coal.

During recent years, however, heat pumps have been developed both in Great Britain and the U.S.A., brought about to a large extent by the high price and scarcity of coal, now being produced at a rate lower than our requirements. When coal is burned it provides heat at the high temperature of combustion ranging from 1,000 to 2,000 deg. F. and this heat is then lowered from these temperatures to a range of from 100 to 60 deg. F. for domestic purposes.

The aim of a domestic heat pump is to take up heat at otherwise commercially useless temperatures, from 10 to 50 deg. F., and to convert the heat efficiency to higher temperatures so that it can be used for heating a house. A heat pump is able to make use of the huge reserves of low-temperature heat stored in the ground, in water and in air. Using electric power to operate the pump, the combustion of one pound of coal in a power station will provide heat in a house with a value of 9,000 British Thermal Units, instead of heat at the extremely low value of 1,500 British Thermal Units when coal is burned in an open fire.

How the Heat Pump Works

Fig. 1 shows the working principle of a heat pump. Water or air is first passed through heat exchanger A, in the second element of which is a refrigerant like freon or ammonia, which can be changed from a liquid to a gas at temperatures ranging from 20 to 50 deg. F. available in the source of low-grade heat. Heat is thereby transferred in A from the air or water to the refrigerant, owing to the change of state of the latter. The air or water used as the source of low-grade heat will leave the outer element of A at a lower temperature than that at which it enters; in this case it is assumed that water enters at 40 deg. F. and leaves at 38 deg. F.

The gaseous refrigerant containing low-grade heat is drawn into the compressor, where it is compressed to that pressure which corresponds to the useful temperature required, that is from, say, 80 to 140 deg. F. Heat contained in the gaseous refrigerant is, therefore, changed from a commercially useless temperature to a useful one, and this is now transferred to heat exchanger B, through one element of which passes the water to be heated. Now this water is at a lower temperature than the gaseous refrigerant, so that the latter will give up its latent heat and will, therefore, be condensed; it will then pass through the expansion valve C and so back to heat exchanger A. The cycle of heat transfer is then repeated.

In other words, we have a system which has taken in commercially useless low-grade heat from water to which we add high-temperature heat produced by the compressor. It means that the user pays for a unit of heat in the form of electricity to drive the compressor, and converts the commercially useless heat contained in the water to heat which can be used for warming his house.

In a heat pump developed for domestic purposes experience has proved that the upper working temperature of the substance to be heated must be limited to about 140 deg. F. if the system is to be an economic proposition. Under normal conditions the heating system should be designed for a maximum temperature of between 130 and 140 deg. F. when using a heat pump.

Low-temperature Radiant-heating System

Experience has proved that maximum effect is achieved with a low-temperature radiant-heating system, using heated floors, ceilings or walls. With this system rooms are warmed by heating the structure itself rather than the air in the rooms. Radiant heat is emitted at low temperature, travelling upwards and in all directions; this radiant heat is partly absorbed and partly reflected. That proportion of heat which is reflected is eventually absorbed at some point of the surrounding surface or by the contents of the room, such as curtains and furniture.

All heat reflected from the floors, therefore, passes from surface to surface until at length it is absorbed by some of the surfaces or objects in the room. We, therefore, have radiation, then absorption, and the re-radiation or reflection, so that finally we come to a state of thermal equilibrium, in which practically uniform heating conditions are established in all parts of the room. In practice it is impossible to achieve complete thermal equilibrium, because there will be slight temperature differences between floors, ceilings and walls. Although such differences are small, they are large enough to set up convection currents and thereby to warm the air uniformly with a steady temperature balance.

A Test Bungalow

In 1951 a test bungalow was built for Mr. J. A. Sumner, M.I.E.E., M.I.Mech.E., and equipped with measuring apparatus and floor heating, so that long-term tests could be undertaken when using a heat pump in conjunction with floor heating. Pipe layout is shown in Fig. 2. The concrete floor of this bungalow, which has an area of 1,650 sq. ft., comprises a slab 5in. thick, resting on a sub-raft of vermiculite concrete 6in. thick. The edge of the slab above the vermiculite is separated from the surrounding brickwork by 1.5in. of wood. Experience appears to prove that the vermiculite slab can be discarded without serious downward heat loss occurring, assuming that adequate edge insulation has been employed.

The bungalow has unventilated 11in. brick cavity walls, a partially boarded loft and large window area. Windows and doors fit very well; since there is no fuel appliance likely to cause draught, rate of air change is less than one house-volume per hour. Accommodation consists of a dining-room and a lounge, two bedrooms, a large square hall of similar area to the rooms, kitchen, bathroom and workshop. During the last three years the coil section feeding one half of each of the two bedrooms has been cut out, thus giving a background temperature of 55 deg. F. in these bedrooms.

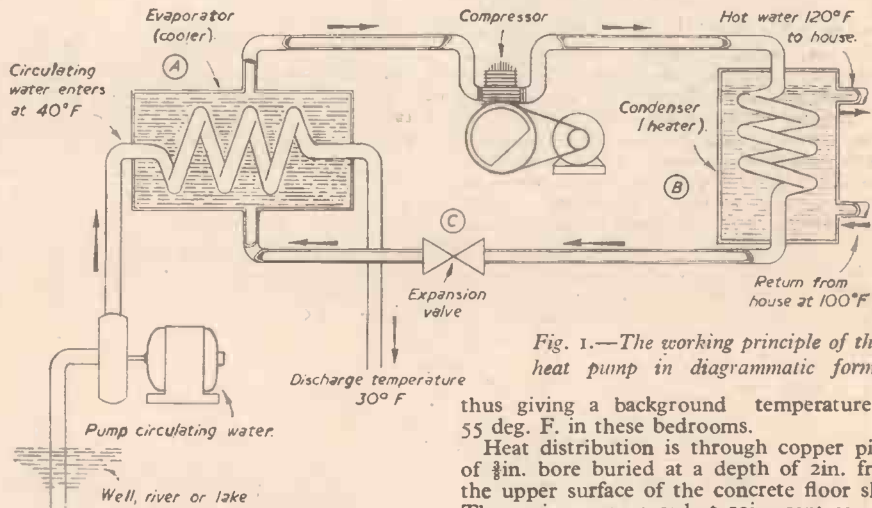


Fig. 1.—The working principle of the heat pump in diagrammatic form.

Heat distribution is through copper pipes of ⅜in. bore buried at a depth of 2in. from the upper surface of the concrete floor slab. These pipes are spaced at 12in. centres, and each room circuit is fed separately from a main header system fitted with sets of isolating valves. Water is heated by a heat pump, which can be changed over for test purposes to a 9.8 kW. immersion heater. The water is stored under thermostatic control in an insulated tank of 100 gallons capacity, from which it is pumped through the floor-heating circuit.

Heat demand has been based on conditions provided in the dining-room, the circulating pump being controlled from there by a thermostat mounted on the wall. There are no time-switches in the installation, and during tests the system was under thermostatic control alone. All floors are covered with Wilton carpets, except for kitchen and bathroom, which are tiled. The hall has a surround of linoleum to the central carpet.

Some Tests Carried Out

From January to March of 1953 a series of tests relating to floor heating was undertaken by Miss Griffith for the British Electrical Industry Research Association (B.E.I.R.A.). From our present point of view a special series of tests taken from October to December, 1954, is of particular interest, because steady running conditions of the heat pump became possible, using a coil of pipe in the ground as the source of low-grade heat. Two electric immersion heaters, with a total loading of 9.8 kW. were also installed in the storage tank for check and test purposes.

These experiments proved that the highest standard of heating, from 65 to 63 deg. F., results in higher temperatures than some people prefer. The whole house was maintained at an average of 64 deg. F. day and night and this represents a standard higher than is usual in most British homes. In order to maintain the same standard with coal fires it was estimated that the test bungalow would have required four fires in constant day and night use, but with considerable variation of room temperature.

In those cases where the thermostat would normally switch on the heat pump at about 10 p.m., the overall delay in resuming heating may be from 12 to 16 hours, which is greater than the "comfort hold over" period of the floor. No appreciable economy seems to be gained by lower night settings.

A standard temperature of 61 deg. was adopted by Mr. Sumner, as experience revealed that most men visitors found this quite comfortable for sedentary use without auxiliary heating ; some women preferred a slightly higher temperature. A room temperature of 56 deg. F. was too low for most people, more particularly if they were sedentary, and some auxiliary electric heating with a source of high-temperature radiant heat had to be used occasionally.

It is of interest to note that after the 1953 tests by Miss Griffith, two improvements in heat insulation were made. The first was to lay insulating slabs of expanded ebonite 1in. thick over the ceiling joists. A second improvement was to fit internal windows and thus to provide double-glazed windows with a ¾in. air space. The new internal windows consisted of glazed wooden frames screwed on to felt fixed on the wood rebates containing the outer casement windows. This is referred to, because attention to insulation has a tremendous influence on cost of heating over a year, and the capital cost of insulation itself will probably be paid off in a remarkably short time.

It was found that the most direct method of approximating heat loss of the building and heat output of the floor, is the practical one of discovering whether the design condition of 60 deg. F. indoor temperature can be satisfied when the temperature of the outdoor air is 32 deg. F.

During a period of test lasting seven days, the 3.6-kW. heat pump ran for only 68 hours. Power input to the machine was found to be approximately equal to the heat loss from the floor, assuming a calculated figure of 1,000 British Thermal Units per hour per degree Fahrenheit.

Another very interesting experiment was a "die-away" test. From the evening at 7 p.m. until the following day at 10 p.m. the heat pump ran continuously. For technical reasons it was shut down from 10 p.m. to 8.30 a.m. on the following day, after which it continued to run normally. Heat input to the floor from the heat pump during the total restoration period was much greater than the calculated heat loss of 1,000 British Thermal Units per hour per degree Fahrenheit from floor and building, but is about equal to loss of heat from the floor during the "die-away" period.

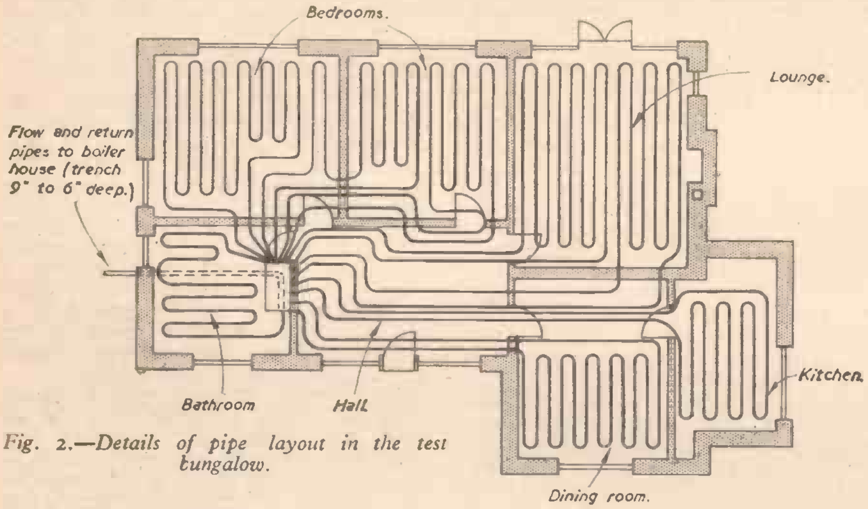


Fig. 2.—Details of pipe layout in the test bungalow.

Economics of the Installation

Considerable economy can be achieved by installing a heat pump. From the Electricity Supply Authorities' point of view, continuous heating for the whole house is being achieved with a maximum demand on the supply of only 3.6 kW. and a seasonal load factor exceeding 40 per cent. Moreover, the householder obtains continuous heating throughout his house with the equivalent of one large electric radiator, used for about 43 per cent. of the season. To provide equivalent heating with open fires would involve four fires day and night, with attendant labour.

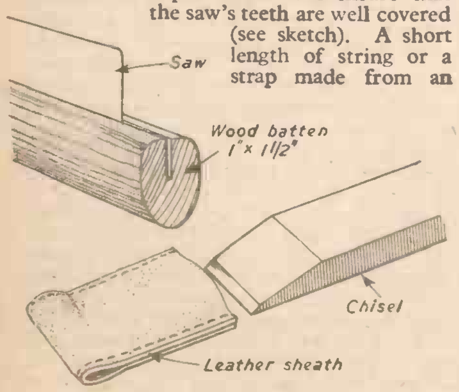
In the particular case quoted, the net cost of copper pipes, valves and labour cost in jointing and laying the pipes was from £70 to £100 after providing the circulating pump. Cases have been quoted recently of tenders from heating engineers for laying floor-heating systems in the ground floor of double-storeyed houses, which would have exceeded £300. From this we are driven to the conclusion that such contractors would prefer to install a conventional radiator system. However, there is no doubt that increasing scarcity of coal and its high price will have a powerful effect on the future development of the domestic heat pump.

Workshop Hints

Protecting Tool Edges

WHEN tools are carried all together in one bag, even on short journeys, they become jumbled together and often sustain damage. Whenever possible, it is advisable to protect the cutting edges. In the case of the saw, a shield made from a piece of batten, say 1in. x ½in. in section and a little longer than the saw itself is very handy. Using the saw, cut into the batten's edge to a depth which will ensure that the saw's teeth are well covered (see sketch). A short length of string or a strap made from an odd piece of leather will keep it in place.

Exposed chisel edges are very prone to damage and a sheath made of leather is ideal for protecting them. Take a piece 2½in. long, its width being that of the chisel plus ½in. Fold it across the middle and stitch the edges as shown in the sketch.—R. A. CROCKETT (Norfolk).



Protecting tool edges.

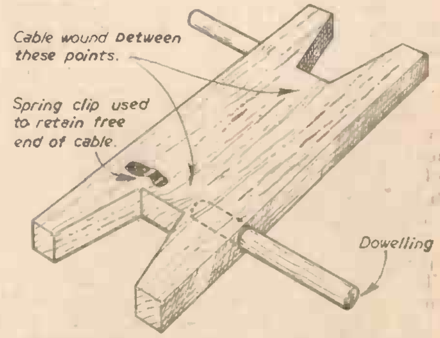
An Extension Cable Reel

IN order to avoid twisting or tangling, and also to provide a means of storing the cable when not in use, a cable reel has been devised as shown in the sketch.

Any piece of ¾in. wood in suitable dimensions would suffice, the two projecting pieces being dowelling of, say, ½in. dia. These dowels are glued in holes drilled horizontally into the main piece of wood.

Assuming that a power tool has been used with the cabling (and extension) fully extended, this is disconnected from the length of extension cabling. The free end of the extension is then placed under the spring clip, and the cable wound in by holding one dowel projection in each hand and turning the reel in a bicycle pedal fashion. The cable will automatically fall into the cut-out areas in each end of the reel.

The length of the reel can be varied to individual requirements, depending upon the length of cable involved. Other uses of the reel might be to hold cabling for car inspection lamps or a clothes line.—D. M. JARMAN (Welling).

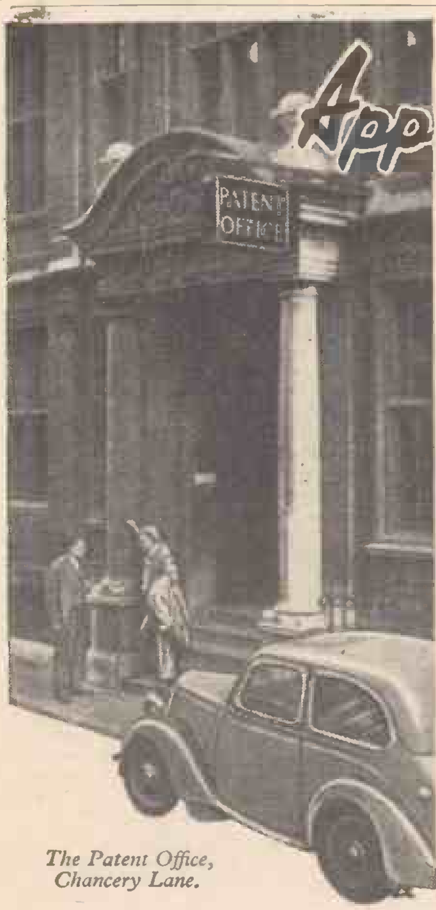


Mr. D. M. Jarman's extension cable reel.

A NEW SERIES

Applications for FOREIGN PATENTS

By "ATTORNEY"



The Patent Office, Chancery Lane.

Valuable Advice to the Inventor on Patent Provisions and Procedure Abroad. This Month—Austria, Belgium, Canada, and Ceylon

Continued from page 136, December issue.

Austria

AUSTRIA is a party to an International Convention enabling an application to be filed in Austria within one year from the date of a corresponding application in the United Kingdom and to be afforded priority rights. Patents are granted for a period of 18 years from the date of publication of the Austrian application. Patents of addition may also be applied for in respect of inventions already protected by a parent patent. A patent of addition is not subject to renewal fees, but expires with the parent patent.

An application may be filed in Austria by the inventor or his assignee and may also be made in the name of a firm or company. In the latter case the name of the actual inventor may be furnished and mentioned in the patent deed and on the official register. It is not usually necessary to file any assignment in support of an assignee application. In certain circumstances, however, the examiner may request information concerning an assignment during the examination of the application.

An application must be accompanied by a signed power of attorney in favour of the Austrian Patent Agents to be responsible for the filing and prosecution of the application. This must be accompanied by a specification in German giving a description of the invention and claiming the features believed to be novel. The specification and drawings, where required, must conform to precise requirements. If the application is filed under convention, the corresponding priority right must be claimed within two months from the date of application for patent in Austria and must give the date and country of the basic application. An officially certified copy of the basic or United Kingdom application does not have to be filed in the Austrian Patent Office unless officially requested.

The application is examined to make sure that it conforms to formal requirements and would be refused if the invention has been previously described in any printed publication, irrespective of country of origin. Prior public use or display of the invention in Austria would also be effective to prevent the grant of a patent. It is usually necessary to advance arguments to show that the invention in an application provides a technical advance as compared with the established prior art. After grant, the patent application is printed and printing fees have to be paid if the specification exceeds a prescribed number of pages and sheets of drawings.

After official publication of an application following acceptance thereof by the Patent Office, opposition may be lodged to the grant of a patent within a period of four months from the publication date. An application may be opposed on the ground that the invention is not novel or patentable and on other grounds. If an opponent has a patent which would be infringed by the performance of the invention covered in the application, the opponent may apply for a corresponding declaration. If no opposition is lodged against an application, a patent is automatically granted at the end of the four months' opposition period.

Austrian Patent Law recognizes third party rights, i.e., persons who have already used the invention or made practical arrangements for using it before an application is filed in Austria may, on strict proof, be given the right to continue such use. A claim to "User" rights is closely scrutinized by the Austrian Patent Office and must be fully proved.

The first annual renewal fee must be paid within two months from the date of official publication of the application in Austria.

If an Austrian patent is assigned after grant, the corresponding assignment must be registered in the Austrian Patent Office in order to be recognized by a Court of Law.

The invention covered by a patent must be worked in Austria within three years from the date of publication of the grant and if not so worked anyone may apply for a compulsory licence under the patent or apply for revocation thereof.

Austrian Patent Law does not, at present, require that patented articles must be marked with the patent number.

Application fees are from £37 15s. and renewal fees rise from £5 7s. at the second year to £52 for the last year of the term.

Belgium

Three kinds of patents may be applied for in Belgium, viz., a main patent, a patent of addition for an improvement or modification of an invention covered by a main patent, and a patent of importation. A main patent is granted for a period of 20 years from the date of application in Belgium. A patent of addition is granted for the unexpired term of the main patent. A patent of importation must be based on the first foreign patent, with respect to Belgium, to be granted. At the time of application for the patent of importation the basic foreign patent must still be in force. Assuming an importation patent to be based on a United Kingdom patent, the term of the former will correspond to that of the British patent. It is, of course, necessary for the patent of importation to be applied for by the owner of the foreign basic patent or his assignee.

Belgium is a party to International Convention arrangements which enable an application for patent to be filed with a claim to priority on the basis of a corresponding British application filed not more than 12 months earlier than the Belgian Application. The application may be made in the name of the inventor or his assignee which may consist of individuals, a firm or a company. An application filed in the name of an assignee must be accompanied by a priority assignment under signature by the applicant of the corresponding United Kingdom application.

Under present Belgian law, a patent application is only examined in so far as formal requirements are concerned and amendments cannot be made in the specification or drawings after the filing of the application. Although a Belgian application is not officially examined to determine whether the invention is novel, a Belgian patent is vulnerable if the invention has, before the effective priority date of the patent, been previously disclosed in Belgian or foreign printed publications. The patent would also be vulnerable if before such effective priority date the invention had been commercially used in Belgium. Amendment of the Belgian patent law is under consideration with a view to making it obligatory for the owner of a Belgian patent to have it submitted, within a period of five years from its Belgian filing date, to an International Patent Institute in Holland with a view to determination of the novelty of the invention. The findings of the International Institute are expected to be made available for public inspection after the expiration of the five years' period.

An application at present matures into a granted patent within a relatively short time after the filing of the application and there is no provision in Belgium for lodging opposition to the grant of a patent. Patent specifications are printed after grant and abridgments thereof are printed in an Official Journal.

An application for a Belgian patent must be accompanied by the first year's renewal fee and subsequent fees are payable annually. If a Belgian patent is based under Convention on a corresponding foreign application effective working of an invention in Belgium must take place within three years from the date of grant of the Belgian patent. Although according to Belgian Law a patent may be revoked on the ground of non-working, the risk of this happening is negligible owing to official recognition of certain International arrangements made at The Hague in 1929.

It is advisable for the Belgian patent number to be applied to the patented articles, although such marking of the patent number is not obligatory under Belgian Law.

Application fees are from £37 10s. 0d. and renewal fees rise from £4 15s. 0d. at the 2nd year to £28 0s. 0d. for the last year of the patent term.

Canada

The term of a Canadian patent is 17 years from the date of its issue and is not subject to the payment of renewal fees in order to keep it in force. An application for a Canadian patent is not available to public inspection until the patent has been issued.

Canada is a party to an International Convention under which an applicant for a United Kingdom patent can apply for the same invention in Canada within a period of 12 months and be afforded priority, as to conception date of the invention, from the date of the United Kingdom application.

An application in Canada may be applied for by the inventor or his assignee. The application documents comprise a special petition, a specification including claims in duplicate and one extra copy of the claims. Drawings, if required, must be filed in triplicate and conform to certain requirements. If the applicant is not the inventor but is the assignee thereof he must prove ownership of the invention as from the date of execution of the petition. It is necessary for the applicant to appoint a Canadian Patent Attorney or Attorneys to act on his behalf if he does not reside in or carry on business at an address in Canada. Where the Canadian application is made by an assignee, the assignment must be recorded in the Canadian Patent Office before issuance of the patent.

An official search is conducted through Canadian patents to ascertain whether the invention claimed in an application is novel. The Examiner may also refer to any other prior publications within his knowledge and usually requests an applicant to give particulars of prior specifications cited against corresponding applications in other countries. An invention is not regarded as novel if it was known or used by others before the applicant's invention of it, and if it was patented or described in any printed publication anywhere before the actual date of filing in Canada. If it has not been possible to file a Canadian application under Convention during the 12 months from the date of the corresponding United Kingdom application, an application may be belatedly filed, providing this occurs before a patent issues on a corresponding application in any other country. A Canadian application or patent is vulnerable if the invention has been used in Canada more than two years before the filing date of the Canadian application.

If an invention covered by a Canadian patent is not worked in Canada within three years from the date of issue of the patent, it is open to any interested party to apply for a compulsory licence. The patent would not be revoked on the ground of non-working if a compulsory licence is ordered.

Official actions in which objections are made against an application as to form or novelty must be usually answered within six months. The response to an official action must be prepared in a special manner and must include a written statement explaining the amendments and how they overcome the examiner's objections. Fresh pages of amended copies of the description must be submitted in duplicate and new claims in triplicate. If the examiner is not satisfied with the response, a second official letter marked "Final Action" will be issued and the applicant must then either amend the application further or ask for the examiner's action to be reviewed by the Commissioner of Patents. It is necessary in such a case for the applicant to submit a comprehensive statement of the grounds of disagreement with the examiner. In lieu of a request for review of a final action by the Commissioner an applicant may appeal directly to the court.

If during the examination of an application the examiner refers to a conflicting co-pending application, both applicants are informed by the commissioner and each is given an opportunity of amending his specification to avoid conflict. Alternatively, each applicant may file an affidavit in which the history of the origin and development of the invention supported by dates is given. An applicant may rely on a conception date of invention in any country. The commissioner after transmitting copies of the affidavits of one party to the other considers the affidavits and decides which applicant is entitled to priority.

A claim by an applicant to priority based on a United Kingdom application may be made at any time prior to the date of payment of a final fee to secure the Canadian patent. This must normally be paid within six months from the date of notice of allowance of the application.

As from the year 1949, Canadian patents have been issued in printed form.

A Canadian patent after grant can only be amended by surrendering the patent and applying for a reissue or by filing a disclaimer. Disclaimer procedure is usually followed when it is a question of cancelling a claim or some portion of the specification. A reissue patent is sought when the original patent is defective or the invention is inoperative through some error. It is necessary, in applying for a reissue patent, to state all the facts and reasons for requiring amendment of the specification and claims. If a reissue patent is granted it bears the date of the original patent.

Application fees are from £39 0s. 0d. and no renewal fees are required.

Ceylon

An application for patent may be accompanied in the first instance by a provisional specification in order to obtain so-called provisional protection for a period of nine months. In order to obtain a patent, the application must be continued by the filing of a complete specification, if necessary with drawings, before the end of the nine months' period or within 12 months upon payment of a fine. An application may, however, be accompanied by a complete specification in the first instance. This is essential if, as is permissible under International Convention arrangements, the application claims priority on the basis of a corresponding United Kingdom application filed not more than 12 months before the date of the application in Ceylon. The term of the patent is 14 years from the date of application in Ceylon or from the date of the United Kingdom application if priority based thereon is claimed.

An application may be filed by the inventor alone or jointly with another person or company. An application may also be filed initially by an assignee who may be an individual, firm or corporation. Where the application is filed by an assignee, the assignment duly executed by the inventor and legalised by a Notary Public must be lodged in the Ceylon Patent Office. If a convention application is made by an assignee, however, it is not necessary to record an assignment. The application must be made on a special form which has to be signed by the applicant in the presence of a Notary Public in the United Kingdom.

An official search is made to ascertain whether the invention submitted in the complete specification is novel. The search is conducted only through Ceylon patents. An invention is not regarded as novel if it has been previously published or publicly used in Ceylon. The complete specification must be accepted within 12 months from the date of filing the application in Ceylon. An extension of time, however, of three months for acceptance can be obtained. Acceptance of an application is advertised in an official gazette and the specification is laid open to public inspection for three months during which time any interested party may lodge opposition on a number of grounds, including the ground that the invention has been published or used in Ceylon prior to the priority date of the application. In the absence of opposition, a request for sealing of a patent must normally be made within 15 months from the date of the application.

In order to keep the patent in force, annual renewal fees are payable commencing at the end of the fourth year from the date of application in Ceylon or from the priority date in the case of a Convention patent.

If an application cannot be filed in Ceylon under the International Convention owing to the expiry of the priority period of 12 months, an application may be made for registration of the British patent. The registration will remain effective for the unexpired term of the British patent. It is necessary, in order to effect such registration, to file in the Ceylon Patent Office two officially certified copies of the sealed United Kingdom patent and two officially certified copies of the United Kingdom printed specification. A further document required is an affidavit which sets out that the applicant for registration of the British patent is the owner thereof. This affidavit must be sworn before a Notary Public.

If a patent is assigned after grant, the assignment must be recorded in Ceylon and a request signed by the assignee must be made for his name to be entered as Proprietor on the Official Register.

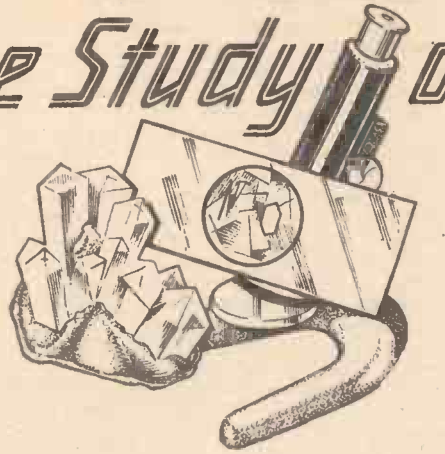
If a patented invention is not worked in Ceylon within three years from the date of the patent application, or the priority date, anyone is entitled to apply for revocation of the patent or for a compulsory licence thereunder. It is not necessary for patented articles to be marked with the patent number.

Ceylon patent specifications are not issued in printed form.

Application fees are from £26 10s. 0d. Renewal fees rise from £6 0s. 0d. at the fifth year to £12 15s. 0d. for the last year.

(To be continued)

Aids in the Study of Geology



SOME source of artificial lighting is required for use with a microscope, and this can vary from an ordinary reading lamp to special types of illuminants manufactured specially for that purpose. The author desired a lamp which could be made to transmit its ray through the microscope without any serious escape of light to fog photographic materials at hand. Figs. 1 and 2 illustrate the basic construction.

No. 2.—Making a Microscope Lamp and Plate Camera

By E. J. WILKINSON

Lamp Construction

The body of the lamp consists of a metal can of the type having an overlapping lid. Measurements of the original are given, but these can be varied to suit materials available.

The base of the can has a hole cut in its centre, which is large enough to clear by about 3/16in. the bayonet socket of a pendant type *metal* lampholder. This clearance is to allow for the circulation of air through the lamp. Four (three would be sufficient) 3/16in. holes, equally spaced, were drilled around the lamphole, half way between it and the edge of the can, and 3/16in. Whitworth bolts inserted from the inside of the body and secured with nuts. Extra nuts served as spacers between the base and the tin which caps it.

One of two fourpenny pie tins from a well-known multiple store was then drilled with 3/16in. holes to match the bolts in the body, and a central hole cut, into which the lampholder could be fitted. The lampholder had an extra shade-ring screwed on before inserting in the pie tin so as to raise the lamp as much as possible. The pie tin was then locked in place over the body of the lamp with washers and nuts, as shown at A in Fig. 1.

To provide for the entrance of cool air the lid (to be the bottom of the lamp) was drilled with a central 3/16in. hole and then by others spaced around it, as shown. These ventilation holes should not be positioned too close to the edge. A disc of tinplate was next marked out with a diameter ⅜in. less than the inside diameter of the lid, cut and drilled 3/16in. in the centre. This was bolted to the inside of the lid with two nuts between to act as spacers, thus allowing air to come through the holes in the lid and round the edge of the disc (the body of the lamp takes up some of the clearance when the lid is placed on it). The second pie tin was drilled and attached to the outside of the lid, again with two nuts as spacers. When surfaces within the two light traps had been painted matt black, this formed a virtually light tight casing.

The Light Outlet

This was made up in three parts. Two tubes 1¾in. in diameter, one 1⅛in. long, the other 2¼in., were made of tin plate and their joints soldered. From the same material, a narrow box was made up from the pattern shown at B in Fig. 1. Each face of the box had a hole cut at its centre large enough to allow the tubes to fit snugly. When bending the tin plate to form the filter holder, care had to be taken to ensure that the two holes corresponded. In this respect errors could have been rendered unimportant by making the shorter tube, say, 1½in. diameter. The two tubes were then fitted into their respective holes in the carrier (making certain that a minimum of metal projected inside the latter) and soldered all round.

It should be explained that the carrier is designed to take 2in. by 2in. lantern-slide cover glasses which are used as filters or, when suitably ground, diffusers.

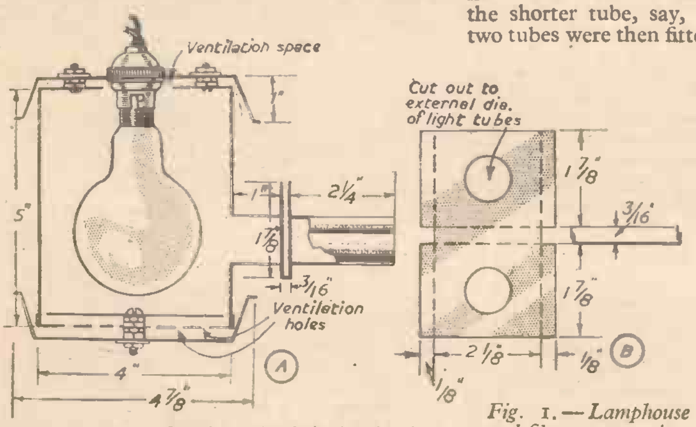


Fig. 1.—Lamphouse and filter construction.

The position at which the shorter tube enters the body of the lamp was determined by placing a 60-watt pearl bulb in the lamp socket and finding a point on the casing directly opposite the greatest diameter of the lamp. A hole was cut to take the shorter tube on the filter carrier and the latter soldered into position. The open end of the filter carrier was arranged to face the lamp socket end of the casing.

Sliding Bracket

Dimensions for the unit which attaches the lamp to its column are given at A in Fig. 2. Sheet steel of a light gauge was used for x, while y is made in hardwood, bored 5/16in. and filed out slightly to make a sliding fit on the 5/16in. diameter steel column. The saw cut and wing nut and bolt make clamping at any position on the column an easy matter. The bracket x is secured to the wooden clamp with a round-headed wood screw, a spring washer between two flat ones serving as a friction plate to prevent the union from working slack. Four 6B.A. bolts attach the bracket to the lamp.

Column and Base

The column, a 1ft. 6in. length of mild steel rod, was threaded for a distance of 2in., the other end being rounded off with a file. Consisting of two pieces of soft wood, connected by a halving joint (B in Fig. 2), the base is made with one foot longer than the other three. The lamp overhangs this longer foot, as can also be seen in Fig. 3.

Two hexagon nuts secure the column to the base, while four rubber cushions on the underside avoid the necessity for recessing the lower nut of the two.

The lamp was finished in black crackle paint; the wooden base and clamp in black enamel.

When the lamp was wired, a switch of the push-button type was connected into the circuit on an extra yard of flex as shown at C in Fig. 2. The reason for this is explained later.

The lamp can be used in any position—shining down on to the microscope mirror, or passing its light directly into the substage.

Filters

The ordinary tungsten filament lamp gives too reddish a light for geological work, upsetting to some extent polarisation colours. A piece of medium blue Cellophane placed between two lantern slide cover glasses and

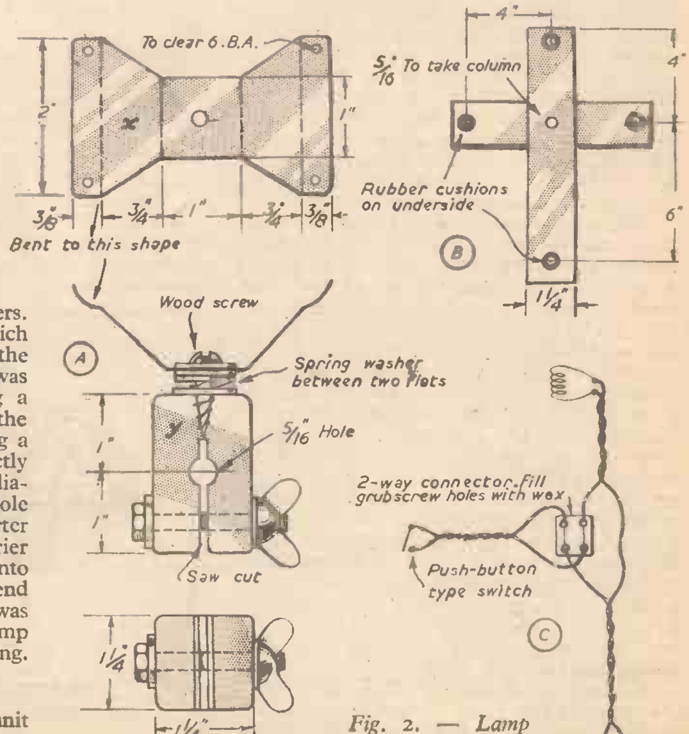


Fig. 2. — Lamp bracket, base and circuit.

bound with adhesive tape of some kind provides a simple yet effective method of correcting this trouble. In addition a 2in. by 2in. cover glass, ground on one (or both) sides makes a useful light diffuser which can be slipped into use when necessary. Those readers who are interested in the lamp for microscopic work other than with rocks could, of course, make up filters to suit their special needs.

Fig. 3.—Lamp unit and adjustable stand.

A Plate Camera

It is a simple matter to place any ordinary camera with its lens against the eyepiece of a microscope and make a time exposure of whatever is in focus on the stage. The amateur microscopist, however, working during whatever leisure time he can devote to his hobby, is seldom in a position to use up a roll of film in one sitting. Should a negative be a failure, it is far better to find out on the spot and make a further exposure while the microscope and other apparatus is at hand and already set up. It was with this consideration in mind that the author decided to abandon his roll-film camera for microphotography and experiment with a home-made plate camera.

The task is far simpler than might appear at first sight. Firstly, the microscope is the camera lens; secondly, as all exposures are "time," the micro-lamp acts as an effective "shutter." In other words, all one really needs is a box into which photographic plates can be inserted at one end, and with a hole at the other against which the microscope eyepiece can be placed. The apparatus is intended for use in a darkened room, but as one wishes to develop as soon as each plate has been exposed, this is no handicap whatever.

Camera Design

Designing began with a piece of stiff white card on which a 2in. diameter circle had been drawn. The microscope was arranged horizontally and the micro-lamp adjusted so that its light tube fitted close up to the sub-stage. This left the room in almost total darkness when the main light was switched off. With a slide in focus on the stage the card was moved away from the eyepiece until the image of the specimen was made to fill the 2in. circle, refocusing of the microscope being necessary as the distance from card to eyepiece increased. The diameter of the circle the image was made to fill was decided by the fact that 2¼in. × 3¼in. plates were to be used with the camera. The distance from card to eyepiece was 3½in. when the image filled the circle, but this will vary from one type of instrument to another.

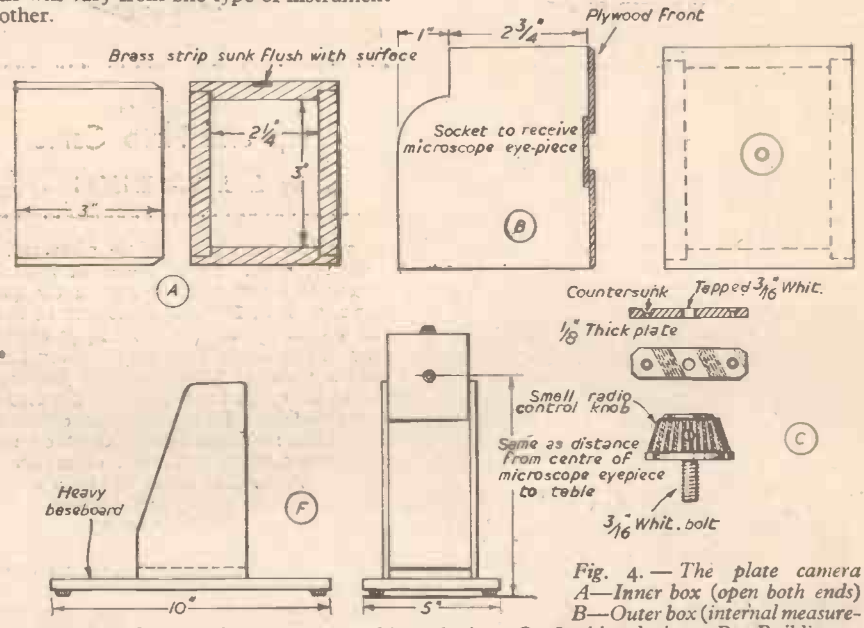
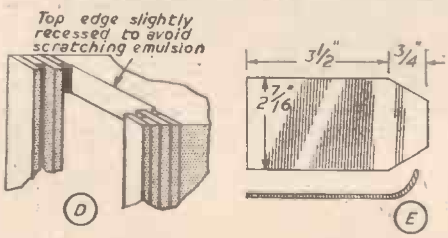


Fig. 4.—The plate camera A—Inner box (open both ends) B—Outer box (internal measurements to match external measurements of inner box). C—Locking device. D—Building up plate grooves on back edge of inner box. E—Camera back plate. F—The camera stand.



Construction

Instead of a single box measuring 3½in. from front to back, it was decided to allow for some adjustment so that the image size on the plate could be altered—chiefly increased. Two boxes, one to fit within the other, were made as at A and B in Fig. 4. The top and bottom of each box was simply rebated and the sides glued and panel pinned into position, making sure that they were square. When the glue had set, the outside faces of the inner box were treated with a scraper until it would slide smoothly inside the outer one. Only the more important measurements are given as the others depend upon the thickness of the wood used—in the prototype ⅜in. mahogany. The side pieces of the outer unit were shaped as shown at B in Fig 4. with the idea of giving extra stability when the inner part of the camera is fully extended.

The outer case was given a 3-ply front in which a hole large enough to admit the microscope eyepiece had been cut and then backed by a disc of ply, having an aperture a little greater than that of the eyepiece.

To ensure that, after adjustment, no movement of one box relative to the other could take place, a locking device (C in Fig. 4) was fitted to the top (back edge) of the outer box. This consists of a ⅛in. thick metal plate tapped 3/16in. Whit. at the centre and drilled and countersunk at each end to take wood screws. A small radio control knob, fitted on to a beheaded Whit. bolt completed the unit. The top of the box was marked from the holes in the plate and the centre mark drilled ½in. to give easy access to the locking bolt. The plate was then screwed into position. To avoid damaging the corresponding face of the inner unit, a narrow strip of brass was let into it so as to receive the applied end of the locking bolt.

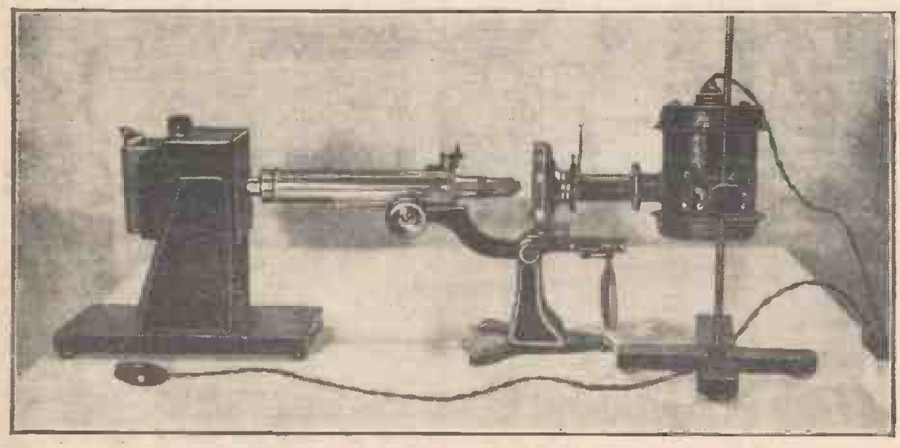
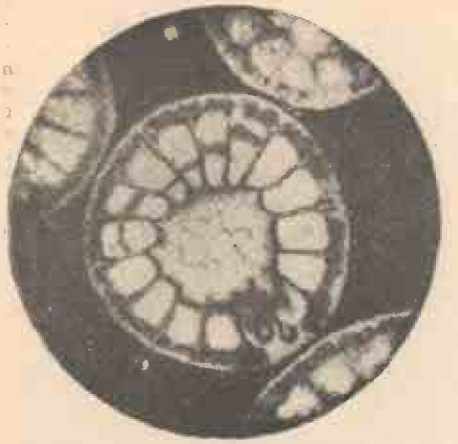


Fig. 5.—The apparatus set up for use.

The Plate Carrier

Being intended solely for occasional microscopic work, it was decided that the plate carrier could be made quite satisfactorily from cardboard. A piece slightly thicker than a photographic plate *with* emulsion surface was chosen and cut into ¼in. and ⅜in. strips. Two of the narrower strips were cut to length and glued down the back edges of the inner box so that a plate (actual dimensions 2¼in. × 3¼in.) would slide freely between. A ⅜in. strip along the bottom edge provided a stop against which the plate could come to rest. Over these three strips were then glued ⅜in. strips, so forming a groove. Two more strips of ¼in. wide card were attached as a third layer, but with a further ¼in. strip across the bottom.



Coral (transverse section). X30. Kodak B40 plate. Ordinary light, one minute.

Intergrowth of quartz and felspar in syenite. X30. Crossed Nicols. Kodak B40 plate, one minute.

Volcanic ash. X30. Kodak B40 plate. Ordinary light, 45 seconds.

Nummulitic limestone. X30. Kodak B40 plate. Ordinary light, 20 seconds.

Spores in coal. X15. Kodak B40 plate. Ordinary light, one minute.

Fig 6.—Examples of microphotographs.

A fourth layer of ⅜in. strip round the three edges completed a second groove (D) to receive a metal backing plate cut to the dimensions given at E in Fig. 4. It was found necessary to file down slightly the top edge of the box so as to avoid scratching the emulsion surface of the plates as they were inserted and removed.

When a plate is in position in the camera, ½in. of it projects above the surface of the box—just sufficient to enable it to be easily withdrawn after exposure. A cardboard cap to fit over this portion was made so as to prevent any stray light from affecting the plate.

For focusing, the plate which had been sacrificed for its dimensions was cleaned of emulsion and ground on one side with medium carborundum powder on a piece of plate glass.

The Stand

With the microscope tube in a horizontal position the distance from the centre of the eyepiece to the table was measured. This height remains constant so no provision for adjustment of the camera position was necessary. Any stand similar to that shown at F in Fig. 4 would serve. When securing the camera to its stand the distance from the centre of the camera aperture to the table was made the same as for the eyepiece-table measurement, the camera being kept parallel with the base of the stand by checking with a spirit level.

All inside surfaces which might give reflection during exposure of a plate, including the metal back plate and aperture socket, were painted flat black. The completed camera is shown in Fig. 5.

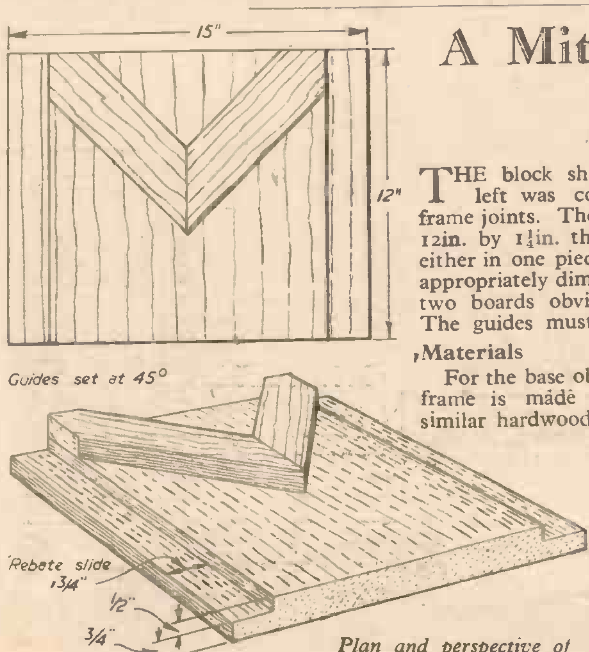
Using the Apparatus

When any microphotography is to be undertaken the room is darkened as for the developing of whatever type of plate is being used. With the microscope and lamp arranged horizontally and as close together as possible, the slide on the stage is focused and positioned. Then the camera is brought up against the eyepiece. (The apparatus is shown in position in Fig. 5.) With the back plate removed, the image is *refocused* on to the ground glass screen (ground side towards the light, and in the same groove as the unexposed plate will be placed). When satisfied that the image is sharp and evenly illuminated, the micro-lamp is switched off (the extra yard of flex to which the switch is attached enables the light to be operated from one's position by the camera). By the glow of the safelight an unexposed plate is substituted for the ground one, taking care to face the emulsion side towards the microscope, and the cap fitted over the projecting end of the plate. The back plate can be slid into its groove before this is done, and care must be taken that the camera is at no time moved, though the rubber cushions on the base make a good non-slip contact with the table. It is then simply a matter of making a suitable exposure by switching on the micro-lamp for a calculated period and removing the plate to the previously prepared chemical baths for development.

No hard and fast guide as to suitable exposures can be given. The speeds of various types of plates vary as well as the subjects being photographed and intensity of lighting. The exposure data accompanying the microphotographs in Fig. 6 will, however, act as a rough guide to any who have never attempted such work before.

A Mitre Shooting Block

By A. CROZIER



Plan and perspective of the shooting block.

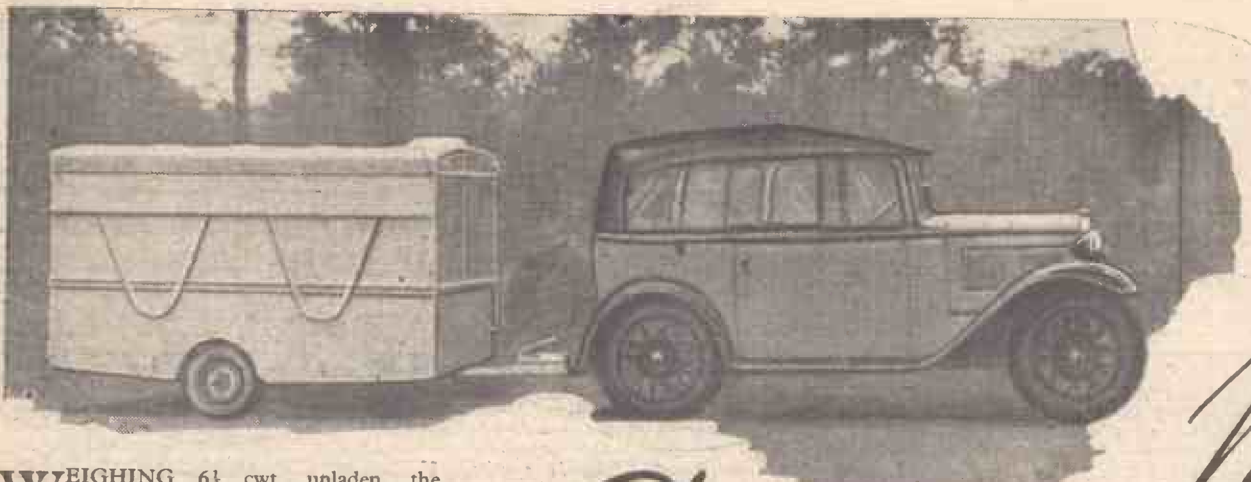
THE block shown in the illustration on the left was constructed for shooting picture frame joints. The outside dimensions are 15in. by 12in. by 1¼in. thick and the base may be made either in one piece or by gluing and screwing two appropriately dimensioned boards together. Using two boards obviates the necessity for rebating. The guides must be set at exactly 45 deg.

Materials

For the base obeche wood can be used and the frame is made from two pieces of beech or similar hardwood, 2¼in. by 1in.

Using the Shooting Block

In use, simply cut the mitres and place the timber against the guides, so that the mitre edge is parallel to the edge of the rebate slide, turn the block plane on to its side and trim accordingly. The mitre block is suitable for timber 1in. wide and ⅝in. thick.



Drawings and No[...]
Construction of a [...]
Opens Out from [...]
Position in [...]

By W. A. HO[...]

Making Camping [...]

WEIGHING 6½ cwt. unladen, the trailer's measurements are 7ft. × 4ft. × 58in. high from the ground when closed, and 7ft. × 8ft. × 6ft. headroom when in use. This area comprises locker space on each side of the 6ft. × 3ft. floor area, curtained wardrobe and storage recesses, also a fold-away sink. It is made mainly of hardboard and the emphasis is on simplicity of construction. The interior of the trailer in the open position is shown in Fig. 6.

The cost of making would have been £45-£50, but this figure was greatly reduced by looking around for cheap materials, various sections being made and stored as the material for the job was obtained.

Chassis, Wheels and Springs

The chassis is made of 27ft. of 1½in. × 1½in. × 3/16in. angle iron, which can be bought at steel stockists, engineers' shops, builders' merchants and sometimes from scrap yards. The sketches given at Fig. 1 show its layout. Bolting the seven members together, as shown, before arc welding, makes the welding job easier, quicker and, therefore, cheaper, also greatly assists in keeping it flat. Two pieces of angle iron illustrated in Fig. 2 are also welded into position on the underneath side of the hitchplate, one each side of the parking-brake lever slot.

The towing hitch used is of the type shown in Fig. 3 and costs approximately £3 5s. od. These can be purchased from caravan equipment specialists such as Joy & Kings, Kensal Rise, London, N.W.10.

The wheels used are the type used on builders' barrows; these have 4 P.R. (ply rating) tyres which are suitable for road use. Air pressure required was found to be 25lb. sq. in. The wheels were altered, as shown in Fig. 4, to enable them to be mounted on Austin 7 stub axles, so giving the wheels the bearings and braking system which are required on trailers of over 2 cwt. These wheels can be obtained new from builders' merchants.

For the axle a length of 1¼in. × 1¼in. steel bar bought at a scrap yard proved suitable, the weight helping to keep the small wheels on the ground. The pair of Austin 7 stub axles bought at the same time make up the wheel unit. Fitting of the axle to stubs can be seen in Fig. 5. The clamping plates are finally arc welded to the stubs.

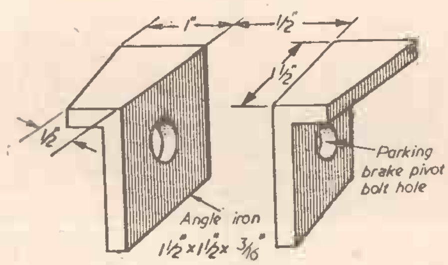
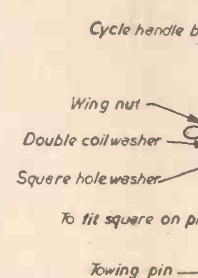
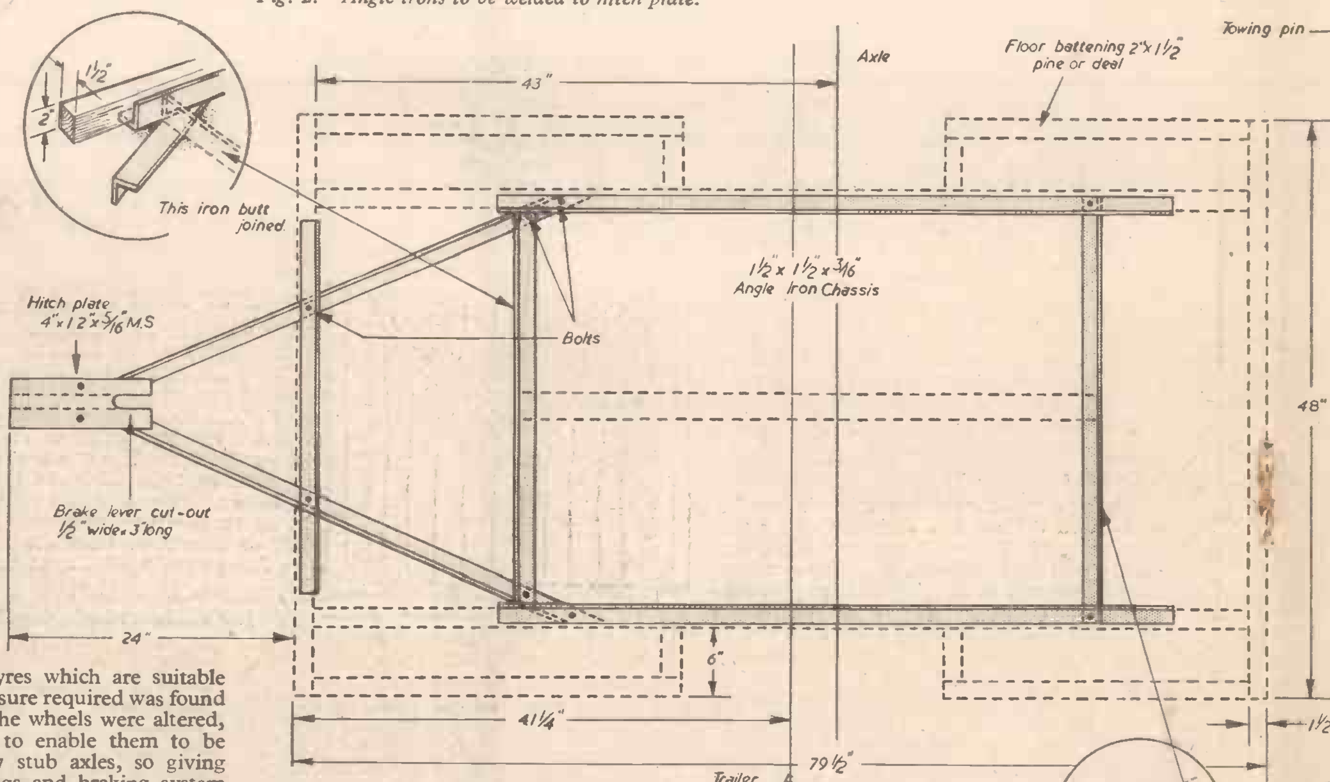


Fig. 2.—Angle irons to be welded to hitch plate.

Springing is effected by a pair of 1938 Morris 8 springs purchased from a Morris spares agent. Having seven leaves, these springs are sturdy, which is a necessary attribute for use with small wheels. This sturdiness, coupled with the correct tyre pressure, gives very steady towing; the springs cost £2 each.

In the chassis sketch (Fig. 1) it will be seen that the wheel centre line is behind the trailer centre line. Putting





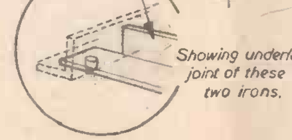


Fig. 1.—Layout of chassis and floor battening (battening shown dotted).

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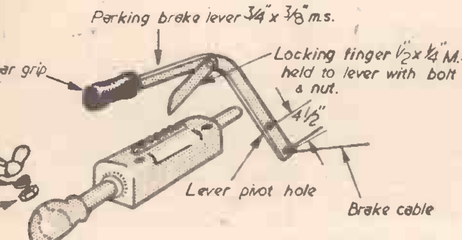


Fig. 3.—The type of hitch and brake lever employed.

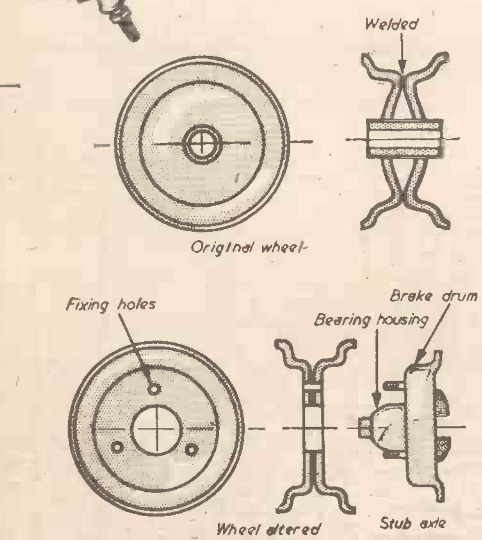


Fig. 4.—Builder's barrow wheels altered to suit Austin 7 stub axles. Fig. 6 (Right).—The interior of the author's trailer.

the wheels farther back in this manner gives more weight to the towing end, lessens snaking and helps to keep the back of the towing vehicle down. The weight of the front half (wheels to towing hitch) is ¾ cwt. more than the back half.

Floor, Ends and Sides

The dotted lining in Fig. 1 shows the layout of floor battening, this being screwed into position with 24 1¼in. No. 10 wood screws, screwing from underneath and side of the angle iron, so locking the battening into position. On to this is made the floor, made up of 75ft. of ⅞in. × 5in. prepared tongued and grooved boards. The ends of this lower part of the trailer are also made from the same size boarding, the boards being glued together with Scotch glue. A few wriggly nails assist in keeping them together while the lengths of 2in. × 1in. on each side of the ends (see Fig. 8) are glued and screwed into position. A central

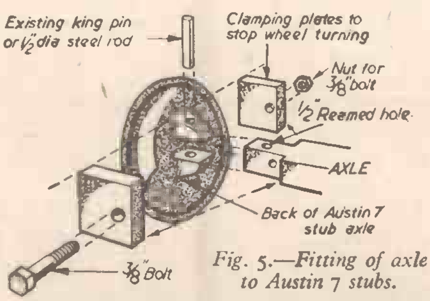
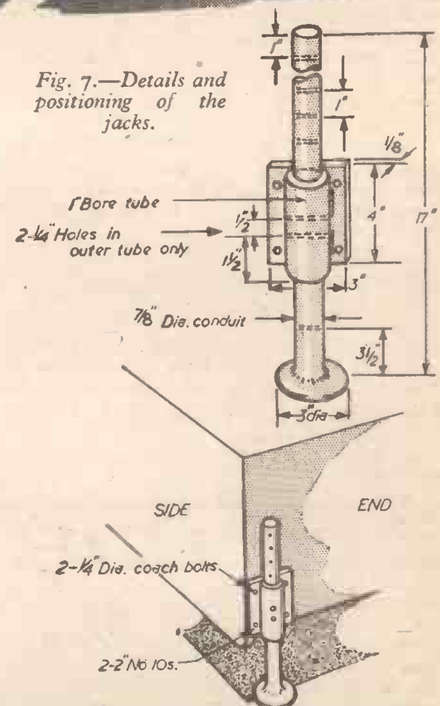
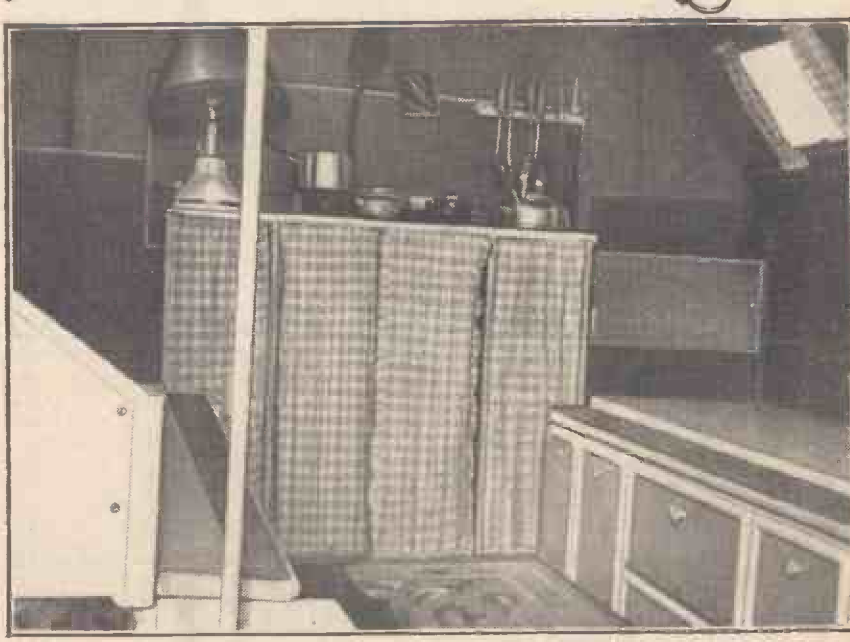


Fig. 5.—Fitting of axle to Austin 7 stubs.

Fig. 7.—Details and positioning of the jacks.





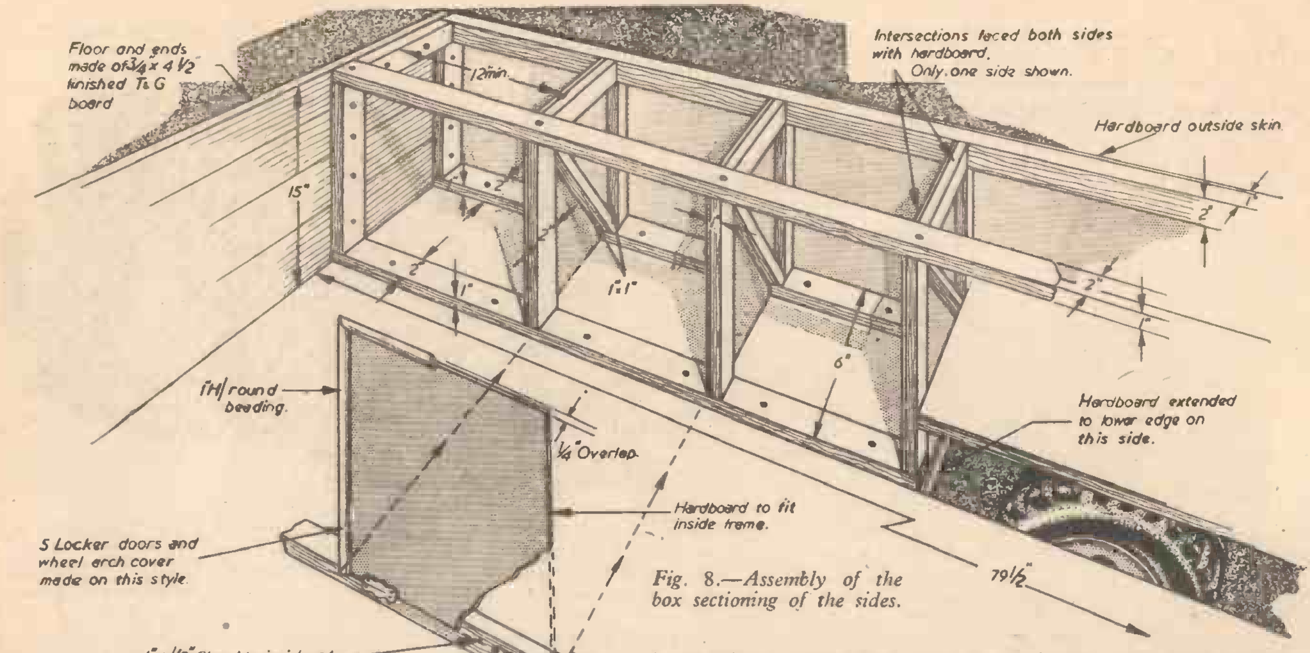


Fig. 8.—Assembly of the box sectioning of the sides.

section of one end is now cut out, this piece forming part of the hinged opening for entry into the trailer when in its closed state.

Box sectioning the sides as in Fig. 8 serves a three-fold purpose; first, it provides strength to take the leverage of the beds when being slept on; secondly, it creates useful locker space and, thirdly, owing to wheels being inset, gives a flush finish to the inside. The main strength is created by the intersections, using the strength of hardboard and glue, coupled with a leverage stop which is the diagonal member of these sections. In turn these are glued and screwed to the outer corner lengths of 2in. × 1in. battening. The completed units are screwed to the floor and end pieces, keeping the whole outside flush to facilitate easy covering with hardboard. The 2in. × 1in. battening used on this section is prepared Perana pine, this type of pine is hard and will hold screws well.

The jacks were fitted next so that they came into use for further building up and can be seen in Fig. 7. The source of material was a scrap yard, where 28in. of ⅛in. × 3in., 16in. of 1in. inside diameter tube and 6ft. of ⅞in. diameter conduit was obtained for a few shillings. All the material had to be steel as welding was necessary. The two holes in the outer tube allow for finer adjustment than would one hole.

(*To be continued*)

MATERIALS REQUIRED

IRON AND STEEL

27ft.	1½in. × 1½in. × 3/16 in. ...	Angle iron.
3ft. 6in.	1¼in. × 1¼in.	Steel bar.
11ft.	3/16 in. dia.	Steel rod.
6ft.	⅞in. dia.	Conduit.
2ft. 4in.	⅛in. × 3in.	Steel plate.
1ft. 4in.	1in. inside dia.	Steel tube.
8in.	⅞in. inside dia.	Steel tube.
8	¾in.	Galvanised saddle clips.
8	⅞in.	,, ,,
20	1½in.	Butterfly hinges with ½in. screws.
10	2½in.	Cast iron hinges.
10	6in.	"T" hinges.
9	2in.	Steel hinges.
10	1in. × ¼in. dia.	Bolts, nuts and washers.
4	3½in. × ⅜in. dia.	,, ,,
1	1½in. × ⅜in. dia.	,, ,,
4	2½in. × ¼in. dia.	Coach bolts, nuts and washers.
4	1½in. × ¼in. dia.	Coach bolts, nuts and washers.
1	1½in. × ¼in. dia.	Bolt, wing nut and washer.
2 doz.	2½in. No. 10's	Csk./hd.
½ gross	2in. ,, ...	,,
1 gross	1½in. ,, ...	,,
2 doz.	1½in. No. 8's	,,
1 gross	1in. ,, ...	,,
4 doz.	¾in. ,, ...	,,
3 doz.	¾in. ,, ...	Roundhead.
½ gross	½in. ,, ...	,,
4 doz.	1½in. No. 6's	,,
2 gross	1in. ,, ...	,,
½ gross	¾in. ,, ...	,,
8 doz.	½in. Parker Calon... ...	,,
3 doz.		Cup hooks.
2 lb.	1in.	Panel pins.
½ lb.	½in.	,,
1 lb.	3in.	,,
1 lb.	2in.	Wire nails
½ lb.	1in.	Brassed roundhead panel pins.

TIMBER

42ft.	Sawn pine	2in. × 1½in.
56ft.	Prepared pine	1in. × 1in.
12ft.	,, ...	1in. × ½in.
149ft.	,, ...	1½in. × 1in.
120ft.	,, ...	1½in. × ⅝in.
14ft.	,, ...	4in. × ¾in.
8ft.	,, ...	6in. × 1in.
12ft.	,, ...	3in. × ¾in.
33ft.	,, ...	1in. × ¾in.
14ft.	Prepared Perana pine ...	2in. × 1in.
76ft.	,, ...	2in. × 1in.
108ft.	Prepared tongued and grooved	5in. × ⅞in.
16ft.	Cornering	1in.
24ft.	Covering	1½in.
105ft.	Half-round beading ...	1in.
14ft.	,, ...	½in.
11½ft.	Sheets hardboard ...	8ft. × 4ft. × ⅛in.

ALUMINIUM

24ft.	Tube	¾in. dia. 16 g.
20ft.	,, ...	⅝in. dia. 16 g.
22ft.	T-section	¾in.
28ft.	J-section	1in.
24ft.	H/round beading... ...	½in.
32ft.	Angle	1in. × 1in. 20 g.

MISCELLANEOUS

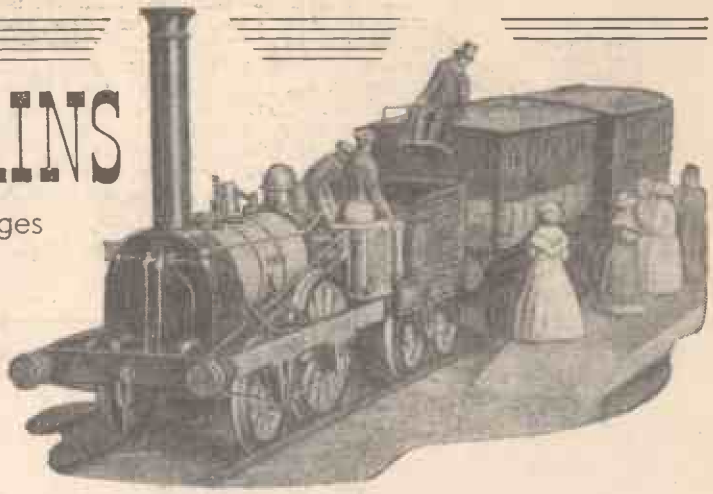
1 towing hitch.
1 pair Austin 7 stub axles.
1 pair builder's barrow wheels (4-ply rating tyres).
1 pair Morris 8 1938 road springs.
2 tarpaulins, 10ft. × 6ft.
1 plastic sink, 12in. × 15in.
1 18 oz. tin Cascamite resin glue.
4 yd. curtaining, 36in. wide.
36ft. rope.
5 doz. eyelets ½in.
1 lb. Scotch glue.
4 window panes, 18in. × 12in.
3 large tubes Sealastik.

MAKING STATIC MODELS

LOCOMOTIVES & TRAINS

Details for Making an 1830 Engine and Carriages

(Concluded from page 153, December, 1956 issue.)



(Right). — The author's model of an 1830 Liverpool and Manchester Railway train.

THE footplate railing and coal guards will try the patience and skill of the modelmaker. The footplate guards will be made independently of the engine and stuck on afterwards. In my own model the top and bottom frames were cut out of thick Bristol-board, divided out with spring needle-pointed dividers, and drilled with a very fine twist drill. All the vertical wires were cemented in the holes. It will be best if the bottom members are divided and the drilling is done through them into the top members. You will then perhaps be able to avoid going right through the latter. Next pass the rods through the bottom and cement them into the top. When the cement here is dry, and you must see that the wires stand dead square and at right angles with the top before the cement dries, you can draw down the bottom member and cement each wire into it, cutting off each wire flush with the cardboard. I think that it would be as well to harden both top and bottom members before drilling by soaking in celluloid lacquer, then, to fix the wires, use celluloid cement. The cut ends of wires can be filed flush with the members and the guards cemented in their places.

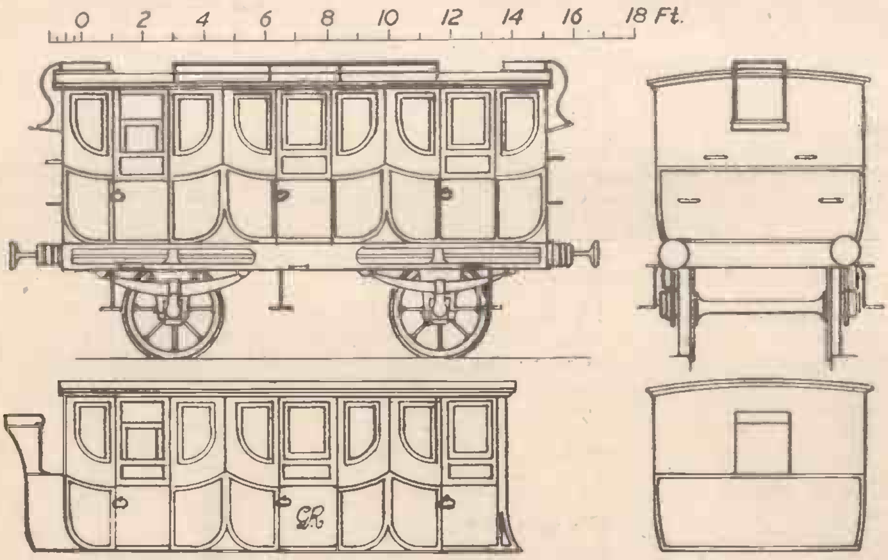


Fig. 6.—Side and end views of a 1st class coach and a mail coach.

For the coal guards the wires can be inserted into the tender body to a good depth and cemented there; they are then cut off at the tops in a straight line to the correct inclination and the top rail cemented down upon them. In the original tender they were ornamental turned balusters and in the model the baluster effect is achieved by barbola paste, thinned down with water. With a fine camelhair or sable pencil (one having long hairs) paint blobs of this paste on to the centres of each of the wires—one large blob—and when these are dry two fine rings, one above and one below each blob, making each baluster as nearly as possible alike in size and proportions.

The Carriages

These are shown in Fig. 6. There will be only one mail coach and this will be at the back end of the train. Just how many first-class ordinary carriages make up the train will be for the reader to decide; there ought to be at least two, though my own model has only one. Anyway, the mail, as can be seen from the drawing, differs from the first class, at least as regards the body, by having a coupé compartment at the front end and a mailboot at the back. This boot extends to the full width of the coach and on its centre a seat is erected for the Post Office official. In all other respects, except that of the colour of the painting of the lower panels, the two carriages are alike. In the models the two bodies are built up of Bristol-board and this may very well be of "6 sheet" thickness on the inside with "4 sheet" and "2 sheet" applied for the relief work. The roof should be of three thicknesses of the "6 sheet," the lowest to form a rebate to go down inside of the ends and the sides. My own coaches are fitted with seats and upholstery, the seating being represented by carved wood arms, squabbing, seat cushions and padded divisions between the seats, of which seats there are three on either side of each compartment. The actual cloth surface of the upholstery is represented by a greyish-beige flock, dusted on to a wet enamelled surface.

If you do decide to fit the interiors, show at least one or two doors, on the nearside of each coach, open; you can then seat one or two passengers in the compartments.

The Windows of the Coaches

These can be formed by inserting, or applying, to the inner face of the cardboard small separate pieces of thin, clear celluloid or cellophane, either tissue or sheet. Perspex is good if it can be obtained thin enough. After the inside of doors, floor and walls above the upholstery of the seat backs are painted the roof may be cemented in. The frame of each coach is of wood with horns of Bristol-board stuck on. The springs can be either of wood or Bristol-board; if of the latter they will be laminated with buckles put on in the thin board and axleboxes built up in the thicker gauge.

Wheels and Axles of the Whole Train

The driving wheels of the engine were 5ft. in diameter and the leading and tender wheels were 3ft. 6in., which in the scale of our model will be 1¼in. and ⅞in. respectively. The carriage wheels were 3ft. on the tread. We shall therefore require to turn three jigs, after the manner shown in Fig. 7. All three will be of the same depth and all will have a dowel standing up at the centre. Next, turn all the rims to the correct diameter and proportions, and also the hubs. These hubs for the engine and for the tender were large and were divided, one division for each spoke. On both the engine and tender the spokes were circular in cross-section and each tapered very slightly, but this taper can be ignored. Plane up a square strip of wood to the correct diameter, glasspaper it

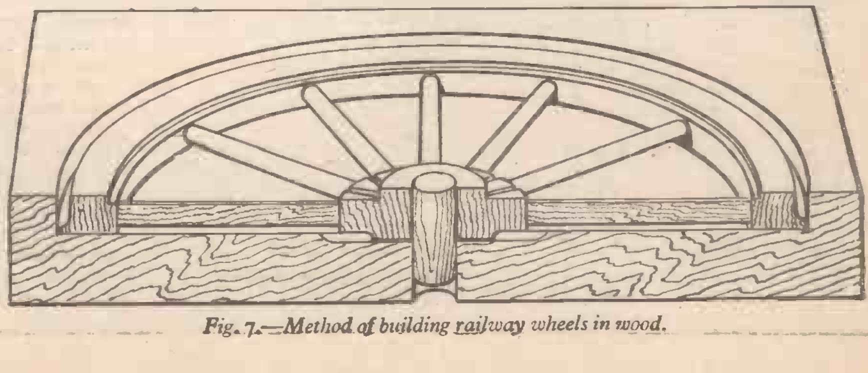


Fig. 7.—Method of building railway wheels in wood.

circular, and cut it into lengths with a razor blade to make each spoke fit exactly between the hub and the rim of each wheel. Be sure to cement each spoke accurately in place so that they are equally distant from one another, and that every opposite pair make a straight line. When dry each wheel is mounted on an axle in pairs, and each pair is cemented centrally in line with its axlebox. It is not necessary for the wheels to revolve, in fact it will be better for them not to be able to do so, for it will prevent the vehicles from rolling when the model is lifted.

The wheels for the carriages will be made in the same way except that the hubs are turned without the divided spoke sockets; that is to say, they are of normal diameter. The spokes will be not round, but flat, and will be cut from "6 sheet" Bristol-board. They are cemented at each end and will be inserted with the width of the spokes across the wheel, so that in looking at the wheel faces only the edges of the spokes are seen. It is surprising how strong this construction is.

Painting

First apply a coat or two coats of thin shellac all over. The colours on the engine are either black or yellow, except for the buffer beam, which is vermilion on its front face, with buffers of tan colour for leather. The spokes of the wheels, the outer faces of the frames and the boiler barrel are yellow, of a shade which in artist's tube colours is called "Deep Naples Yellow." On the tender the wheels are also of this yellow, whilst the frames and tank sides are a bright, rather bluish, chrome green. This green can be obtained by mixing pale chrome yellow with cobalt blue or prussian blue. For all the black I myself prefer to use black cellulose lacquer, the kind which dries with an eggshell gloss. On the first-class carriage the colour on the lower side and end panels is the same yellow as on the engine. On the mail coach these panels are "Post Office Red," which is, of course, middle vermilion. The rest of each coach is black, with the exception of the window frames and the doors, everywhere above the yellow, or the vermilion, lower panels. These parts were brown and were presumably, of varnished wood. They can be painted a tan colour brown, the same as the buffers. The outside faces of the frames will be painted with this brown. On the mail coach the boot was black at the sides and had a vermilion panel below the waistline at the back. The upper portion, including the seat, was black, as were also the wheels.

Fig. 8.—Driver, fireman and passengers of the 1830 period.

The Figures

The driver, the fireman and the passengers are the last items. They are illustrated in Fig. 8. These are all to be in the fashions of 1830. The engine crew will have flat, peaked caps of navy blue, tunics or coats with high collars, of the same colour, and white trousers. I have not drawn the travelling carriage porter or guard, but he will wear a top hat and be dressed in navy blue entirely.

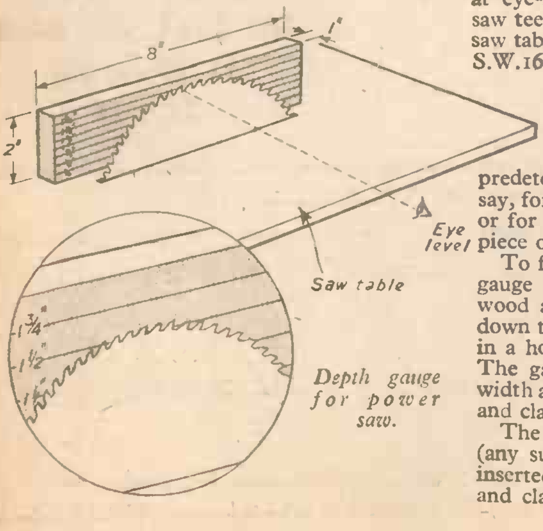
Among the passengers there will be one or two gentlemen; they will have light-coloured trousers and black, dark blue or dark green coats; they will wear top hats. The ladies' fashions for outdoor wear will be generally as I have drawn them, and the colours will be quiet and restful, trimmed with brilliant and harmonising ribbons, feathers and trimmings. In the main the figures will be carved with the points of sharp knives in plaster of paris or dried clay, or in wood such as soft pine, clean deal or lime; though the men may be modelled on a wire frame with barbola paste. There are nine figures on my model and no fewer than five different methods and materials were used in their making. The ladies were made mostly of plastic wood, though one was carved from plaster and the gentleman was carved from a stick of chalk. The driver was carved from a bit of pine, but the guard and the fireman, because of their attitudes, were modelled with barbola paste on wire frames. Chalk can be carved beautifully, but it is soft and brittle. The cleanest job results when the figure is roughly moulded first in plaster of paris and then finished by carving. A few drops of gum should be added to the water with which the plaster is mixed. The ladies' hats, apart from bonnets, are not carved; they are put on afterwards in paper and the trimmings applied by a brush with barbola paste. All the figures must be shellac varnished and then painted with either flat oil colour or body water colour. Any white used alone in water colour had better be process white. The gentlemen wore side whiskers and no moustaches in those days.

Depth Gauges for Sawing

Depth Gauge for Power Saw

THIS is a handy accessory for use in conjunction with a power saw. It enables the saw table to be set quickly and accurately for depth of cut in grooving. Take a piece of white close-grained wood (beech is excellent) 8in. x 2in. x 1in. On one of the 2in. sides scribe lines ¼in. apart with a marking gauge and fill in the lines with black; any ball-point pen will do the job.

In use lay the block on the saw-table alongside the saw blade and sight the markings at eye-level against the maximum height of saw teeth for depth of cut, then tighten the saw table screws.—S. L. R. SIMPSON (London, S.W.16).



Depth gauge for power saw.

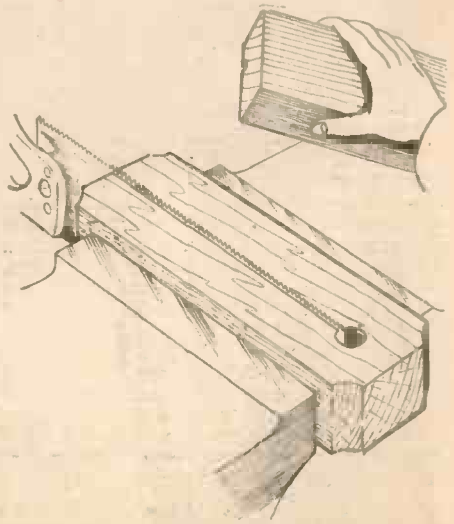
A Handsaw Depth Gauge

USING a handsaw in the usual way, it is not easy to make a quick accurate saw cut to a uniform predetermined depth in small pieces of wood, say, for grooving or rebating across the grain or for reducing the diameter at the end of a piece of dowelling.

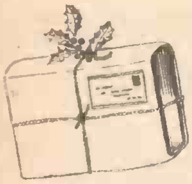
To facilitate accurate work a simple depth gauge may be made with a short length of wood about 2in. x 6in. A saw cut is made down the centre length to finish near the end in a hole bored through to prevent splitting. The gauge may now be slightly reduced in width at either end to give a grip for adjustment and clamping.

The illustration shows the end of the saw (any suitable fine-toothed saw or saw blade) inserted in the kerf at the adjusted depth and clamped in the vice.

The wood being worked is first sawn to less than the required depth and finished off by moving it over the fixed saw teeth. When rebating, further saw cuts may then be quickly made in the waste wood before final chiselling.
—W. G. GRAHAM.



The saw blade inserted in the kerf at the adjusted depth and clamped in the vice.



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Space Visitors

From Which Planet Do They Originate? Is There Life on Them?

By "THEORIST"

[*We Do Not Necessarily Subscribe to the Author's Opinions.—Ed.*]

If flying saucers and their operators are of extra-terrestrial origin we are confronted with a question of great magnitude—from where in the solar system or beyond do these visitors and their strange vehicles stem ?

The Solar Planets

With the aim of establishing whether or not the respective physical conditions of the planets are capable of sustaining life, we turn first to the planet Mercury.

Antoniadi, the Greek astronomer, came to the conclusion that Mercury revolved on its axis once in 88 days. This is equal to its orbital period. Schiaparelli had previously suggested this to be the case. It is thus seen that Mercury has a similar axial rotation relative to the sun as the moon has relative to the earth. Therefore, apart from libration due to the ellipticity of the Mercurian orbit, the planet always presents the same face to the sun. Mercury, being an inferior (inner orbit) planet the same as Venus, varies in appearance from the crescent to the gibbous form as viewed from the earth. It is not an easy planet to observe due to the close orbit it pursues around the sun. Just before sunrise or shortly after sunset it may be visible.

Certain dusky patches on the planetary surface are obviously permanent; chief amongst these being the Solitudo Hermae Trismegisti, meaning the Wilderness of Mercury the Thrice Greatest. When at perihelion (nearest the sun) in its orbit the temperature of the sunlit planetary face exceeds 800 deg. F.; whilst the face that is continually turned away from the sun registers a temperature lower than anywhere else in the solar system.

Due to the small mass of Mercury and its proximity to the sun, general scientific opinion holds that any atmosphere the planet originally had must have virtually escaped into surrounding space. If this is true then the planet must be completely eliminated as a possible abode of life in any form. This sweeping assumption has, however, been challenged more than once.

Schiaparelli and Antoniadi both noticed that the permanent markings on the Mercurian surface were at times very obscure. This led them to suppose that some form of cloud was responsible for the fluctuating clarity of the markings. As clouds cannot travel laterally unless an atmospheric medium is available, it was assumed that Mercury *did* in fact possess some type of atmosphere. This opinion was substantiated by the research of Dr. Dollfus, who in 1950 announced the probability of a tenuous atmosphere surrounding Mercury. A peculiarity of this evidence is that Dr. Dollfus and his colleagues drew their conclusions from polarimetric observation, which, unlike direct observation, is an indirect approach to the problem. They do not necessarily agree, however, with the opinion that cloud forms exist in the tenuous atmosphere. Nevertheless, the evidence from these two different sources of investigation strongly suggests that Mercury is not devoid of an atmosphere.

Another puzzling feature of Mercury is the temperature distribution over the planetary surface. At the terminator or division between light and darkness, quite often referred to as the *twilight zone*, the temperature will drop from somewhere in the region of 300 deg. F. to well below zero. It seems feasible from this that a certain band of the surface encircling the planet will possess an equable and moderate temperature. By moving towards or away from the sun horizon one could experience all the gradations of temperature existing between terrestrial equatorial and polar limits—and a lot more besides if one so wished. The real problem here is to try to postulate what would happen to a planetary atmosphere under these conditions.

It is obvious that any type of atmosphere on Mercury must be generated in the twilight regions. The intense cold on the darkened hemisphere must bind the majority of elements in a liquid or solid state, whilst the heated side could only retain an atmosphere composed of the heavier elements such as oxygen and carbon dioxide.

In the terminator regions of the planet it is probable that lower forms of life could emerge and survive, but the prospects of finding higher manifestations of the life force are rather remote. Nevertheless, it must be confessed that even the *worst* apparent location as an abode of life cannot be dismissed as entirely impossible.

When at some future date space travellers from the earth make the arduous and dangerous trip to Mercury, it will be in the Mercurian zones of twilight that they land their spaceship.

Mystery of the Major Planets

Moving outwards beyond Mars we come to the giant planets of Jupiter and Saturn and their many attendant satellites. These, along with Uranus and Neptune, are known as the major planets of the solar system. Each one of them is enveloped in an extensive atmosphere which rules out the chance of observing the planetary surface. The generally held view that each has a thick shell of ice enclosing the planetary core is open to question when considering the observed activity of these dense atmospheres.

A detail typifying the mystery which literally surrounds the major planets is the great red spot seen in the atmosphere of Jupiter. This phenomenon, which is elliptical in form, with a maximum dimension of well over 25,000 miles, has been observable for about three-quarters of a century. Sometimes it is of striking intensity whilst at others it becomes difficult to locate. The probability of its being a gigantic cloud of gas and dust overhanging a Jovian volcano is sometimes refuted on the grounds that the red spot has

Name of planet	Mean distance from Sun in miles	Period round Sun in years	Period of axial rotation	Diameter in miles
Mercury ...	36,000,000	.24	88 days	3,100
Venus ...	67,200,000	.62	20 to 30 days	7,700
Earth ...	92,900,000	1.00	23 hrs. 56 mins.	7,927
Mars ...	141,500,000	1.88	24 hrs. 37 mins.	4,200
Jupiter ...	483,300,000	11.86	9 hrs. 50 mins.	88,700
Saturn ...	886,100,000	29.46	10 hrs. 14 mins.	75,100
Uranus ...	1,783,000,000	84.01	10 hrs. 48 mins.	30,900
Neptune ...	2,793,000,000	164.79	15 hrs. 40 mins.	33,000
Pluto ...	3,666,000,000	248.43	Unknown	5,000(?)

Notes: The planetary diameters stated are equatorial. The Sun is 864,000 miles in diameter and revolves on its axis in 25.38 days.

Some of the chief figures relating to the Solar planets.

an erratic period of rotation around the planet, which should not be the case if it were in any way directly related to a special area of the planetary surface. This argument falls down, however, when we visualise the upward progress of a vast volcanic cloud through hundreds of miles of restless atmosphere. The variation of drift between successive upsurges of volcanic matter could be very extensive indeed, and thus appear to the earthly observer at irregular periods and different locations in the outer shell of the Jovian atmosphere.

The atmospheric belts circulating round Jupiter vary from one another in their periods of rotation. These belts are of a rich coloration in general, red being the predominant colour. However, pale shades of blue, dull green, brown and orange may be observed in the various belts. Another peculiarity is the opposite variation of colour in the two hemispheres of the planet. When the colours in one hemisphere are predominantly red and orange, the observed colours in the other hemisphere are very diffuse greens and blues ; and conversely so. No explanation of this colour variation or even of the colours alone is available. It may be remarked, however, that the cyclic effect just described could be the result of changes at the planetary surface, much in the same way that the physical appearance of the earth and Mars alters with the seasons.

The extremely low temperatures usually associated with Jupiter and the other major planets are not easily reconcilable with the vigorous nature of the observed atmospheric currents. If the sun's thermal radiation has so much decreased at those distances as to preclude it from having any pronounced effect on the atmospheric masses, then there is the possibility that some internal source of radiation is at work. This naturally weakens the hypothesis of a vast sphere of ice enclosing the core of each major planet.

It is apparent that until more definite knowledge of the Jovian and Saturnian planetary surfaces is available we cannot decide whether animal and reasoning life-forms could evolve on them. There is one thing, however, of which we may be sure. If these planetary surfaces are not the ice-bound barren wastes which popular scientific opinion suggests, then the door is wide open to reasoned speculation. All the planets have a common similarity to one another in that the basic elements of their constitution stem from a single source, the sun. The life impulse which quickens inanimate matter is no frail transient manifestation of nature, but a vigorous natural law which operates not only in perfect environs, but in many seemingly impossible conditions. Its tenacity and readiness to act is clearly demonstrated in numerous biological experiments. There are certain organisms whose survival temperature limits are approximately 150 deg. C. on the one hand and −272 deg. C. (the temperature of liquid helium) on the other.

One further word about Jupiter. Dr. Burk, of the Carnegie Institute, Washington, D.C., fairly recently discovered the emission of radio signals from the planet. At intervals of three days extending over a period of a month, Dr. Burk intercepted signals lasting on each occasion for approximately one second. Many radio sources have now been located throughout the Milky Way galaxy, but they are of a continuous order. The remarkable point about Dr. Burk's discovery is the regularity of the emissions. As Jupiter revolves in less than 10 hours, it would seem that the emissions occurred only after each seven or eight revolutions of the planetary body. The phenomenon, therefore, can scarcely be linked with the axial rotation and atmospheric circulation of the planet.

Venus and Mars

These two planets are the earth's nearest neighbours. This fact alone is sufficient to make them of unique interest to us, but in addition, in many aspects, they are comparable to our own planet. In mass and diameter Venus is almost a replica of the earth, whilst Mars, though considerably smaller than our planet, displays polar caps, seasonal change of surface features, a not too harsh temperature range, and—most striking, perhaps, of all—a period of axial rotation which is only 41 minutes more than that of the earth.

There are two distinct schools of thought regarding the physical condition of the planet Venus. One is that the planetary surface represents a scorching desert whereon no life could evolve. It is assumed that the lack or early cessation of volcanic activity on Venus, precluded the emission of substantial amounts of water vapour into the Venusian atmosphere. Thus it would not be possible for oceans to form. The excessive amount of carbon dioxide and negligible amount of oxygen present in the dense atmosphere of Venus suggest a dearth or absence of vegetable life on the planet.

Oddly enough, the other opinion regarding Venus is that the planet is almost, if not entirely, covered by a deep hydrosphere, for the atmospheric conditions outlined above are in no way incompatible with such a view. Further, it cannot be said that volcanic activity has entirely ceased on Venus. Such outbursts of activity on the planet as that

Fig. 1.—The planet Venus. (*Photo by courtesy of Mount Wilson and Palomar observatories.*)

recorded in 1868, when it emitted bright flashes of light and a vivid red spot was observed in its atmosphere, and again in 1884, when an intense white patch was visible on Venus, tend to substantiate the idea that volcanic eruptions may still occur on the planet.

As dense cloud or dust haze in the lower layers of the Venusian atmosphere prevents observation of the planetary surface, we are denied one of the positive means of establishing the planet's axial rotation period. If the axial period is equal to the orbital period (between 224 and 225 days)—thus resembling the moon and Mercury in this respect—it detracts from the prospects of the planet as an abode for higher life-forms. For though solar radiation could to a limited extent be transmitted to the perpetually darkened hemisphere by atmospheric processes the actual planetary surface on that side would be intensely cold. To a degree, however, this belief may be discredited, for there is evidence of heat radiation from the Venusian "night" side. Also, from other fairly recent investigations it is thought that Venus may have an axial period of less than 30 days. Therefore the Venusian year may consist of seven or eight very long days and nights.

Perhaps the most interesting features of the planet Venus are the two suspected polar caps. They have been observed occasionally ever since the middle of the seventeenth century and apparently mark the north and south poles of the planet's axis of rotation. Their existence is accepted without doubt by many eminent observers. They appear as brilliant white areas and have been described as high snow or ice covered plateaux. Viewing of these phenomena is, of course, constantly impaired by low layers of cloud. The persistence of these white areas near the cusps of the planetary image infers that they are not transient effects within the atmosphere, but permanent features of the planetary surface. Should these features be extensive regions of ice and snow, it is obvious that the theory of Venus being a planet of hot arid wastes and gigantic dust storms must be forsaken.

The presence of ice or snow caps on Venus is of very great importance in our speculations as to whether conscious forms of life exist on the planet ; for water is imperative in the creation and survival of plant and animal forms. (Indeed, 75 per cent. of the human body is constituted of water in solution, or combined with tissue colloids where it exists in the bound state. All reactions connected with the assimilation of food take place in aqueous solution.) Should the planet also possess even a very modest amount of oxygen the possibility of plant life evolving there is greatly enhanced. And where plant life evolves we may with confidence expect animal life to manifest. For even though the oceanic theory is probably the correct one, it is not conceivable that the lithosphere or crust of the planet is everywhere smooth and evenly covered by the hydrosphere ; rather is it more logical to suppose large areas of the lithosphere upthrust above the water level to form continents on which plant life may thrive. This assumption is best explained if for a moment we visualise the early evolution of planets such as the earth and possibly Venus.

As the planet gradually radiated its initial heat its lithosphere would commence to cool. This action would be accompanied by contraction and frequent fracture of the crust as the internal stresses increased. Vast mountain ranges and plateaux would be cast up above the normal surface level. Huge quantities of water vapour and carbon dioxide would be discharged and the planet would be shrouded in stygian darkness, due to the blanketing cloud-shell.

Much of the sun's radiation would be reflected or absorbed by this new atmospheric shell, and even though the planetary surface would remain hot for a long time precipitation would occur in the lower layers of the atmosphere. The rain would be vaporised repeatedly as it neared the surface, but with further cooling the precipitation would proceed continuously until the great oceans of the planet were formed. The photograph in Fig. 1 shows the planet Venus.

Life on Mars

In the case of Venus we see that the question of sentient life existing thereon is still a very open one. There are clear arguments for and against the proposition, with if anything the evidence tending to favour the planet as a possible abode of life. When we survey the information relevant to the planet Mars, however, there are distinct signs that it ministers to various forms of life.

(*Concluded on page 207*)

The planet possesses water and oxygen and even though they are of restricted quantity, we must never overlook the ability of living creatures to adapt themselves to rigorous external conditions.

Investigation of the Martian polar caps indicates that they are *not* simply atmospheric phenomena or areas of hoar frost on the planetary surface. They are composed of much more substantial material. When melting occurs during the summer and the affected cap decreases in size, its colour strongly resembles that of *terrestrial ice*. The caps must indeed consist of snow and ice.

The seasonal change of colour of the many dark regions on the Martian surface can only reasonably be attributed to the growth and decay of vegetation. Thus, when it is the middle of winter in the southern hemisphere the darker areas in that hemisphere remain decidedly green, whilst in the northern hemisphere, where it is the height of summer, the suspected vegetal cover assumes a brown or pale coppery hue. It is clear from this that plants of terrestrial deciduous and alpine types may exist on Mars. If the two types grow together it would account for the predominance of green in the winter hemisphere, for then the deciduous plants would be stripped of their leaves and they would assume a dull neutral shade merging completely with the green of alpine growth.

The argument that these dark regions of Mars are of an inorganic nature manifesting chemical change due to variation of moisture and temperature is at once refutable. Dust storms of considerable magnitude are known to occur quite regularly on Mars, and if these areas were of rock or similar inorganic formation they would long since have been smothered under a vast layer of dust and sand. Apart from the polar caps, one would then expect no portion of the planetary surface to be much different in colour from the desert areas. Only the recurring cycle of strong and vigorous plant life could defeat the advance of drifting sand and swirling dust.

The Martian Canals

With the safe assumption that vegetable life flourishes on Mars we must logically concede that animal life is also present. It is almost impossible to admit the one form and exclude the other. Just how far conscious life has evolved on the planet is a complex question. In attempting an answer to this fascinating problem one is compelled to dwell on the most significant " clue " of all—the canals.

Since Schiaparelli first discovered this amazing pattern of lines on the Martian surface in 1877 the controversy has continued without abate as to their true nature. At the time of writing this article Mars is moving into opposition with the earth, when it will at one point be 35,162,000 miles away from us. Once again hundreds of astute observers will try to define the true meaning of the geometrical pattern which enmeshes the vast desert areas of the planet. However, actually to witness the canals is by far the exception rather than the rule. Unless superbly clear conditions prevail and the observer has acute vision, he is doomed to disappointment. That these remarkable lines *do* exist cannot be doubted, for they have on one or two occasions been photographed.

The assumption that the lines are the result of chance arrangement of surface features is open to strong criticism. This is understandable when in many cases the lines are so disposed as to form junctions in desert areas. They pass from junction to junction or across deserts from one dark region to another by the shortest route—as though some immense engineering project had been undertaken after a thorough and accurate survey of the planetary surface. Only highly intelligent beings could possibly have conceived and executed such a mighty task. The opinion that these lines are canals or waterways is substantiated by the manner in which they develop and become more clearly defined when the polar caps decrease and the surrounding area is apparently flooded. In such cases it is natural that sentient beings would strive to utilise the precious water to best advantage. That the estimated width of individual canals varies between 20 and 50 miles does not, of course, mean that the water channel is that width. Rather should we visualise a water channel of modest width (possibly no more than one or two hundred yards) irrigating by secondary canals an area some 20 to 50 miles across. Put this way it becomes obvious that it is not the actual canal which is seen, but the vegetal belt associated with it.

It is in these vegetal belts traversing equatorial latitudes that we may expect to find Martian settlements. Having won their precious water supply from the frigid polar regions, it is perfectly natural that they would desire to live at latitudes where a more suitable temperature range prevailed. Even so, the most amicable regions for humanity within the Martian equatorial zones are rigorous from a climatic point of view. For whilst the temperature may rise to slightly over 50 deg. F. about noon, it plunges well below freezing point at night. Even at midsummer on latitudes close to the equator it starts to freeze as the sun sets. Nevertheless, it would seem that, provided the oxygen content of the Martian atmosphere near the surface is sufficient, we ourselves could survive at those latitudes without any great difficulty. A photograph of Mars is shown in Fig. 2.

Fig. 2.—The planet Mars. (Photo by courtesy of Mount Wilson and Palomar observatories.)

Martian Space Travellers

If we accept the proposition that the lines on Mars are canals flanked with vegetation, we must also accept that these canals were artificially constructed, for there is no naturally formed geological feature present on the earth or the moon which may be even remotely compared with them. The stupendous task of constructing between 50 and 60 canals (some of them approaching 3,000 miles in length) across the face of the planet can leave little doubt in the mind as to the industry, tenacity and intelligence of the builders. Considering such mental and practical qualities in a race of beings evokes the vital question; have they since applied those exceptional qualities to the conquest of space? There is no reasonable ground to deny them the ambition to explore outer space. Indeed, it would seem to be more to their advantage to do so than it would to our own; yet we earthlings are strongly attracted to such a glorious adventure and are even now striving towards its realisation.

One thing we may be sure of—the tenuity and general clarity of the Martian atmosphere would enable an observer on that planet to view the earth in nearly perfect conditions. It would not fail to arouse his keenest interest. Any space expedition setting out from Mars would almost certainly have the earth as its goal. Whether they would utilise the moon as a base from which to examine the earth is speculative, but highly probable if eventual colonisation of the earth was intended. In the extreme minority of their numbers it would be madness to attempt any immediate settlement amongst terrestrials, particularly if the latter showed signs of quarrelling amongst themselves.

Lunar Bases

In the polar terminator zones of the moon bases could be established by space visitors. The temperature range within these regions is tolerable. Bases in the lunar equatorial zones would be exposed to the direct rays of the sun for a certain period each month as the satellite orbited the earth. Any base established on the moon would invariably be of an underground type. Properly lined to prevent leakage of air through the porous rocks, one may visualise the creation of a subterranean village. This type of base would also offer the greatest safeguard against impinging meteorites, for we must remember that the moon has no protective atmosphere. Possibly when earthlings land on the moon this type of base will be contemplated—possibly they may be invited to share accommodation already prepared! Over the years evidence has accumulated which suggests that the moon may have been visited and explored by beings other than ourselves. Flashing points of light on the lunar surface, discs of light observed leaving or approaching the moon, and various other phenomena all suggest that our satellite may be utilised by sentient beings.

In conclusion we must concede that life is far from being the monopoly of the earth. Sentient beings on other solar planets or even on planets beyond the solar system may be expected at some time during their evolution to entertain the idea of space travel and eventually to put that idea into effect. Just as astronomy ranks with the noblest of the sciences, so the concept and realisation of space flight must represent an immortal achievement in the annals of mankind—here or elsewhere.

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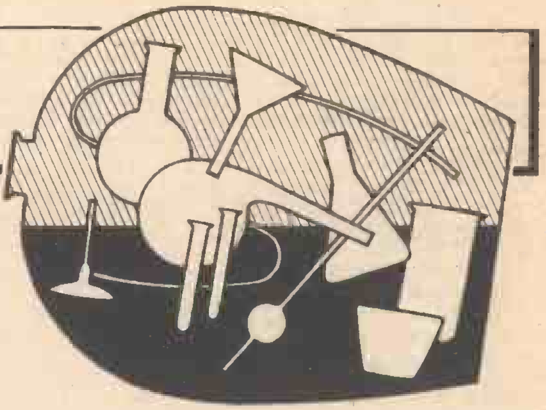

A Series of Articles Describing Experiments Suitable for the Home Laboratory

No. 2.—Experiments with Oxygen

OXYGEN is the first necessity of our existence. The atmosphere we breathe is made up of a mixture of oxygen, nitrogen, carbon dioxide (carbonic acid gas), and a small percentage of rare gases, including helium. It is the oxygen alone which is essential for the life of all breathing animals, the nitrogen and rare gases are inert, while the carbon dioxide is the product of our breathing ; we inhale oxygen and exhale carbon dioxide. Remarkable as it appears, in spite of the rate at which oxygen is taken from the air by our lungs and replaced with the deadly carbon dioxide, the percentage of the life-giving gas remains the same. This is due, briefly, to the breathing action of green plants in sunlight, who find carbon dioxide as necessary to their existence as we find oxygen. The story of this wonderful provision of nature, this photo-synthesis, as it is known, which keeps a constant supply of oxygen in our atmosphere, is worthy of study and experiment by any scientifically-minded individual.

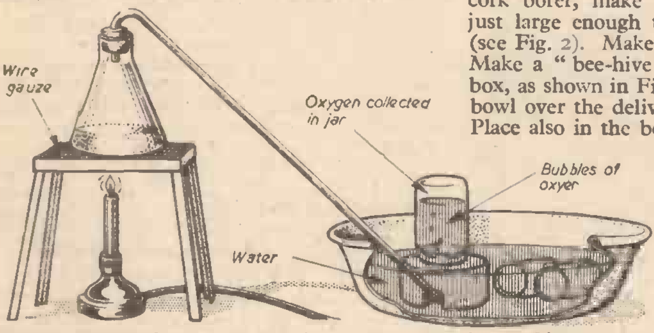

Fig. 1.—General arrangement of the apparatus for making oxygen.

Oxygen

The process of breathing is one of combustion, or burning ; we take into our lungs air, the oxygen in it combines with the food carbon in our bodies, and we breathe out carbon dioxide. If the amount of oxygen in the air were greater, the combustion would be accelerated and our lives would probably be correspondingly shortened. As an example of this it might be observed that one of the earliest experiments was the introduction of living mice into an atmosphere of pure oxygen, when an immediate increase of vitality and quickened movement were manifest.

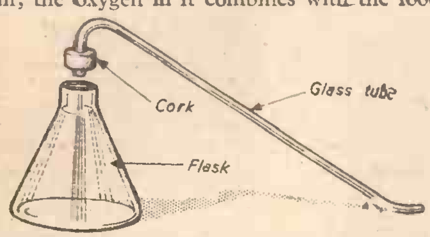

Fig. 2.—The tube fitted into the cork of the flask.

Preparing Oxygen

The following apparatus is required:

A small glass flask with a cork to fit.

A length of narrow glass tubing (about 18in.).

A large bowl.

A few jam jars, each with a piece of stout paper to cover its mouth.

A " bee-hive " shelf.

Arrange the apparatus as shown in Fig. 1. Bend the glass tubing, following the directions given in last month's article, and, using the cork borer, make a hole through the cork just large enough to accommodate the tube (see Fig. 2). Make sure the joint is air-tight. Make a " bee-hive " shelf out of an old tin box, as shown in Fig. 3, and place this in the bowl over the delivery end of the glass tube. Place also in the bowl the jam jars and their paper covers. Now pour water into the bowl until the jars (lying on their sides) are submerged and full of water (see Fig. 1).

Procure $\frac{1}{2}$ oz. of potassium chlorate and $\frac{1}{2}$ oz. of manganese dioxide, mix them gently on a paper and introduce the mixed powders into the flask. Replace the cork and tube. (*Caution : When handling potassium chlorate treat it with respect and care ; friction will cause it to explode readily.*)

Now commence to heat the flask gently with either the bunsen or a spirit lamp, exercising caution and control over the heat at first, thus avoiding cracking of the glassware.

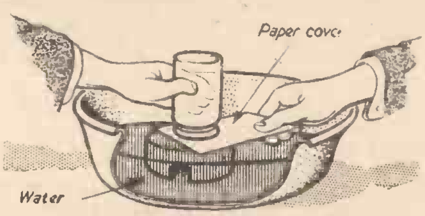

Fig. 4.—Slipping a sheet of paper under the bottom of a jar filled with oxygen.

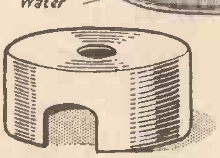

Fig. 3 (Left).—The beehive shelf.

Bubbles will be seen rising from the end of the delivery tube. For the first two or three minutes neglect those, as they are formed merely of hot air driven out of the flask by expansion. When a steady stream of bubbles is seen to be delivered from the tube, take hold of a jam jar, bring it upright, keeping its mouth beneath the surface of the water, and stand it over the hole cut in the top of the " bee-hive " shelf. The gas will bubble into the jar, displacing downwards the water which fills it. When the jar is full of oxygen and all the water is driven out quickly slide a paper cover over the mouth of the jar (see Fig. 4) and remove it from the bowl, at the same time replacing it by another jar. Continue this until no more gas comes over, collecting as many full jars as possible.

We have now several jars of pure oxygen with which to perform some fascinating experiments.

Stopping the " Sinking Feeling "

Remove the cover from a jar of oxygen and take two or three deep breaths of the contents. A feeling of buoyancy and exhilaration will immediately be noticed.

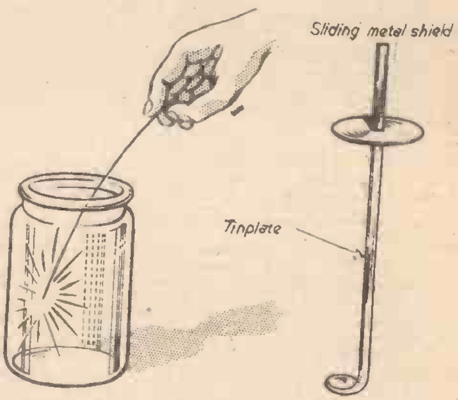

Fig. 5.—Making iron wire burn in a jar of oxygen.

Fig. 6.—A long-handled tinplate spoon.

Re-lighting a Piece of Charring Wood

Obtain a thin splint of wood and hold it in a flame until it takes fire. Now blow it out, and as it is glowing, plunge it into a jar of oxygen. Immediately the stick bursts into a brilliant white flame, reminding one of November the Fifth.

Artificial Daylight

This experiment is far more effective if performed with the " lab." in darkness. Holding a 6in. length of magnesium ribbon with a pair of pliers, ignite its free end in the bunsen flame and lower the burning metal into a jar of gas. The magnesium burns with a most intense and blinding white flame, which lights up the room like brilliant sunlight. Do not look directly at the light, unless through smoked glass, otherwise the optic nerve will become temporarily " fogged." Performed out of doors, on a large scale at night, the neighbourhood can be well illuminated for some distance around.

Making Iron Wire Burn

For this experiment we require a length of florists' iron wire. Hold one end in a flame until red hot, then quickly introduce it into a jar of oxygen (see Fig. 5). The wire takes fire, burning brilliantly and throwing off sparking globules. As we are apt to regard iron as being of an incombustible nature, the spectacle of iron wire actually burning is most interesting. A darkened room again improves the experiment.

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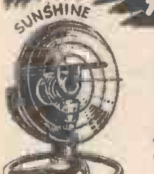

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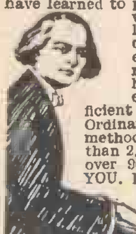

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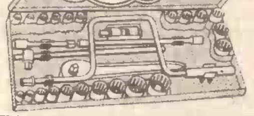

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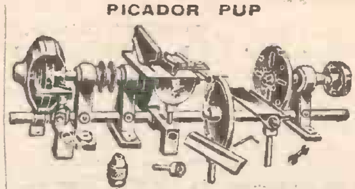

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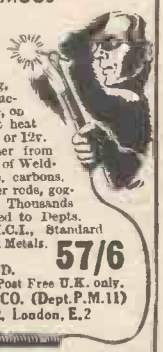

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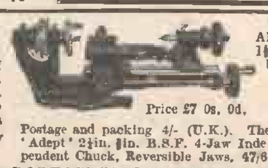

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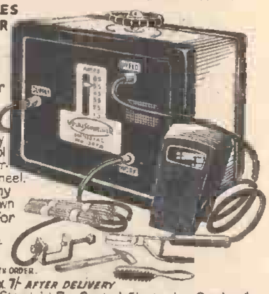

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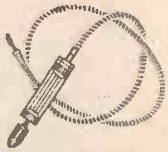

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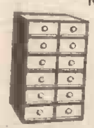

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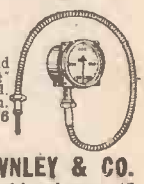

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With the aid of the long-handled tin-plate spoon, the construction of which is shown in Fig. 6, the home experimenter can continue to perform a multitude of entertaining experiments with his jars of oxygen. A small fragment of lighted candle, for instance, lowered into oxygen burns with a flame of surprising brilliance, as does also a fragment of glowing charcoal. Bright blue flames are given by a pinch of burning flowers of sulphur. When performing this last experiment it is advisable to have the jar near an open window in order that the choking fumes may be readily conducted away.

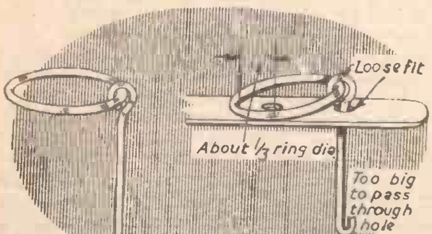
Next month's instalment in this series will contain details of some more interesting experiments.

Making a CHINESE PUZZLE

A Centuries-old Device Which Will Mystify Your Friends

For the Junior Reader

WHETHER this puzzle really originated in China seems a doubtful question, but there is no doubt at all that it is one of the oldest and most fascinating puzzles ever made. It can be made with any number of rings, but the usual numbers are from six to ten. The six-ring puzzle can be done in about one minute (when you know how to do it !), but each added ring makes the puzzle take about twice as long to solve, thus a ten-ring puzzle should take about a quarter of an hour. Working such a puzzle is rather like knitting; you " knit " away for a quarter of an hour, more or less, and eventually the two pieces of the puzzle separate.



Figs. 1 and 2 (Left).—Wire rod attached to curtain ring. How rings are attached to a wooden bar.

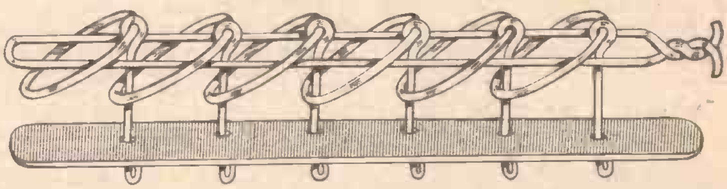


Fig. 4 (Right).—The first move in solving the puzzle.

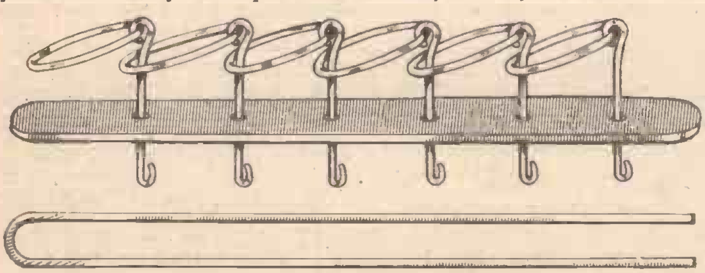


Fig. 3 (Left).—The puzzle with all the rings attached and the open-ended loop of wire.

Construction of the Puzzle

First obtain six curtain rings about 1in. diameter and some brass wire about 16 gauge, then form an eye in the end of a piece of wire, say, 3in. long, so that the eye holds a ring as shown in Fig. 1. Make six parts like this. Next take a piece of wood or metal or any other material that suggests itself to you, say, 6in. long, ¾in. wide and about 1/16in. or ⅛in. thick. Drill a hole 1in. from one end, large enough to take the wire freely, put a wire (with ring attached) through the hole and bend over the bottom end of the wire, as shown in Fig. 2. Then drill a second hole about one-third across the first ring (see Fig. 2) and insert a second wire and ring. Repeat this procedure until all the wires and rings are fixed and the puzzle should look like the sketch in Fig. 3.

The Loop to Complete the Puzzle

A length of about 18in. of 16-gauge wire is cut off and bent in the middle to form an open-ended loop (see bottom of Fig. 3). Thread this loop through the rings and twist the ends together as shown in Fig. 4 and the puzzle will be complete. The problem is to remove the loop.

How it is Done

To solve the puzzle take hold of the loop by the twisted end in the right hand with the rounded end pointing to your left; the puzzle then appears to you as Fig. 4. Let the rings and the base hang down from the loop and manipulate the rings with the left hand. For ease of reference let us number the rings 1 to 6, that on the left being No. 1, the others being numbered consecutively towards the right. Draw the loop through the rings towards the right as far as it will go, lift rings 1 and 2 together over the end of the loop, then push the loop back to the left and drop the rings through as shown in Fig. 5. This illustration shows the rings nearly half way through the loop, but they will fall right down and rest on the base. Now the secret of the whole thing is that the second ring from the left-hand end of the loop can always be removed.

After removing 1 and 2 as just described, the ring at the left-hand end of the loop is No. 3, and the second from the end No. 4; No. 4, then, is the next ring to come off. It is removed by drawing the loop as far as possible to the right, lifting 4 up over the end of the loop, pushing the loop back to the left, and dropping the ring through in the same way as you did 1 and 2 (see Fig. 5).

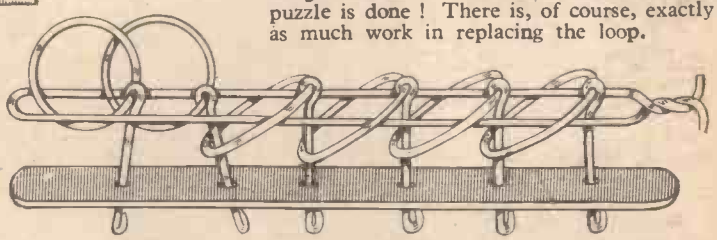


Fig. 5 (Right).—The second move in solving the puzzle.

Removing the Three Remaining Rings

You now remove No. 3, and to do this put Nos. 1 and 2 on again by reversing the process for taking them off, i.e., push rings 1 and 2 up through the loop as in Fig. 5, draw the loop to the right and allow the rings to drop below the rounded end of the loop. Now draw the loop to the right, lift up No. 1 only, push loop to the left and drop No. 1 through. No. 3 then becomes the second from the end, and can be removed in the usual manner. To remove No. 2, put No. 1 on the loop again (by passing it up from below in the same manner that you put 1 and 2 on together), then remove 1 and 2 together as before. Now 5 and 6 only are on the loop, and No. 6, being second from the end can be removed. Then proceed as follows:

Put on 1 and 2 together. Remove 1. Put on 3. Put on 1. Take off 1 and 2 together. Put on 4. Put on 1 and 2. This leaves 1, 2, 3, 4 and 5 all on the loop, and the only result so far has been to get No. 6 off. To proceed: Take off 1. Take off 3. Put on 1. Take off 1 and 2. Take off 5. Put on 1 and 2. Take off 1. Put on 3. Put on 1. Nos. 1, 2, 3 and 4 are now on and 5 and 6 are off. Take off 1 and 2. Take off 4. Put on 1 and 2. Take off 1. Take off 3. Put on 1. Take off 1 and 2 and the puzzle is done ! There is, of course, exactly as much work in replacing the loop.

Not Haunted

MOST " haunts " seem to be in the minds of the haunted. If mothers told their children stories of coats hanging in dark corners, how they came from the sheep, how the sheep was clipped, the wool spun and the cloth dyed, all these details would make children friends of shadows.

When a child complains of noise from wardrobes and a chest of drawers, explain how wood stretches and how growing mushrooms can push up a stone, and how an expanding girder in a bridge could smash the whole structure if it was not allowed to move, then he will be quite happy.

That, of course, is the explanation of most ghosts. Add a few beetles, a rat or two and some strong imagination and there, I believe, is your ghost ready-made.

A Morse Buzzer Set

Our Junior Section

A Unit for Practicing the Morse Code

MAKE the buzzer first. The frame (A, Fig. 1) is cut from a piece of hardwood, ½in. thick, while the core of the electro-magnet (B, Fig. 1) is a large nail at least ⅛in. in diameter. Thoroughly soften it by heating to red-heat and allowing to cool. It should then be cut to size and pushed, a tight fit, into a hole drilled about ½in. from the end of the buzzer frame. Countersink the head so that it is flush with the underside.

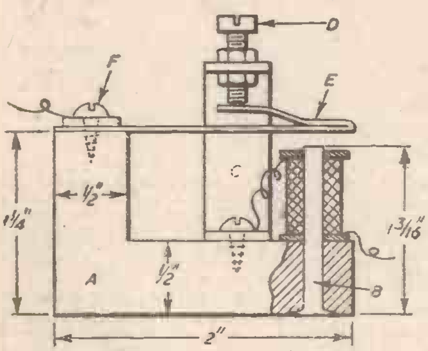


Fig. 1.—Details of the buzzer.

The Bobbin

This is made by wrapping a strip of glued paper around the nail and fitting it with cardboard ends ½ in. in diameter. When dry wind on five layers of No. 30 D.C.C. wire, leaving a few inches at each end for connections.

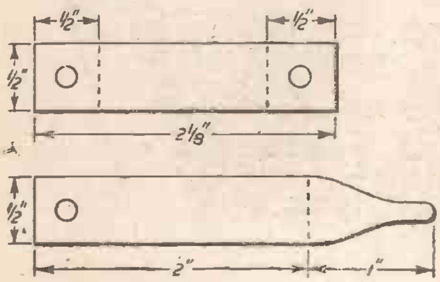


Fig. 2.—The bracket strip and armature.

Next make the bracket (C in Fig. 1), which holds the contact screw. Cut it from stout brass to the measurements given in Fig. 2, drilling the two ends and then bending them at right-angles at the dotted lines. Attach it to the buzzer frame close to the electro-magnet, with a round-headed brass screw; but first bare the end of one of the wires from the electro-magnet and give it a few turns round the screw before tightening up. The contact screw (D, Fig. 1) is a very small bolt, secured by two nuts.

The Armature

The armature (E in Fig. 1) is cut from stout tinplate to the measurements given in Fig. 2. The narrow end is doubled over at the dotted line and hammered flat, the point being then raised so as to form a spring contact with the screw D (see Figs. 1 and 3). Attach the armature to the buzzer frame with a round-headed screw and washer (F, Fig. 1), gripping one end of a few inches of copper wire under the screw head for connecting purposes. There should be 1/16in. gap between the armature and the magnet pole. This completes the buzzer.

The Base

This takes the form of a box without ends and may be made from ¼in. fretwood, the dimensions being given in Fig. 3. Glue the buzzer to the top, leaving room for the tapper key. This latter consists of a strip of springy brass, having a small wooden knob fastened at one end by a round-headed screw, the other end being attached to the box by a similar screw which also grips the end of the copper connecting wire from the buzzer. If the point of this screw projects inside the box it must be filed flat so as not to foul the battery.

Testing the Set

When the tapper key is depressed, it makes contact with a short brass strip, which is secured by a 1in. round-headed brass screw (A, Fig. 3). A second 1in. screw (B, Fig. 3) grips the bared end of the remaining connecting wire of the electro-magnet. Now slip a flash-lamp battery into the base, and adjust the brass strips so that they make contact with two screws, A and B. Secure the battery in place by wedging it with a folded piece of cardboard.

The set is now complete. Depress the tapper key and adjust the contact screw on the buzzer until the loudest note is obtained. As a certain amount of sparking will occur, it is advisable to clean the tip of the contact screw occasionally.

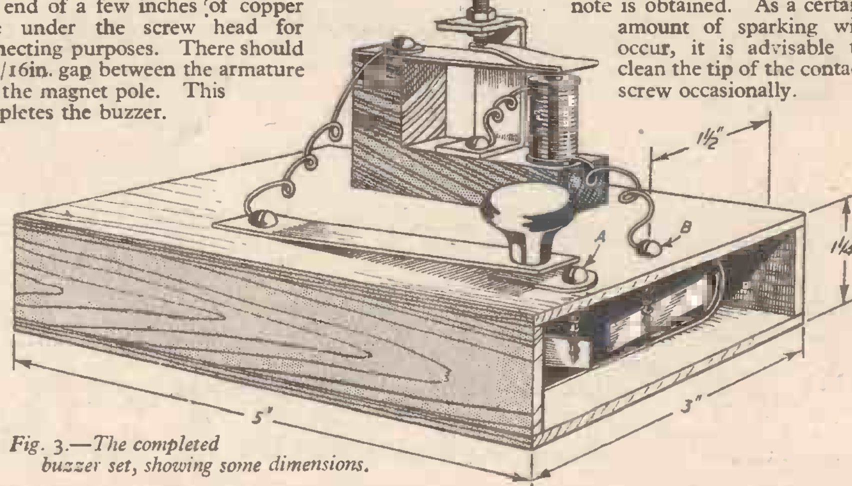


Fig. 3.—The completed buzzer set, showing some dimensions.

Making Crayons at Home

Materials and Method of Mixing

THE materials used are powdered pipeclay and china clay, curd soap and, of course, the colouring matter, which is usually natural earths.

A good mixture is equal parts of china clay and pipeclay; this should be well stirred and then the colouring matter intimately mixed with it. For a black crayon, mix 1½ parts of lampblack to every 10 parts of clay and add 1/6 part of Prussian blue. For coloured crayons mix sufficient dry colours to obtain the desired tint.

Colouring Materials

For red, use Venetian red or carmine. For blue, use Prussian blue or artificial ultramarine. For yellow, use yellow ochre or chrome yellow. From these colours you can get others by judicious mixing. Obtain an ounce of curd soap, shred it finely and dissolve in a pint of water, this is the mixing fluid. Mix this with the pipeclay and colours until a thick mass results, then leave it for two or three days. Knead it well and roll into a ball until it is of the consistency of stiff dough with the minimum of moisture still present.

Shaping the Crayons

Place the ball on a glass plate supported by a wooden baseboard and roll it into lengths with the aid of another piece of board used as a pressure roller, and cut into pieces. The crayons should now be laid on a board, each separated from the other, and allowed to dry in a warm room. They will take some little while to dry properly.

Wax Base

Many of the crayons sold in shops are made with a wax basis, using the same colouring matter as for the clay types. They are easily made, using cerasine or Japan wax. Melt only sufficient wax for one particular colour. Put the wax in a tin or jar, place the tin into a vessel of water and put over the fire until the wax is melted.

Add plenty of colouring matter, and take the vessel off the fire. Lift the tin out and keep the contents stirred until the wax commences to set. Unless this is done, the colour will settle to the bottom. Turn the mass out of the tin on to the glass plate, and roll into lengths; then cut off and leave to set hard.

Letters to the Editor

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

Silvering Glass by Spray

SIR,—In the November issue of PRACTICAL MECHANICS appears a letter from D. E. Challis (Enfield). The correspondent deals broadly with Silvering Glass by Spray.

From the correspondent's reply to another reader's enquiry on the subject, the matter appears to be very simple ; this, of course, is rarely the case. Mr. Challis is entirely wrong in stating that the silvering solution is sprayed from a single nozzle. In actual fact the guns used for this purpose have approximately six nozzles arranged concentrically within the cap of the gun head. It is quite true that the mixture issues forth from one large nozzle in the cap of the gun head, but only after the respective solutions are intimately mixed within the cap by the six or so fine holes.

The process of spray silvering was originally evolved for metallising wax impressions of type before electrotyping and was performed in order to render the wax conductive so that copper could be easily deposited on the silvered surface. The process is due to research carried out by the Printing Packaging and Allied Trades Research Association (Patra), and may only be operated commercially by licence from the organisation named. The necessary equipment is, of course, relatively expensive. The process is, however, now being applied to silvering glass, and it is suggested that anyone sufficiently interested should get in touch with "Patra," Patra House, Randalls Road, Leatherhead, Surrey, for information on the subject.

Having had considerable experience in such matters, we can assure your readers that the process, although attractive from a commercial standpoint, is not practicable for the amateur.—H. E. CANE (Argenta Products, Sussex).

DDT Moth Spray

SIR,—I noticed with interest that your Query Service in the November issue of PRACTICAL MECHANICS recommends DDT as a moth spray, and says that DDT is available from "Geigy Pharmaceuticals, Ltd.," at an address in Deansgate, Manchester.

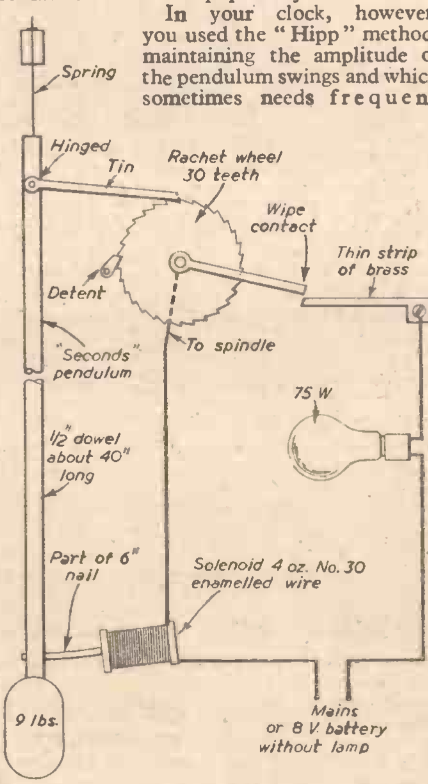
You may like to know that DDT is in fact sold by the Geigy Company Ltd., whose address is Rhodes, Middleton, near Manchester. The DDT formulation designed for the purpose in question is Irgatex MD Solution, which is based on a highly refined solvent and is thus harmless to fabrics. It is, however, available only to the trade.

Your correspondent would find in the shops a number of proprietary preparations containing DDT, such as, for example, Dylon Mothmaster Carpet Cleaner; and, as he specifically mentioned eggs, it is perhaps worth pointing out that DDT will not destroy moth eggs, but will kill the young larvae soon after they hatch.—B. H. DE C. IRELAND (The Geigy Co., Ltd).

Electric Clock Movement

SIR,—Some time ago I successfully made up the "Electric Clock" described in your "PRACTICAL MECHANICS How-to-Make-It Book," and have since converted to electricity several grandfather clocks which seem to have lost their old popularity.

In your clock, however, you used the "Hipp" method, maintaining the amplitude of the pendulum swings and which sometimes needs frequent cleaning of the contact points and/or adjustment.



Mr. L. M. Barnes' electric clock modifications.

The sketch shows my method, which has proved very efficient and almost foolproof. The contact here is a wiping one and needs no cleaning, while the oscillations keep up with a 9lb. weight well over the 60 seconds given by the 30-toothed spur wheel.

I find a solenoid more efficient than a bipolar magnet, a longer "pull" being obtained, and the one-minute impulse can also be used to drive other clocks by means of a ratchet and electromagnet operating on a 60-tooth wheel on the minute-hand shaft. All the non-essential "works" can be scrapped.—L. M. BARNES (Worthing).

Setting Up a Cold Water Aquarium

SIR,—With reference to the information given to Mr. V. W. G. Hughes, of Bedfordshire, in answer to his query in the November issue concerning the setting up of a cold water aquarium, the growth of algae is *encouraged* by excessive light, and not the reverse, as suggested. It is also greatly *discouraged* by a wealth of higher plant life, so that 30 or 40 plants would be nearer the mark for a tank of this size.

Also, the presence of plants does not affect the oxygen content of an aquarium to any significant extent.—IVOR W. BRASSINGTON (Cannock).

Wet and Dry Indicator

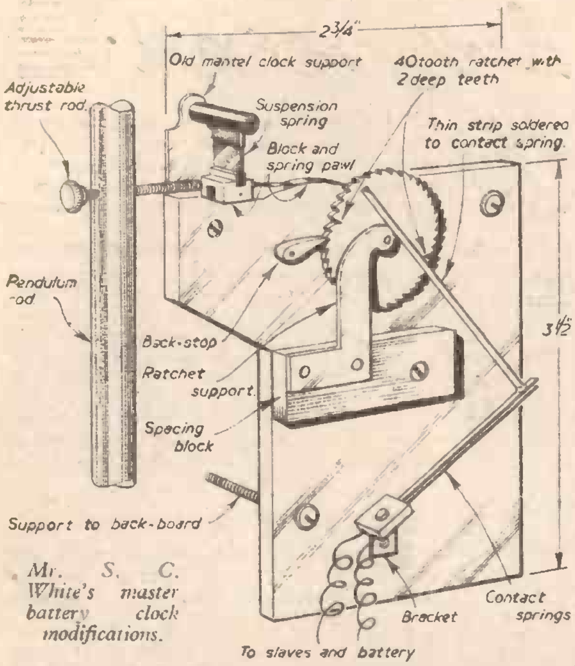
SIR,—On seeing query, "Wet and Dry Indicator," in "Information Sought," September/October issues, I turned up a small volume, "The Story of the Weather," by G. F. Chambers, F.R.A.S., and came across this information which may be of interest.

"Hygroscopes," the vegetable kingdom, furnishes various hygroscopic mediums such as: (1) Cobeena Hooloo of Mysore; (2) Avena fatua, or "Wild Oat"; (3) Funaria hygrometrica, or "Cord Moss"; (4) Seed of Stipa pennata, or common "feather grass"; (5) Arundo phragmites, or common "Reed."

I have one of these old type "wheel barometers," and the damp indicator appears to be of the reed variety, 1½in. long and 1/16in. thick, mounted by the centre on a brass upright, perhaps with wax, as you suggest. Some time ago I tested it and found by just laying on the support it would bend to a "teaspoon" of hot water held underneath it, but when held in position on the wall it never moved.—J. E. SHACKLETON (Ealing, W.5).

Master Battery Clock Modification

SIR,—I have completed a Pendulum Master Battery Clock from one of your blueprints, carrying out several modifications. Originally the slaves were to receive their electric impulse from a pin mounted on the minute spindle, but this I found allowed the contact to remain closed for two swings of the pendulum, causing a heavy drain on the battery. I therefore carried out the modification shown in the sketch. I purchased a 40-tooth ratchet-wheel about 1¼in. diameter and cut two of the "notches" *deeper* by just over 1/16in. These cuts are on opposite sides of the wheel, so there are 20 teeth between each cut. I mounted the wheel on a piece of hard insulating fibre board, so that the complete unit could be assembled with ease, and then fixed to the back board of the master clock. Above the ratchet a spring pawl was attached to the base of a suspension spring and the other end of the pawl rested in one of the notches of the ratchet. Next I soldered a thin light strip of brass to the upper blade of a relay contact spring; this thin strip was 2in. long and 1/10in. wide. Placing the base of the contact on the fibre below and to the right of the ratchet, until the thin strip was just a fraction below the



Mr. S. C. White's master battery clock modifications.

spring pawl, I marked and drilled the fibre to take the contact. My contact was screwed to a small bracket and the bracket bolted to the fibre ; in this way the correct " spot " can be found by gently swivelling the strip towards the pawl and locking the nut.

Next I drilled the pendulum rod 4½in. down from the *top* of the suspension spring. Both the springs are manufactured and are 1in. overall, of the twin spring type. Through the hole in the pendulum I screwed a 1½in. length of threaded ⅛in. rod ; on the left side of the pendulum I screwed on a terminal head and locked it with a small nut. The rod now acts as an adjustable " thrust." The fibre board unit is then fixed to the back board so that the suspension block is in line with the pendulum " thrust."

When my pendulum is at rest, the end of the thrust rod is 1/16in. from the suspension block.

When the pendulum is set in motion the thrust rod pushes against the suspension block carrying the spring pawl; the pawl moves the wheel forward one tooth. As the pendulum swings away, the suspension spring pulls the pawl back, riding over the next tooth to go forward. This is repeated with each swing of the pendulum. Now when the pawl drops into one of the cuts and is pushed forward the pawl comes up against the contact strip which closes the contact blades, and an impulse is sent to the slaves.

As the pendulum makes 40 swings a minute (the ratchet having 40 teeth), one impulse is received by the slaves every 30 seconds or two a minute. I have yet to build my slaves, but I tested the impulse unit with an electro magnet wired to another room, and the armature closed faithfully every 30 seconds. The duration of the close was about a half second.

The whole impulse unit was fixed to the back board by two pieces of narrow threaded brass tube ¼in. diameter. A threaded rod to fit is screwed into the back board until about 4/10in. is left protruding. On to this is turned the tube. Having previously drilled the fibre board accurately to correspond with the tubes, a bolt and washer are required to fix the unit in position, passing the bolt through the fibre board into the end of the brass tube and screwing home. The length of the tubes in my case is 1½in. The fibre board was 2/10in. thick.—S. C. WHITE (Harrow).

Magnetic Board

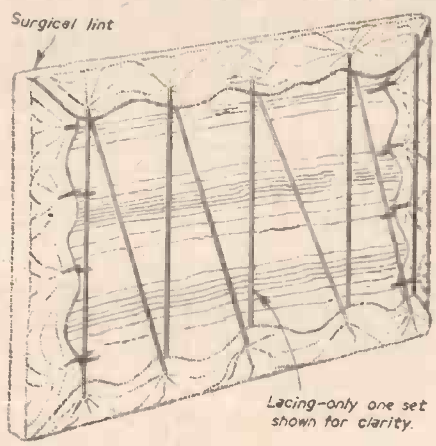
SIR,—Regarding the inquiry of Mr. J. K. Swells in the November PRACTICAL MECHANICS for details for making a 4ft. by 3ft. magnetic board for instructional purposes, may I suggest he makes a lint board ?

The construction of one of these is quite simple and it is trouble-free in operation.

The demonstration board is covered with a piece of fluffy surgical lint, large enough to allow for a 2in. overlap all round. The best method of fixing this is to lace the opposite sides together as indicated by the sketch. One set of lacing has been omitted for clarity. The lint must be used fluffy side outwards.

Flat models may be cut from light card of any size and shape, having lint stuck to their backs, again fluffy side out.

These models may then be " stuck " to the board merely by placing them where required, where they will remain until moved.—JAMES J. FOWLER JNR. (London, E.7).

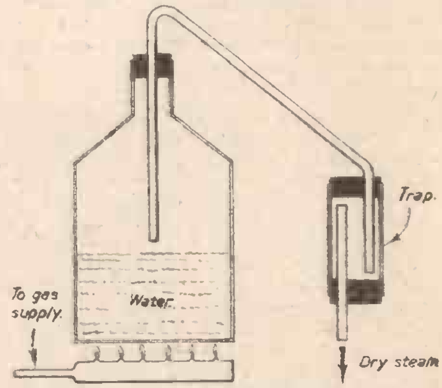


Details of a lint board.

Producing Dry Steam

SIR,—In reply to a query in " Information Sought " in the October issue, a drawing of a steam trap is given below.

The trap illustrated is made of glass. It should be placed in the steam pipe as near the point of delivery as possible.



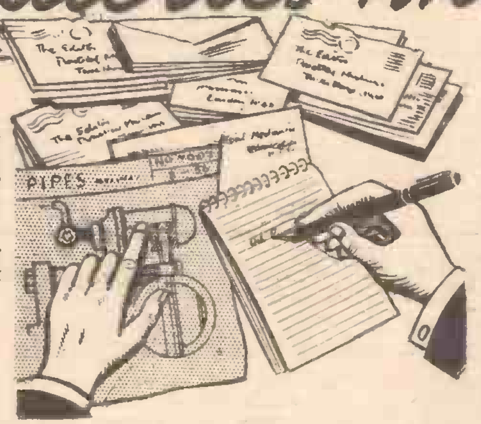
Mr. B. A. King's method of producing dry steam.

The apparatus should be worked for a few minutes to warm it up before the steam is used.—B. A. KING (Worcs).

P.M. Easibinders

SIR,—I am delighted with my volume of PRACTICAL MECHANICS now that I have inserted the issues and the index. I have a large pile of previous volumes and I propose to purchase additional binders to keep them in order—and to prevent friends " borrowing " copies which are seldom returned. My wife is delighted, too, for at spring cleaning time I had difficulty in preventing her from tidying them away ! I think this system of loose binding is an improvement on the standard binding since the volume opens flat at any page and the covers are more substantial than the usual binding cases. I take it that when ordering binders you will block the appropriate volume numbers on the spine.—E. F. N. (Doncaster).

Your Queries Answered



QUERY SERVICE
RULES

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

Paste for Label Work

I HAVE to make a quantity of cardboard boxes, which I shall cover with decorative paper. Please tell me how to make up a cold glue or paste for use in fixing the cover papers to the boxes.—D. J. Priddle (Yeovil).

AN excellent and fairly cheap paste for your label work can be made according to the following formula :—

White dextrine	5 oz.
Starch	5 oz.
Water	3½ oz.
Glycerine	1½ oz.
Phenol	1 gram.

Make a smooth paste of the white dextrine, starch, and approximately half the water. Then add the rest of the water. Heat the mixture on a steam bath, stirring it continually until it becomes perfectly smooth and homogeneous. Then stir in the glycerine and the phenol—the latter merely functioning as an antiseptic to prevent the paste from becoming mouldy. By using yellow dextrine, instead of white dextrine, the paste may be given slightly stronger adhesive properties, but, since it will tend to stain white paper, we advise the use of white dextrine which can be obtained from any chemical laboratory suppliers such as Messrs. Griffin & Tatlock Ltd., Kemble Street, Kingsway, London, W.C.2, or, in larger quantities (of about 14 lb.) from Messrs. Henry Smith & Co Ltd., Diggle, Yorks. This thick, white paste can be thinned out to a certain extent by incorporating more water.

Heat-resisting Cement

PLEASE give me the correct formula for making up a fireproof cement or clay for binding together firebricks. It must be able to stand a fairly high degree of heat and be, at the same time, durable. —E. J. Pape (Lincoln).

HERE are two heat-resisting cements which should serve your purpose :—

	(by measure)
(a) Powdered pumice ...	9 parts
Asbestos powder ...	2 „
Waterglass	

Mix the pumice and the asbestos. Then slake with waterglass to mortar consistency.

	(by measure)
(b) Graphite	2 parts
Manganese dioxide ...	2 „
Common salt	1 „
Borax	1 „
Fine iron filings ...	4 „
Dry, powdered clay ...	8 „

Mix all the ingredients together. Then mix with water to mortar consistency. Use immediately.

Formula (a) gives a white cement. Formula (b) gives a more greyish cement. It is essential to allow the cement to dry out slowly before subjecting it to heat. If you omit this precaution, the cement may crumble.

Setting Spirit Level Tubes

PLEASE tell me the usual compound that is used for setting tubes in spirit levels and what is the easiest method of setting the tubes correctly ?—C. B. Gibson (Lincoln).

VARIOUS compounds are used for the setting of spirit-tubes into spirit-levels. The choice of such compounds depends on the general nature and construction of the level. An ordinary slow-setting plaster mixture will suffice in many instances, whilst in others an everyday cellulose tube cement will do, whilst in still other instances a thick, rubbery compound such as Chatterton's compound, well known to radio and electrical workers, can be used.

A very good, clean, cementing compound can readily be made by grinding together four parts of Portland cement and one part of ordinary shellac. The resulting powder is moistened with methylated spirit containing an equal volume of water until a paste-like cement is obtained. This is packed into the cavity and put away for two or three hours in a warm oven until it dries out and sets hard.

In setting the tubes in the levels, the level base is placed on a flat, accurately levelled surface, and the cementing compound is packed into the groove in the level base which is to receive the spirit tube. The spirit tube is then gently pressed into the groove, in which it is usually held down in two places by metal straps, ties, cross-pieces or some other similar device.

Making Barrier Cream

CAN you tell me the formula for making a non-greasy barrier cream, please ?—L. Charles (Liverpool).

BARRIER creams consist usually of an emulsified stearic acid, which has been formulated on the basis of any ordinary vanishing cream and which has been coloured merely by inclusion of a little red oxide pigment such as iron oxide. You can make one by means of the following process : Heat 12 grams stearic acid to about 170 deg. C. until it is thoroughly molten. It is then rapidly stirred and the following mixture is added to it, drop by drop :—

Triethanolamine	½ c.c.
Glycerine	4 c.c.
Water	40 c.c.

If you desire a coloured product, merely add a pinch of rouge (iron oxide) to the molten stearic acid before commencing the liquid addition. Under conditions of rapid stirring, a smooth cream will work up. The stirring should be continued whilst the mixture is cooling, and, during this stage, 1 c.c. of any desired perfume, essence or germicide should be stirred in. When the preparation has thoroughly cooled it will be ready for use.

Embossing on Leather

HOW can I emboss initials in gilt, also gilt and colours, on leather wallets, etc. ?—E. Payne (Belfast).

THE embossing of initials and other characters on leather articles comes properly within the art of the bookbinder, and you will find this referred to in detail in any book on bookbinding, such as, for instance, J. Kay's "Bookbinding for Beginners" (Cassell and Co., Ltd.). The letters, or other devices, are pressed into the leather with ordinary hand pressure, using for this purpose a sort of cast steel type which may or may not be mounted in a suitable holder. The impressed letters are then painted over thinly with a little glair, which consists of egg white diluted with water. When this has dried it is breathed upon to remoisten it, after which a sheet of gold leaf is laid down on it and gently rubbed at the back. The leaf is then gently stripped away, leaving the gold adhering to the impressed letters. Similarly, gold powder (genuine or imitation) can be dusted on the glaired surface in a similar manner, as also may be dry powdered colours.

An alternative method for colouring the embossed work is to use the special colours provided for this purpose.

You will be able to get all the necessary materials from either Dryad, Ltd., St. Nicholas Street, Leicester, or Messrs. G. W. Russell and Co., Ltd., Hitchin, Herts.

THE P.M. BLUE-PRINT SERVICE

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The above blue-prints are obtainable, post free, from Messrs. George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

*An * denotes constructional details are available free with the blue-prints.*

Paint Strippers

I SHOULD be grateful for any information you can offer me upon liquid paint strippers, for the removal of old paint prior to repainting, and for cleaning paintbrushes.—D. H. O. John (Hornchurch).

THE whole essence of a successful paint stripper is that it should contain wax or cellulose dissolved in a liquid or mixture of liquids which will soften the paint film. Such liquids are volatile ones, and the function of the dissolved wax is to form a layer on the surface of the paint to prevent the too speedy evaporation of the solvents, the wax itself having nothing whatever to do with the actual paint softening. The following formula, based on this principle, will be found to be quite efficient. It will soften the hardest oil paint film within half a minute:

Paraffin wax	1 lb.
Benzol	$3\frac{1}{2}$ lbs.
Methylated spirit	$3\frac{1}{2}$ lbs.
Acetone	4 lbs.

Melt the paraffin wax. Add the benzol first, then the acetone with continuous stirring. Then slowly stir in the methylated spirit, which will precipitate the wax as a voluminous suspension. Store the resultant product in tightly corked bottles. For use, it is merely brushed over the paint to be softened, left for about a minute and the softened paint then scraped off. Usually, after this operation any wax remaining on the woodwork will have to be carefully rubbed away by means of a cloth charged with benzol.

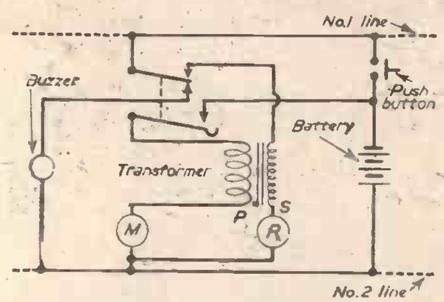
A paint stripper suitable merely for softening old paintbrushes can be made according to the following formula:

(a)	Petrol, paraffin or white spirit	2 parts (by volume)
	Oleic acid	1 part
(b)	Ammonia	$\frac{1}{4}$ part
	Methylated spirit	$\frac{1}{4}$ part

Stir (b) into (a) (not vice versa) with rapid stirring until a smooth cream results. Stand the hardened brushes in the above for 24 hours. Then wash them out with hot water and soap.

House Telephone Circuit

PLEASE advise me how the three-way house telephone circuit that you published on page 54 of the October, 1956, issue of "Practical Mechanics" could be adapted to allow the use of three ex-G.P.O. handsets (No. SA5063), which have a three-core cord; the inter-connection between receiver and microphone being built into the instrument casing and not, therefore, capable of being disconnected and re-wired to the four-core cord the circuit requires.—R. C. Price (Hinckley).



Suggested house telephone circuit.

THE simplest circuit for you to use would be the one given above, which is suitable for use with standard G.P.O. handsets. Any number of stations can be employed, these being connected between the same two lines; but the pressing of the ringing push button at any station operates the buzzers at all the other stations. You could use a $4\frac{1}{2}$-volt flashlamp battery at each station although a $4\frac{1}{2}$-volt dry battery of larger size, or three Leclanché cells would be better. The transformers could have a ratio of about 50 to 1.

Flashing Sign Operation

PLEASE tell me how to make the mechanism for an electrically operated sign similar to the sketch, in which the lights go on and off continually in order from 1 to 12, and then start again until the current is switched off.

Each bulb would only need to be on for a short period, say, half a second.—C. F. Smith (Westgate-on-Sea).

THE simplest method would be to use a small geared motor driving a disc or drum of insulating material. On the periphery of the disc or drum may be mounted a copper ring about $1\frac{1}{2}$ in. deep. On one side of the ring can be screwed a copper segment about 5/8in. wide and occupying rather less than one-twelfth of the periphery. A flexible contact may be arranged to press on the uninterrupted side of the ring and connected to one pole of the supply. Twelve flexible contacts may be arranged round the ring, opposite the projecting contact, so that this moving contact touches the twelve contacts in turn. Each of the twelve contacts should be connected to one side of each bulb, the other sides of the bulbs being connected to the second pole of the supply.

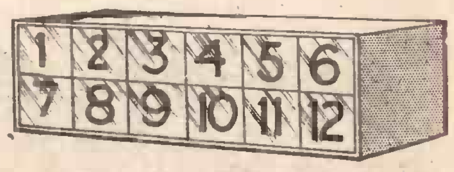


Diagram of the electric sign.

Embossed Frame Decoration

I AM making a plaster pattern for a small picture frame from which I shall make a mould in flexible rubber compound.

I wish to embellish this pattern with embossed floral decoration. Can you please tell me of a suitable plaster or other substance which can be applied with a fine paint brush to do this embossing, and which will not set while being worked.—Lewis W. Leach (Prestatyn).

THERE are many possible materials which you can use for your purpose. We suggest that you use a mixture of approximately equal parts of ordinary whiting and zinc oxide. This should be made into a paste with a solution of 10 parts of ordinary gelatine in 90 parts of water, the solution being applied warm. If you find that this paste sets too quickly for your purpose, stir into it a few drops of glycerine. If the paste is going to be kept for a long time, it will be advisable to stir into it a small quantity of Lysol or carbolic acid.

Information Sought

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

Lamp Device

I RECENTLY observed a glass vessel containing two dissimilar liquids which did not mix, both being colourless but the lower and obviously heavier liquid contained a small quantity of fluorescent material.

The glass vessel was mounted on a small plinth, housing what appeared to be a 15-watt pygmy bulb. The heat from this bulb lowered the specific gravity of the lower liquid, causing it to rise in attractive convolutions into the upper liquid, where it cooled and subsequently dropped back to the lower part of the glass container.

What are the two liquids concerned?—W. G. Such.

Wind Indicator

I WOULD like to make a wind indicator to take the form of a small tin, say, 5in. high by $2\frac{1}{4}$in. diameter, that could be fixed to the mast of my yacht, just under the boom, and that would emit a constant trickle of smoke through a small hole in the top for, say, about an hour at a time.

Could you suggest any chemical or other substance I could use for this?—J. E. Prangnall.

Blotting Paper Impressions

WHEN the uppermost sheet of paper in a writing pad is written upon, the sheet below contains an impression of the writing on it. I believe that this impression can be "developed" if given suitable treatment. Can you tell me how to do this?—F. R. Kane (Co. Derry).

Sensitive Metal Detector

PLEASE give me details for making a very sensitive metal detector capable of detecting, say, the nail of a boot buried several inches below the ground.—C. G. Stevens (S.W.13).

Bronze or Copper Finish

PLEASE supply me with a method for applying an oxy-bronze, oxy-copper or antique copper finish to steel screws. A simple method would be preferred, i.e., using chemicals, but I should be pleased to know also the electro depositing process and circuit.—A. D. Rothwell (Altringham).

Dyeing Fur

CAN you let me know the method of dyeing fur dark brown or black by chemical action and where I can obtain dyes and chemicals in small quantities. I have a practical knowledge of cutting and nailing furs, but little or none of dyeing.—H. T. Leaver (S.W.1).

Welding Polythene

I HAVE been trying to use polythene to make film negative albums with but partial success, using a heated poker and other methods.

Is it possible to make a tool, similar to an electric soldering bolt, which would maintain a regular temperature for welding polythene or any other such material?—W. Smellie (S.W.3).

Speedometer Conversion

I WANT to convert an ordinary car speedometer (recording the speed m.p.h. and the number of miles travelled) into a boat's log to record the number of miles travelled through the water. If I obtain a log line, fin and connect it up, what additional adjustments must I make? I have a "Smith" F.N. speedometer.—S. G. Williams (Ammanford).

A Swinging Garden Seat

PLEASE tell me what materials are required to construct a swinging garden seat, suspended between two tripods. What section would you advise to use for a 6ft. wide seat and can such an article be constructed without welding? Where can I buy materials?—A. J. Stael (Middx.).

THE Cyclist
Editor : F. J. CAMM

VOL. XXV JANUARY, 1957 No. 414

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2

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

WHAT I THINK

By F. J. C.

Why Cycle Car ?

THE passing, with the December issue, of *The Light Car*, formerly entitled *The Cyclecar*, leads me to wonder why such a term was ever applied to those early light motor-cars. The term is intended to cover three-wheelers and four-wheelers. A three-wheeled car to-day is still considered as a motor-cycle, but to call a four-wheeler a cyclecar seems to me to be a misnomer, even allowing for the period in which it was used. It is true that the motor-car and motor-cycle developed from the cycle, and in some respects the tubular construction and bicycle type wheels were used on the early small cars. Werner, who produced the first practicable motor-cycle, merely attached a De Dion 216 c.c. engine to the downtube of an ordinary bicycle with strengthened front forks. *The Light Car* was founded by the late Edmund Dangerfield, who was himself a famous racing cyclist, and who has his name inscribed on the original Bath Road Cup now in my possession. However, even the latter title, *The Light Car*, hardly fills the bill, for it dealt mostly with cars weighing anything from 1 ton to 35 cwt. It is always sad to hear of the passing of a contemporary, for in its 44 years of existence it played a most important part in the development and the improvement of the motor-car. I designed and marketed a light car, or cyclecar, some years ago—the Cambro—and my first advertisements appeared in *The Light Car*. The proprietors of this journal bought a number of them which were offered as prizes in *Tit-Bits*.

When the paper was started, motor-cycles were just coming into their own, but cycling was quite unaffected by the new competition, and it continued to gain in popularity. At that time there were literally dozens of weekly and monthly periodicals devoted to cycling. Some had a circulation of a few hundreds only. The manufacturers, however, got together and limited the advertising of members of the Union to certain nominated periodicals, and the vast majority of the journals died as a result. Our own paper, *The Hub*, died under the ban.

The Show

THE strike which caused the Cycle Show to open a day late had an unfortunate effect upon attendance, which last year was considerably down on the previous year. It seems particularly unfortunate, and, indeed, unfair, that the whole industry should be used as a whip in order to settle a dispute between a trade union and one particular firm. The industry itself is going through a lean time, and the great expense of organising a show of this magnitude no doubt figured largely in the deliberations which led to the announcement that, in future, the shows are to be held biennially. It was expected, as a result, that at the final annual show there would be a bumper attendance. The newspapers were full of the strike, coupled with announcements that the opening of the show was bound to be delayed. The same prominence, however, was not given to the fact that the strike had been settled, and no doubt this affected attendance. It seems to me that the organisers of the exhibition should seek assurances before they embark upon another show, from the various trade unions concerned, that there will not be a strike during the run of the show, nor immediately previous to it.

Apart from financial considerations, I agree with the idea of a biennial show. Once a year is far too often for an industry which has little new to offer and in which design has reached stalemate. The improvements mostly are in accessories and colour schemes.

The large number of exhibits of mopeds and motorised bicycles is an indication that the utility cyclist is deserting the bicycle as such for the vehicle which was described by the secretary of the C.T.C. as neither fish nor flesh.

Petrol Rationing

ONE effect of petrol rationing, reintroduced 11 years after the war, has been greatly to increase the sales of the power-assisted bicycle, and makers report that stocks are running low. That should be a good thing for the cycle industry, but there are many motorists who will now clean up and put into good working order for short journeys the nimble two-wheeler which they purchased during the war and which has probably been hung up in the garage since petrol rationing ceased. It may even increase the sale of bicycles.

The Late Sir Arthur Du Cros

THE late Sir Arthur du Cros bequeathed to me the copyright in his splendid book, *The Wheels of Fortune*, together with all original photographs and blocks. It is a fascinating book and sets forth the facts concerning the early days of air tyres, and the extensive litigation which followed after the discovery of Thomson's patent. Dunlop, before he moved to Dublin, did not live far from Thomson, who resided in Ayrshire, and who had marketed the tyre for horse-drawn carriages. I do not think that when Dunlop made his early tyres for his son's toy tricycle he had any idea that he had made an epoch-making invention. His son suffered from spinal trouble, which was aggravated when he rode his tricycle on the stone setts of Dublin. It was the du Cros who saw the commercial possibilities and who really put air tyres on the map. Dunlop always denied that he had ever seen a Thomson tyre.

I lunched regularly with Sir Arthur until a few months before his death and he was a fascinating raconteur of those early days. He was the guest of honour at a dinner given by the Roadfarers' Club to celebrate the Diamond Jubilee of the invention of pneumatic tyres.

He had known everyone connected with tyres, especially the three famous W's—Welch, Woods and Westwood. It was Welch who invented the wired-on cover, Woods who invented the valve and Westwood who invented the rim for wired-on tyres. I always felt sorry for Woods, who threw a fortune away by not accepting a royalty per valve. He wanted a lump sum down—£1,000, and that sum was paid to him. Had he accepted the royalty offer (I believe 9d. per valve) he would have been a millionaire within a few years. He died not so long ago, somewhat disgruntled, like Dunlop. Some of the photographs which appear in *The Wheels of Fortune* are quite priceless. Sir Arthur also handed over to me a number of volumes dealing with the history of Coventry. About a year before he died he became greatly interested in the commercial possibilities of the helicopter for passenger-carrying and business purposes. He was a great sportsman and indulged in his favourite hobby of swimming and diving well into his seventies.

When the time is propitious I may consider reissuing Sir Arthur's book, a copy of which he sent to every library in this country and the continental countries and the Commonwealth to set the true story of the pneumatic tyre on record for posterity. It will be remembered that Dunlop himself wrote a history of the pneumatic tyre. This is also a fascinating book, but unfortunately is marred by a number of inaccuracies. Those interested in the history of the pneumatic tyre should endeavour to get hold of copies, second-hand, of both these books. Another feeble attempt to produce a history of the bicycle was the late Bartlett's *Bicycle Book*, which was sponsored by Dunlop's. This, too, contains a large number of inaccuracies, both of chronology and of fact, and is therefore misleading. Another monumental work, produced by the egregious, pompous and self-important H. O. Duncan, was *The World on Wheels*. Its hundreds of pages are not indexed and it is in reality a heterogeny of miscellaneous and unclassified press cuttings, with plenty of material to impress the reader with the importance of H. O. Duncan. Even the fact that he won a club handicap organised by a practically unknown club, against the field of about a dozen riders, is recorded in his book.

The Car Door Danger

ALMOST every week a motorist is charged with carelessly opening a car door and injuring a passing cyclist. One such motorist was charged recently at West Bromwich with carelessly opening the car door and injuring a woman cyclist, as well as damaging her machine. The magistrate said the case was proved but granted the defendant an absolute discharge on payment of 4s. costs. He had a few caustic comments to make about cyclists who pass too close to cars. In view of the wide publicity given to these cases, it is difficult to understand why cyclists have not become car-door conscious and even apprehensive when passing a stationary car. Self-preservation is the first law of Nature. It is nonsense to say that they have to pass close otherwise following motorists show their irritation by hooting. According to my own observations, cyclists, especially those of the militant C.T.C.-N.C.U. type, have no regard for following motorists and could not care less whether they are irritated or not. Some, indeed, love to irritate motorists. It is equally nonsense to say that in passing wide they place themselves in peril. If they do so, they are riding carelessly or dangerously. They should wait until there is no peril before they pass as other road users are expected to do.

WINTER CYCLING

Some Aids Towards Comfort and Safety

PEOPLE who may be in the normal way enthusiastic cyclists but who have never tried winter cycling often have the idea that those who do venture out during the months between October and March have to suffer for the privilege. This, of course, is nonsense. Those cold, clear days with which the English winter is sometimes blessed, are ideal cycling weather, and there are very few week-ends when a ride of some sort is not possible.

The secret of enjoying winter cycling is to be properly equipped. This does not mean that you need another cycle for the winter, but a few modifications to the machine and some attention to suitable clothing will certainly pay dividends.

Tyres

Most of the "Sports" cycles and lightweights to-day are equipped initially with light skin-sided tyres which have only a thin tread on the part of the tyre that is in contact with the road, and the tyre is narrow in section. In summer they are ideal for fast and easy riding, but in winter something more substantial is needed. The tyre shown in Fig. 1 is very much more suitable. The thick rubber tread helps in preventing punctures from the grit thrown over the roads to make them less slippery in very cold or snowy weather, the heavy ribbed tread on the shoulder of the tyre gives a better grip when cornering on wet and muddy roads and, of course, brake efficiency is greatly increased.

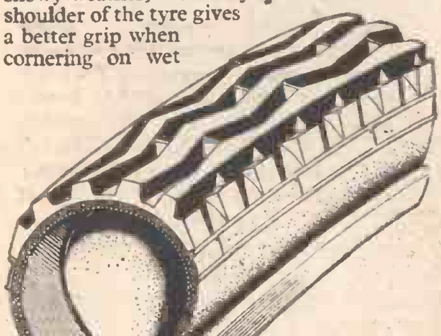


Fig. 1.—A tyre with a substantial tread made by Michelin.

Lower Gear

Riding a lower gear is not strictly a necessary winter modification, but a great many clubmen do put on a larger chain sprocket, or use continually a low gear on a multi-speed machine. One reason is, of course, that distances ridden are shorter, and speed is not so important as keeping warm. Fast pedalling in a small gear is one solution to this and also makes it easier to propel the larger and heavier tyres already mentioned.

Splashguards

Mudguards and mudflaps on the lightweight machine have, in the interests of lighter weight, been drastically reduced in size, and it is certain that they do not provide the same protection as do the wider type. For winter riding, then, make sure that your mudguards are efficient. The mudflap on the front, too, can have its efficiency improved by substituting one of the heavier varieties intended for mopeds and lightweight motor-cycles. Plastic splashguards are also available, and can be fitted to the wheels as shown in Fig. 2. These, of course, can easily be made from pieces of an old oilskin cape and ordinary elastic. Attention to these points should prevent rain from splashing up from the road. A mudguard extension and mudflap fitted to the rear mudguard, as shown in Fig. 3, will be appreciated by the riders behind when club riding. It can be made from an old mudflap and part of a broken mudguard. With extension and flap in position the wheel will be covered almost to the ground, preventing entirely the miniature fountain of dirty water spraying up from the road.

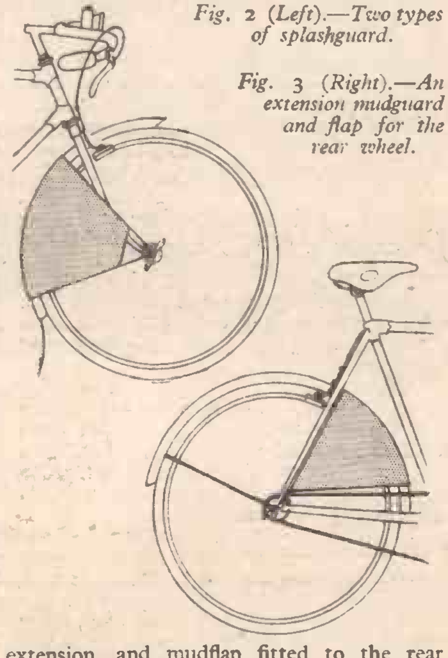


Fig. 2 (Left).—Two types of splashguard.

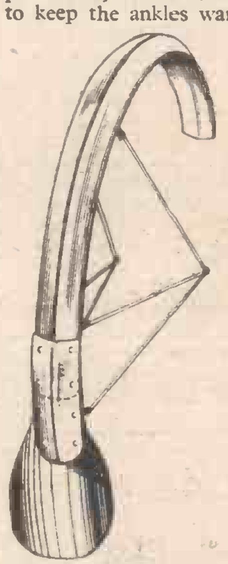


Fig. 3 (Right).—An extension mudguard and flap for the rear wheel.

Clothing for Winter

Whilst allowing freedom of movement, clothing must essentially keep the wearer dry and warm. One of the simplest ways to keep warm is to wear a couple of thin wool jerseys and a windproof jacket over the top, but the snag with this is that perspiration has no chance to dry out, and the rider risks catching cold every time he stops. A far better idea is to wear just as many jerseys as it takes to keep warm, finely knitted ones underneath and the big Continental-type sweater over the top.

Plus fours were at one time considered the ideal wear for the cyclist but to-day they have lost a great deal of their popularity. Their bulk, which certainly gave freedom of movement, had its disadvantages as well. The big fold of material at the bottom always managed to contact the chain somehow, and in wet weather the heavy folds of material became sodden with water. The socks worn with plus fours, no matter how thick, never seem to keep the ankles warm.

American - style jeans are the uniform of the young club rider to-day. These, though made only of a thin material, are closely woven and are wind resistant to a surprising degree.

Keeping the hands warm on a cycle is another difficult problem. Heavy sheepskin gloves are ideal at the beginning of a ride, but directly the rider warms up his hands are too hot; if he takes off his gloves they are freezing again. The solution is to wear two pairs—a thin woollen pair and leather gauntlets over the top. Three alternatives are thus provided—either pair or both. Make sure, however, that the gloves worn are not too bulky to allow the brakes to be used properly.

Keeping the feet warm on a cycle is a problem to which I believe there is no solution.

When it Rains

At these times the only thing to do is to don the whole waterproof regalia—sou'wester, cape and leggings and then go more slowly. Capes and leggings in various shapes and sizes in both plastic and oilskin are available and choice is largely a matter of personal preference. Make sure, however, that a large-size cape is obtained, one that will tuck down behind the saddle at back and reach well over the handlebars in front. Many riders dislike the sou'wester for the reason that the rain is inclined to run off it into the rider's eyes and wear a cap as an alternative. Wet weather clothing should be part of your permanent kit in the winter months; the day you leave it behind it is sure to rain. It is common sense, too, for the tourist to carry spare jerseys, socks, etc.

Greasing Chrome Work

This is an old tip, useful for the cyclist who is proud of his machine and wants to keep the chromium-plating in good condition. Almost any kind of grease can be used and only a thin coating is necessary. It should be applied to rims, fork crown, fork ends, chainset, cranks, etc. The snag is, of course, that it collects dirt, but in spring dirt and grease can be cleaned off to reveal the unspoiled chrome work. Make sure, though, that grease does not get on to the braking surface of the wheels.

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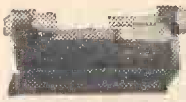

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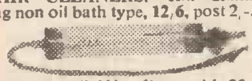

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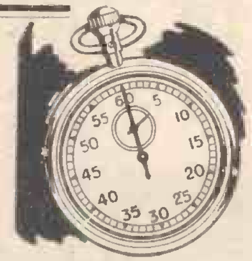

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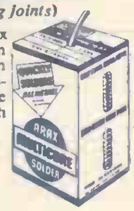

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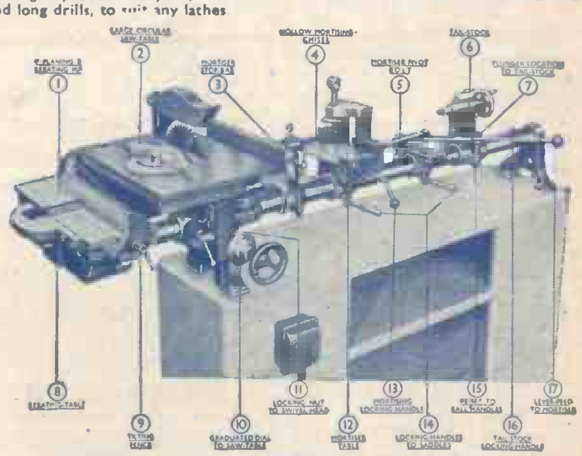

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