Making a Puppet Theatre

NEWNES

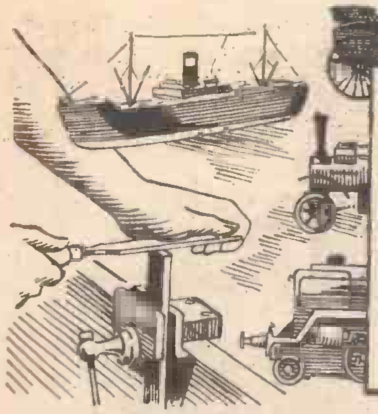
PRACTICAL MECHANICS

1'3

EDITOR : F. J. CAMM

1957

Contents



Practical Mechanics

Vol. XXIV. No. 282 AUGUST, 1957
"The Cyclist" and "Home Movies are temporarily incorporated

Editorial and Advertisement Offices
"PRACTICAL MECHANICS"
George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.
Phone : Temple Bar 4363.
Telegrams : Newnes, Rand, London.

SUBSCRIPTION RATES
Including postage for one year

Inland - - - - 18s. 6d. per annum.
Abroad - - - - 17s. per annum.
Canada - - - - 17s. per annum.

CONTENTS :

CONTRIBUTIONS

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

FAIR COMMENT

SCIENTIFIC DEVELOPMENTS THROUGH A RUSSIAN CRYSTAL BALL

IF the scientific developments of the next 40 years as forecast by 15 leading Russian scientists seem far fetched, we must also remember that television, radio, the aeroplane, radar and nuclear energy seemed equally fantastic to us 50 years ago. These 15 Russian scientists in "Youth Pravda" have given their views as to what is going to happen by A.D. 2000. The motor car of that period will be entirely automatic and controlled by the voice of the driver. He will speak into a microphone on the dashboard and merely state his destination. The car will immediately start itself and pick its own route. The Russians are, of course, cautious, because they add "This is how our world will look if we do not have an atomic war to blow us to bits." One scientist says, in connection with ships, that he has found that a 45 per cent. increase in power is possible by splitting a ship of conventional design into equal halves and mounting the power unit between them, thus lifting the hull and cutting down water resistance. However, he inclined to the view that at the beginning of the 21st century most ocean trips will take place under water with atomic powered engines.

Everyone at the beginning of the next century will have a small cigar-sized individual TV set. You call up a friend by the press of a button and providing no oscillating waves appear indicating that the number is engaged "the screen lights up and on it appears the face of the person called, drawn with an electronic ray pencil to such a degree of clarity that you could count every eyelash or dimple." By means of this device you will not need to crowd into a stadium or large arena to watch a football match, or a boxing match, nor any other public spectacle : you will just tune into it on this midget TV. The car of the future will not have piston engines and steering wheel, but will have an aircraft-type tail and cables beneath the roadway will set up an electro-magnetic field, while aerials below the car will pick up direction and power impulses. The driver will give instructions to the mechanism through a microphone. The scientist takes it for granted that the moon will be colonised, but first it will have to be cultivated so that it could feed the colonists. He visualises plantations begun from earth plants with radishes growing to the height of palm-trees. He foresees aluminium, water and oxygen supplied by moon minerals and industries for making rockets for journeys to the earth and cosmic travel ships.

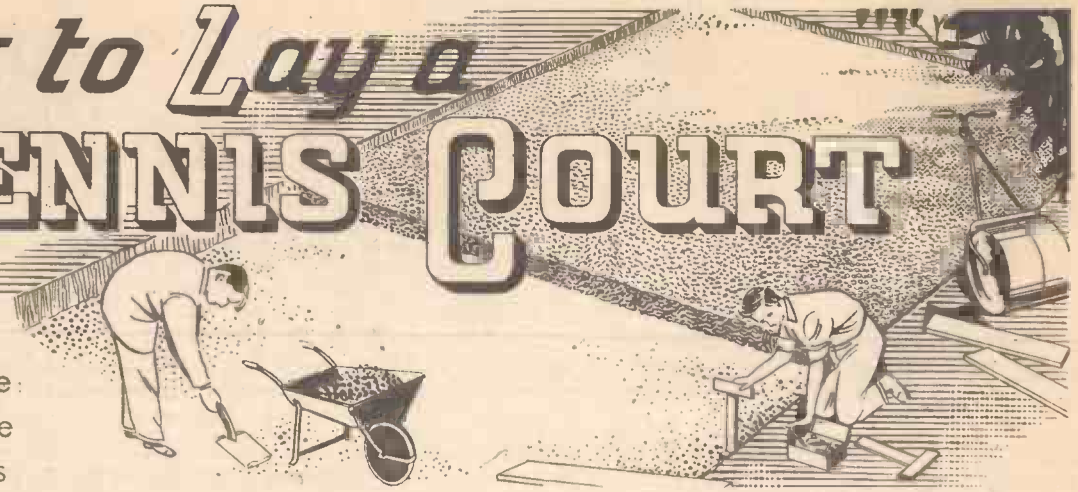
Food production can be doubled, we are told, by means of new root stimulants that will end the myth of only one crop a year. We are told that a few such stimulants already exist, but in a few years' time there will be hundreds of them.

Nobody will work underground by the year 2000 : a control engineer will set a task on his electronic panel and a caterpillar of machines below ground will select, split and bring up coal without further direction.

An intriguing forecast ! Whilst we must preserve open minds on such possibilities in view of the rapid strides in technical developments now being made, we must not forget that there were scientists 50 years ago who entered this world of fantasy and vaticination and very few of their forecasts have come true. However, we know that scientists in this country are paving the way for future scientific developments. The world's largest radio telescope, for example, has been handed over to British radio astronomers, who will use it for probing the mysteries of outer space a thousand million light years away.

The steerable paraboloid altazimuth radio reflector consists of a 250ft. diameter reflecting surface cradled in a bowl of structural steelwork, this structure being pivoted between two 180ft. high steel lattice towers.—F. J. C.

How to Lay a Tennis Court



Choosing the Site : Laying Base and Surface : Drainage : Maintenance and Provision for Nets

By "JONISON"

SELECT an area that appears to be reasonably level and slightly larger than the actual size of the tennis court.

Place pegs A, B, C and D at each corner of the area, tie a line between A and B and by means of spades cut a grip in the ground or, if it is grass, remove a line of sods about 12in. wide. Repeat this, between all the pegs, until the perimeter is well defined, Fig. 1.

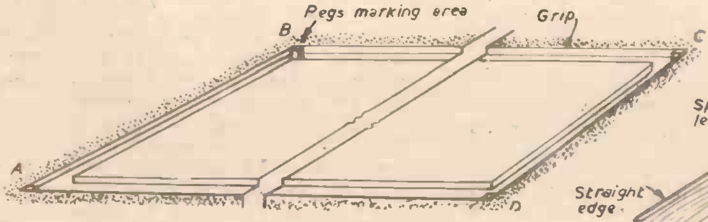


Fig. 1.—Pegging out the perimeter of the court

All grass sods should be stockpiled away from the area and, if not required, may be sold to help pay for the materials. Decide on the surface level of the court and knock the peg A into the ground until the top is equal to the level.

By means of a straight piece of timber and a spirit level transfer the level of peg A to peg A1, working in the direction of peg B, Fig. 2. The level A1 is now equal to A and may be transferred to peg B by means of a set of boning rods made from 2in. x 1in. timber, Fig. 3. Place one boning rod on A, another on A1 and the third one on peg B, sight along the top of the boning rods, knocking down peg B until the tops of the three boning rods are level, Fig. 4. Repeat this levelling in the same way between pegs BC, CD and DA, this will make all four pegs equal in level. The ground outside the area bounded by the pegs will probably be higher.

To obtain intermediate level pegs between each of the main ones place a boning rod on A and another one on B, insert a peg in the ground between these two and hold the third boning rod on it. Sight over the top of the boning rods until each one appears to be level; repeat this between each of the main pegs. We now have eight pegs all of equal level, Fig. 5. To insert level pegs inside the area of the proposed tennis court hold a boning rod on A, another one on C, and knock a peg E into the ground half-way between these two and sight over the boning rods as before, Fig. 6. Any number of pegs may now be obtained to denote the finished level of the tennis court and once set in position they need not be removed until the whole of the work is nearly completed.

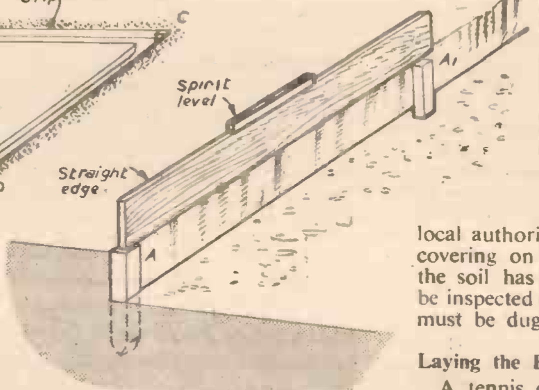


Fig. 2.—Levelling off the pegs with a piece of timber and spirit level.

Having obtained all the level pegs, the soil must be dug out for a depth of 7in. over the whole area. In most cases, soil of good quality can be sold to gardeners or nurserymen, and this may be another way of earning money to pay for materials: on the other hand if it cannot be sold many local authorities will remove it and use it for covering on controlled tipping sites. When the soil has been removed the area should be inspected and any roots of weeds remaining must be dug out and not chopped off

Laying the Base

A tennis court should be reasonably free from any ponding of water on its surface and it should be reasonably flexible. The base plays an important part and care must be taken to see that it is laid properly.

The main pegs previously set out should be painted white, this will save time later in trying to identify them from other pegs. By means of the boning rods a number of intermediate pegs should be "sighted in" for a quarter of the actual area of the tennis court, which

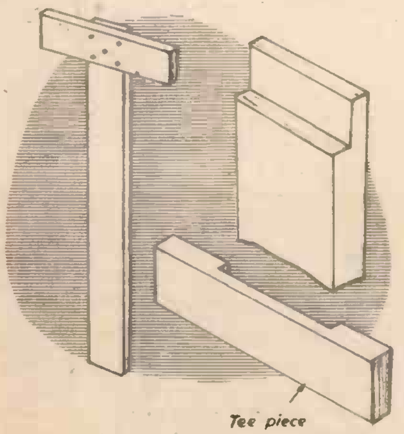


Fig. 3.—Constructional details of the boning rods.

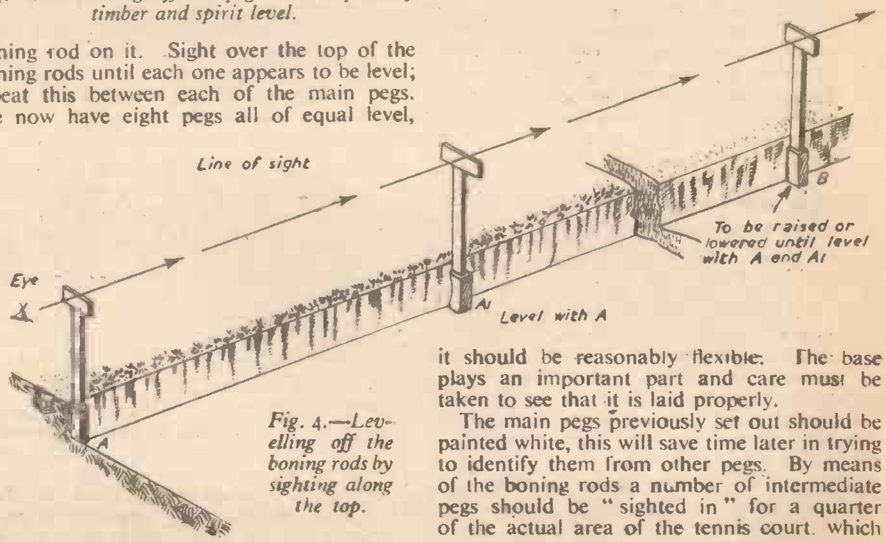


Fig. 4.—Levelling off the boning rods by sighting along the top.

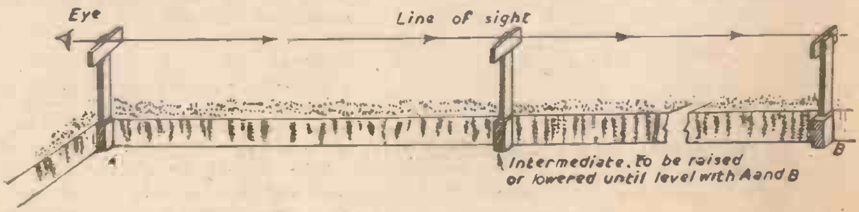


Fig. 5.—Further details for levelling off the boning rods.

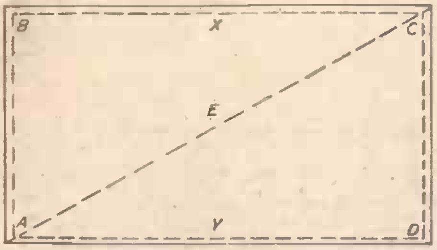


Fig. 6.—Inserting level pegs inside the area.

will be slightly less than the total area previously prepared; a margin of 2 or 3ft. all round the court for drainage purposes will be adequate.

Having set the pegs to their correct levels, well burnt clinker should now be laid to a loose depth of 6in. over this area and consolidated by means of a roller 25 to 30 cwt. in weight. This type of roller can be hired at a reasonable cost on a daily or weekly rate from a local contractor or the local authority.

If a hand roller has to be used, two layers of clinker each 3in. deep should be laid and consolidated in turn to make up the required consolidated depth of 4in. The remainder of the area may be treated in the same way until the whole area is completed. It is important that a uniform depth be maintained throughout.

Producing a Crossfall

To prevent ponding of water on the surface of the court it is necessary to produce a crossfall to enable the surface water to be conducted clear of the area.

Excessive crossfall must be avoided, otherwise players will be impeded when using the surface. The amount of crossfall given will depend upon the size of court, but in general a fall of 3in. for each 30ft. of court will be sufficient. The centre line of the court could be the highest point with a crossfall to the sides AB and CD: this will balance the players in so far as the court is concerned.

If a crossfall of 4in. is required, place pegs X Y equal to the required level and by means of boning rods used between A and Y produce intermediate pegs, obtain further pegs between B and X and between X and Y, Fig. 7.

Repeat this in the area bounded by pegs X Y C and D. We now have a series of pegs that will give the required crossfall. Clinker should be added to the base previously consolidated, and the pegs removed, the clinker should now be consolidated with a roller working from the centre line X Y towards the outer side A B and then the other half treated in the same way.

Laying the Surface

Before the surface is laid the base should be reasonably well knit, if it is found to be loose an application of water from a spray and a further rolling will produce good results.

The materials to use for the surface will require careful consideration, particularly regarding the money available. Pit gravel which is obtainable from sand and gravel merchants, or a cold bituminous emulsion covered with pea gravel or small chippings may be used.

Using Gravel

If it is decided to use gravel it should consist of particles of fine gravel and a more coarse gravel mixed together. The fine particles will bind the coarse particles together and produce a reasonably good surface.

The gravel should be at least 2in. deep over the whole area and well consolidated, to obtain this a uniform depth of 3in. of loose gravel should be laid over half the area of the court and rolled by means of a powered roller 25-30 cwt. in weight. After the first rolling the area should be sprayed with water and further rolled.

The second half should be similarly treated and then the whole area rolled lengthways, and for its full width. Should any loose gravel remain, fine particles should be sprinkled over the area, watered and then rolled again.

Using Emulsion

The whole of the clinker surface should be lightly covered with pea gravel or very small chippings and rolled.

Cold bituminous emulsion is obtainable in steel drums of 40 gallons capacity and hand-spraying machines may be hired at a small cost.

The whole of the prepared surface should be sprayed at a rate of 4 square yards per gallon and lightly covered with pea gravel or small chippings and left for about 24 hours.

The surface should be sprayed with emulsion a second time at 6 square yards per gallon and completely covered with pea gravel or small chippings and rolled with a roller 25-30 cwt. in weight. After a period of four days all loose chippings should be brushed off and stockpiled ready for another surface dressing at 8 square yards per gallon two or three months later, Fig. 8.

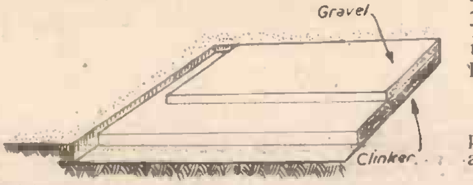


Fig. 8.—Adding surface-dressing.

Maintenance

Both types of tennis court will require periodical maintenance if they are to remain in good condition. A bass broom passed to and fro over the surface once a month and a rolling with a hand roller will be sufficient, weeds that start to grow should be dug out by the roots. A light application of cold bituminous emulsion at 10 square yards per gallon once a year for the first three years will produce good results in each case.

Drainage

It may be necessary to provide a small drainage system to keep the tennis court reasonably free from water and also the surrounding ground.

When setting out the area a margin 2 or 3ft. wide was allowed and it is this that will assist with the draining of surface and ground water.

Outside the edge of the tennis court between pegs A and B cut a trench 18in. deep and 18in. wide and remove the soil. In the bottom of the trench and for a depth of 12in. place broken bricks and cover over with coarse clinker up to the level of the tennis court. Make a similar trench between pegs C and D, Fig. 9. Between pegs B C and A D and for the full width of the margin lay clinker to the level of the tennis court; it is not necessary to roll the margin.

The drainage provided will keep ground water down to a level that will not affect the courts.

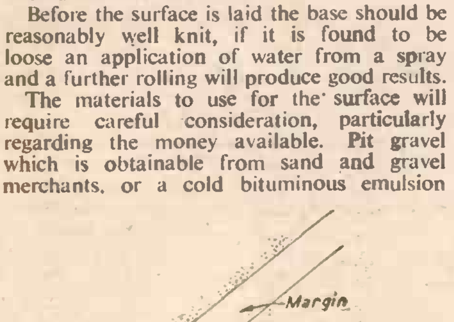


Fig. 9.—Draining the court.

Provision for Nets

A simple housing may be provided for the posts on which the nets are erected after the court is complete. Decide the position of the posts and cut out holes 12in. square and 12in. deep, form a housing with four pieces of hardwood in each case, the inside measurement being suitable for the posts, Fig. 10. Mix some concrete consisting of 1 spade of cement, 2 spades of sand and 4 spades of chippings and add a small amount of water.

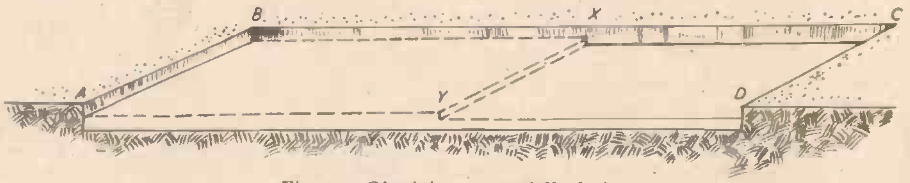


Fig. 7.—Obtaining a crossfall of 4in.

Place 2in. of concrete in the bottom of the holes and set the housing in position. Surround the housing with concrete up to the level of the court and leave for at least four days, after which the posts may be set in position.

Materials Required

The amount of material required must be known before any costs can be estimated, and the following table may be used as a guide :—

3in. clinker ...	Approx.	20 sq yd. per ton.
3in. gravel ...	„	14 „ „ „ „
¼in. chippings	„	160 „ „ „ „
Bituminous emulsion ...		4 to 10 sq. yds. per gallon.

Clinker may be obtained from factories, power stations or through a builders' merchant at a small cost.

Gravel is obtainable from a quarry or through a builders' merchant.

Chippings and cold bituminous emulsion are obtainable through a builders' merchant. To hire a roller contact a local public works contractor or a highways department of the local authority.

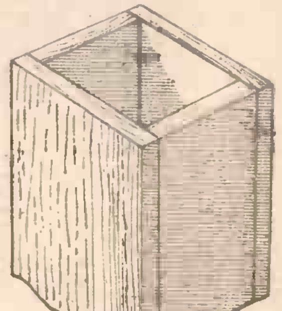


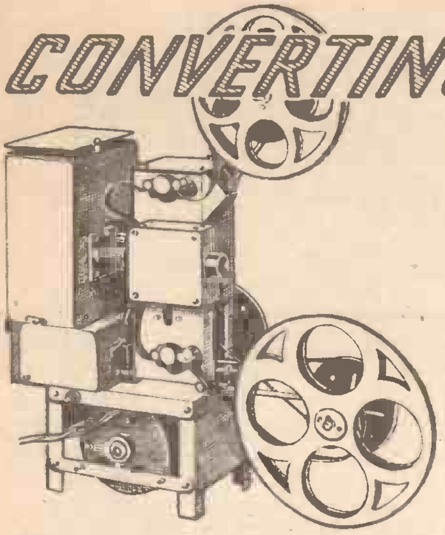
Fig. 10.—Housing for making provision for the posts on which the net is erected.

One of the most suitable types of gravel is one termed "Breedon" gravel, obtainable through a leading builders' merchant. This gravel is self hardening when rolled and sprayed with water. On setting, the gravel has an amber colour.

Another surfacing material is "Red Shale."

CONVERTING THE P.M. PROJECTOR

By L. COGSWELL



All the Modifications Required to Convert to 8 mm. the 9.5 mm. Projector Described in the December, 1956 to March, 1957 Issues

This article is published in response to many readers' requests.

THE 9.5 mm. silent film projector described in the December, 1956-March, 1957, issues of PRACTICAL MECHANICS may be converted for 8 mm. use by modifying the guide, the frameshift mechanism, sprockets and spool spindles. The general arrangement and continuous mechanism remain unchanged and, as the 8 mm. projector aperture occupies the same optical centre as the 9.5 mm. aperture, no repositioning of the lamp, condenser and objective is necessary. The modified pull-down movement components occupy the same picture head positions as their 9.5 mm. counterparts.

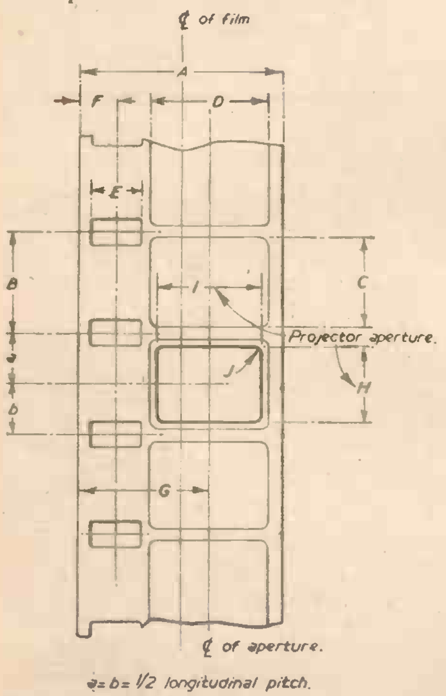


Fig. 1.—Principal dimensions of 8 mm. film.

	Inches	Millimetres
A	.315	8.
B	.150	3.810
C	.138	3.51
D	.189	4.80
E	.072	1.83
F	.072	1.83
G	.205	5.22
H	.129	3.28
I	.172	4.37
J	.010	.25

The picture area of 8 mm. film is approximately a quarter that of 9.5 mm. film, therefore, a shorter focal length lens is necessary to project to the dimensions of the 9.5 mm. picture, at an equivalent throw. The shutter diameter determines the shortest focal length lens that may be used. The modified cam wheel and shutter permits the use of an F⅞ lens, which for 8 mm. projection purposes is a popular focal length, and with the existing lamp should give a well illuminated picture 2ft. wide at approximately 7ft. 6in. from the screen.

The Guide and Gate

The guide and gate is of a similar pattern to that used for the 9.5 mm. projector, and if desired by the constructor the assembly may be made to allow for frame centring of the film. A frame centring device is not essential, but it is a useful feature when the printed film frames are off register to the perforations. With printed film stock, the horizontal frame centre line is situated midway between the perforations, see a and b, Fig. 1. Normally when set correctly in the guide no "off-racking" should occur whilst the film is running. Occasionally, however, the frame line may be observed appearing from the top or bottom of the screen. By shifting the aperture slightly in the required direction the frame lines can be eliminated.

Except for the dimensions shown at A in Fig. 2 (the changes are indicated in dark lines), the gate bracket may be made from 19 s.w.g. brass plate to the dimensions at Fig. 3 (pages 142-143, December issue). Unlike the 9.5 mm. guide the 8 mm. guide is offset to the aperture and claw slot, and care should be taken in positioning the aperture and slot in relation to the film path.

As a safeguard against dimensional errors occurring when bending the bracket, it would be advisable to bend the long tab at right-angles to the bracket face, prior to marking out the film path position.

The aperture dimensions are given in the table at Fig. 1, but if the constructor wishes to include the frame centring arrangement the aperture should be increased in height 1 mm. each way of the centre line as indicated by the dotted lines at A in Fig. 2.

The guide strips should be made from 19 s.w.g. brass plate to the dimensions at Fig. 2 (pages 142-143, December issue), and set to an 8 mm. clearance channel in the back face of the bracket, by the method described for the 9.5 mm. guide (page 143, December issue).

Make the backplate from 19 s.w.g. brass plate to the dimensions at B in Fig. 2, and the pads from 20 s.w.g. brass to the dimensions at D. The lower pad only is slotted. It is important that the backplate aperture

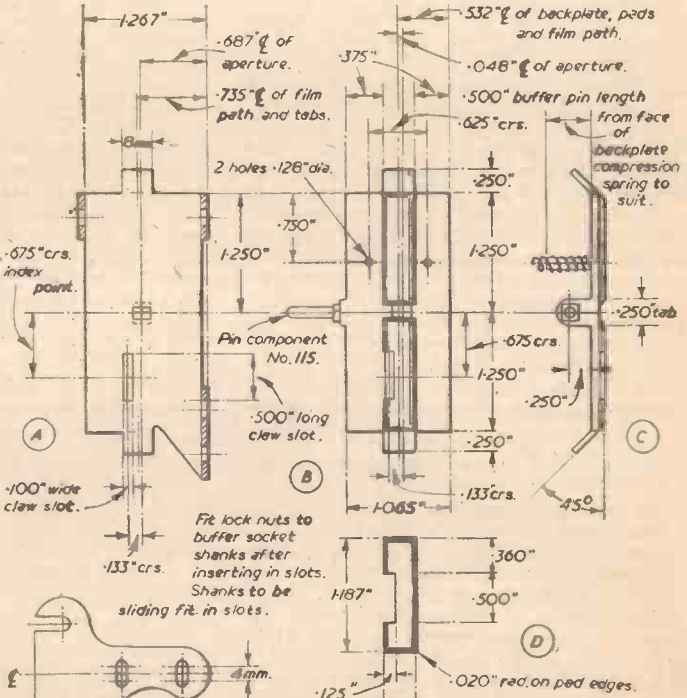


Fig. 2.—Film guide (1 off). A—Gate bracket, made from 19 s.w.g. (.040in.) brass. B and C—Backplate (with pads fitted) made from 19 s.w.g. brass. D—Lower pad, made from 20 s.w.g. (.036in.) brass. E—Buffer bracket, made from 14 s.w.g. (.080in.) brass.

and claw slot are correctly positioned, as both front and back apertures and slots must align when the components are assembled. If frame centring is to be used the backplate aperture should be finished to the dimensions at H.I.J. in the table at Fig. 1. For non-frame centring the backplate aperture may be approximately .020in. larger all round than the bracket aperture, and the side centre tab and pin will not be required.

The assembled guide will be situated approximately ⅛in. nearer the objective than the 9.5 mm. guide, the buffer pins should therefore be increased by .125in. in length and the free length of the compression springs increased accordingly.

Rivet the pads in position and the buffer

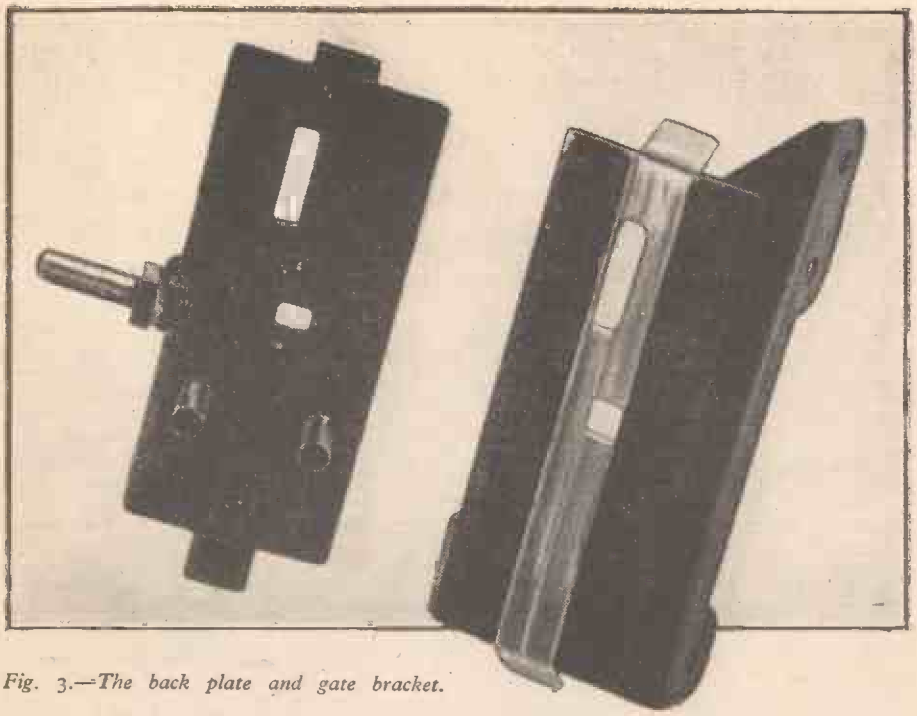


Fig. 3.—The back plate and gate bracket.

pins to the backplate as described (page 144, December issue).

The minimum necessary area of the emulsion coated film surface should contact the guide face, the gate bracket guide face should therefore be relieved as indicated at Fig. 7 (page 144, December issue). The completed film guide should be polished and entirely free from pits and scratches.

For frame centring the buffer bracket should be modified as shown in Fig. 2. All dimensions not given in Fig. 2 may be to Fig. 6 (page 144, December issue). For non-frame centring no modification to the 9.5 mm. buffer bracket is necessary. The complete assembly is shown in Fig. 3.

The Modified 9.5 mm. Intermittent Movement

By making a cam and claw to suit the 8 mm. frame advance, the existing 9.5 mm. movement may be utilised. The cam should be made to the dimensions given in the ".432" column at A, in Fig. 4.

The cam is constructed from the equilateral triangle shown in the dotted lines. The radius B (the minor offset) is first struck from each of the three corners of the triangle, the radius C (the major offset) is then struck from the triangle corners to blend into the B radii. The sides of the triangle are equal in length to 8 mm. film perforation pitch (the frame height).

The cam is to be spigoted at one corner of the triangle to the concentric cam wheel centre. When used with the associated follower and claw, the cam eccentric will transmit to the claw a linear motion equal in length to a side of the triangle, thereby advancing the film by one frame. The pull down movement is described in detail in pages 183-185 of the January issue.

A cam and its associated follower may be made to any size, and to suit any gauge of film, 8 mm., 9.5 mm., 16 mm. and 35 mm., providing that the difference in the cam offset lengths (the radii B and C at A, in Fig. 4) is equal to the frame height of the film to be used.

The 9.5 mm. claw should also be modified The overall claw width should be increased to enable the claw tip to align with the 8 mm. perforation track, and the claw length increased, as, due to the smaller cam eccentric, the existing claw would not engage in the perforations. Except for the dimensions given in the ".432" column at C in Fig. 3, the claw should be made to Fig. 16 (page 185, January issue).

The 8 mm. claw index point is situated 4½ frames (.675in.) below the horizontal gate aperture centre line, the claw bracket should therefore be repositioned on the follower arm. The new 8 B.A. claw bracket fixing hole should be drilled above the existing hole in the follower arm.

Although the above cam and claw modification may be a convenient method of effecting the 8 mm. conversion, it should be noted that due to the shutter interposed between the lens and the gate aperture the minimum focal length lens that may be used is F.1.

A Smaller Intermittent Movement

By making the cam to the dimensions in the "275" column at A in Fig. 4 and the follower to the dimensions at B in Fig. 4, the movement will enable a F⅝ lens to be used.

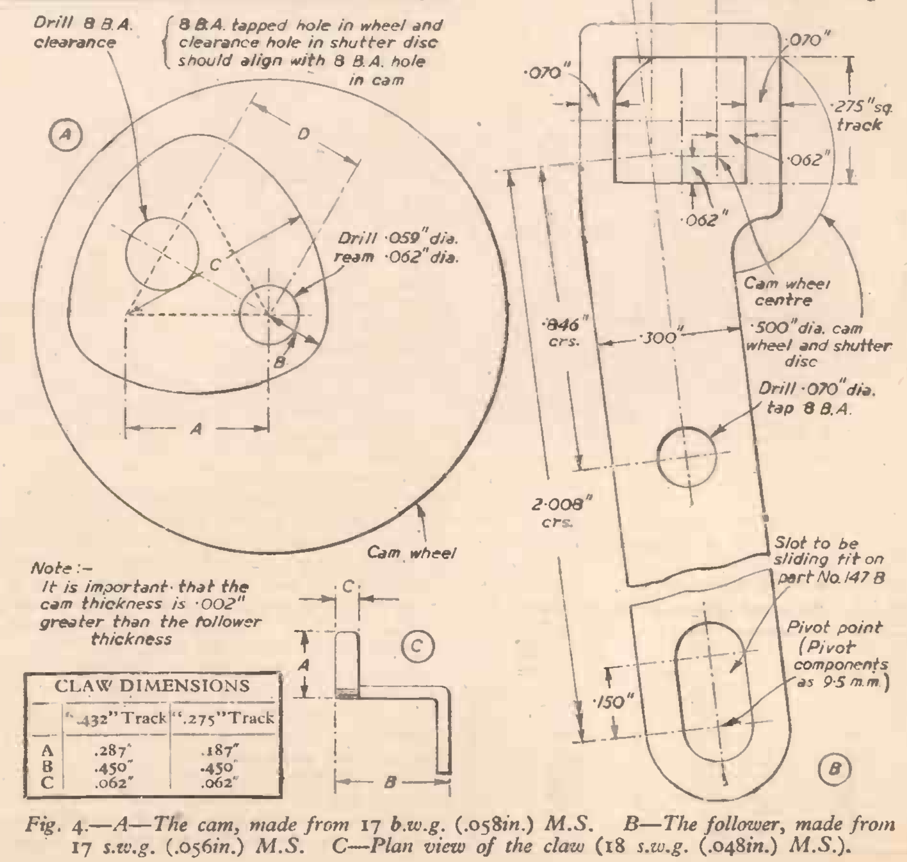
The brass cam wheel should be turned to ½in. diameter and, except for the flange diameter and the position of the 8 B.A. tapped hole in the flange face, the wheel may be made to the dimensions at Fig. 12 (page 184, January issue).

The shutter should be made from 25 s.w.g. brass as shown at Fig. 15 (page 185, January issue), except that the disc diameter should be modified to ½in. and the blade length to .520in. before forming to the contour of the disc. The 8 B.A. clearance hole should be repositioned to correspond with the tapped hole in the wheel face.

Except for the dimensions shown in the ".275" column at C in Fig. 4, the claw should be made to Fig. 16 (page 185, January issue).

Whichever method is used for the conversion the intermittent components should be accurately made, as the pull-down must commence precisely at the same point at each frame advance. With the aid of a height gauge, angle plate and micrometer, the items can be satisfactorily produced by the home constructor, as outlined on page 184 of the main series on the 9.5 mm. machine. The

CAM DIMENSIONS		
	".432" Track	".275" Track
A	.150"	.150"
B	.141" rad.	.062" rad.
C	.290" rad.	.212" rad.
D	.218"	.130"



CLAW DIMENSIONS		
	".432" Track	".275" Track
A	.287"	.187"
B	.450"	.450"
C	.062"	.062"

Fig. 4.—A—The cam, made from 17 b.w.g. (.058in.) M.S. B—The follower, made from 17 s.w.g. (.056in.) M.S. C—Plan view of the claw (18 s.w.g. (.048in.) M.S.).

modified claw and follower are shown in Fig. 5.

The Film Sprockets

Occasionally new 8 mm. film sprockets may be obtained from ex-Government supply, or scientific apparatus stores, in which case a modification to the sprocket bore may be all that is necessary to fit the sprockets to the constructional outfit axles used with the machine.

If ready made sprockets cannot be obtained, built-up sprockets similar to those used with the 9.5 mm. projector could be produced by the constructor. As the 8 mm. perforation pitch is half (within .003in.) of that of the 9.5 mm. film, it would be possible to use the 9.5 mm. toothed disc in conjunction with the 8 mm. bobbins, shown at A and B in Fig. 6. The teeth would thus engage in every second perforation of the 8 mm. film, but due to the slight pitch error and the possibility of impaired film transmission, it would be preferable to use a 12-tooth sprocket of the correct pitch.

The component parts of the built-up sprocket are shown at Fig. 6. Unlike the 9.5 mm. sprocket the teeth are offset to the sprocket centre, the bobbins A and B will therefore be of different widths. The toothed disc, shown enlarged at G, may be produced by part machining or marking out the tooth form as described on page 239 (February issue).

As it is important that the assembled sprockets run true on their spindles, the bore of each component part must be concentric to the diameter, and the component faces square to its bore. The modified sprocket and cam are shown in Figs. 7 and 8 respectively.

Assembly and Adjustment

Mount the intermittent movement components to the picture head in the positions indicated at Fig. 10 (page 183, January issue) and pivot the follower arm with the components listed in the table at Fig. 18 (page 238, February issue). The guide assembly should be mounted to the picture head at the slots and brought to its correct position relative to the claw tip by the method described for the 9.5 mm. machine (pages 238-239, February issue).

If the frame centring arrangement is to be used, lock nuts should be fitted to the buffer shanks, and adjusted so that the backplate may be raised or lowered, freely, by means of the pin fitted to the side tab of the backplate. Both front and back horizontal aperture centre lines should be brought into alignment before setting the claw tip.

Mount the pads and sprockets in the positions shown at Fig. 10 (page 183, January issue) and as described (page 239, February issue) ensuring that they align on the film path. To suit the 12-tooth sprockets the existing 9.5 mm. sprocket spindle speed must be reduced 2:1. The ¾in. dia. (14 teeth) chain wheel fitted to the end of the take-off sprocket spindle should be replaced by 1½in. (28 teeth) chain wheel, the 1in. dia. (18 teeth) chain wheel fitted to the 57 tooth gear spindle substituted with a ¾in. dia. (14 teeth) wheel and the 2in. dia. (36 teeth) chain wheel of the take-up sprocket spindle replaced with a 3in. dia. (56 teeth) wheel.

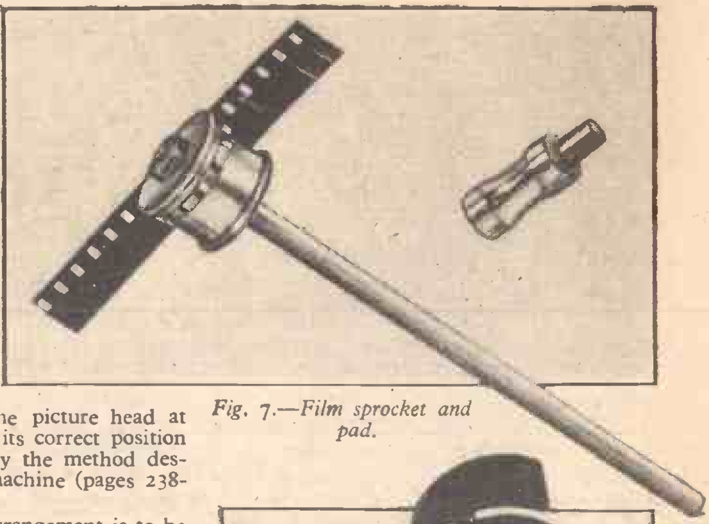


Fig. 7.—Film sprocket and pad.

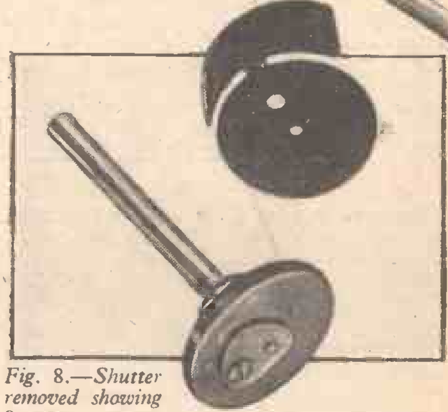


Fig. 8.—Shutter removed showing 8 mm. cam (.432in.) spigoted to 9.5 mm. cam wheel.

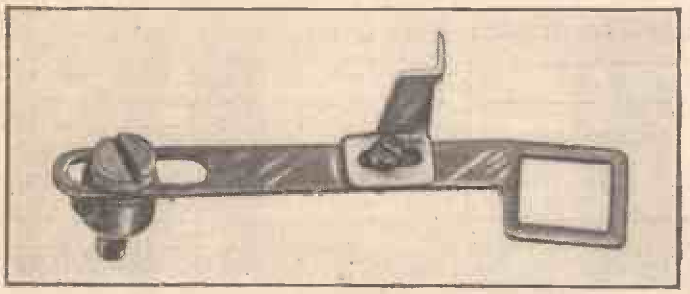


Fig. 5.—8 mm. claw (.432in.) fitted to 9.5 mm. follower arm.

To adapt the 9.5 mm. spool carriers for 8 mm. use the 15/64in. outside dia. sleeves should be replaced with .312in. dia. sleeves, and the carrier wheel dog pins reset to suit 8 mm. spools.

To check that the sprockets and intermittent movement are functioning correctly, a preliminary run should be made using a short length of new opaque leader film. The film should be laced with the emulsion surface facing the objective and a loop formed between sprockets and guide, see Fig. 10 (page 183, January issue). Any necessary adjustments can be made during or after the run. As the film is rewound it should be inspected closely to ascertain that it has not become scratched or fractured. A tiny burr on the sprocket pads or guide face will mar the emulsion surface the entire length of the film. A claw that is incorrectly indexing will fracture the perforations throughout the film.

If the intermittent movement components have been correctly made and adjusted the movement should function smoothly. The claw will "flick" the film down quietly and a steady picture will be obtained. The probable causes and remedies for an unsteady picture (should the constructor experience this nuisance) are given in page 297 of the March issue.

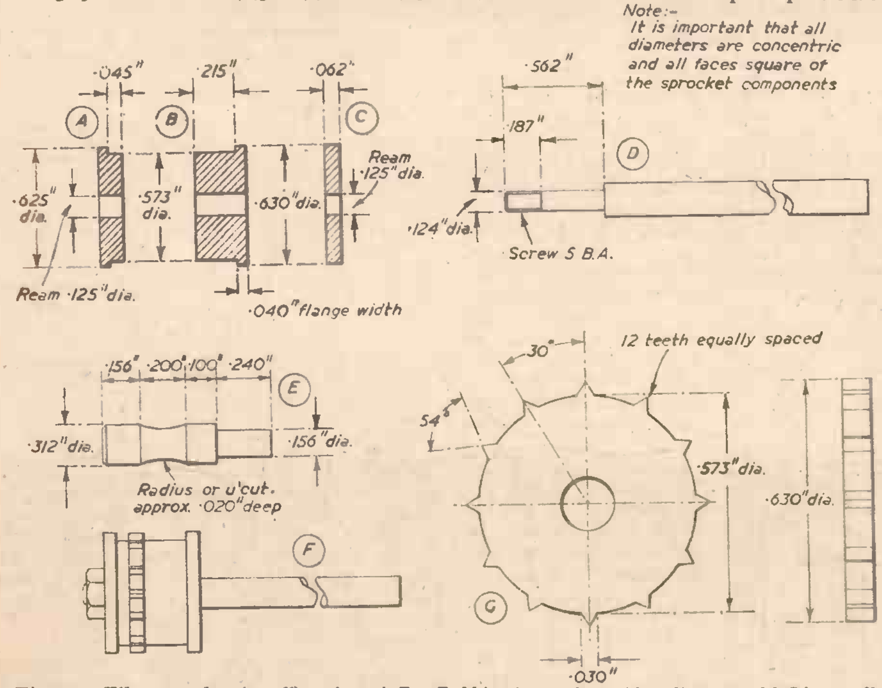


Fig. 6.—Film sprocket (2 off). A and B—Bobbin (turn from ⅝in. diameter M.S.), 1 off each per sprocket. C—Disc (turn from 41/64in. diameter M.S.), 1 per sprocket. D—Spindle (turn from standard axle), 1 per sprocket. E—Pad (turn from 5/16in. diameter M.S.), 2 per sprocket. F—Sprocket assembled on spindle. G—Enlarged view of toothed disc.

Appendix

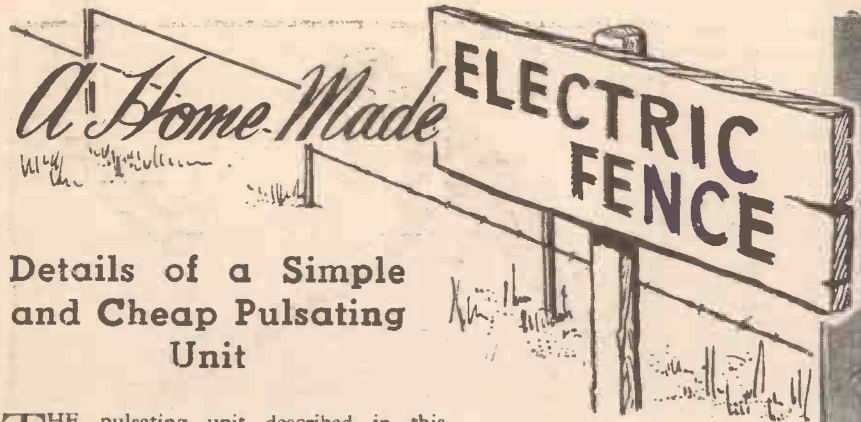
$$\text{Focal length} = \frac{\text{lens to screen distance}}{(\text{Magnification} + 1)}$$

$$= \frac{88\text{in.}}{\left(\dfrac{24\text{in. (Screen width)} \times 25.4\text{ mm.}}{4.37\text{ mm. aperture width}}\right) + 1}$$

$$= .625 \text{ (very nearly)}$$

$$\text{Minor Offset (".432" Cam)} = \frac{\text{Width of follower track} - \text{Perforation Pitch}}{2}$$

(Concluded on page 550.)



A Home-Made ELECTRIC FENCE

Details of a Simple and Cheap Pulsating Unit

By R. J. HODNETT

THE pulsating unit described in this article can be made in the home workshop in a couple of hours and costs very little. A second-hand car ignition coil, a condenser and a pair of contact points are the only items the constructor will have to purchase. No springs are used either on the armature or on the balance-wheel as the unit operates in a vertical position and depends on gravity for its action. The completed pulsator is shown in Fig. 1.

The component parts, viz., the coil, armature, condenser and balance-wheel assembly are mounted on an oak or other hardboard panel measuring 9in. x 9in. x ¾in.

The Balance-wheel

The balance-wheel (Fig. 2) is a 3¾in. dia. circle cut from 5 or 6 s.w.g. (approximately 3/16in.) mild steel. A 5/16in. hole is drilled in the centre and tapped ⅜in. Whitworth. The spindle is made by taper-turning both ends of a steel rod 2in. long and ⅜in. dia. to an included angle of about 70 deg. and then threading the rod for a distance of 3/16in. beyond the middle of its length. The spindle should be hardened before screwing it into the tapped hole in the balance-wheel.

Bracket

The balance-wheel bearing bracket is made from 9in. of ¾in. x ⅛in. mild steel. Drill and countersink 3/16in. holes as indicated in Fig. 2 (b) and make countersink impressions at A and B with the point of a drill ground to a 90 deg. angle. These impressions are to locate the hardened tip of the spindle when the bracket is bent to shape as shown. The point contact gives a frictionless bearing with no appreciable side-shake. Bend the bracket at right-angles at C and D so that the countersunk impressions will neither be too loose nor seize on the tapered spindle.

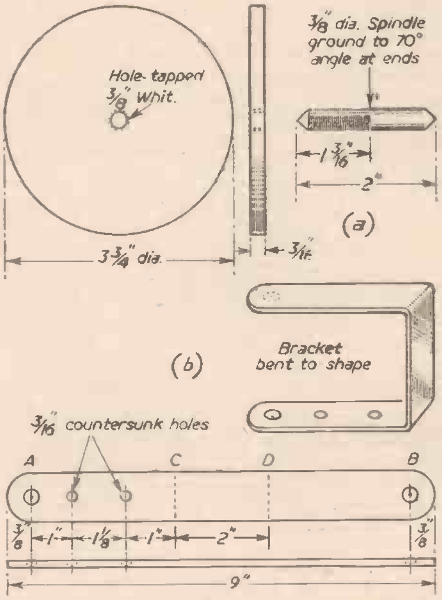


Fig. 2.—Details of the balance-wheel spindle and bracket.

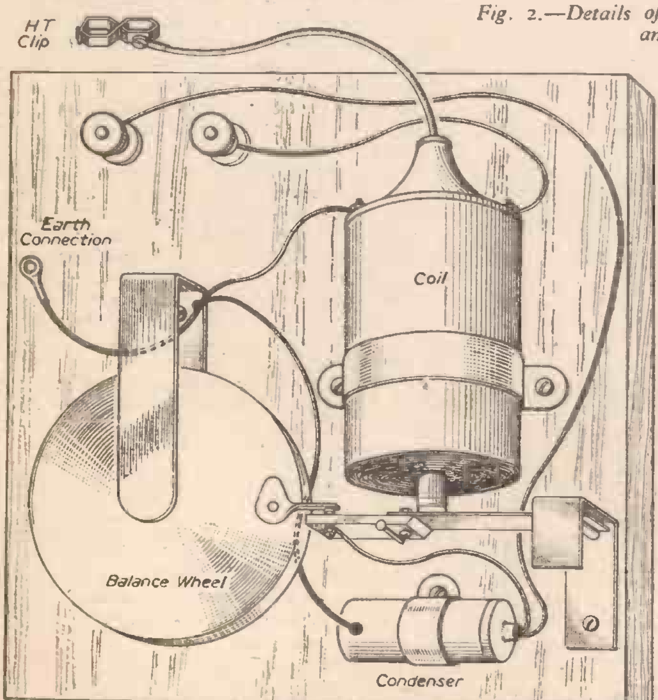


Fig. 1.—The completed pulsator.

Contact Points

The next job is to fit a contact point to the wheel. Drill a 3/16in. hole about ½in. from the edge of the wheel and attach the contact point here using a short 3/16in. bolt and nut. Do not tighten the nut fully until the other point is in position. Now drill a ⅜in. hole near the edge of the wheel 90 deg. behind the contact point as shown in Fig. 3. The wheel should now balance with the contact point 45 deg. from the vertical as shown. If it drops too low the hole should be enlarged to 7/16in. or ½in. If it does not drop low enough a small hole should be drilled diametrically opposite the original one. When proper balance has been obtained fix the bracket to the panel, in the position indicated in Fig. 5, by means of two woodscrews.

Armature

Fig. 4 shows the construction of the armature and its bracket. The armature is made from 3½in. of ¾in. by ⅛in. M.S. brazed to a 5/16in. round spindle 2¼in. long with tapered ends similar to the balance-shaft spindle. About 1½in. of ¾in. by ¼in. Perspex is attached to the free end by means of a ⅛in. bolt and nut and an adhesive such as "Evostick." The bracket is marked out as shown in Fig. 4(b). The drilling and bending procedure is similar to that for the balance-wheel bracket.

Fix the armature bracket to the panel in the correct position (Fig. 5) by means of a

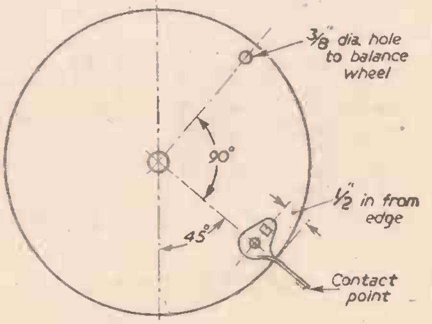


Fig. 3.—Positioning the contact point.

single woodscrew. This makes it easier to bring the contact points into alignment later on. Drive a 2in. nail into the baseboard to act as a stop for the armature. Bring the contact point on the balance-wheel hard against the Perspex so as to mark the position of the other contact point. Remove the armature, drill a ⅛in. hole in the Perspex and fit a screw-type contact point. Attach a length of flex under the retaining-nut. Now replace the armature and bring the points into proper alignment. The point on the balance wheel may be bent slightly

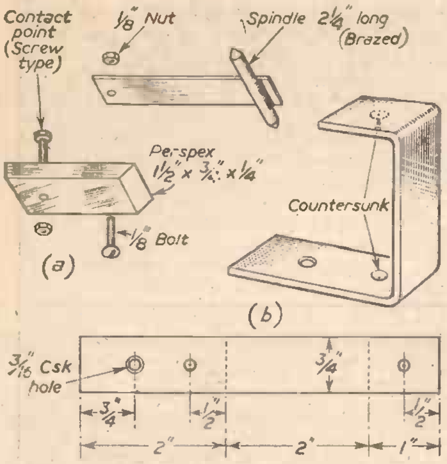


Fig. 4.—The armature and its bracket.

to one side if necessary. Tighten up the 3/16in. bolt and nut clamping the contact-point in position and also the screw attaching the armature bracket to the baseboard.

LIST OF MATERIALS

- 1 6-volt car ignition coil (secondhand).
- 1 condenser (car ignition type).
- 1 pr. contact points.
- 1 pr. brass terminal screws.
- 1 piece 9in. x 9in. x ⅞in. hardwood.
- 1 piece 4in. x 4in. x 6in. s.w.g. mild steel.
- 3in. of ⅜in. diameter cast steel.
- 3in. of 5/16in. diameter cast steel.
- 2ft. of ⅝in. x ⅛in. mild steel strip.
- 2ft. H.T. cable.
- 2yds. single-core plastic-covered flex.
- 1 piece Perspex 1in. x ¾in. x ¼in.

The Coil

This should be of the 6-volt type and in fairly good condition. Cut off about ½in. of the bottom of the steel case—being careful not to damage the winding—and remove the porcelain insulator to expose the end of the iron core. Straighten out the lugs and re-bend so that the coil will rest flat against the panel. Now place the coil in position (Fig. 5) so that the iron core will be about 3/16in. from the armature when the latter is against the stop. Fix the coil to the panel using two woodscrews and washers. Fix the condenser in position using a single woodscrew. If the latter item is second-hand it should be tested before fitting. A new condenser is a much safer proposition.

Wiring Up the Apparatus

This is a comparatively simple job. Lighting flex is suitable for all the L.T. wiring and only three soldered joints are necessary. Figs. 1 and 5 show the wiring diagram. The flex from the contact point to the armature should be of such length as not to interfere with the movement. The purpose of the Perspex is to prevent a short circuit of the H.T. spark due to the secondary winding of the coil being in contact with the iron core. The L.T. circuit is as follows: From the positive battery terminal through the primary winding to the balance wheel, through the contact points and back to the negative battery terminal. The condenser is connected across the contact points.

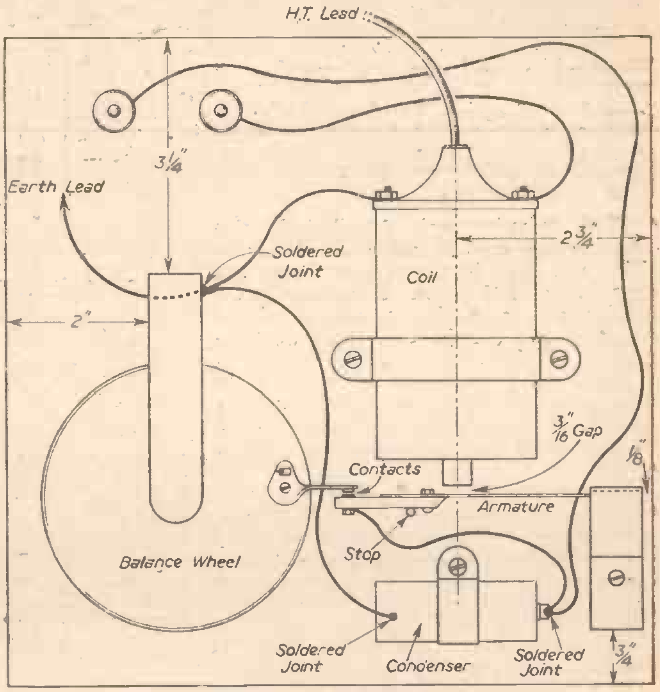


Fig. 5.—Position of components and wiring.

Operation

When the current flows around the primary winding, the iron core becomes a magnet and attracts the armature. This kicks the balance-wheel upwards and opens the contact points, causing a very high voltage to be induced in the secondary winding. The frequency of the pulsations can be varied by inclining the panel backwards slightly on top.

The completed unit should be housed in a vertical position in a strong weather-proof box. The battery (a 6-volt motor-cycle type is suitable) should be installed in the same box. A ⅜in. hole is drilled in the box and the H.T. lead pushed through it. The earth wire is attached to a metal spike which is itself attached securely to the box and driven into the ground.

Metal posts, insulators and fencing wire can be purchased at a moderate price from almost any hardware dealer.

Solar Heated Offices

Technical Discussion in the U.S.

THE world's first solar-heated office building, located at Albuquerque, New Mexico, survived its initial winter trials "satisfactorily," it was revealed recently at a meeting of engineers in San Francisco. In a technical session dealing with methods of using the sun's heat for practical purposes, three New Mexico engineers said that a system installed in their own offices last year "performed satisfactorily through the worst part of the winter including a much cloudier than normal January."

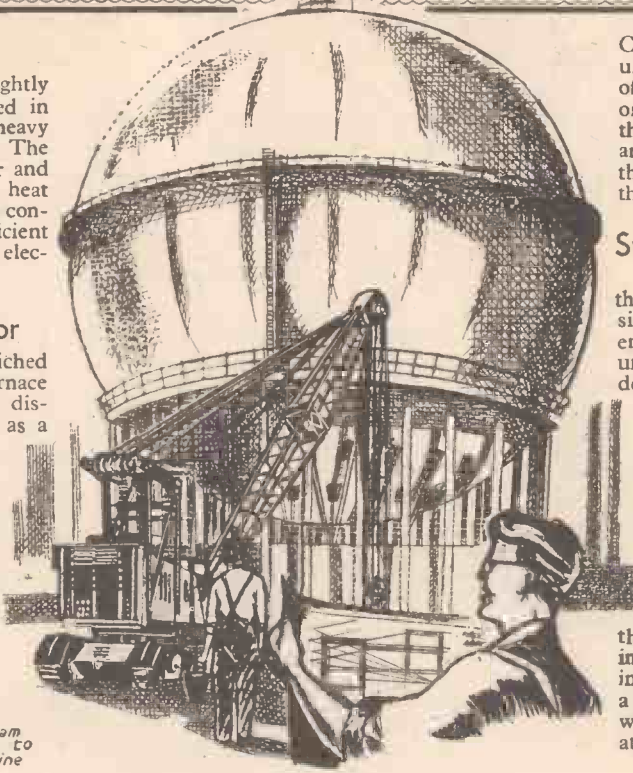
Economic evaluation of the unit, however, is not yet possible. Some of the technical problems encountered included corrosion of metal parts, freezing of water in the exposed area of the unit during the night and difficulties caused by air bubbles in the circulating system. The unit consists of an inclined "flat plate collector" which uses heat from the sun to raise the temperature of water. Heat from the water, stored in a 6,000-gallon tank, is used, as needed, to warm the building.

Another technical paper, presented at the same session as part of The American Society of Mechanical Engineers' semi-annual meeting, reviewed present use of the sun's heat to supply hot water for various uses. The author, Erich A. Farber, pointed out that many areas of the world, although lacking conventional fuels, have abundant sunshine which can be put to use economically. In the United States almost all areas have enough sunshine to permit solar water heating for domestic use during the summer, but only limited regions have enough winter sun to permit economical year-round use of solar energy to-day.

Particular emphasis was placed on silicon converters, which can be used to charge special electric batteries. A solar-powered automatic radio repeater station has been installed for the U.S. Forest Service and work is progressing on units to power warning beacons in remote locations at sea.

It was also stated that improved storage batteries are now available to store electricity generated during the day for night use. With to-day's equipment enough energy to supply the average household could be obtained from a set of "silicon converters" only 36in. square installed on the roof of a house. The efficiency of these converters is now being improved and their cost being substantially reduced.

VARIOUS TYPES OF NUCLEAR REACTORS



Boiling Water Reactor

IN this first type, shown in Fig. 1, slightly enriched uranium fuel is suspended in a special tank through which heavy water is circulated under pressure. The heavy water serves both as a moderator and as the heat transfer medium. The heat produced by the reactor is sufficient to convert the heavy water into steam in sufficient quantities to operate the turbine of the electricity generation plant.

Homogeneous Power Reactor

This type is shown in Fig. 2. Enriched uranium fuel is fed into the reactor furnace in the form of uranium sulphate salt dissolved in water. The water acts both as a moderator to slow down the neutron particles which maintain the fission reaction and as the means for transferring the heat from the nuclear furnace to the heat exchanger.

Sodium Graphite Reactor

In this reactor liquid sodium metal is used to draw off the heat from the nuclear "furnace." The liquid sodium is circulated through channels in the main graphite moderator structure into which the rods of slightly enriched uranium fuel are inserted. This is shown diagrammatically in Fig. 3.

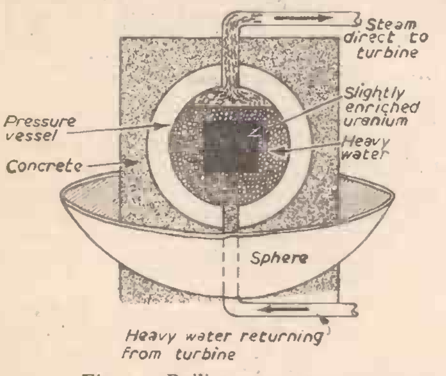


Fig. 1.—Boiling water reactor.

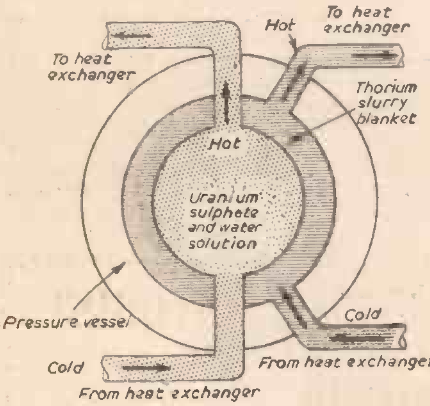


Fig. 2.—Homogeneous power reactor.

The Basis of Fission and Atomic Power

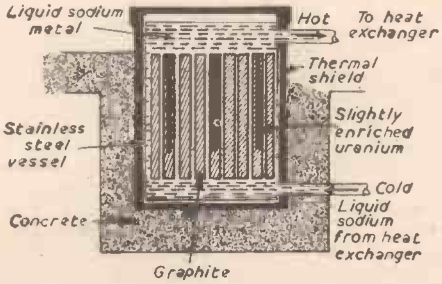


Fig. 3.—Sodium graphite reactor.

Graphite Moderated Reactor

In this type of nuclear reactor power plant, shown in Fig. 4, which is typified by the Calder Hall atomic power station, uranium metal is inserted into a mass of exceptionally pure graphite. Gas or water is circulated round, or through, this central core of graphite and uranium in order to draw off the heat for steam production and the generation of electricity.

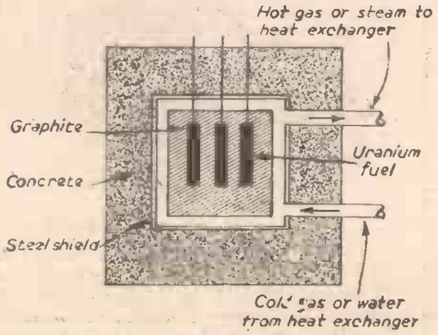


Fig. 4.—Graphite moderated reactor.

Swimming Pool Reactor

This is a research reactor in which the atomic fuel elements, which consist of natural uranium metal enriched with additional quantities of uranium 235, are suspended in a deep uncovered tank of ordinary (or heavy) water. Such reactors, which have power ratings of from 100 kilowatts to 10,000 kilowatts, are one of the simplest and most effective forms of research reactors. Fig. 5 shows this type.

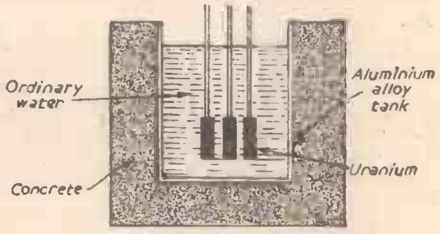


Fig. 5.—Swimming pool reactor.

Heavy Water Reactor

The principle of this type is that the natural uranium atomic fuel in the form of metal slugs is suspended in a mass of heavy water which acts as a moderator. Heavy water is water in which the majority of the hydrogen atoms are twice as heavy as ordinary common hydrogen atoms. The hot heavy water (which is heated by the fission, or burning, of the uranium) is used to convert ordinary water into steam in the heat exchanger. See Fig. 6.

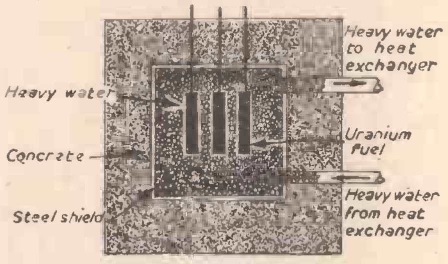


Fig. 6.—Heavy water reactor.

Liquid Metal Breeder Reactor

Liquid uranium 233-bismuth compound is circulated through channels in the graphite inner core of the reactor, shown in Fig. 7, while a liquid thorium-bismuth metal compound is circulated through the graphite moderator of the adjoining, but separate, outer core. Thorium atoms in the outer thorium-bismuth core are converted into new fissile U.233, which the heat generated in both the inner and outer cores is withdrawn to nearby heat exchangers.

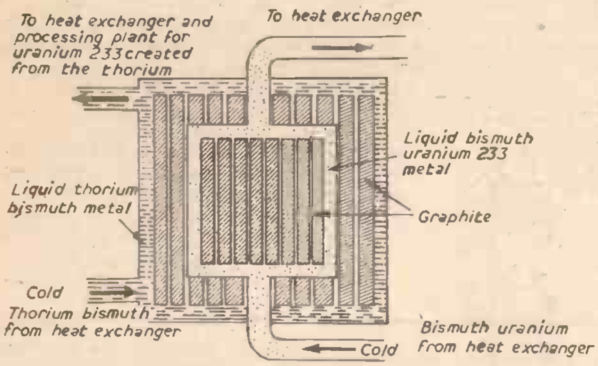


Fig. 7.—Liquid metal breeder reactor.

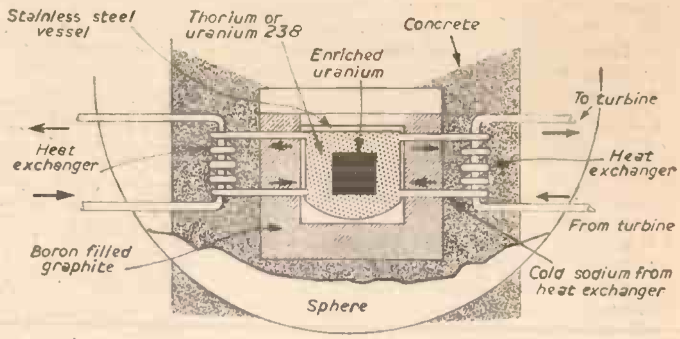


Fig. 8.—Fast breeder reactor.

Fast Breeder Reactor

This type of reactor, shown in Fig. 8, has no moderator to slow down the neutron particles which maintain the fission chain reaction. It burns almost pure fissile material in the form of uranium 235, plutonium, or uranium 233 in its central core. This central core is surrounded by a "blanket" of "fertile" material from which further quantities of new fissile material are created by those neutrons which leave it.

Suspop Reactor

This is shown in Fig. 9. The uranium fuel used is forced through the reactor "furnace" in the form of granules by pneumatic pressure. The fuel may be in the form of either a uranium-beryllium compound or in the form of uranium granules. In the latter case it is forced through a series of graphite tubes in the reactor core.

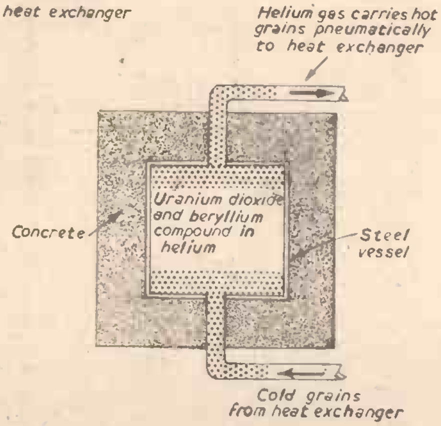


Fig. 9 (Left).—Suspop reactor.

The information contained in this article and in the one following will, if kept as reference, be useful to the layman in helping him to understand more fully press reports on the subject of atomic energy.

Both this article and "A Glossary of Terms Used in Nuclear Physics" which follows were reprinted from "The Financial Times" Atomic Energy Survey by permission of the Editor.

A Glossary of Terms Used in Nuclear Physics

ACCELERATOR:—An "atom smasher"; a machine which, by using either electric or magnetic forces, accelerates heavy particles of atoms to very high speeds. Used for research and for a number of industrial purposes such as, for example, "irradiating" plastics in order to alter their physical properties. Examples of these machines are the linear accelerator, the cyclotron, the Van de Graaff accelerator (Fig. 2), the betatron, the synchrotron and the Bevatron.

Alpha particle:—Nucleus (central core) of an atom of the gas helium. Streams of particles of this type (also known as alpha rays) are emitted by some radioactive substances.

Atomic number:—The number of electrons rotating round the nucleus (central core) of the atom of any substance. This is also the number of protons in the nucleus of the atom of any substance. (See *electron* and *proton.*)

Atomic pile:—A nuclear reactor having a graphite moderator.

Atomic weight:—Weight of an atom of an element expressed on a scale in which the weight of the oxygen atom is exactly 16.

Beta particle:—A fast-moving electrically charged particle (with either negative or positive charge) emitted by some radioactive substances. Streams of beta particles (beta rays) possess greater penetrating power than alpha particles.

Boron:—A metal obtained from borax or boric acid which absorbs the neutron particles which keep the uranium fission process (or burning) in a reactor going. Rods containing this material can thus be used to control the burning of nuclear reactor furnaces.

Breeding (of atomic fuel):—See "Various Types of Nuclear Reactors."

Cæsium 137:—Cæsium with an atomic weight of 137. A fission product or "ash" from the burning of uranium in a nuclear reactor. A radioactive form of the silvery white metal Cæsium 133.

Chain reaction:—The "burning" reaction in a nuclear reactor furnace. This fission, or splitting (or burning), of one atom leads to the release of atomic particles, called neutrons, together with energy in the form of heat and fragments, called fission products. These neutrons hit other fissile (or burnable) atoms—for example, atoms of uranium 235 or plutonium—causing them in turn to split up, thereby releasing other neutrons which in their turn hit yet other fissile atoms, causing them to split, releasing still further neutrons and so on.

Cold cathode trigger tube:—An electronic valve which emits a single short burst of electrical energy each time the number of electrical pulses or energy fed into it reaches an exactly determined amount. They differ from the conventional thermionic valves (like those used in radio sets) in that the cathode electrode from which electrons (electric current) are emitted is not heated, whereas in the thermionic valve the cathode is heated.

Core (of a nuclear reactor): — The central portion of a nuclear reactor furnace containing the atomic fuel (uranium or plutonium) and the moderator material (e.g. graphite, or heavy water). The core may contain either solid uranium or plutonium, and perhaps thorium in the form of metal alloy slugs or rods, or it may contain a liquid uranium or thorium salt solution. (See Fig. 1 and also the previous article "Various Types of Nuclear Reactors.")

Cosmic rays:—Very penetrating radio-active radiation which is continually reaching the earth from outer space.

Creep (in metals):—A change in length, or other physical dimensions, which occurs when the metal is constantly under a high stress or strain.

Creep strength (of metals): — The measure of the highest stress which a metal can constantly withstand without showing any significant creep.

Critical mass:—The smallest mass of fissile material in which a chain reaction can take place.

Curie:—Unit denoting the activity of radioactive substances. Equals the activity of one gramme of radium.

Cyclotron:—A machine for accelerating particles of atoms to very high speeds (and thereby increasing their energy) by means of repeatedly passing them through a mag-

Fig. 1.—A technician adjusts a control rod in the core of a nuclear power plant.

netic field (see *accelerator*). Invented by the U.S. physicist E. O. Lawrence in 1932.

Diffusion plant (in atomic energy):—A plant or factory where the rare uranium 235 is concentrated from the natural uranium. The uranium is converted into the form of a gas (uranium tetrafluoride) and then passed through a series of many thousands of porous membranes. The uranium tetrafluoride molecules containing the lighter uranium 235 pass more readily through the membranes than those containing the heavier and more abundant uranium 238 molecules.

Electrometer:—Instrument for measuring differences in voltages which does not draw off any current from the source, the differences in voltage of which are being measured.

Electron:—The smallest atomic particle and the lightest component of matter. It is the fundamental negatively charged element of electricity and one or more electrons are present in every atom of all substances, (See also *atomic number*.)

Electron volt (eV):—Unit of energy used in nuclear physics. The amount of energy acquired by an electron when it is accelerated by being passed through an electric field having a drop in electric potential of one volt.

Enriched fuel:—Natural uranium to which additional quantities of the fissile uranium isotope (see *isotope*) uranium 235 have been added. Uranium 235 is present in nature in a concentration of one part of U.235 in every 140 parts of non-fissile uranium 238.

Erg:—A measure of force.

Fall out:—The dust and other matter which falls back on to the earth's surface after the explosion of either an atomic bomb or hydrogen bomb. The majority of the fragments in the "fall out" are radioactive.

Fuel elements:—The rods or slugs of atomic fuel in a nuclear reactor furnace.

Fissile material (atomic fuels):—Materials which disintegrate to give a "chain reaction" when hit by a neutron particle, e.g., uranium 235, uranium 233 (produced by exposing thorium in a nuclear reactor) and plutonium.

Fissile uranium:—Uranium in the form of the isotope of uranium having an atomic weight of 235. (See *fissile material, enriched fuel* and *atomic weight*).

Fusion:—In nuclear physics; the joining together of two atoms of low atomic weight such as, for example, heavy hydrogen or triple heavy hydrogen (tritium).

Gamma rays:—Radiation emitted by some radioactive materials as they decay.

Geiger counter:—Instrument for detecting alpha, beta and gamma radiation and measuring the amounts in which they occur, by means of the degree to which they cause the air (or a gas) to become ionized (electrically charged).

G-value:—The number of molecules produced in a chemical reaction stimulated by irradiation per 100 electric volts of energy absorbed by the chemicals irradiated.

Half life:—The time taken for the activity of a radioactive substance to decay to half its original value—that is, for half the atoms present to disintegrate. Half-lives may vary from less than a millionth of a second to millions of years, according to the isotope.

Heavy elements:—Elements having a large atomic weight, for example, actinium (atomic weight 227), thorium (atomic weight 232), protactium (atomic weight 231), and uranium (atomic weight 238).

Heavy hydrogen:—Hydrogen in which the atoms have an atomic weight twice that of ordinary hydrogen.

Heavy water:—Water in which the hydrogen atoms which are present have an atomic weight of 2, or twice that of ordinary hydrogen atoms.

Ionisation:—The formation of ionised, or electrically charged, atoms.

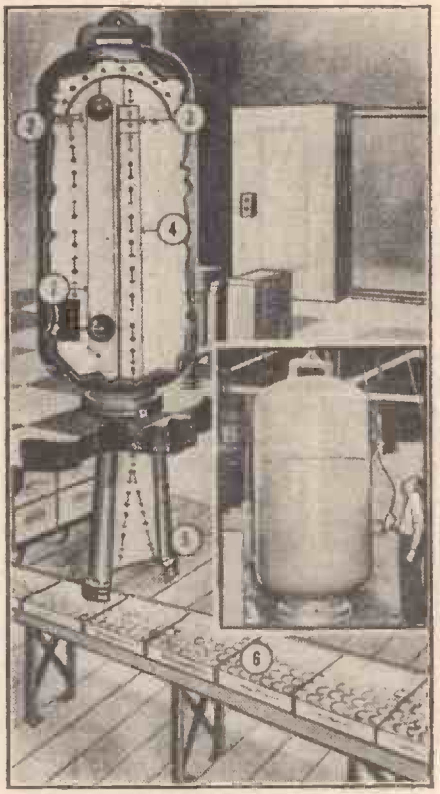


Fig. 2.—A 3,000,000-volt Van de Graaff particle accelerator, shown diagrammatically, to illustrate its operation. An electric charge, sprayed on a fast-moving belt (1), *is carried to a terminal* (2), *resulting in a great voltage difference between the upper and lower ends of the machine. Charged particles leave the terminal through a heated cathode* (3) *and pass downward along the high vacuum tube* (4), *where they are accelerated to almost the speed of light. A funnel-like attachment* (5) *directs the particles precisely on to material being irradiated, which is passed through the beam on a conveyor belt* (6).

Ionising radiations:—Radiations which ionise atoms or make them electrically charged. Examples are alpha and beta rays.

Irradiated fuel:—Atomic fuel that has been used in a nuclear reactor.

Isotopes:—Atoms of the same element which are identical in their chemical behaviour but which have different atomic weights and also different nuclear properties.

K-value:—The symbol for degrees of absolute zero, 0 degrees K means 0 degrees absolute zero (equivalent to minus 273.16 degrees Centigrade).

Megacurie:—One million curies.

Megawatt:—One million watts.

Mesons:—Unstable atomic particles which are found in cosmic radiation. They have a mass (or weight) intermediate between electrons and protons.

Moderator:—The material in a reactor used to reduce the speed of the fast neutrons produced by the fission of a uranium atom as far as possible without capturing them.

Molecule:—Smallest portion of a substance capable of existing independently while retaining the properties of the original substance.

Natural uranium:—Uranium metal as obtained from the natural ore. It contains both the heavier uranium 238 (which is non-fissile and is the parent material from which plutonium is created) and the lighter uranium 235 (a fissile atomic fuel) in the proportions of 139 parts of uranium 238 to every one part of uranium 235.

Neutron:—An atomic particle having no electrical charge. It is found in the nucleus of the atom and plays a vital role in nuclear fission (the burning of atomic fuel).

Neutron flux density:—The density of neutron emission from fissioned (or burnt) atoms in a nuclear reactor.

Parent material:—Material such as uranium 238 and thorium from which fissionable nuclear fuel such as plutonium or uranium 237 is produced.

Proton:—An atomic particle which has a positive electric charge. It is found in the nucleus of the atom.

Rad (the):—A measure of the amount of radioactivity deposited in a material subjected to irradiation. One rad is equivalent to the deposition of 100 ergs or radiation per one gramme of material.

Radioactive isotopes or radioisotopes:—Radioactive isotopes. (See *isotopes*).

Roentgens:—Unit of radiation dosage.

Scintillation counter:—An instrument for measuring the amount of radioactivity present in which phosphor compounds are used.

Stable isotopes:—Isotopes which do not readily undergo change with other lighter isotopes.

Thermal breeder:— A breeder reactor in which a moderator is used to slow down the neutron particles produced during fusion.

Thermal reactor:—A nuclear reactor in which the neutrons are slowed down to low speeds by a moderator before causing fission.

Thorium:—A metal which when irradiated is converted into the fissile atomic fuel uranium 233.

MAKING FULL USE OF YOUR CIRCULAR SAW

By JAMES VOSE

In Addition to Straight Ripping and Crosscutting, a Variety of Operations can be Performed on the Saw Bench Described in the June Issue

(This article is continued from page 476 of the July issue)

A SECOND person should always be at hand when bevel ripping is being done, and also, if the piece being sawn is of any length, a bevel-edged board should be cramped or nailed to the table to support the lower edge of the work, and prevent it from sliding away from the fence.

Sawing Sheet Materials

Materials like plywood and hardboard can be cut quickly, and without tearing or ragging of the underside, with any of the blades "B," "C" or "D" in Fig. 1. The ripping blade "A" will cut sheet materials, but will probably splinter the edges. For the cleanest cutting the blade should not project more than about ½in. above the table. Small panels of sheet material are cut by sliding along the fence in the usual manner, but if the panels are too large for this, they must be marked out clearly, and cut by sighting the saw-blade along the marked out line.

The chief difficulty when cutting large panels of thin plywood or hardboard is flexing or buckling, the unsupported edge falling down over the side of the table and causing the middle of the sheet to lift up over the top of the saw. This can be very dangerous, as any attempt to correct the buckling by lifting up the edges causes the middle of the sheet to drop down on to the saw again, and the whole sheet may then be thrown violently backwards, ruining the material with certainty, and perhaps damaging the operator. An effective way of overcoming this difficulty is to stiffen the edges of the sheet with strips of grooved wood. There are usually some rippings from the grooved edge of flooring or matchboards lying about the workshop, and these are suitable for the purpose. In Fig. 11 an 8ft. by 4ft. sheet of hardboard is being sawn down the centre, single handed, with the assistance of grooved strips pinned to the edges, as shown in the inset sketch. A large sheet like this is best cut half-way along the length, then lifted clear of the saw, reversed end-for-end, and the cut completed from the opposite end.

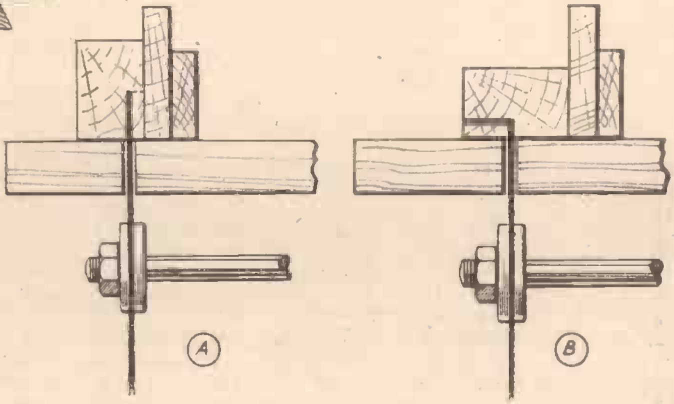


Fig. 12.—Sawing out a rebate in two successive cuts.

Fig. 11.—Large panels of plywood or hardboard can be cut if the edges are stiffened with grooved strips pinned on to prevent buckling.

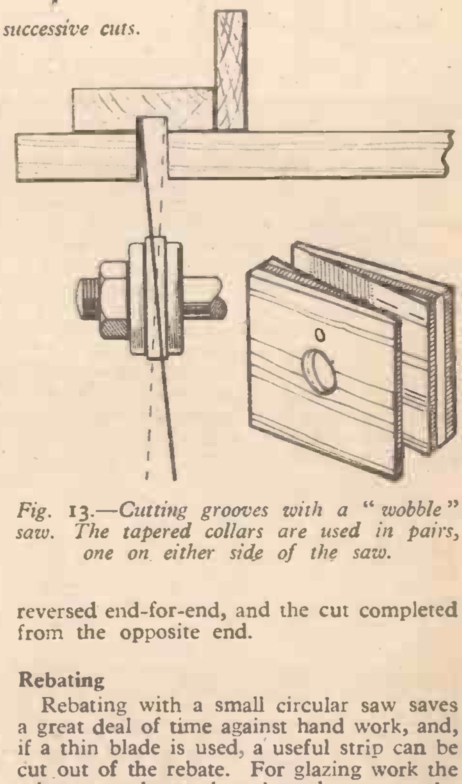


Fig. 13.—Cutting grooves with a "wobble" saw. The tapered collars are used in pairs, one on either side of the saw.

Rebating

Rebating with a small circular saw saves a great deal of time against hand work, and, if a thin blade is used, a useful strip can be cut out of the rebate. For glazing work the rebates need not be cleaned up, as the slight "tooth" left by the saw forms a good key for putty. It is usually better to cut the deep cut first as at "A" in Fig. 12, and then to turn the work down so that the face edge—the edge away from the rebate—is against the fence whilst cutting the shallow cut. Working this way saves turning the

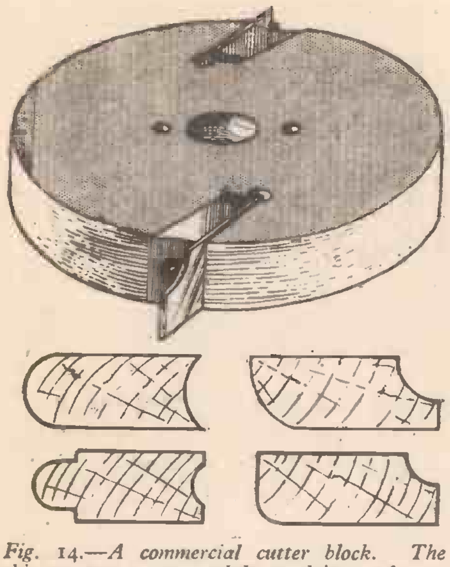


Fig. 14.—A commercial cutter block. The thin cutters are secured by wedging and may be ground to a different profile each end as shown.

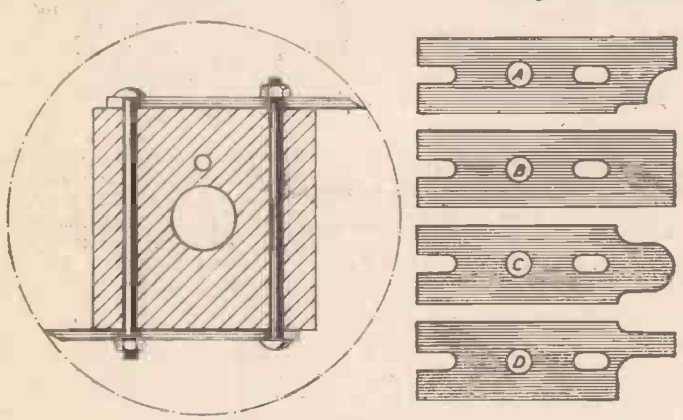


Fig. 15.—A home-made cutter block and cutters. A is a moulding cutter, B is for small rebates, C is for grooving, and D is a fluting cutter. Only one of each is shown, but the cutters must be used in pairs.

pieces end-for-end, and it also obviates the danger of the loose rebate strip being trapped between the saw and the fence and being shot back by the saw. The long auxiliary fence must be used, and it is a good idea to clamp it firmly to the bench at the far end to prevent it springing away and so varying the width of the rebate. Bevelled rebates, as required for window sills, may be cut by canting the fence or by fitting a riding strip to the fence in the same manner as that described for bevel ripping.

Grooving

Grooves of any required width can be cut by taking a succession of cuts side by side with the saw projecting an amount equal to the depth of the groove. This usually leaves a series of thin ribs between the cuts, but these can be easily taken out with a narrow chisel. This procedure is all right for an odd piece or two, but for a longer run of grooving it is better to set up a "drunken" or "wobble" saw so that the grooves can be taken out cleanly and at one pass. Special wobble saws are obtainable for this purpose, mounted in adjustable collars for any required width of groove, but it is unlikely that the amateur woodworker will have enough grooving to do to warrant the purchase of one of these.

An improvised wobble saw will do grooving quite well. The only snag is that it takes a bit longer to set up, as the width of the groove can only be determined by trial and error. An ordinary blade can be made to wobble sufficiently to cut a narrow groove by packing it with strips of cardboard on opposite sides of the spindle between the saw and the collars. A better way is to prepare some plywood packings as shown in Fig. 13. These are made in pairs and are planed slightly wedge-shaped, the amount of this wedging or taper determining the width of groove which will be cut. Sets of these packings can quickly be made to suit different widths of groove, marked plainly with their respective sizes and kept in the toolbox for use when occasion requires. The same blade should be used with these wobble collars every time, otherwise the groove width may not be to the dimension wanted.

The gap in the table has to be enlarged to clear a wobble saw. This can be done by fitting the wobble saw to the spindle in its lowest position, and then raising it very slowly and carefully while the saw is running. The saw will cut its own path through the table. If the gap is too wide afterwards for delicate sawing, an auxiliary table of thick plywood could be screwed down over the existing one. It is hardly necessary to stress that the saw nut must be tightened carefully when using a wobble saw, as a certain amount of vibration is set up which might possibly cause the nut to slacken. When grooving with a wobble saw the work must not be forced. The saw must be allowed time to cut its path through the wood, or it will be found that the groove will not be of a uniform width. Grooving can also be done with narrow cutters mounted in a special cutter block, and in this case the groove width will be the exact width of the cutters. For precision work this method of grooving is preferable to the wobble saw.

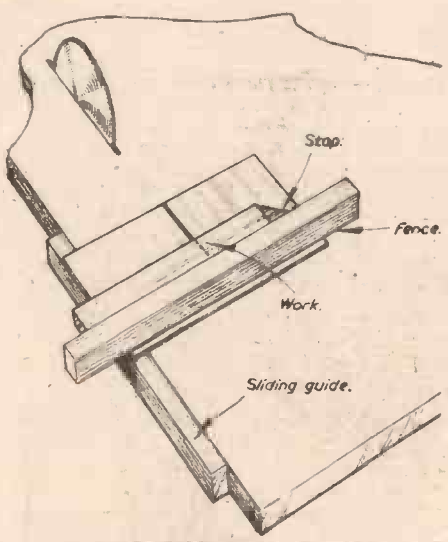


Fig. 16.—The sliding jig used for accurate crosscutting.

The Cutter Block

A most useful accessory for the small circular sawbench is a cutter block for cutting mouldings, fluting and grooving. These blocks may be purchased in several designs. One of the best, shown in Fig. 14, uses thin high-speed steel cutters, fixed securely in place by means of a wedging action. This enables the cutters to be adjusted to any desired position. It also makes possible a saving in cutter steel, as the cutters may have each end ground to a different profile. The steel is supplied in lengths, ready hardened, and only requires cutting to length and grinding to the shape required.

For occasional use a home-made block (Fig. 15) will give good service. This may be of steel, brass or light alloy. In an emergency a hardwood block will serve, but in this case it is essential that the bolts are inserted across the grain of the wood, so that there is no danger of the wood splitting when in use. A convenient size is 3in. square and 1in. thick, and this will allow mouldings to be worked ½in. deep. The cutters are of 1in. x 3/16in. steel, bolted through slotted holes with ¼in. dia. bolts. It is necessary, when setting out the bolt positions, to ensure that the bolt heads and nuts come inside the cutting circle. File steel can be used for cutters, but the file teeth must be ground off, or the cutters will break. The steel must be hardened throughout, and then tempered from the tail end of the cutter until the extreme cutting edge becomes a light straw colour. This leaves the body of the cutter fairly soft to resist breaking. The aim should be to get the area round the front bolt hole to a blue spring temper before quenching.

Fig. 17.—The same sliding jig being used for cutting the shoulders on tenoned work.

Moulding is carried out by placing the cutter block on the spindle, adjusting the height until the cutters project the required depth of the moulding, and feeding the work slowly and steadily past the cutters. The work is guided by the fence which must extend right across the table and be clamped at the far end to prevent any springing. Moulding should be done at a speed of about 4,000 r.p.m. for the best results, but satisfactory work can be done at slower

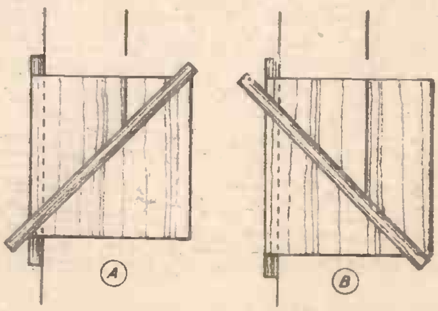


Fig. 18.—Similar sliding jigs, but with the fence at 45 deg. are used for sawing mitres.

speeds providing the wood is straight grained, and free from knots. It is always advisable to do the work in two or more cuts, the last cut being a fine one to produce a good finish. Wherever possible the work should be relieved by sawing a chamfer from the edge before moulding. In addition to moulding, the cutter block may, with suitable cutters, some of which are shown in Fig. 15, be used for cutting small rebates at one pass, and for fluting and grooving.

Cross-cutting

For ordinary cut-off work, the wood is fed free-hand, but where it is necessary that the cut end should be square, or at a certain angle, a sliding fence is required. On commercial sawbenches, the fence has a tongue underneath, which slides in a groove planed in the table top. This tongue and groove is apt to get choked with dirt and with resinous sawdust, making it difficult to slide the fence smoothly. A fence sliding along the edge of the table does not have this drawback, but it must be held tight up to the table edge by hand pressure. This is not difficult, and it becomes automatic after a time.

The fence shown in Fig. 16 and in use in Fig. 17 can be made up easily from scrap timber. The sliding piece, which must be straight, is nailed or screwed to the underside of a piece of plywood. The fence is similarly nailed or screwed on top of the plywood, at right-angles, or at an angle if required. The work is held up to the fence with one hand, and the jig slid along with the other, the cut-off line being aligned with either the saw-cut in the plywood base, or with a mark on the fence. If a fine cross-cut saw is used, the cut end will be in perfect condition for glue jointing, without any cleaning up. Similar sliding jigs are used for mitring and for cutting the shoulders of tenons, as described later.

Mitring

Perfectly fitting mitres can be cut at one pass, using the sliding jig described for cross-cutting, but having the fence at an angle of 45 deg. With square, unmoulded material, one cut is made with the face side down, and the other cut with the face side up, thus making the two cuts "in pairs." But this is not practical with moulded material, such as picture frame stock, because the moulded face does not seat properly on the jig, and also the moulded face is apt to chip if cut face down. For this work two jigs should be made, one to cut each side of the mitre, as in Fig. 18. It is, of course, possible to make an adjustable jig in which the fence can be swivelled to any angle, and secured by a bolt and wing nut. This is handy for irregular mitres, but for 45 deg. mitres it is better to use two jigs permanently set to the correct angle.

Great difficulty is often experienced in setting out the angles for irregular mitres, such as are needed for multi-sided figures. A useful method of cutting these mitres so that they will fit precisely without trimming is shown in Fig. 19, where a hexagonal frame is being dealt with. The alternate members are temporarily secured to a baseboard of scrap plywood by lightly glueing or pinning. The remaining members are then placed on top of the pieces first fixed, with the joints overlapping, and these are again glued or pinned down. The mitre lines are set out from the overlapping joints to the centre of the figure and the mitres cut with a fine saw right through both pieces at once and through the baseboard. When the pieces are removed from the temporary baseboard the mitres will fit perfectly. If the figure is required to finish to precise limits it is necessary to allow for the thickness of the saw blade.

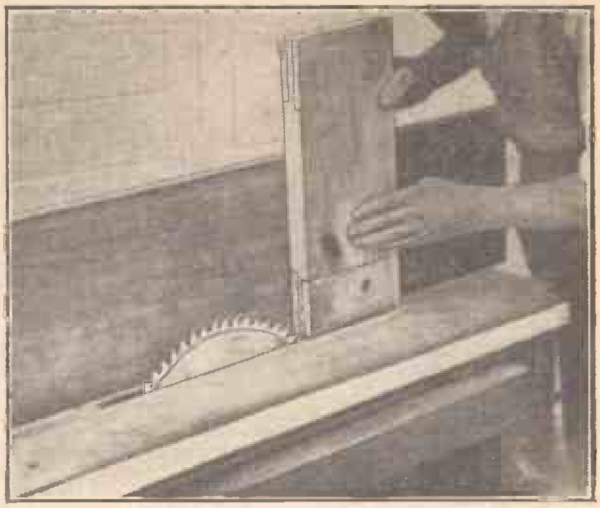


Fig. 21.—Ripping tenons by sliding the work along a wide fence.

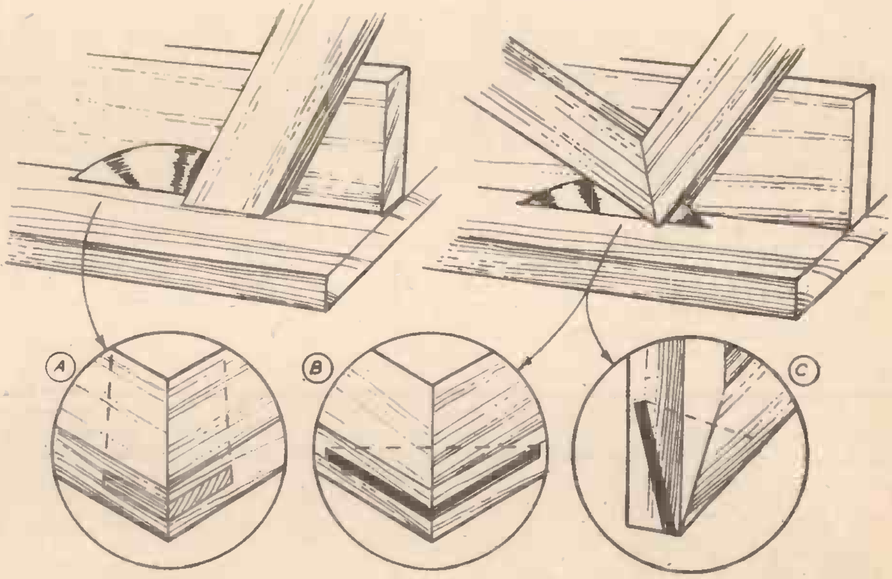


Fig. 20.—Mitred joints may be strengthened by grooving and fitting glued "keys" of veneer or plywood.

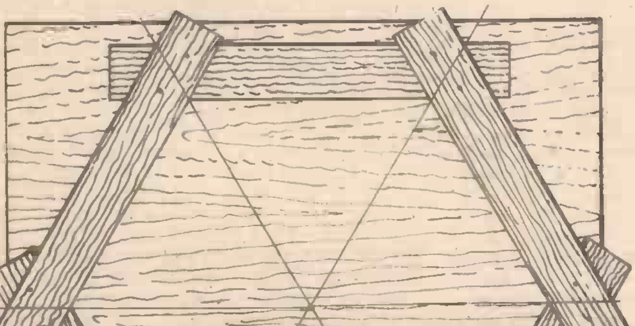


Fig. 19.—A useful method of cutting mitres.

Mitred joints can be made exceptionally strong by "keying" with slips of cross-grained hardwood or thin plywood. This may be done in two ways, shown in Fig. 20. At "A" the mitred pieces are grooved before assembly and a loose tongue inserted at the time of glueing up. At "B" the completely assembled and glued-up frame has its corners grooved and a slip of veneer or plywood inserted in the groove across the angle. The groove may be made at an angle, if desired, as shown at "C." This gives a kind of dovetailed grip to the glued-in slip. Good glued joints are necessary when mitred joints are being grooved in this way, otherwise the joint might break apart during the sawing.

Trenching

The cutting of trenches, across the grain, is often necessary when doing cabinet work or shelving. This operation may be done by adjusting the saw to project an amount equal to the depth of the required trench and passing the work over the saw, guided by a sliding jig as described for cross-cutting. A number of cuts may be made, side by side, and any remaining ribs removed with a narrow chisel. When a number of pieces are required to be trenched it is worth while setting up a "drunken" or "wobble" saw to cut the trenches cleanly in one pass. The cutter block used for grooving with the grain is not suitable for trenching across the grain, because, unless it has special side cutters fitted, it will tear the sides of the trench badly.

(To be concluded)

ULTRASONIC TESTING OF METALS

Principles and Practical Applications

By ERIC N. SIMONS

ULTRASONIC testing is one of the most recent of all the various methods of testing materials, and as yet it is still too recent for a great deal of research to have been embarked upon in connection with it. However, we shall endeavour to summarise as briefly as possible the principles and specific features of this promising method.

Principle of Supersonic Testing

Most readers will not need to be told that sound waves travel at the rate of 13,000in. per second through the air. But when they are transmitted through metals they travel much faster. For example, if one rings a brass bell the sound can be shown to travel through the brass at the rate of 174,000in. per second. If a piece of steel is rung, the rate increases to 229,000in. per second, or more, according to the type of steel, and a piece of aluminium in which sound waves are propagated allows the sound to travel at 245,000in. per second. Thus, sound has varying rates of travel through different materials.

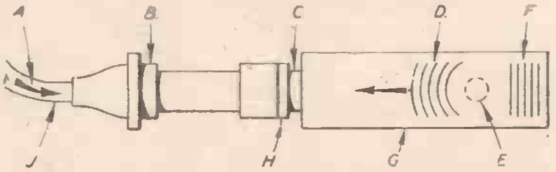


Fig. 1.—The ultrasonic reflectoscope (after F. A. Firestone). A—Electrical impulses from oscillator ; B—Detachable connector ; C—Film of oil ; D—Part of waves reflected by discontinuity ; E—Small defect ; F—Waves propagated ; G—Testpiece ; H—Piezo-electric crystal ; J—Flexible cable ; K—Impulses returned to oscilloscope.

The Air-gap

Let us now assume that in the material through which the sound waves pass there is a crack or other discontinuity. The waves as they travel meet the air gap between the two walls of the crack. The result is that they are mostly thrown back from the air-metal interface and little sound crosses the gap. That is why a cracked coin or bell sounds "dead" when rung.

The Stethoscope Test

In fact, one of the oldest methods of testing metal for cracks is precisely the striking of the specimen with a hammer and listening to the tone given off. In the testing of welds, for example, a common test is to strike the weld with a hammer and apply a stethoscope to the neighbouring metal and the weld. By listening to the increasing tone produced, an expert operator is able to decide whether or not there is a flaw, and the test can be made to give valuable indications.

Ultrasonic Waves

It is, however, a test which is capable of revealing only the larger discontinuities, and for the detection of small internal and fine cracks some much more sensitive method is necessary. In supersonic testing, sound waves of high frequency are propagated in metallic test pieces and when reflected back are picked up on their return. This is explained in detail later. The test is being increasingly employed for the testing of railway axles, and is advantageous for massive blooms, billets and blocks, because any faults in these may be discerned before time and money are spent in carrying their processing a stage or stages further. An ultrasonic testing unit is shown in Fig. 1.

Frequency of the Waves

The ultrasonic waves may have a frequency as high as five million cycles per second, with a length of wave as little as 1/16in. Such waves behave in a manner very similar to that of a light wave. If the discontinuity is small, it throws back a small amount of energy to the starting point or point of propagation. Large discontinuities throw back a much larger amount of energy, and the measurement of the amount of energy reflected enables the operator to decide on the size of the flaw. It is necessary also to know the precise location of the flaw, and this can be achieved by measuring the length of time it takes the waves to reach it, in a manner similar to radar. There is some reason to believe that the test can offer a useful indication of the grain size of the test piece, and it is stated that average grain size may be measured by measuring the scattering or attenuation of the waves.

The Properties of the Ultrasonic Wave

An ultrasonic wave, despite being essentially a sound wave, is inaudible to the human ear, but it is not this property that affects the test, but the shortness of the wave length. There are three main types of these waves, but the one with which we are concerned here is the longitudinal wave. (There are ultrasonic waves of other types, but we are dealing here solely with those capable of being transmitted through solid bodies and of use in ultrasonic testing.) A rate of 256,000in. per second has been obtained when such waves are transmitted through certain types of steel.

Detection of the Waves

The piezo-electric crystal is employed in both the propagation and reception back of the waves, and this crystal is almost always a carefully selected and prepared piece of quartz. The method of its application may be directly contactual or it may be placed in a water-filled or oil-filled container and the sound waves passed through the test piece in the same vessel. (A general outline of technique is given later.)

Types of Equipment

There are both complicated and simple types of ultrasonic testing apparatus. The least complex is that which passes an uninterrupted succession of waves through the test piece, the discontinuities being detected by their casting a perceptible acoustical shadow on the opposite face of the test piece. Alternatively, it is possible to propagate a succession of sound waves, few in number, but taking only a few millionths of a second to pass through the test piece. If any discontinuity exists, it reflects the waves. (It will be appreciated that the waves will be reflected, assuming there is no defect, back from the other face of the test piece.) The reflected waves are picked up by a cathode-ray tube. This type of equipment is known as the ultrasonic reflectoscope (see Fig. 1).

Other Causes of Reflection

Discontinuities are not the only causes of reflection of the waves. They may, for instance, be reflected by sharp changes in density or elasticity, and such reflection is employed in establishing the state of the internal structure of a metallic component.

Applications of the Test

As stated earlier, much development work has still to be done before the ultrasonic test's full possibilities are explored, but in the meantime there are numerous existing applications. One of these is, of course, the revelation of minute discontinuities. If the reflectoscope is employed for this purpose, the method adopted is to attach the quartz crystal to one extremity of a flexible cable and bring it into contact with the work. The tube screen immediately shows the distance of a flaw from the surface.

Range of Penetration

The ultrasonic waves have a range of penetration of approximately 20ft. into solid metal, and a blowhole or other spherical space can be disclosed at a few inches from the point of contact even when it is as small as 0.02in. in diameter. At 10ft. a similar defect 0.2in. in diameter is readily discernible, assuming normal circumstances. It should be noted that the clarity of the indications provided by the test is affected considerably by the condition of the metal undergoing test; if the metal contains a good deal of foreign matter or non-metallic inclusions, it lowers the sensitivity of the test considerably. Another factor in reducing sensitivity is the state of the surface, which for the best results should be smooth. Given clean metal of close grain structure and under good conditions it is possible to pick up holes 0.001in. in diameter.

Form of the Crystal

Because it is essential to make effective contact with the surface of the metal to be tested, it may be necessary to give the piezo-electric crystal a special form to suit the work. Thus, if the part has a curved surface, it may be necessary to shape a corresponding curve on the face of the crystal. This only applies, however, when the curve of the part is less than 3in. radius. For all curved surfaces of greater radius than this a flat crystal may continue to be employed.

Detecting Large Discontinuities

It is not essential to use the reflectoscope for the detection of large discontinuities, such as laminations in rolled plates. The simpler type of apparatus employing continuous waves will serve. There are two alternative methods, one consisting of a complete scanning of the entire area of the work with the ultrasonic waves. The other is to use the reflectoscope and propagate, towards the plate edge, a beam of polarised sound which passes across the plate and is thrown back by the opposite edge or by intermediate discontinuities. The second method is the quicker because it involves only the testing of one edge.

Testing Welds

The method adopted in testing welds depends largely on whether one surface or both can be reached. Assuming it is possible to reach both surfaces, the reflectoscope can again be employed, and will clearly indicate whether the union between the two components is sound.

Testing Tubes

It is possible to employ certain types of ultrasonic waves in the testing of tubes. The method adopted is to propagate the waves about the entire circumference of the tube and so enable its entire internal and external area to be tested by means of an ultrasonic contact instrument employing polarised sound.

Technique of the Ultrasonic Test

The ultrasonic test is more accurate than other acoustical methods of testing, but it is more complicated and calls for highly specialised apparatus. It is essential that the work should be firmly mounted on a work-holding support. The piezo-electric crystal is connected, as we have seen, by a flexible cable to a high frequency oscillator which is pulse-modulated by an oscillator of low frequency. Another crystal, usually of rochelle salt, is also secured to the test piece, and is connected by way of an amplifier and rectifier to a cathode-ray tube oscilloscope. In this way it becomes possible actually to see the reflected waves as they pass through the test piece.

Carrying Out the Test

It is usually the practice to carry out the test at the outset on a series of standard test pieces, the reflected waves being studied on the screen of the oscilloscopes. Discontinuities are revealed by an additional pulse not found when the test piece is without flaw. If the test piece is in the form of a bar without change of cross-section, it is possible to measure the distance between the pulses in the succession of reflected waves, and such waves may be compared with those of the standard test pieces.

The Tank Method

In the tank method, the piezo-electric crystal immersed in a fluid-containing tank propagates waves upwards in a vertical direction in the form of a pencil or beam. Where this beam strikes the surface of the fluid (oil in most instances, but sometimes water) a ray of light is focused and reflected on to a screen. The test piece is also inside the tank and is placed in the beam of sound. The variations in the intensity of the reflected light serve to show the quality of the test piece. It is sometimes found desirable to revolve the test piece or part at a slow rate in the tank.

Measuring Thickness

The ultrasonic test may be employed as a means of measuring the thickness of a wall where the opposite side cannot be reached. For this purpose, assuming the thickness to be measured is more than 7/64in., the reflectoscope is employed. It gives a direct indication of thickness by showing the length of time it takes for the waves to complete a full circuit. The degree of precision of the measurement depends on the thickness of the material and the extent to which the walls of the tube or sheet are parallel, being less as parallelism declines but greater as wall thickness increases.

For measuring sheet thickness, an instrument developed by Wesley S. Erwin, the "sonigauge," which determines the resonance through the thickness of the sheet is used; but this does not mean that the reflectoscope cannot be used for the same purpose.

Specialised Uses of Ultrasonic Waves

Space does not permit of a detailed description of the specialised use to which the shear, Rayleigh and other types of ultrasonic waves are put, but it may be briefly stated that among their actual or potential uses are the measurement of average grain size, the inspection of regions of a test piece close to the surface only, and the measurement of the amount of preferred alignment of the grains of a steel sheet or forging.

Kelvin Hughes Ultrasonic flaw detector depth gauge.

Preparing the Testpiece

To give the surface of a test piece or part to be tested by ultrasonic waves the necessary finish, it is desirable that it should be ground at the point where contact with the piezo-electric crystal is to be made. This is particularly necessary when a casting with a rough surface has to be tested. The surface is given a light coating of oil where it is not fully submerged in a tank of oil.

Basic Physical Facts

In conclusion, one or two basic physical facts will help the reader to grasp the principle of the test. The time taken by the waves to travel is in ratio to the distance through which they travel and the speed with which they are propagated is governed by the mean density and elasticity of the material.

A Telescope Tranquilliser

Apparatus for Improving Astro-photography

THIS device is designed to steady the dancing image of, for instance, a planet so that detailed photography may be undertaken through an astronomical telescope. The unit is in successful operation at Vanderbilt University's Dyer Observatory, Nashville, Tennessee, U.S. It steps up the sensitivity of the telescope 100 times and employs a television camera pick-up tube and many other electronic circuits.

The first report on its operation was made to the American Astronomical Society, after it had been used to obtain clear short-exposure photographs of the planet Jupiter and its moons. The new device is known as a "seeing compensator," and the increased contrast obtained by the use of the television apparatus makes faint planetary markings more easily visible than with the unaided eye at the telescope.

During the observation of the planets, it is well known that fine detail often becomes clearly visible for short periods, but becomes blurred when attempts are made to photograph it. This blurring is caused by the "dancing" or turbulence of the earth's atmosphere which is greatly magnified by the telescope. The larger the telescope's field, the more the effect is magnified.

The new apparatus overcomes these atmospheric disturbances by compensating electronically for the movements and by permitting exposures only one-hundredth as long as without it.

The method used for image compensation is to divide the planet's light in half as it leaves the telescope. The orthicon's cathode receives one image and the other falls on two photocells after being passed through two slits placed at right angles to each other. The current caused in the photocells by the light hitting them is amplified and used to control the telescope's motion.

The Sun and the Solar System

Part 2.—The Sun's Surface : Photpsphere : Sunspots : Prominences

(*Concluded from page 488, July issue*)

THE sun has been radiating light and heat for many millions of years; just how many is not known. It is continuing to do so without any signs of diminution, and the probability is that it will go on doing so for further millions of years. Enormous though the sun may appear to be to us it seems a wonderful thing that it can be capable of sustaining itself so that it never seems to change. It can radiate light, heat and power and seems to generate these, within itself, by its own volition. How this happens was for a long time a problem, the solution to which no one was able even to guess. The discovery of radio-active substances and radio-activity may have offered the first glimmerings of the truth, for it was suggested that radio-activity in the sun may account for its radiation over a reasonable period. But no radio-active elements were to be found in the sun, though lead, the product of exhausted radio-activity is present, which appears to show that if the sun once possessed such active elements, they must have long since become exhausted. It was not until the formulation of relativity was it put forward that the old ideas of the conservatism of matter must be discarded, and that the way lay open for the explanation of the continued radiation from the sun.

To Lord Rutherford must be awarded the honour of making the great research in liberating sub-atomic energy by breaking up the nuclei of atoms. The result of this has made the physical mechanism of the sun's interior more understandable. Lord Rutherford's work was continued by scientists both in this country and in America. It is now admitted that the conversion of hydrogen into helium would liberate the energy required to meet the observed radiation and continue to maintain the sun in its present state.

Lord Rutherford started by bombarding atoms of nitrogen and other gases with A-rays from radium. He found that these were fast-moving, positively charged nuclei of helium. By these means, when the nitrogen nuclei were struck, he succeeded in breaking up nitrogen atoms into atoms of oxygen and hydrogen. Later, fast-moving protons—hydrogen nuclei—were found to give better results than A-particles as bombarding missiles. A beam of these protons was produced by accelerating hydrogen nuclei along a tube in an intense electric field. In this way, lithium, bombarded by hydrogen, produced helium only. Further apparatus was designed culminating in the *cyclotron*, wherein the proton stream takes a spiral path in an enormously powerful magnetic field which is excited by a potential of over a million volts. Neutrons, components of atomic nuclei, which have no electric charge, were discovered and used as bombarding missiles. These proved more effective as they were not deflected from a target, as the A-particles and protons were, by their positive charges.

Under the conditions maintained in the sun, where the temperature is in millions of degrees, atomic nuclei will be stripped of their electrons and crushed together to such an extent that their kinetic energy is far greater than that produced in the laboratory under intense electrical excitation. Further collisions amongst the crowded nuclei and, therefore, the effect of bombarding hydrogen protons, is much more likely than is attained artificially.

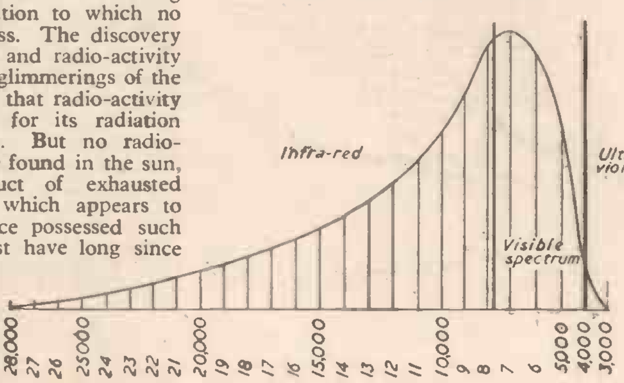


Fig. 5.—Light waves in Angstrom units.

In 1939 Dr. Bethe, an American physicist, and Weizsaker, a German physicist, put forward the theory that a certain cycle of nuclear reactions, converting hydrogen into helium, could be happening in and around the central parts of the sun and could account for its observed radiation. Four hydrogen nuclei are converted into one helium nucleus and three quanta of radiation. Carbon and nitrogen are the only other elements required for the completion of this cycle, and they remain unaltered. The net result is the conversion of hydrogen into helium and the resulting radiating energy is liberated; whether the hydrogen-helium conversion theory is true or not, and it is generally accepted as true, it does seem probable that the abundant amount of hydrogen in the sun serves as fuel, in that, or a very similar process. If the supposition is true that large quantities of hydrogen are in a constant state of change into helium, another interesting question is raised, namely: is the temperature of the sun rising or falling? It has generally been described as a G-type dwarf star which is cooling, but providing that sufficient hydrogen is present, the time taken will depend upon the proportion of carbon and nitrogen available; if we assume that this is one per cent., which astro-physical evidence seems to show, then the energy liberated at 20,000,000 deg. would agree with the observed energy radiated. The amount of helium would gradually increase and replace the hydrogen. Helium at high temperatures is more opaque to radiation than hydrogen, therefore, there would be a tendency to retain the liberated energy which could very well increase the general temperature of the sun during the next 10 to 20 millions of years. The conclusion that this brings us to is that the sun is still a G-type main sequence star, which has not yet started to decline.

Fig. 6.—The great sun-spot of June 22nd, 1885.

Radiation is constantly passing outward from the sun's surface, and it has been estimated that about four million tons of solar matter are being converted into energy every second in order to maintain this radiation. Yet almost the whole of this enormous output is dissipated in space; only about one hundred millionth part being intercepted by the planets. The intensity of solar radiation is measured in the form of heat intercepted by the earth, and this is the only means we have of estimating the observed radiation in its totality. The proportion absorbed by our atmosphere necessitates very

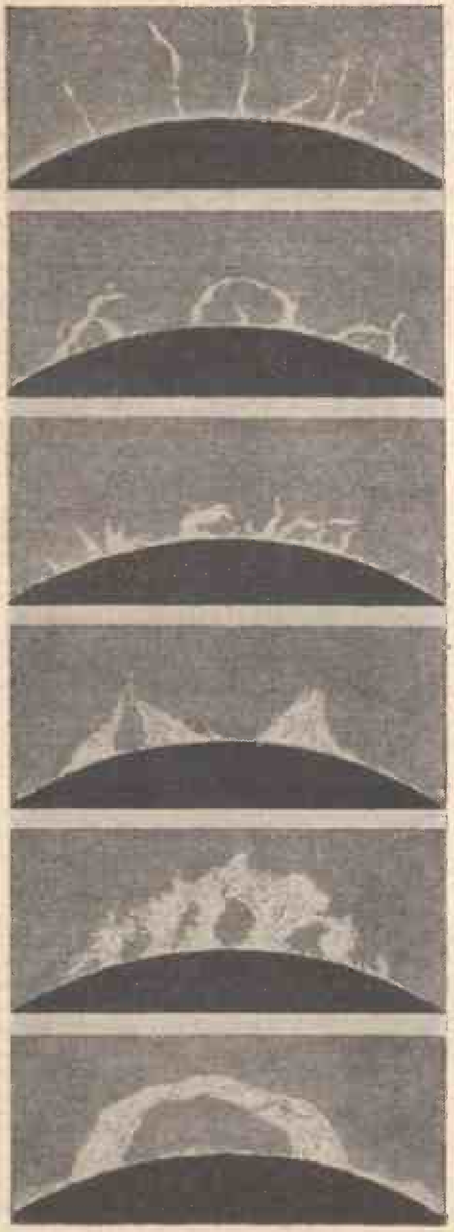


Fig. 7.—Types of prominences.

careful research to reach a valuation of that received outside of, or above, our atmosphere. The instruments used: voltmeters, pyrheliometers, etc., are very sensitive, and depend upon the varying resistances to electric currents of certain metals when heated. The metals, in the form of wires or strips, are blackened for absorption and to eliminate reflection, and their changes in resistance are determined by sensitive galvanometers from currents passing through them when heated. The radiation can be spread into a gradation of wave lengths so that they can be analytically measured by the spectroscope.

The greater portion of the short waves, the ultra-violet, are intercepted by our higher atmosphere, and it has been found that nearly all the radiation that reaches the earth falls within the limits due to light and to heat, that is to say, the visible and the infra-red rays. Fig. 5 illustrates by a curve the intensity of the rays with their lengths in Angstrom units.

The Sun's Surface

If we project the image of the sun on to a white screen by means of a telescope or look at it directly through an eyepiece with a sun-diagonal fitted with a dark glass or a polarising prism we see what is known as the *photosphere*.

Photosphere

We shall see that this is mottled or granulated, especially if we increase the magnification, and we can do this if the atmospheric conditions are good. The surface is mottled in two ways. For instance, there are patches of white separated by darker spaces or divisions and the whole surface consists of tiny (more or less) circular grains of light. These grains or granules have a diameter of about 500 miles, though, to us they only subtend an angle of about one second of arc. It is not known to what this granulation is due, but it has been assumed that we are looking down upon the upper parts of circular columns of hot gases kept in a constant state of rotation. The granules appear to be more marked near the centre of the disc and are less distinct towards the limb, which is as we should expect to find them if they are the crests of dome-shaped columns of gas. The high temperature of the gases which form the granules, together with the low pressure at the surface, results in their being highly ionised and it is probably this ionisation, combined with free electrons, which cause the extreme brightness and the continuous spectrum which is emitted. Besides being less visible the granules in the photosphere are less distinct and less brilliant towards the limbs. This is as we should expect, because (1) the sun's radiation, including light, proceeding from a depth to a surface, is more direct in the centre of the disc and (2) the darkening as we look outward from the centre towards the limb is due to the general absorption by the sun's atmosphere. The light has to pass through a greater thickness of these gases in just the same way as the sun's image, and light is cut off by our own atmosphere when the time of sunset approaches.

Sunspots

When seen through a telescope with moderate magnification, sunspots appear as disfiguring marks upon an otherwise bright uniform surface, but with a much increased power it will be noticed that each spot has one or more dark and uniformly toned nuclei. Each is called an umbra and each is surrounded by an even-toned or light background which is referred to as a penumbra. This penumbra increases the area of the spot very considerably.

The umbrae of sunspots appear very dark by contrast with the brilliant photosphere but actually if the umbra could be looked at alone, without the glare of the solar surface, it would be far too bright for the unprotected eye to look at. The cause of sunspots is at present unknown and we do not know how deeply they penetrate the surface, but to the writer they appear to be the opposite in action to prominences. Sometimes the granulated surface is in a form of eruption and at others the surface sinks and breaks away, leaving apertures showing a darkened interior. Some may extend to depths of thousands of miles, whilst others may be mere shallow depressions. Of this we may be sure, that just as prominences are due to forces from within, sunspots are due to partial vacua. They are due to variations in the magnetism of the whole and are not themselves the cause of such magnetic variations.

The appearance of the penumbra appears to be due to disturbances of the photospheric granules. At the periphery of the penumbra these granules are often crowded together, giving extra brilliance to the surrounding photosphere. This often occurs next to the umbra itself, even when there is no penumbra, as is often the case with small spots. It has been discovered that there is often a distortion of the spectrum lines over sunspots, which appears to indicate a radial motion of certain gases outwards across the penumbra and also an inward flow of hydrogen and calcium gases at a higher level.

When a spot is forming, the granules part, exposing a larger patch of cooler gas beneath. Sometimes this patch closes up after a short time, but if it does not do so it gradually increases in area and umbra appears, apparently due to cooling consequent upon its expansion, the granules at the periphery becoming a penumbra. In complicated or clustered groups of spots, such as that shown in Fig. 6, some of the largest spots will have umbrae, whilst others, especially small ones, will consist of penumbra only.

Sunspots vary greatly in size from the most minute pores, scarcely visible with high magnification in the telescope, to enormous outbreaks of thousands of square miles in area. The largest ever recorded since reliable records have been made occurred in 1947, when an area of over 6,000 million square miles became a gigantic group of sunspots.

Sunspots are confined to latitudes below 40 deg. north or south of the solar equator and are most prevalent between 6 deg. and 28 deg. They never appear at the poles. All spots appear to move in the direction of the sun's rotation and the speed is dependent upon the varying zonal rotation.

It appears to be a fact that the umbra of most spots is only slightly, if it is at all, below the penumbra. In some cases there appears to be no differences between the

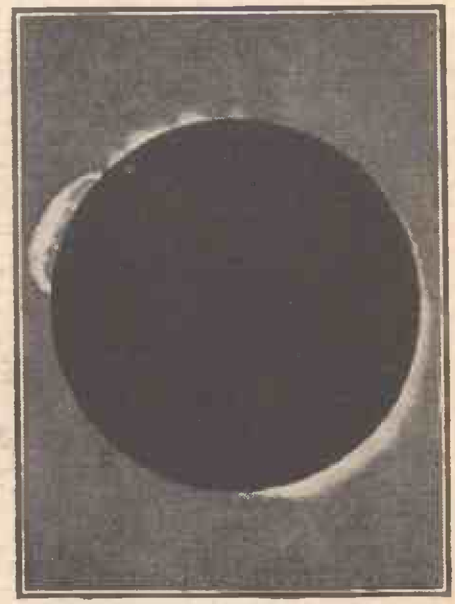


Fig. 8.—The great arched prominence seen in 1919.

levels, whilst in others there is a slight depression of the umbra; when the spot is near the eastern limb the eastern side of the penumbra merely shows a little broader than the west.

Prominences

Up to the present, all that has been referred to has been possible to see with the telescope, under ordinary conditions, but we come now to phenomena which either require special apparatus or, waiting for those few moments when, in an eclipse of the sun by the moon, the disc is totally obscured. These phenomena relate to the chromosphere and prominences. The chromosphere is an extremely rarefied gas and this presents an apparently opaque surface of extreme brilliancy. This surface radiates light of every visible and invisible wave length, so that in the spectroscope a full and continuous spectrum is produced. Work in the laboratory leads to the expectation that only incandescent liquids, solids and gases under high pressures show the continuous spectrum. No doubt the depth of the gases of the photosphere and the ionisation of the atoms and free electrons, due to temperatures beyond those which are obtainable in laboratories, are responsible for this. The chromosphere is a layer of incandescent gas immediately above the photosphere and resting upon it, rapidly thinning with height until it merges into the corona.

The extreme lower layers of the chromosphere, having a depth of perhaps 400 miles above the photosphere, have the atoms of all the elements found in the sun, except those lighter and more easily ionised gases such as hydrogen, helium and calcium, etc., and these are in the upper layers at 10,000 or 12,000 miles or more. The Fraunhofer lines are due primarily to the atoms in the lower chromosphere; these are extremely agitated by thermal collisions, ionisation and radiation, their electrons flying from orbit to orbit and absorbing light of the frequencies corresponding to the flights. So long as the brilliant continuous emission spectrum of the photosphere acts as a background, only their absorption leaps outward are visible, as dark Fraunhofer lines, corresponding to these frequencies. When, during the total eclipse of the sun, the moon has just covered and cut off the light of the photosphere, the lower layers of the chromosphere is seen for an instant without the bright photospheric background; then the inward or emission leaps of the electrons only are seen. The result is a bright line emission spectrum, and so a reversal of the ordinary dark lines; the lines are seen, suddenly bright, against a dark background and this is known as a flash spectrum.

We can only consider the chromosphere, therefore, as a kind of ocean of incandescent gas overlaying the brilliant photosphere. In this vast expanse there are enormous flames which we call prominences. Some of these are quiescently glowing and taking a variety of shapes, whilst others, especially in the vicinity of sunspots, shoot up with explosive speed in the form of jets, then curve over to form arches; some rush away from the solar surface, whilst others come pouring down at great speed and appear to be drawn into the sun again.

All of the various kinds of prominences are shown in Fig. 7, which illustrates six different types. Starting at the top of the drawing there is the rocket type which shoots up at terrific velocity often almost, or quite, radially from the sun's centre: such heights as between 500,000 and 600,000 miles have been recorded. These rocket flames are often wholly detached from the sun. The second sketch, coming down, shows the interactive type, the flames of which seem to have a mutual attraction for they rise from two widely separated points, arch over and meet. No. 3 are brilliant, smaller and numerous flames. No. 4 are flames which are quiescent and are not so brilliant and take a pyramidal form; sometimes they are open, i.e., made up of two similar flames which meet at the tips and sometimes are broad sheets of flame. No. 5 shows flames which are known as "forests" because they resemble trees in their forms, and the last sketch, No. 6, seems to be similar to No. 5 but larger, and are made up of two flames only, though in this case it is only one flame which, rising up on one side turns, or bends, over and rejoins the chromosphere, often at times many thousands of miles away. It must not be thought that these prominences rise and flicker for a few minutes and then die away, for the arched prominence shown in Fig. 8 was seen on the eastern limb of the sun on March 22nd, 1919: it gradually increased in height and intensity as the sun rotated and on May 28th it had reached a height of 76,000 miles and extended over a distance of 400,000 miles. On the following day, the day of the annular eclipse, it had attained a height of 500,000 miles and had almost disappeared. At the period when it reached its most marked form the span of the arch was as shown in Fig. 8 and equalled one-third of the sun's diameter or 288,000 miles.

Power from the Tide

THE electro-hydraulic power station at the mouth of the river Rance, in Brittany, will be the first electro-hydraulic power plant of its kind in the world.

The tide at the spot chosen rises very high, some 45ft. The water will flow into 38 groups of a new type of turbine that will be worked by both the incoming and outgoing tides. The annual production will be about 800 million kWh. It will go gradually into service between 1962 and 1964.

"*Firestreak*," *an air-to-air weapon which homes on the heat-rays from enemy aircraft, photographed just after launching, will be fitted to the English Electric P.1 and the Gloster Javelin aircraft, and was developed by de Havilland Propellers, Ltd.*

A new Autoclave

A UNIQUE windowed autoclave has been designed by engineers at Battelle Institute for use in the study of corrosion by 600°F water. Because of the high vapour pressure and the corrosiveness of water at this temperature, two high-strength glass windows are mounted at the ends of water-cooled legs. One window is used for illumination of the specimen and the other for taking time-lapse photographs.

Special Landing Gear

A NEW device has been developed by an American firm for use on helicopters to stop them from sinking into soft surfaces. The landing gear is made of aluminium and resembles snow shoes in appearance.

New French Train Control

SIXTY miles of mountain railway track between Dijon and Vallorbe is to be under exterior control, independent of the engine driver. While waiting for complete automatic control, the driver will be guided by signals of the "cab signal" type common in the U.S. Track signals will be suppressed and all indications will appear on a screen in the cab.

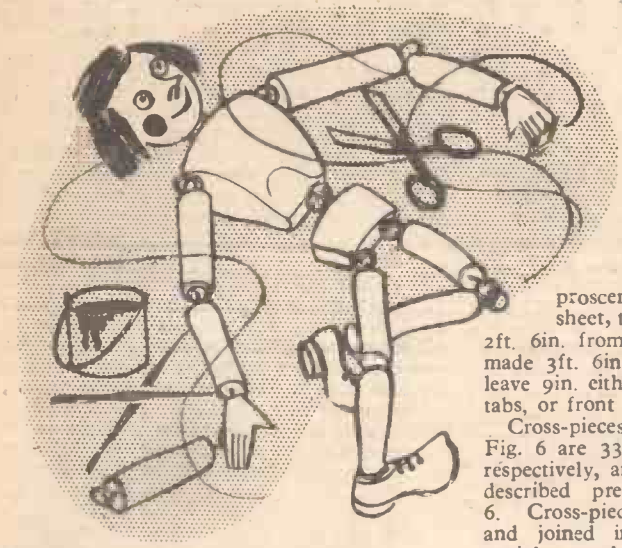
The new M.L. Light Aircraft. The novel wing construction is entirely without rigid bracing and is an inflated fabric envelope, in which pressure is maintained to provide a stiff aerodynamic surface. The 'plane, with wing collapsed, is towable behind a private car.

Turkish Radiotelephone

EUROPE'S longest radiotelephone system is to be installed in Turkey. There will be 120 telephone tracks divided into four sections. The system will complete that already being built connecting Izmir to Greece and Italy, Istambul, Ankara and Sivas.

MAKING A

Constructional Details of the Theatre and a M



FOR the size of puppets described (15in.) the proscenium opening needs to be approximately 3ft. 6in. wide and 2ft. 6 in. high. Timber, 2in. x ½in., should be used for the framework, and as a first step six uprights, each 7ft. 6in. long, are cut and planed. These are marked 1-6 in Fig. 6. Four cross-pieces are then cut to fit between the uprights 1 and 2 to form the front of the theatre, as shown in Fig. 1 Details of the joints, the length of the cross-pieces and other dimensions are all given in this figure. Two screws in each joint should secure firmly. This frame may be covered with a piece of hardboard, 7ft. 6in. x 5ft., and the proscenium opening is cut out of this sheet, the bottom of the opening being 2ft. 6in. from the floor. If the opening is made 3ft. 6in. wide, as suggested, this will leave 9in. either side of the opening for the tabs, or front curtains, to be hung behind.

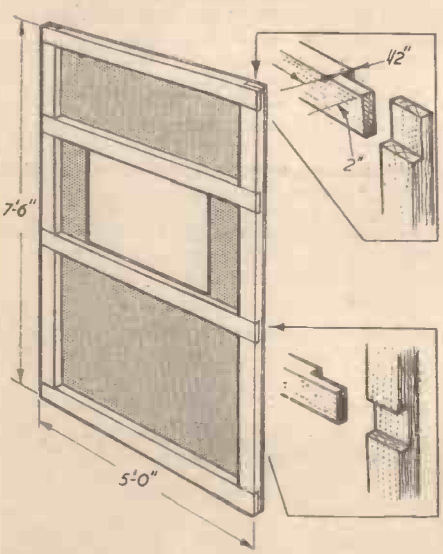


Fig. 1.—Framework for theatre front. (Joints inset.)

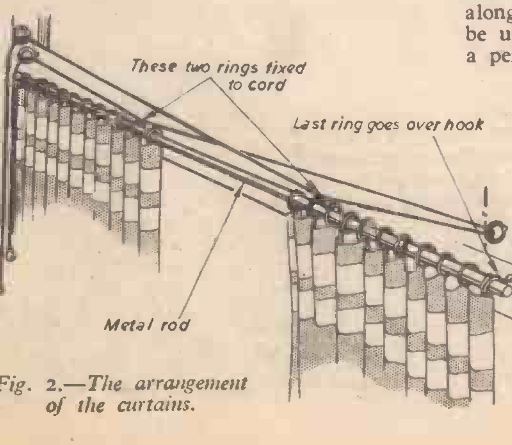


Fig. 2.—The arrangement of the curtains.

Cross-pieces, marked A, B, C and D, in Fig. 6 are 33½in., 18in., 17½in., and 17½in. respectively, and these are joined, in the way described previously, to uprights 5 and 6. Cross-pieces for the other side are cut and joined in a similar manner to the uprights marked 3 and 4, and the theatre-front framework, which is quite separate at this stage, can now be nailed on to the ends of A, C and D, and their opposite numbers on the other side, driving the nails through from the front.

A 5ft. piece of the 2in. x ½in. should be cut and nailed on to the tops of the uprights 4 and 5. (This is marked x in Fig. 6.)

Two pieces of plywood or hardboard are now required for the floor and back wall of the stage itself. The floor is 5ft. x 18in. and is nailed into position after the corners have been cut out to fit. The back wall needs to rise above the level of the proscenium opening so that the operator's body is not visible even if the stage is viewed from a low angle. In this case it should be 5ft. wide and about 3ft, or 3ft. 6in. high, depending on how tall the operator is. The puppets will be held, of course, while standing on the low platform at the rear, and if this is erected first, one can try the back wall for size. It is important to get this height correct, so that an extra strut may be nailed between uprights 3 and 6, running along the top of the back wall; this can be used for resting one's elbows on during a performance.

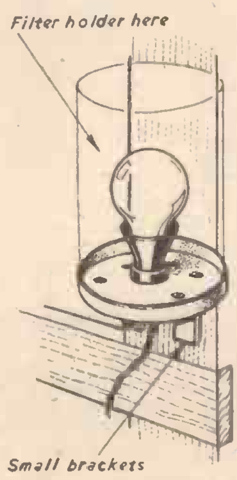


Fig. 3.—Lighting "flood" in position.

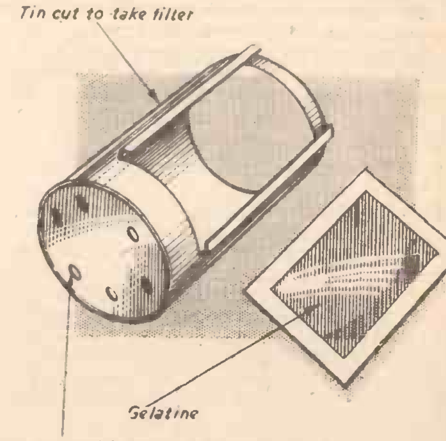
The Rear Platform

The wood for the rear platform is 5ft. x 18in., with corners cut to fit, and this needs to be stout wood of 1in. thickness. If thinner material is used, then a middle support should be added.

The sides and back of the theatre should be draped with dark coloured cloth and lighting effects will be more satisfactory if some material is put over the top to prevent shadows being cast when a performance is being given in a low room.

Curtains

Any bright material may be used for the tabs, or front curtains, and these should have small curtain rings sewn along the tops and threaded on to a metal rod. To enable them to be opened and closed easily, fix in the way shown in Fig. 2. Two eyescrews are put in the upright on the left side and one on the right, just above the cup-hooks holding the curtain rod. Picture cord is threaded through the upper of the two on the left, along to the right-hand curtain, and tied to the second ring from the middle. From there it continues to the right-hand eyescrew and then back to the second ring from the middle on the left-hand curtain, where it is once more tied. It is taken from there to the lower eyescrew on that side and the two ends are left hanging at a convenient height, with perhaps two or three large knots in them to make them easier to hold while pulling. A good idea is to put knots in one of these strings and, say, a large curtain ring on the other, so that they can be identified by touch.



Lights

For a theatre of this size a car battery or large dry battery would provide enough current, but it is much more convenient to use the mains supply. Having decided how many switches are needed plug into a three-pin socket and use a circuit similar to the one shown in Fig. 7.

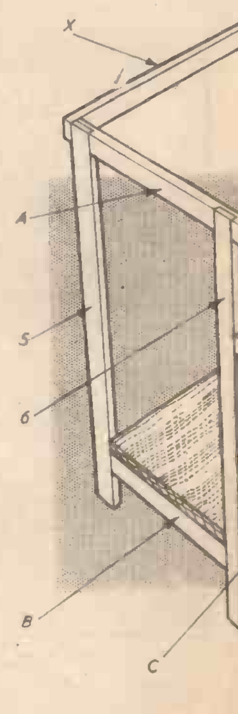
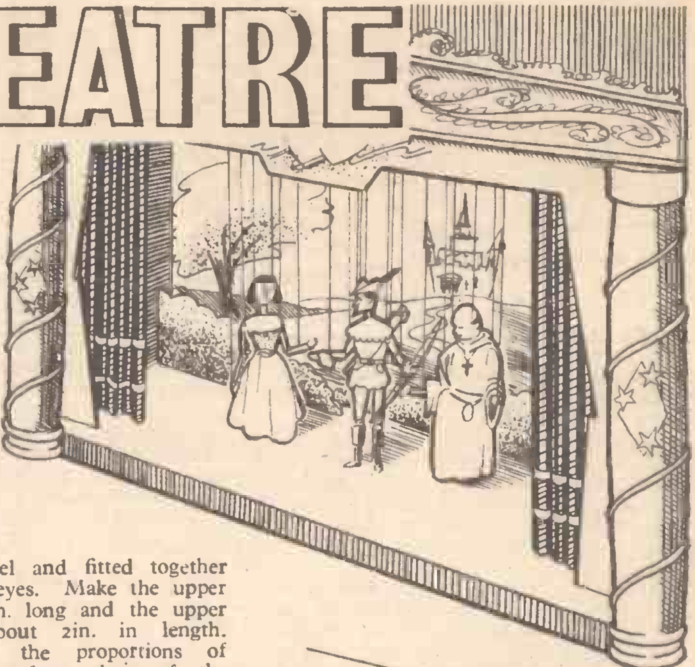


Fig. 6.—Ge

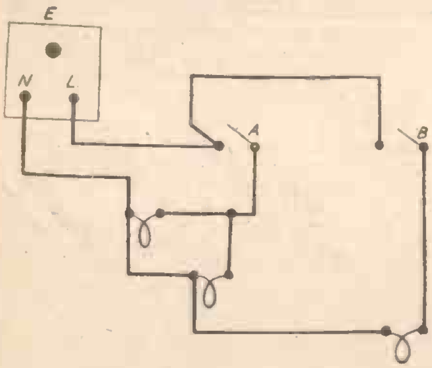
PUPPET THEATRE



ethod of Making the Puppets

By I. W. BRASSINGTON

Every care must be taken to ensure that the "live" side of the circuit goes to the switch or switches. Home-made lampshades can be cut from dried milk tins, as shown in Fig. 4, so that gelatine colour-filters can be inserted in the grooves. A hole must be cut in the centre of the lid to fit a standard bakelite lampholder and this is best cut with a plumber's tank-cutter. The lampholder is



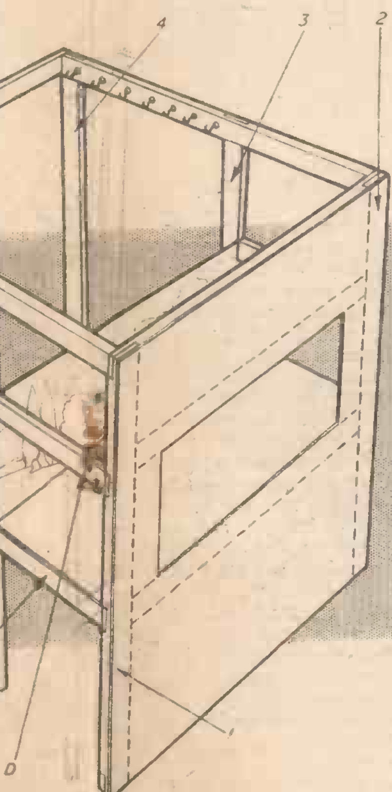
Figs. 4 and 5.—(Left) Dried milk tin cut and bent to shape, and filter. Fig. 7.—(Right) Lighting circuit. ('A' controls two lights and 'B' controls one).

then put in and held in place with the bakelite ring provided.

The lid is now attached to the upright of the proscenium arch, as shown in Fig. 3, being fixed in position by two small brackets. The tin is inverted on to the lid and can be used as it is or a colour-filter can be slid down the grooves, even whilst in use. A few small holes should be made in what was the bottom of the tin, to let the hot air escape. The switches should be fitted in a convenient place and marked or numbered to avoid confusion.

Coloured gelatine can be bought in sheets and several colours should be cut to size and glued into a cardboard frame, as shown in Fig. 5. Every effort should be made to get the correct size, and the edges smooth, so that they will slip into place with the minimum of trouble during a performance.

On the inner side of the top cross-pieces (on the framework) a row of cup-hooks should be placed so that the puppets can be hung out of the way quickly without the strings becoming entangled.



neral layout of the framework.

Making the Figures

Though there are many ways of making puppets and a wide variety of materials at one's disposal, the following method is one of the most simple, yet gives a lifelike performance in use.

The body is made from a piece of wood 6in. x 3½in. and about ¾in. thick. This should be shaped as shown in Fig. 8, so as to form a waistline. The limbs are cut from a length of ⅜in. dowel and fitted together with ordinary screweyes. Make the upper and lower arms 2½in. long and the upper and lower legs about 2in. in length. Generally speaking, the proportions of puppets should vary from those of the human body in that the puppet's body is shorter, the head and hands larger and the arms longer, though, of course, these rules may be modified in the interests of caricature, which should be very freely used in puppet making.

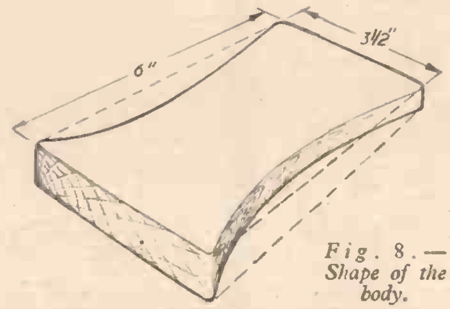
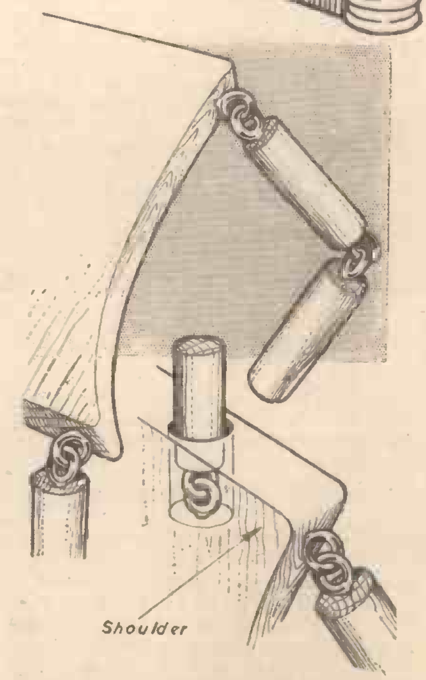


Fig. 8.—Shape of the body.

Use a gimlet to start the screweyes, especially in the dowel, as this is quite hard wood. Join two screweyes together at each joint by prying one of them open with a pair of pliers, threading through and then closing again. Fig. 9 shows how the limbs are joined. Be sure to screw the screweyes right home so that the space between each limb is only about ½in.

For the feet, obtain a piece of wood approximately 1½in. x ¾in. x ¾in., and with saw and file shape roughly into the required proportions. The drawings in Fig. 11 show the various stages and the foot attachment is the same as the other joints, except that a staple may be used in place of a screweye on the foot side of the joint.

The hands are a little more difficult, but great detail is not essential or even desirable, and I have found that plastic wood is extremely easy to use for this purpose. Hands can be modelled in this material without the prerequisite of a high degree of artistic skill, and if a screweye is used in the bottom of the lower arm the plastic wood may be keyed on to this, building up a thin layer at a time, until a kind of mitten is made. It is not necessary to model or carve individual fingers. This method does not allow the hand to move independently of the lower arm. If a wrist joint is required so that the hand may move on its own, then the screweye is still used in the lower arm, but the hand must be modelled on to something else, say a piece of wire appropriately



Figs. 9 and 10.—Limb joints and the neck joint.

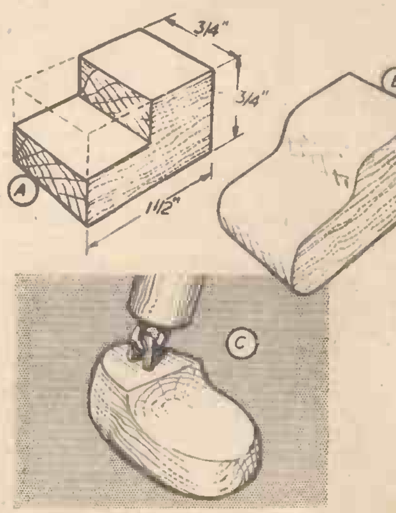


Fig. 11.—Stages in making the foot.

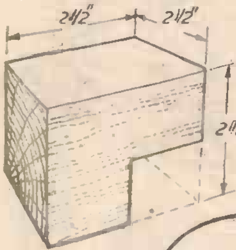
shaped, which can then be threaded through the screweye. In the beginning, however, I advise doing without the wrist joint until the operator has had some experience in manipulation, as the jointed hand is likely to be difficult to control.

Making the head is a very individual affair and there are a good many materials and methods at the puppeteer's disposal. The following method is recommended because of its simplicity.

A 2½in. cube of wood is cut as shown in Fig. 12 and all the corners are rounded off with a file. This gives the basic shape and the features are then built up in plastic wood, using a thin layer at a time. When the shape is satisfactory the head can be smoothed with sandpaper and hair can be painted on or theatrical hair can be glued into place, though plastic wood will give a very lifelike effect.

It is easier to get the required shades when painting if the face is first painted white.

The head is attached to the body with another piece of dowel, which forms the neck. A ½in. diameter hole is bored into the top of the body for a depth of about ½in. to receive the neck. A screweye is put into the underside of the back of the head and attached to a second screweye in the top of the neck. It may be found better to countersink this screw slightly into the base of the skull in order to hide the joint. The bottom of the neck also has a pair of screweyes and when these are attached and in position they are let into the hole prepared in the body and screwed in place. Fig. 10 shows how this is done.



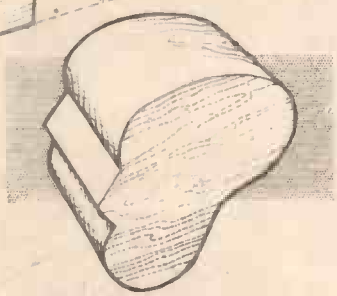


Fig. 12.—Basic shape of the head.

The controls for a normal puppet are included in two pieces of wood in the shape of a cross, the longer, vertical piece being about 1ft. in length and the cross-piece about 6 to 8in. and joined at right-angles to the long piece, about three-quarters of the way up.

The wood used must be strong enough to allow a cup-hook to be screwed into it and the two pieces are joined with a cross-halving joint as shown in Fig. 13. This may be either glued or nailed. A cup-hook is then screwed into the vertical piece at somewhere near the position of this joint and another screwed into the top end of the vertical, the latter being used to hang up the puppet when not in use.

A small cobbler's tack may be driven into the puppet at the control points so that the strings may be tied to them. These points are: one on each side of the head; one in the middle of the back, between the shoulder blades; one for each hand and leg. Black thread is used for stringing and the head strings are attached to the ends of the cross-piece and the back string to the base of the vertical. It will be seen from this that if the vertical is tipped forward the puppet will bow.

The hand strings are now attached (but with plenty of slack) to the ends of the cross-piece also and these are manipulated with the fingers. It is a good idea to attach the leg strings to the knee rather than to the foot and these strings are led to either end of a new piece of wood, 7in. or 8in. long, which has a cup-hook in its centre. This leg control is hooked on to the cup-hook near the cross-piece when not in use. But in use it is taken from its "mooring" and used in the left hand.

Fig 14 shows the stringing.

The method described for making and stringing puppets is intended to provide a basic method of working and the enterprising puppeteer will no doubt wish to construct more elaborate figures. There is an endless list of characters to choose from and, for a variation in methods of construction, the reader is referred to the article, "Making a Skeleton Marionette" which appeared in our September, 1956, issue. Animals too provide a profitable field for puppets but, of course, different methods of stringing will have to be devised to operate them.

It is well to remember too that a great deal of the effect of a puppet show depends on its presentation and that extensive rehearsal and practice is necessary before a show is presented.

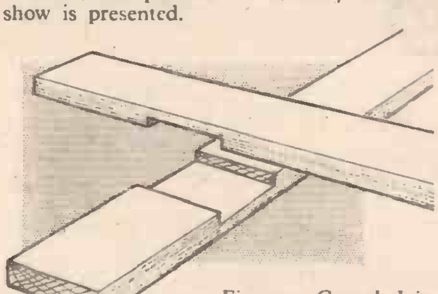


Fig. 13.—Cross-halving joint.

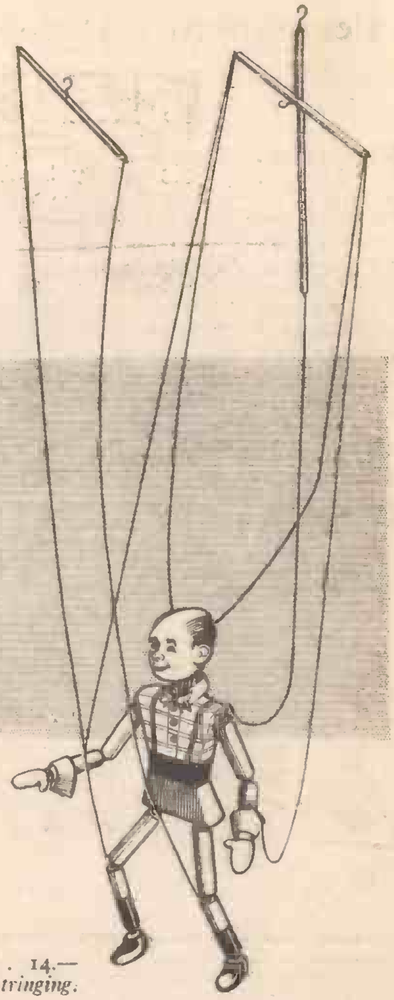


Fig. 14.—The stringing.

Parking Meters for Great Britain

An American Idea Which is to be Introduced to Solve the Parking Problem

LONDON and the other great cities of Britain with the gravest problem yet in the world of transport—that of dealing with daily hordes of cars which bear their owners to business in the morning and must then be left somewhere to await their removal at night.

One of the first partial solutions which will be applied in many areas will be the installation of parking meters, well known as an essential feature of American and Canadian streets for a quarter of a century but new to British motorists. These, generally speaking, will permit up to a two-hour spell of parking in certain specified streets or other sites at a charge of probably 6d. per hour.

The Red Ball Parking Meter.

First to be accepted and approved by the Council of Industrial Design in the field of British-built machines is the Red Ball Parking Meter, product of the company of the same name. The Red Ball meter has been designed in collaboration with Mr. J. Beresford Evans, a consultant recommended by the Council.

Streamlined and elegant in appearance, the Red Ball meter is operated by the motorist lifting the handle, in which operation he automatically winds up the meter clock before inserting coins at the 6d.-per-hour rate. When his time is up, the red ball, from which the machine takes its name, ascends into a glass dome on the meter's head and the parking attendant is thus able to see at a glance which cars have overstayed their limit, even from some hundreds of feet away.

The Red Ball meter's compact appearance and efficient protection against dust, rain and the vagaries of weather make it possible that it will soon become as familiar a part of the British city street scene as the pillar-box or the lamp-post.

Parking meters have already been accepted in principle by the City of Westminster, but rejected by the City of London.

A Camera Cradle For Copying

Use This Device for Photographing Documents, etc.

By P. WILDON

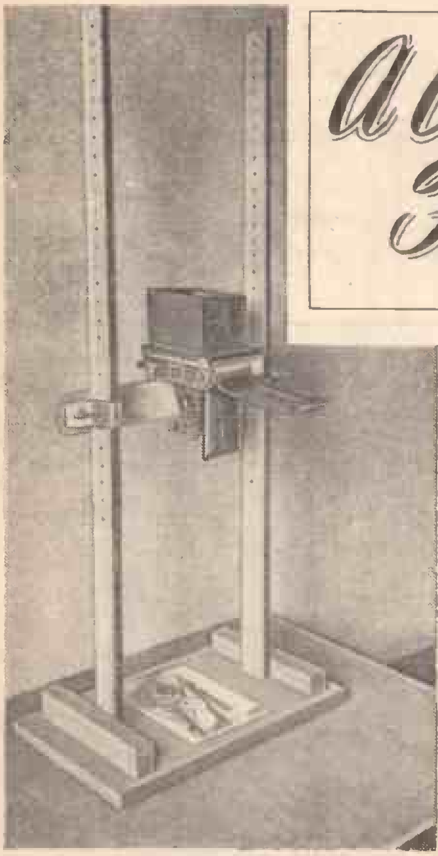


Fig. 1.—The completed camera cradle.

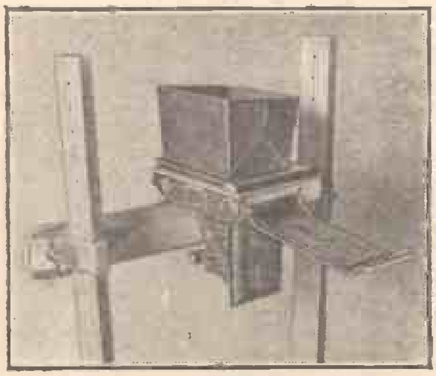


Fig. 3.—The camera in position.

THIS cradle, constructed to enable the camera to be used for copying photographs, documents, etc., is used in conjunction with two items which were described in previous articles. One is the plate back adapter (January issue), which enables the user to focus the object that is to be copied on the focusing screen.

The other item used is the baseboard and columns of the enlarger described last month. The enlarger head is lifted off and the "cradle" substituted.

As can be seen in Fig. 5, the "cradle" consists of a crossbar of wood, held in position by specially-shaped brackets which fit over the columns. One end of each bracket is screwed to the crossbar, while the other end, which is bent to lie about ½in. away from the surface of the wood, is secured by a wingnut and bolt (see Fig. 2). Tightening the wingnuts clamps the brackets to the columns.

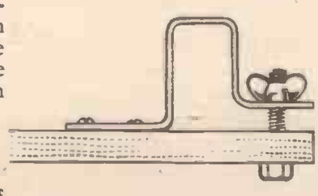


Fig. 2.—Details of the bracket.

The camera is held in position on the "cradle" by means of a piece of wood which is screwed to the crossbar. A hole is drilled in it through which a bolt is passed to screw into the tripod bush of the plate back adapter. If the plate back adapter is not used the bolt will be screwed directly into the camera tripod bush. Fig. 3 shows the camera fitted into position.

The distance the wood is fixed along the crossbar depends upon the width of the camera used. It should be positioned so that the camera is susper.ded centrally between the two columns.

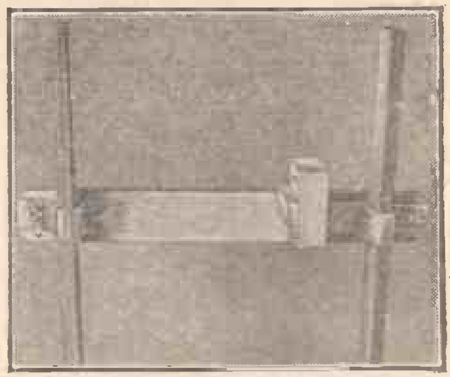


Fig. 5.—The cradle.

A small bar of wood is screwed into position under the securnig bolt to give further support to the camera. The underside of the camera itself rests on the top of the crossbar, where a small strip of baize or felt is glued to prevent any chafing.

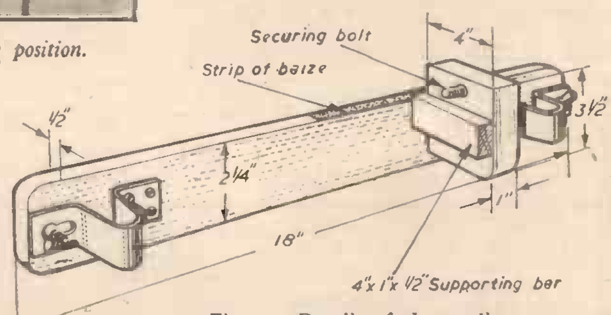


Fig. 4.—Details of the cradle.

Fig. 4 shows full dimensions of the "cradle," and Fig. 1 shows the cradle in use.

New Solar Clock

A Light-operated Timepiece

GENERAL TIME CORPORATION, an American firm, has developed a new "solar clock" which is operated by light. A short exposure to ordinary incandescent light or to sunlight will run it for days; the equivalent of a day of such light will operate the clock for a month.

The new solar clock requires no electric cord or "transmitter"; it is completely portable, and requires no winding or battery replacements. The clock contains a series of voltage generators (silicon solar cells) which, when exposed to incandescent light or sunlight, generate voltage to charge an accumulator cell ; this, in turn, operates the electric clock mechanism. The accumulator is a special rechargeable one and will last as long as the clock.

If exposed to light from time to time the clock will run indefinitely without further attention; even if the owner is away from home for a month or so there is sufficient capacity in the energy storage unit to keep the clock functioning for over a year without any light. If the clock stops after long storage in a dark closet, all it needs is exposure to light, and it starts up again. Production has not yet started.

Right. — The General Time Corporation Solar Clock.

THE JUNIOR CHEMIST

A Home Made Bunsen Burner

A Useful Piece of Equipment for the Home Laboratory

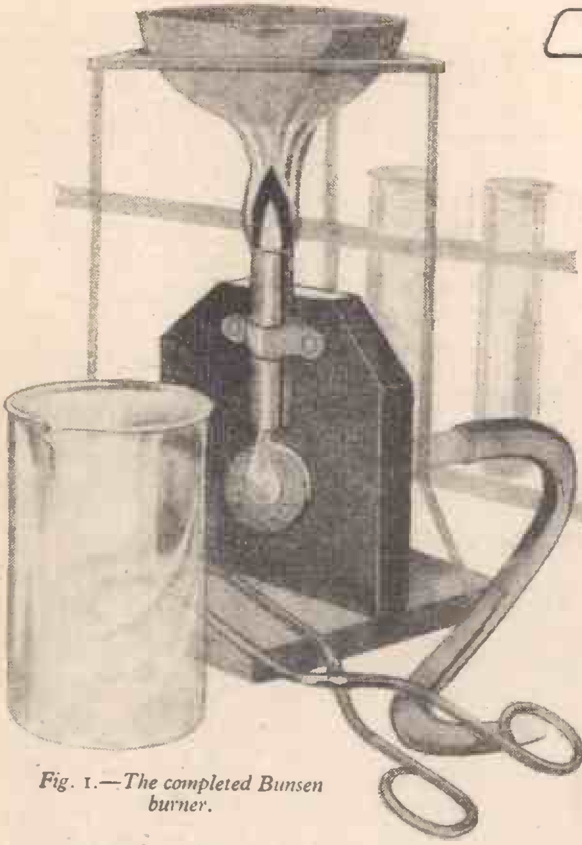


Fig. 1.—The completed Bunsen burner.

A BUNSEN burner is a valuable piece of apparatus to the home chemist or to anyone wishing to temper small tools or to bend glass. It can be made with but a few oddments and a few tools.

As will be seen from Figs. 1, 2 and 3, the base and main support are made from two pieces of wood, each measuring 4in. x 2½in. x ½in., the centre support being grooved into the base for strength and the top corners cut off as shown.

Procure a cork, as shown in Fig. 4, with a diameter of 1in. or 1¼in., and in the upright piece of wood, 1¼in. from the bottom, bore a hole to fit the cork, as shown in Fig. 2.

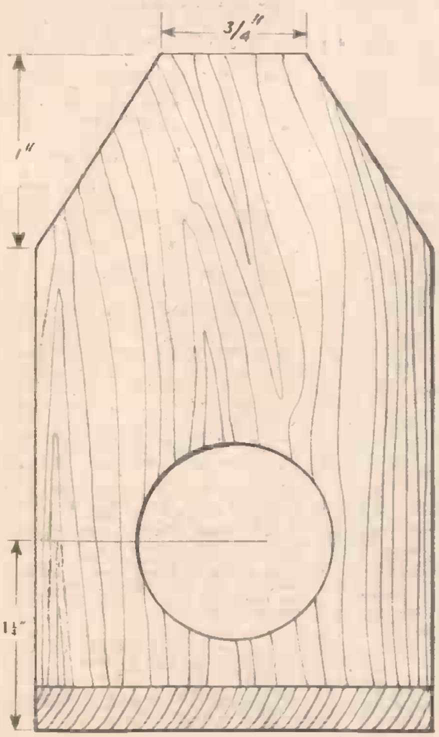


Fig. 2.—Base board with upright attached.

The Plate and Tube

For the tube, obtain a piece of brass-drawn tubing, about 3in. long and ⅜in. dia., and fasten this to the upright by means of a plate, measuring 1½in. x ½in., as in Fig. 4. The plate can be made from brass or tinplate and is shaped to fit round the tubing. Two methods of doing this are shown in Fig. 5, one using a shaped wood block and the other the vice jaws. Drill or punch two holes in the plate to take two round-headed screws and then use it to fix the tube centrally to the upright.

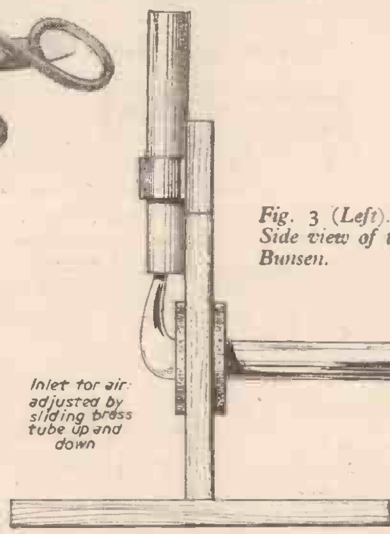


Fig. 3 (Left).—Side view of the Bunsen.

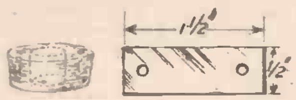


Fig. 4.—The cork and the plate.

The Glass Jet

The shape of this is shown in Fig. 6, and standard methods of producing it are employed. A fishtail gas burner is the best to use and the centre of a piece of glass tubing is held over the flame until it is melted sufficiently to enable it to be pulled into the shape shown at the top of Fig. 6. The thin part is then nicked with a small file and broken off to form a jet. The portion of the tube where the bend is to be is then heated and, when it becomes sufficiently plastic, is slowly bent to the required shape.

Assembly

Push the long end of the glass tube back through the hole in the cork; if a cork borer is not available, burn a hole through

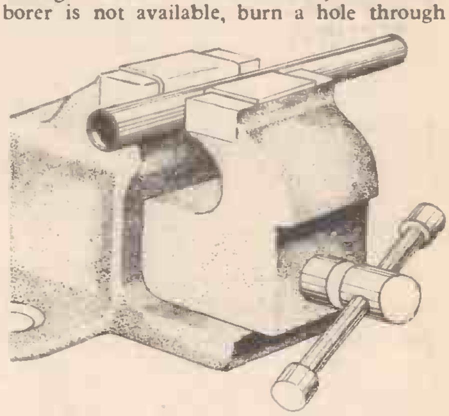


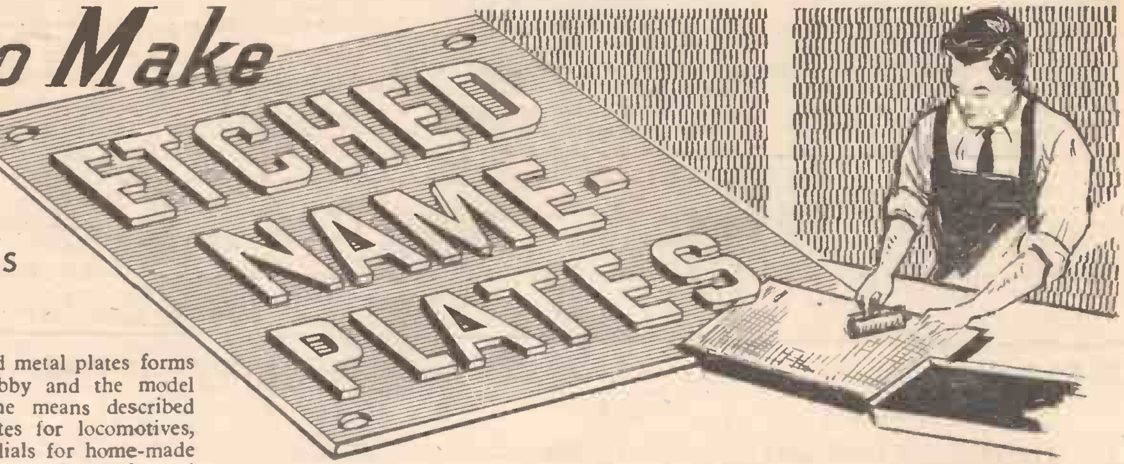
Fig 5 (Above and Right).—Two methods of bending the plate.

of slightly less diameter than the tube which is to be inserted. Place the cork tightly in the hole in the upright piece of wood, and if you have securely fixed the wood joint

Fig. 6.—Making the glass jet.

everything is ready for use. Fix a tubing connection from the gas on to the big end of the glass tubing, turn on the gas and light same at the top of the brass tube. To adjust the air supply slide the tube up or down.

How to Make ETCHED NAME-PLATES



Details of a Useful Process

THE making of etched metal plates forms an interesting hobby and the model maker can by the means described below make number plates for locomotives, etc., or clock faces and dials for home-made instruments. Decorative metal panels and photo frames can be produced by using a suitable design instead of lettering.

The first step is to get the required design on to the metal plate and brass is most frequently used for the purpose, the usual thickness being about 18 gauge. It should be quite flat; if cockled, it is difficult to manage and does not look so well when finished.

A Simple Design

If the design is simple and not too small, it may be painted direct on to the metal with celluloid enamel and etched without further preparation as soon as it is dry; but as a rule it is better to draw the design, say, about twice the required size in Indian ink on white Bristol-board and then photograph it on to the metal. To do this a negative must first be made by photographing the drawn design, a camera with double extension to the bellows being required for this purpose. If the design is drawn double size, the lens will need to be about three times its focal length away from the drawing, while the camera extension will then be about one and a half times the focal length. The negative must show almost or quite clear glass in the lines, with a very dense background. Special process plates are most suitable for this work and will give much better results than any fast plates. The set-up is shown in Fig. 1.

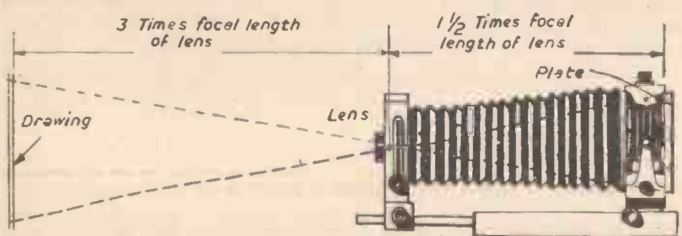


Fig. 1.—Photographing a design.

Having obtained a suitable negative, it must next be printed on to the brass plate, which must be sensitised with a solution made up as follows: To 4oz. of water add the white of one egg and beat up thoroughly with an egg whisk. In another vessel dissolve 15 grains of ammonium bichromate in 1oz. of water, and when dissolved add it to the white-of-egg solution; then filter this solution through a piece of cotton-wool placed over the drain hole in a glass funnel.

Sensitising the Plate

The plate is scoured with fine pumice powder applied with a wet rag, then all traces of pumice powder rinsed off by washing under a tap. The plate is finally wiped over with a tuft of wet cotton-wool. Shake as much water as possible off the brass plate, and while it is still wet flow the sensitising solution over the surface; then stand the plate up in a negative rack and allow the surplus sensitiser to drip off at one corner. When it ceases to drip, say, after a couple of minutes or so, flow the sensitiser over the plate again, and stand it up in the rack again so that it drips from the opposite corner to last time, then allow the plate to dry in a warm, dark place; on no account allow it to dry in daylight, as it becomes sensitive to light as it dries. When quite dry the plate is ready for exposing behind the negative in an ordinary printing frame. The exposure will probably be a minute or less in bright sunlight, and will vary between this and half an hour or more on a dull day.

The Exposed Print

This should be taken into a darkened room and its surface covered over with a thin film of printing ink. This is best done with a printer's hand-roller, but a passable result can be obtained by dabbing the ink on by means of a piece of soft rag folded up into a "dabbler" as shown in Fig. 2. Work the ink well into the dabbler by dabbing it on a piece of flat metal or glass first, and then work it over the plate till the latter is covered with a thin even film of ink. Next place the inked plate in a dish of water and leave it for about five minutes, after which a light wipe over with wet cotton-wool should remove all the ink from the background, leaving ink only on the lines which have become insoluble owing to the light action when printing. Give a final rinse under the tap, shake off surplus water, and dry by heating the plate gently.

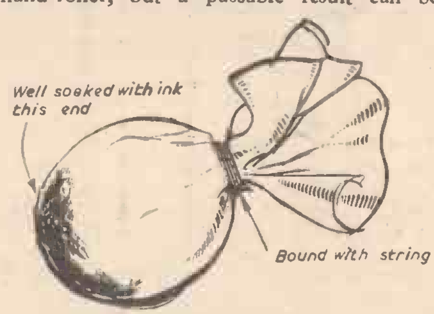


Fig. 2.—The inking pad.

Dust the plate with finely-powdered bitumen; resin may be used, but bitumen is better. Remove every trace of the powder from the plain metal by rinsing under the tap and wiping over with wet cotton-wool, leaving only the powder which adheres to the tacky ink on the lines. Dry the plate as before and then heat it until the bitumen or resin melts and becomes incorporated with the ink, forming a hard image of acid-resisting properties when cool. This part of the process is similar to that used for making line blocks.

Etching

The etching solution consists of iron perchloride. This may be obtained from chemists in lumps usually as big as a walnut. Get about a pound of it and dissolve it in sufficient warm water to cover the lumps. This forms a heavy, dark brown solution, nearly black, and when cold it is ready for use; do not use it in a metal container, which would rapidly become eaten into holes. Put the brass plate in a porcelain photographic dish, pour on the iron solution and rock it exactly like developing a plate for, say, five or ten minutes, depending upon the depth required.

The Etching Solution

The solution will etch a great many plates, and will keep well in a glass bottle; it will not harm the fingers beyond staining them slightly, but do not allow it to splash on to clothes or it will make an indelible stain unless immediately and thoroughly washed off.

On removing the brass plate from the etching bath it should be rinsed under a tap and mopped over with a mixture of vinegar and salt; this removes all trace of sediment and leaves the brass in a clean, glistening condition. Rinse again under the tap thoroughly and then the plate is ready

Fig. 3.—The etching solution.

for blackening. This is done by black nickel plating.

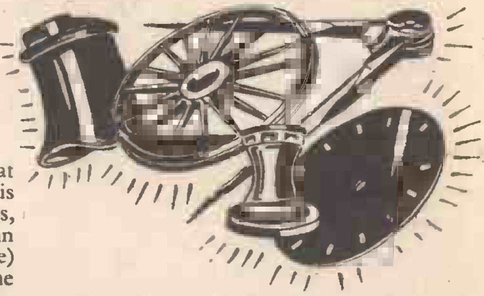
The plate should be placed straight into the black nickelling bath immediately after rinsing; it should not be dried at all between the etching and the blackening.

After blackening the plate is dried and cleaned with turps; this removes the ink film from the top of the lines, leaving bright brass lines standing in relief on to a black background. The plate is finally finished off with any available clear lacquer. Thin shellac varnish may be used, though it is not the best thing for a lacquer. It is usually necessary to warm the plate slightly before lacquering.

"Reverse" Name Plate

If incised black lines on a bright brass background are required, a photographic positive should be made from the negative and the metal plate printed from the positive. All subsequent operations are then exactly as described above.

BLACK NICKEL PLATING



A Fine Metallic-looking Black Finish

MOST readers will be familiar with the black metallic finish that is given to some instruments and to the metal parts of some cameras. It is done by a nickel plating process in which a black compound of nickel is deposited electrically instead of the more common shiny nickel. It forms a very fine finish for models—particularly for brass parts—because it may be applied to part of the work only by protecting with shellac varnish the parts that are to remain bright. For instance a brass casting may be black nickelled on the unmachined surfaces, leaving all the machined parts bright ; this gives a highly finished appearance. Alternatively, the casting may be black nickelled all over before machining and when machined a similar result will be obtained, though, of course there is a greater chance of the finish becoming accidentally damaged.

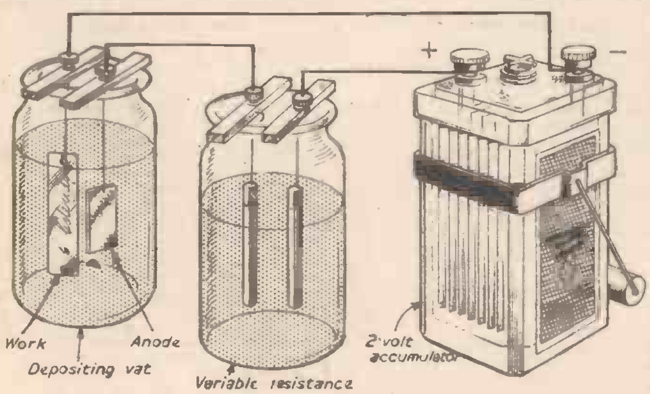


Fig. 1.—The apparatus used.

The Solution

Small parts may be done at home using a jar of suitable size for a vat and a 2-volt accumulator for the electrical supply. This voltage is too high for the purpose, so a resistance will also be necessary. This will be referred to again later.

The solution for the depositing vat is made up as follows :—nickel ammonium sulphate, 2 ounces ; zinc sulphate, ½ ounce ; ammonium sulphocyanide, ½ ounce ; warm water, 1 quart.

The water should be warmed to assist the chemicals to dissolve : it should be about as hot as you can bear to dip your finger into, but should not be boiling. The solution must be allowed to become cold before it is used. Remember that a solution containing any form of cyanide is very poisonous, so avoid the use of cooking utensils, etc., when making up this solution.

An anode of some kind must be provided, the anode being connected to the positive terminal of the accumulator and the work which is to be plated connected to the negative terminal ; both the anode and the work are, of course, immersed in the depositing solution. The proper material for the anode is cast nickel, which may be obtained specially for the purpose from Messrs. Canning and Co., Ltd., Great Hampton Street, Birmingham. If it is intended to plate only a few articles, however, a carbon rod (obtainable from an old dry battery of the electric-bell type) may be used. With a proper anode the nickel dissolves away, thus maintaining the strength of the solution, but with a carbon anode the solution becomes impoverished and must be strengthened by the addition of chemicals from time to time. The work should be kept well clear of the anode, say from 4in. to 6in. away and should be turned during the process of deposition, otherwise the side away from the anode will have less deposit than the near side. If two anodes are used, one on each side of the work, turning is not necessary.

The Resistance

This may consist of two strips of copper or brass or, better still, two carbon rods hanging in a jar of slightly acidulated water (a few drops from the accumulator may be used). The resistance may be varied by altering the amount of water in the jar or by bringing the strips closer together. Of course, if you have a suitable variable resistance among your wireless apparatus, that would be the ideal thing. In any case, the resistance must be adjusted until the voltage across the depositing vat, while it is working, reads ¾ volt on the voltmeter. You can do without a voltmeter by making a few trials on a piece of scrap metal of similar size before putting in the article to be nickelled, but this is working more or less in the dark. If the deposit is grey and powdery, instead of smooth and black, increase the resistance by taking away some of the water in the resistance jar and try again. The article should remain in the vat from 15 to 30 minutes, and if it is not a good black by then the resistance should be decreased by adding water or by bringing the strips closer together. Take out the work as soon as it is a good colour, swill it in hot water, and wipe dry on a clean rag. It should be given a coat of lacquer as soon as it is dry, to preserve the colour ; a substitute for the lacquer is to rub the article over with a little furniture cream or wax polish.

The Preliminary Cleaning

A most important stage of the proceedings not yet mentioned is the preliminary cleaning of the work ; great care must be taken to remove every trace of dirt and grease. If the article has any oil or grease on it it should be first washed in clean petrol and dried. Then dip it in a hot, strong solution of soda and scour it well with an old toothbrush and pumice powder. Rinse well under the tap, and without drying it and without touching the surface again with the fingers, hang it up in the depositing vat.

If the article has been previously nickel plated, it will be necessary to clean off the old nickel by means of a pickling bath consisting of one part water, one part strong nitric acid and two parts strong sulphuric acid ; add the sulphuric acid last, a little at a time and stir well. This will dissolve some of the work away, so do not leave it in longer than is necessary to remove the old plating. *Do not put your fingers into the acid or get it on your clothes!* Do not let any of this acid get into the depositing vat or the solution will be spoiled. If you rinse the article after "pickling," then dip it in the soda, scour, and rinse again—all trace of acid will be removed, so avoiding any chance of acid clinging to the work being transferred to the vat and spoiling the solution.

A Conjuring Trick With Ice

A Simple but Effective Experiment

HERE is a conjuring trick to amuse your friends and a unique way of making ice. From a photographic dealer purchase 50 grams of ordinary hypo. Place this in a small flask such as any chemistry outfit will supply and melt the crystals over a small flame. When you have obtained a clear liquid, put a plug of cotton wool in the mouth of the flask and set it on a table to cool.

Do not touch the glass again until about an hour and a half after the preparation of the solution. When the time is up, take a tiny crystal of hypo and announce to your friends that you will produce ice in the twinkling of an eye. Remove the cotton wool, pick up the flask and quickly drop into it the crystal of hypo, at the same time giving the flask a good shake. Immediately a solid mass of crystals will appear and the flask, which was originally cold, will become decidedly warm, showing that when water freezes, heat is actually given off. Your audience will be completely mystified.

READERS' SALES AND WANTS

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

HOBBIES

TOY & GAME MANUFACTURE. The world's first journal specifically devoted to the manufacture of toys, games, sports equipment and amusement novelties. Annual subscription £1/10/-. Specimen copy 2/6. Techniview Publications Ltd., 125, Oxford Street, London, W.1.

MAKING YOUR OWN? Telescopes, Enlargers, Projectors or, in fact, anything using lenses. Then get our booklets "How to Use Ex-Gov. Lenses & Prisms," price 2/6 ea. Comprehensive lists of optical, radio and scientific equipment free for s.a.e. H. W. English, Rayleigh Rd., Hutton, Brentwood, Essex.

ILLUSTRATED CATALOGUE No. 13. Containing over 450 items of Government Surplus and Model Radio Control Equipment, 2/2, refunded on purchase of goods; 2/6 overseas seamail. Arthur Sallis Radio Control Ltd., Department P.M., 93, North Road, Brighton.

WOODWORKING

WOODWORKING MACHINES, all cast-iron constructed. Complete Saw Benches, 7in., £4/15/-; 8in., £5/10/-; 10in., complete motorised, £30. Planers, 5in., £12; Bowl Turning Heads, £4; with 8in. Saw Tables, £7/10/-. Lathes, £7/10/-; Combination Lathes, £10/10/-. Motors, Pulleys, Belts, etc. 12 months' written and money refund guarantee. 4d. stamp for illustrated booklet. James Inns (Engineers), Marshall St., Nottingham.

ARE YOU LOOKING FOR A RELIABLE FIRM for Timber, Plywood, Wallboard, Veneered Plywood? Call at our warehouse or send s.a.e. for price lists. N. Gerver, 2/10, Mare Street, London, E.8 (near Cambridge Heath (E.R.) station). (AMHerst 5887.)

STOP!

Before buying that woodworking machine it will pay you to see the Myblo range. Sawbenches, Planers, Bandsaws, stocked by many leading tool merchants. Write for lists or better still call in for a demonstration. We know we can interest you.

P. BLOOD & CO.
ARCH STREET, RUGELEY, STAFFS.

WOOD LATHES, Motors, Jig Saws, Planers, Circular Saw Blades, Saw Spindles and Benches, Turning Tools, etc. New illustrated literature, price list, extended credit terms now available, price 6d. (stamps, please). D. Arundel & Co., Mills Drive, Farndon Road, Newark, Notts.

SAWBENCHES, 6in. to 30in., from £6; motorised, £19; Petrol Portable Benches, £39; Multi-Purpose Sawbenches. Planing Machines. Saw Spindle Assemblies for any size saw from 37/6. Motors, Engines, Blades, Bearings, Pulleys, Belts; deferred terms. Send 1/6 for handbook - catalogue. List free. Beverley Products, Sturton-le-Steeple, 51, Notts.

SAW REPAIRS

SAW SERVICE BY POST: Circular saws set and sharpened 5d. per inch diameter; tensioned, set and sharpened, 8d. per inch; recut, 1/3 per inch. Minimum charge per saw, 2/6. (Prices include return postage.) 48-hour postal service. Cash with order. J. A. Fowle (Dept. C), 18-22, Bell Street, London, N.W.1. (Established 1840.)

PATENTS

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

FOR SALE

HOUSE SERVICE METERS, credit and prepayment; available from stock. Universal Electrical, 221, City Road, London, E.C.1.

GLASS FIBRE car bodies, sidecars, boats, models, trial unit, 13/9. Glass Cloth for wooden boat repairs, trial lot 26/3, or quotation for any surface area. Polyester Resin Embedments, biological, botanical and metallurgical mounts, beautiful water white castings, impregnate porous metal castings, trial unit 11/3. Epoxy Resin, the best resin for metal car body, mudguards, wheel-arch and frame repairs, trial unit 12/6. Burst pipes and tanks with glass cloth and tape 12/-. Trial Units for all purposes, each containing free mixing and dispensing equipment and information sheets. Epoxy Paint, waterproof, heat resistant porcelain finish for baths, kitchen walls, hardboard, etc., 14/- pint, with Catalyst, white, black or clear. Information Sheets on glass fibre technique, list with price list, stamp, please. "Business Man's Guide to the Glass Fibre Technique," 15/-, post free, 81 pages. Glass Fibre Experts with units for all purposes are Silver Dec Plastics. Desk A4/3, Hartington, Staveley, Chesterfield, Derbyshire. Part post 1/- on units, please.

RUBBER MOULDS for Plastic Ornaments from 1/- each. New illustrated catalogue 9d. Moulding compound for mould making 8/6 per lb. Metal toy casting moulds from 3/- each; s.a.e. for list. F. W. Nuthall, 69, St. Mark's Road, Hanwell, London, W.7.

"PERSPEX" for all purposes, clear or coloured dials, discs, engraving. Denny & Company Ltd., 15, Netherwood Road, W.14. (SHE 1426, 5152.)

COMPRESSORS for sale, single cylinder, approx. 1½in. b., 1½in. s., good condition, 7/6 each, post 3/- extra. James Refrigeration Limited, 57, Trafalgar St., Sheffield. (Phone: 25666.)

NUTS, BOLTS, SCREWS AND WASHERS for Mechanics, 2 B.A., 4 B.A., and 6 B.A., 7/- packet, 432 parts, post 1/4. Available Hex. Hd., Rd. Hd., Ch. Hd. and Csk. State which. 3 or more packets post free. 1,000 item list free. K. R. Whiston (Dept. P.M.S.), New Mills, Stockport.

CHEMICALS AND APPARATUS. Send 2½d. stamp for catalogue and details of special offer. Scientific & Technical Supplies Ltd., Dept. P.M., 9, Wellington Circus, Nottingham.

LENSES, Prisms, Cine Projector Spares. Dozens of items useful for experimenters and "Do It Yourself Brigade." 6d., please! Burgess Lane & Co., Thornton Wks., Thornton Ave., Chiswick, W.4. (CHIswick 5752.)

FIBREGLASS

BONDAGLASS FOR FIBREGLASS

REPAIRS TO RUSTED CAR BODYWORK WINGS, WHEEL ARCHES, BOOTS, ETC. MADE EASILY & CHEAPLY AT HOME WITHOUT SPECIAL EQUIPMENT

FOR EXAMPLE: AMPLE MATERIAL TO REPAIR TWO BADLY RUSTED DOORS:—

1 Bondaglass Car Repair Kit ...	13 . 9
1 Bondafiller Handypack (for finishing)	6 . 6
Post and Packing	1 . 6
	21 . 9

OR SEND S.A.E. FOR FREE HOW-TO-DO-IT INFORMATION, PRICE LIST, ETC.

BONDAGLASS Ltd. (Dept. S)
40A PARSONS MEAD, W. CROYDON

ELECTRICAL

ALL TYPES OF ELECTRICAL GOODS at extremely competitive prices, e.g., 5 amp. Twin Cable, 48/- 100 yards; Lampholders, 7/- doz.; 5ft. Battens, 51/6; quality and immediate despatch guaranteed. Request list. Jaylow Supplies, 93, Fairholt Road, London, N.16. (Telephone: Stamford Hill 4384.)

BRAND NEW
BROOKS ELECTRIC MOTORS

Single Phase. ⅓ h.p. 1,425 r.p.m. £7. 5.0
½ h.p. 3,000 r.p.m. £9. 5.0
1 h.p. 3,000 r.p.m. £10.10.0

Fully guaranteed by makers, approval against cash. Carriage paid mainland. State voltage. FREE. A Three-step "V" Pulley with each motor.

P. BLOOD & CO.
ARCH STREET, RUGELEY, STAFFS.

BRAND NEW guaranteed Electric Motors at lowest prices. ¼ h.p. to 1 h.p. Ball Bearings, single-phase and three-phase; also Bench Grinders and Polishers. Ask for trade discounts. Gill, 48, High Street, Brighton, Sussex.

SPARES, REPAIRS, REWINDS. Replacement Armatures and Fields for most Vacs. and Drills. Emergency Rewinding Service to 30 h.p. available. Hodson (Croydon) Ltd., 75A, George Street, Croydon, Surrey.

WATCHMAKERS

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

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

WATCHMAKERS! Use genuine replacement parts. Catalogues of Tools, Parts, etc., free. T. G. Loader, Dept. B, Milstone Rd., Carterton, Oxford.

SEVEN-DAY SERVICE. Watches and Motor Clocks expertly repaired and cleaned and overhauled. Moderate charges. Estimates free. I. Podgorney, 11, Hatton Garden, E.C.1.

TOOLS

THE NEW 1957 fully illustrated Catalogue of Hand Tools, Portable Electric Tools and Machinery. Now available, price 6d., postage 3d. Parry & Son (Tools) Ltd., Dept. P.M.6, 329, Old Street, London, E.C.1.

SITUATIONS VACANT

A.M.I.Mech.E., A.M.Brit.I.R.E., City and Guilds, etc., on "No Pass—No Fee" terms. Over 95% successes. For details of Exams and courses in all branches of Engineering, Building, etc., write for 144-page Handbook—Free. B.I.E.T. (Dept. 967B), 29, Wright's Lane, London, W.8.

PHOTOGRAPHY

ENLARGER and Camera Bellows supplied; also fitted. Beers, St. Cuthbert's Road, Derby.

PHOTO-ENLARGER Castings and Bellows, for 35mm., 2¼in. x 2¼in., 2¼in. x 3¼in., 35/- per set; s.a.e. for details. V. J. Cottle, 84A, Chaplin Road, Easton, Bristol, 5.

EDUCATIONAL

MERCHANT NAVY Radio Officer Cadet Training School. World travel and adventure overseas. Brook's Bar, Manchester.

LEARN IT AS YOU DO IT—we provide practical equipment combined with instruction in Radio, Television, Electricity, Mechanics, Chemistry, Photography, etc. Write for full details to E.M.I. Institutes, Dept. PM47, London, W.4.

FREE! Brochure giving details of Home Study Training in Radio, Television, and all branches of Electronics. Courses for the Hobby Enthusiast or for those aiming at the A.M.Brit.I.R.E., City and Guilds, R.T.E.B., and other Professional examinations. Train with the college operated by Britain's largest Electronics organisation. Moderate fees. Write to E.M.I. Institutes, Dept. PM28, London, W.4.

HANDICRAFTS

MUSICAL MOVEMENTS

from 12/9 post free.

Grand piano kits, 29/- post free.

THE SWISSCROSS CO.
(Dept. V), 116 Winifred Road, Coulsdon, Surrey

MISCELLANEOUS

THE BENDELLE CHART solves bend allowance problems and slide rule type calculations, 7/6, post free. Whittaker Enterprises, 233, Pear Tree Avenue, Bitterne, Southampton.

BUILD YOUR OWN REFRIGERATOR, all components available at reasonable prices. Frigidaire flowing cold units, £5; small units, Kelvinator, etc., £4; ¼ h.p. heavy duty Motors, £3; Chrome Cabinet fittings, new, £1; money back guarantee; s.a.e. for list and schematic diagram. Wheelhouse, 13, Bell Road, Hounslow. (Phone: Hounslow 3501.)

RUBBER MOULDS for Plaster Ornaments, Wallplaques, etc. Sample and list, 4/11; trade enquiries invited. Castmoulds (Dept. M), 43/45, Waller St., Hull.

AQUALUNG and Compressor Equipment, Ballraces and Miscellaneous Items. Lists 2d. Pryce, 157, Malden Road, Cheam.

"FORTUNES IN FORMULAS," 900-page American book of formulæ. American technical hobby and other books covering every interest. Stamp for lists. Herga Ltd. (Dept. P2), Hastings.

SUPERTONIC SUNLAMPS, listed £7/10/-; 80/-; s.a.e. brochure. Scientific Products, Dept. I, Cleveleys, Lancs.

"ESCAPOLOGY FEATS AND STUNTS" fully explained, 6/-. Professional "Mental-Telepathy" Performance, 20/-. "Ex-professional," 12, Carlton Avenue, Romiley, Cheshire.

CENTRE LATHE Turning and Machining. Estimates free. Trill, 11, Wessex Rd., Ringwood, Hants.

SALE.—All issues "Practical Mechanics" from 1940. Hudson, Glenfield, Copmanthorpe, York.

INDEXES of "Practical Mechanics" required, Vols. 19, 20, 21, in good condition. Write Box R/10, Strand House, London, W.C.2.

ADEPT SHAPERS
for Hand or Power operation

Particulars on receipt of stamp.

F. W. PORTASS MACHINE TOOLS, LTD.,
Adept Works, 141a, Nicholson Rd., Heeley, Sheffield, 8.

Letters to the Editor

Address letters to The Editor, "Practical Mechanics," Tower House, Southampton Street, London, W.C.2.

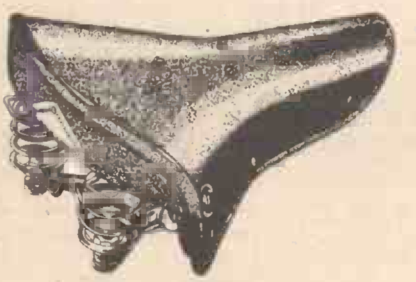
The Editor Does not Necessarily Agree with the Views of his Correspondents

"Featherbed" Saddle

SIR,—We were interested to read in your article, "What I Think" (May, 1957, issue), your views regarding seating arrangements suitable for newcomers to cycling. We heartily endorse the opinions you express; they are our own, and we have indeed tried to give tangible expression to them.

The sketch shows our Featherbed Model 505, which was designed expressly to ensure that the first ride should be as comfortable as the last, with many years interval in between them! We think any user of the Featherbed would tell you that our designers' objective has been fully realised.

Whilst comfort of this order naturally costs a little extra, it is our belief that the tyro wise enough to follow your recommendation will be a permanent convert and a good ambassador to other potential cyclists.—A. V. TYLER (The Wright Saddle Co. Ltd.), Dale Road, Selly Oak, Birmingham, 29.



The Wright "Featherbed" saddle.

The Junior Chemist—Reader's Criticism

SIR,—On page 457 of the June, 1957, issue of PRACTICAL MECHANICS you describe how to prepare nitric acid. May I point out two facts. You should never use a cork bung in preparing nitric acid. Nitric acid is one of the strongest acids, and it will eat the cork away very quickly. A glass bung would be safer because nitric acid cannot eat glass. Water should be poured on the receiving flask to keep it cool, because, if not, the flask might burst.

Why not use a retort, which would be ideal for the experiment? Sodium nitrate is equally as good as potassium nitrate (saltpetre) in the preparation.—R. GRAY (York).

SILK SCREEN PRINTING MATERIALS

SIR,—We have read with interest the article on "Making a Silk-screen Printing Outfit" in the June edition of PRACTICAL MECHANICS.

We would be pleased to supply any of your readers with lengths of Swiss screening silk of not less than one yard. The screening silk is woven in various widths to save wastage. Also, a red guide line is woven in the weft and the warp at intervals of one foot to facilitate easy stretching on the screen.

The most popular meshes are Nos. 8 and 10 for general work, and for very fine printing we would suggest the meshes Nos. 12, 14 or 16. The higher the mesh number, the finer the silk.

With regard to the stretching of screening silk on wooden frames, we supply eyelet tape, and, although this is one of the oldest methods of stretching silk, it may prove to be useful to the "do-it-yourself" enthusiast where modern equipment is limited. Eyelet tape, 1in. wide, is supplied in 50-yard lengths at 1s. 8d. per yard.

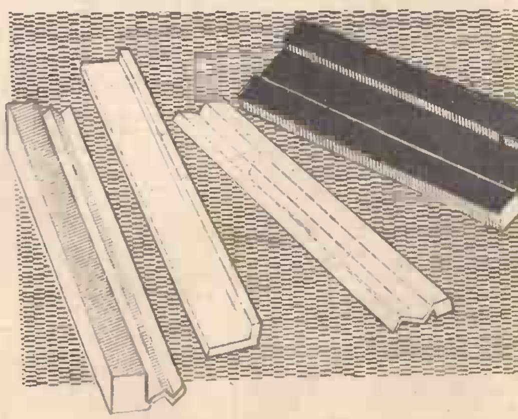
The eyelet tape is nailed to the frame on the four edges and the same tape is stitched to the silk to be stretched, then the two eyelet edges are laced together and pulled tightly.

We have had much experience in all screen printing trades, and hope to be of help to your readers should they require our service.—PRONK, DAVIS & RUSBY LIMITED, 44, Penton Street, London, N.1.

P.V.C. INSERTS FOR TERRAZZO FLOORS

SIR,—On page 461 of your June issue is an article on how to embody colours in terrazzo floors and walls, and we thought it might interest your readers to know we have produced for several years special P.V.C. sections in a variety of colours for use in terrazzo floors and walls (see sketch).

To produce fancy designs, the strips are warmed and can then be formed into any desired shape. When the fabric of the floor or wall has set, the whole surface, including the P.V.C. inserts, can be levelled as usual. We wish to point out, however, as manufacturers we cannot accept orders for less than 1,000ft. per section and colour. — MELWOOD THERMOPLASTICS LTD., Willoughby Road, Harpenden, Herts.



P.V.C. sections for decoration.

Reversing Negative Film

SIR,—*Re* the answer to the query on this subject, in the June issue, there is an easy and certain process for producing positives by direct reversal.

Kodak Ltd. have published data for the reversal of Pan X film, but with some considerable loss in emulsion speed. With any Ilford 35-mm. or roll film, however, no increased exposure is required, and processing, although critical for best results, is quite a simple procedure. Ilford Technical Information Sheet No. T203 gives the necessary directions.

For general information on the subject, including reasons why reversal processing gives a sharper and more fine-grain transparency than the usual neg-pos. process, I would refer you to articles by Stanley W. Bowler in the *British Journal Photographic Almanacs* for 1950 and 1956.—D. J. HUTCHINSON (Co. Durham).

"Domestic Generating Plants"

SIR,—*Re* your article "Domestic Generating Plants" in the June issue, I should like to comment on the drawing showing a suggested layout for an engine house.

Both oil drum and fuel tank will require venting to atmosphere, thus preventing fuel starvation, due to an air-lock.—G. E. WINFIELD (Lincs).

Vapour Phase Inhibitor

SIR,—Mr. G. D. Smith, of Middlesex (whose query appeared on page 462 of the June issue), might like to try a vapour phase inhibitor, such as Shell's "V.P.I."—J. C. WILLIAMS (Edgware).

ENDLESS CHAIN IN WOOD

SIR,—I was interested in "A Chain Made from Wood," which appeared in your April number.

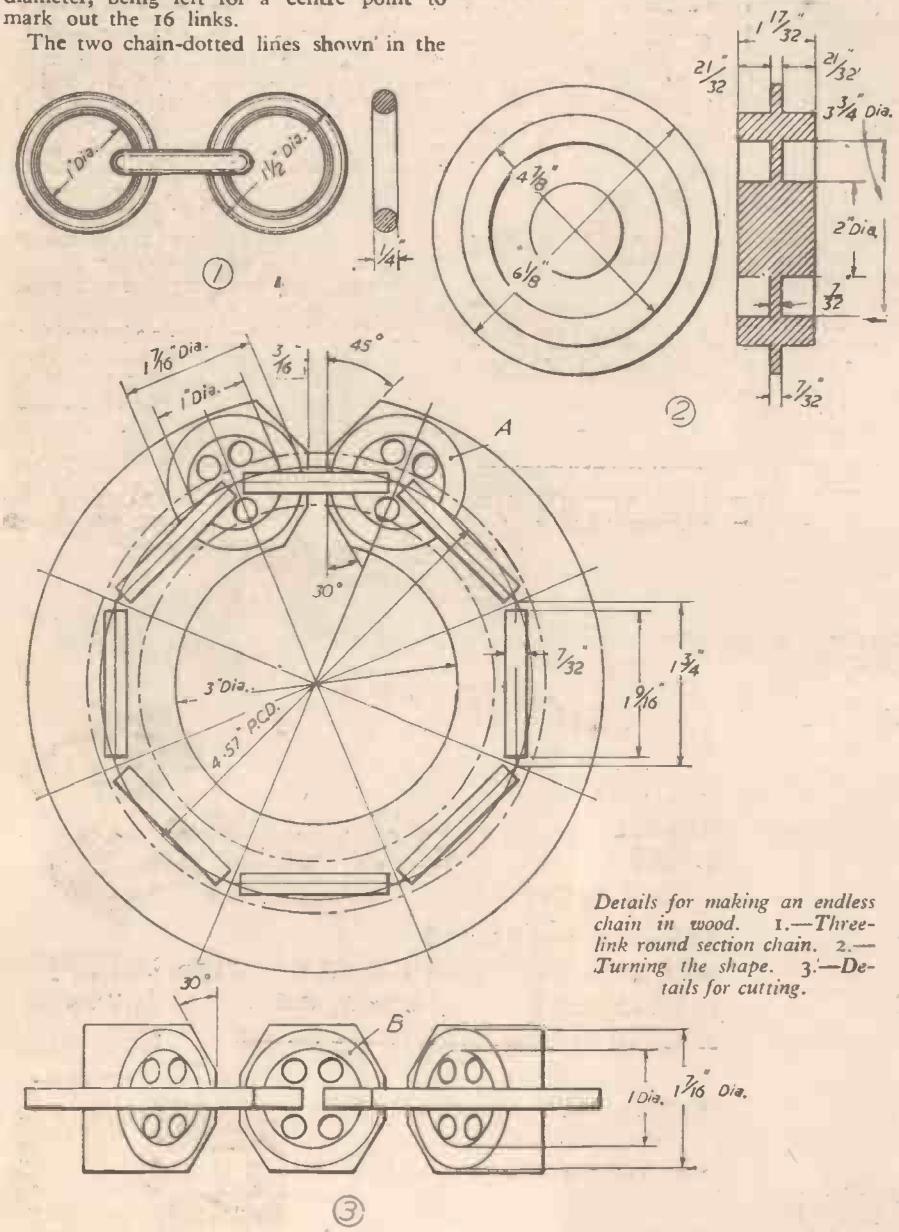
I had just completed a three-link chain of round section in pearwood as at 1 in the sketch, a fortnight before I received the publication. I saw one in a museum, and wondered how it was made, so I thought it out on drawing paper and did it exactly as you describe.

I then thought it would appear more puzzling if it was made endless, and proceeded to draw out an octagon design as at 3 in the sketch.

It was first turned to the section, as shown at 2 in the sketch, the centre block, 2in. diameter, being left for a centre point to mark out the 16 links.

The two chain-dotted lines shown in the elevation (3) correspond to the two diameters 3¾in. and 4⅞in. (2), and out of this wood were chiselled the eight pieces shown 7/32in. x 1 9/16in. The spaces left between the pieces provide the centres to strike the eight links A, and the 3/16in. spaces with the 45 deg. saw cuts provide the centres to strike the eight links B.

After completing the marking out, the work was returned to the lathe and the centre block cut out, leaving a hole 3in. diameter. The internal diameters, shown 1in., were drilled with ¼in. centre bit, roughed out with a coping saw, and finally finished with a gouge. The wood used was beech, and the links were left in square section—J. E. FOSTER (Colchester).



Details for making an endless chain in wood. 1.—Three-link round section chain. 2.—Turning the shape. 3.—Details for cutting.

Electric Vehicle Transmission

SIR,—With reference to Mr. Brooks's suggestion for an electric transmission for a vehicle in your June issue, I am sorry to disillusion him, but it just would not work. He has entirely overlooked the fact that a battery requires a higher voltage to charge it than that at which it discharges. Secondly, if the central clutch were engaged then exceedingly heavy currents would flow between generator and motor and one or other would burn out.

Many years ago patents were taken out for utilising the heavy currents produced by this means for traction purposes in conjunction with a storage battery but, like all systems of this type, including the Tilling Stevens petrol electric system, the weight of the equipment mitigates against its use from an economic standpoint. Every little extra weight consumes more fuel and, therefore, contributes more in taxation per mile which is now of equal, if not more, importance than the cost of fuel itself.

Mr. Brooks also has little knowledge of nickel-iron batteries in that he implies that they are not sufficiently robust for traction purposes. Three and more times the life of lead acid batteries on similar duties must be obtained from alkaline batteries to make them of economic advantage, yet alkaline battery manufacture is an expanding industry throughout Europe and America. As for mechanical strength, there are alkaline batteries that have travelled many millions of miles on the footplates of A.T.C. fitted locomotives, batteries that have resisted the shocks on shunting locomotives for 18 years and batteries carrying out most arduous duties on electrically propelled trucks in factories. Alkaline batteries are also used in connection with projectiles, and are subject to enormous shocks under these conditions. Many years ago an alkaline battery was dropped from an aircraft (without parachute) in connection with the rescue of Amundsen in the Arctic. Electrically, the alkaline battery will accept heavy currents and would be ideal for Mr. Brooks's purpose, were it a practical and economical possibility. The only limiting factor from the point of view of the battery would be temperature rise due to I^2R losses in the battery itself.

Something approaching Mr. Brooks's idea was utilised by a Mr. C. Nicholson, of the then Central Electricity Board, during the late war. He built a vehicle having a Morris Cowley engine driving a generator/motor through a Borg and Beck clutch which could be locked in the "out" position. An alkaline battery was used and, with the engine running, the battery was charged. Throwing out the clutch allowed the generator to "motor" from the battery and drive the car, or he could use both motor and engine to ascend steep gradients. The normal gear-box was retained and, by leaving the gear in neutral and running the engine, the vehicle became a self-contained generating plant.

His favourite trick was to go into a garage with the engine running, switch off, ask for a gallon of petrol, give up his money and coupon and then depart silently as an electrically-propelled vehicle, leaving the attendant aghast!—G. H. DOWSETT (Beckenham).

Converting the P.M. Projector

(*Concluded from page 522*)

$$= \frac{.432\text{in.} - .150\text{in.}}{2} = .141\text{in.}$$

Claw Index Point

Position of 8 B.A. hole on follower arm from intersection point of arm.

$$.187\text{in.} + \left(\frac{.437\text{in.}}{\text{Tan } \theta}\right) - (\text{Cos } \theta \; 2.119\text{in.} + \text{Tan } \theta \; .331\text{in.}) = .804\text{in.}$$

where θ is 9°, and .437in. the distance from claw tip to follower arm centre line.

and

$$.187\text{in.} + \left(\frac{.337\text{in.}}{\text{Tan } \theta}\right) - (\text{Cos } \theta \; 4.153\text{in.} + \text{Tan } \theta \; .287\text{in.}) = .846\text{in.}$$

where θ is 4° and .337in. the distance from claw tip to follower arm centre line.

$$\text{Sprocket Bobbin Diameter} = \frac{\text{Perforation Pitch} \times 12}{\pi}$$

$$= \frac{.150\text{in.} \times 12}{3.141\text{in.}} = .573\text{in.}$$

TRADE NOTES

A Review of New Tools, Equipment, etc.

New Swiss Drill

A NEW drill has been added to the Lesto Pistolgrip Drill range with the high speed of 2,500 r.p.m. It has a Jacobs type chuck and the maximum capacity of the new model is ¼in. in mild steel. With this

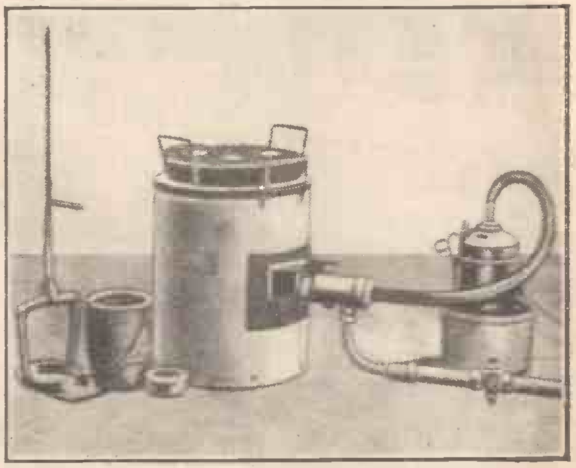
The new Lesto Pistolgrip drill

size drill bit, the machine cannot be stalled. A quick-release vertical drill stand is also available. The price of the drill is £12 10s. carriage paid in the U.K., and the stand costs £5 15s.

MINIATURE CRUCIBLE FURNACES

THE Morgan Crucible Company produce three models, being fired by paraffin (kerosene), gas and coke respectively. The paraffin model is fired by a self-contained paraffin burner. The welded steel pressure tank is fitted with a long stroke, quick acting air pump and contains enough fuel for 3 or 4 melts. The price is £56.

The gas fired model is suitable for operation on a town's gas supply of 3 in. to 5in. (7,160 cm. to 13 cm.) water gauge pressure. The gas consumption at 4 in. (10 cm.) W/g pressure is 500 cu. ft. (14 m^3) per hour. Air is supplied by a compact electric blower unit. The built-in universal motor can be supplied for 110 v., 200/220 v. or 230/250 v. A.C. single phase and D.C. Price is £56.



Miniature crucible furnace, fired by gas

The coke fired model is supplied with air from a compact electric blower unit. The built-in universal motor can be supplied for 110 v., 200/220 v. or 230/250 v. A.C. single phase and D.C. according to the local voltage. Coke should be of good metallurgical quality of 1in. to 1½in. size. The coke fired unit is also supplied with a coking cover. This model costs £50.

All enquiries should be addressed to the Morgan Crucible Co. Ltd., Battersea Church Road, London, S.W.11.

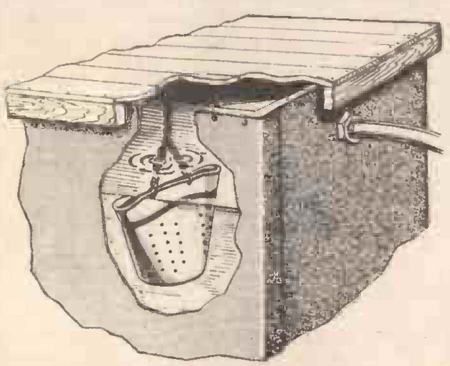
New G.E.C. Range of F.H.P. Motors

NEW fractional horsepower induction motors, of ¾ h.p. and 1 h.p. capacity, in single phase capacitor and three phase versions, have been developed by The General Electric Co. Ltd. The motors are smaller, lighter and of more modern appearance than their predecessors, though of equivalent rating and performance. Continuously rated and fully complying with B.S.170/1939, they are drip-proof, foot-mounted and available with sleeve or ball bearings, or flange-mounted with ball bearings. The motors are constructed to the dimensions of frame 66 of B.S.2048/1953, "Dimensions of Fractional Horsepower Motors," and are therefore mechanically interchangeable with other A.C. and D.C. motors complying with this specification.

RUST INHIBITOR

AQUA-CLEAR is a chemical which, when introduced to water, puts a microscopically thin film on all metal surfaces with which the water comes into contact so that rust cannot get into the water and the water cannot make new rust. It can be obtained in two forms, liquid and crystal. The liquid is used in static water systems, such as hot water central heating, where there is no connection with the water main and is added to the water in the ratio of 12oz. to every 100 gallons. One 12oz. bottle costs 18s. The crystals are introduced to the domestic water system in two ways; first by means of a "feeder" attached to the mains water supply and secondly by means of a polythene container which is lowered into the feed tank, as shown in the sketch. The amount of crystals used is based on the total capacity of the feed tank, hot water tanks and pipes in the ratio of 2lb. to every 200 gallons of water. The price of a "feeder" for a ½in. pipe is £18, price of crystals per lb. £1 3s., and 5s. for the container designed to take 2lb. of crystals. Aqua-Clear will also soften the hardest water and yet it will be safe for drinking purposes.

In addition to its use in domestic hot water systems, the chemical will have many applications for the mechanic.



Domestic water tank cut away to show chemical in its container

Solder for Stainless Steel

A NEW patented solder paint for speedy hot tinning of stainless steel has been developed by the Research Laboratories of Perdeck Solder Products Ltd., Waltham Abbey, Essex. It is known as "Epatam 3311" Code PLF.73/11.

Possessing high degreasing and penetration properties, PLF.73/11 also effectively tins through iron welding scales, rust and grease, depositing a bright tinning, thereby overcoming many other soldering problems in addition to its major feature for use on stainless steel.

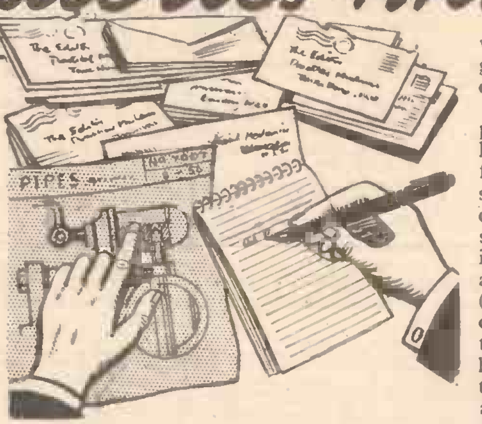
The increasing usage of stainless steel in industry prompted this development of a material to simplify and improve on existing methods.

This product will be of particular interest to the dairy, food handling equipment, brewing, chocolate, oil, motor and electrical industries to name but a few.

The solder paint is merely painted on straight from the tin, undiluted, followed by heating by any convenient method to normal soldering temperature. If used on brass or copper it may be slightly diluted with water for greater economy.

Trial 1lb. packs are available to the following specifications: 40-60 tin/lead, 9s. 3d. post free; 60-40 tin/lead, 9s. 9d. post free; pure tin content, 12s. 6d. post free; from the manufacturers, Perdeck Solder Products Limited, Abbey Mills, Waltham Abbey, Essex.

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.

Treating Porous Rubber Dinghy

IS there any preparation which will render an ex R.A.F. rubber dinghy airtight? I have had the dinghy three years, and although it is not damaged in any way, it is porous and remains rigidly inflated for only about 15 minutes.—E. J. Ingrey (Ely).

THE following preparation will be suitable for waterproofing a rubber surface which has become porous.

Obtain a tube of "rubber solution." Thin it out to paint consistency with a mixture of approximately equal quantities of white spirit and boiled linseed oil. Paint it thinly on the rubber surface, giving three or four separate coatings, and allowing each coat to dry before applying the next one.

A good bituminous paint would have a similar effect. These paints are usually obtainable locally, but a recommended one is the "Bituminastic" paint manufactured in several colours by Wailes Dove Bitumastic, Ltd., Collingwood Buildings, Newcastle-on-Tyne.

Electric Propagator

RE the article on An Electric Propagator in the May, 1957, issue, I would appreciate some further information on the type of transformer to use.

I have a robust all-mains transformer, taken from an old wireless set, input tappings 210V., 230V. and 250V. and output tappings 5V., 6.3V. and 400V.; is this suitable? If so how should it be connected? Would the popular transformer with steppings from 2V. up to 30V. at 3 amps. be suitable, or will it have to be the heavy type at £3 to £4?—A. G. Reynolds (Birmingham).

IN choosing the voltage for the transformer it is well to understand the effects of larger and smaller voltages. Mains voltage is altogether too high for safety in the damp conditions of a propagator without very special precautions. With a transformer, we recommended 24 volts as a maximum, for with this voltage the length or brown-covered iron wire required for the element, or each separate wire of it, will be uncomfortably long to be conveniently handled; moreover, there may be slight difficulty in controlling the heat as there will probably be only one wire for maximum heat.

On the other hand, a low voltage such as 4 volts will need special precautions to ensure that a badly made joint or dirty terminal do no damage, should either overheat. A 4-volt element takes 60 times the current (amperes) for the same heat as mains voltage, and a bad connection that would cause no trouble with mains might get red-hot with 4 volts. The proper precaution is to make sure that a hot terminal or joint cannot come into contact with anything inflammable.

There is no reason why an amateur should not make this propagator, and in stressing the precautions that should be taken we do not intend to dissuade you from making it.

The table below gives the lengths of the brown-covered iron wire that have proved suitable:

Volts	4	5	6	8	12	24
Feet	11	13	16	21	32	64

and it so happens that a single length across the transformer terminals will give a heat corresponding to one-third the length in watts. Where a single wire is used in the heating element, temperature can be controlled by switching off for a period during the day. Thus, with 24 volts using a 64ft. wire the watts would be 21; if this gave too great a heat it might be switched on for the night only.

The wireless transformer which you propose to use is of a conventional type with heater voltages of 5 and 6.3 volts, and from your description it will probably be satisfactory, but should be adapted with caution. In the first place try a single wire, say 16ft., joined to the 6.3-volt terminals; if the transformer remains cool to the touch after an hour's running, add a second wire (to either 5 or 6.3 volt terminals) and so on until the full number is in use. The transformer should not be allowed to become hot to the touch; this would indicate that the transformer was overloaded. As an additional precaution it would be well to place the transformer in such a position that accidental overheating due to an overload or short circuit cannot do damage—though the fuse should guard against this. The high-tension terminals are not required and should be insulated.

For a long trouble-free life a proper soil warming transformer is to be recommended; but for those who are of an experimental turn of mind, the ordinary sort, well boxed in and well coated with insulating varnish, should do well. One of those transformers giving stepped voltages from 2 to 30 volts would be suitable, giving 24 watts at 12 volts; moreover, changing the voltage would give an easy heat control. Wireless filament heating transformers should also be suitable.

Flattening Perspex and Removing Scratches

PLEASE inform me if it possible to remove scratches from Perspex car windows and also to straighten them out. —J. T. Schofield (Southampton).

YOU cannot possibly remove scratches from Perspex except by repolishing the surface of the material with a polishing wheel charged with a fine-grade abrasive of the aluminium oxide type. Even with a rapidly-revolving wheel the task is a slow one. If the scratches are deep ones, you could "hide" them by filling them up with a thick solution of Perspex in trichorethylene or chloroform applied with a fine camel-hair brush. When the applied solution has dried and hardened the original scratches will be practically invisible.

You cannot flatten out warped Perspex by any means other than by heavy pressure in a warm press capable of exerting a minimum of 1 ton per sq. in. pressure. Even this treatment is not reliable and the sheets may afterwards rewarp. In our opinion, any attempt to flatten the sheets would not be worth the trouble and cost entailed. It is, however, uncommon for sheets of genuine Perspex of adequate thickness to twist and to warp unless they have been maltreated, particularly in the way of exposing them to undue heat.

Foam Bath Salts

PLEASE let me know the type of liquid soap used in foam baths. Also the name of a firm who can supply.—J. A. McKechnie (Kent).

WE suggest that you make enquiries at any of the following firms: Boots Pure Drug Co., Ltd., Station Road, Nottingham, Messrs. Osborn, Garrett & Co., Ltd., 51/54. Frith Street, London. W.1. The

THE P.M. BLUE-PRINT SERVICE

12FT. ALL-WOOD CANOE. New Series No. 1, 4s.*

10-WATT MOTOR. New Series. No. 2, 4s.*

COMPRESSED-AIR MODEL AERO ENGINE. New Series. No. 3, 5s. 6d.*

AIR RESERVOIR FOR COMPRESSED AIR AERO ENGINE. New Series. No. 3a, 1s. 6d.

"SPORTS" PEDAL CAR. New Series. No. 4, 5s. 6d.*

F. J. CAMM'S FLASH STEAM PLANT. New Series. No. 5, 5s. 6d.*

SYNCHRONOUS ELECTRIC CLOCK. New Series. No. 6, 5s. 6d.*

ELECTRIC DOOR-CHIME. No. 7, 4s.*

ASTRONOMICAL TELESCOPE. New Series. Refractor. Object glass 3in. diam. Magnification x 80. No. 8 (2 sheets), 7s. 6d.*

CANVAS CANOE. New Series. No. 9, 4s.*

DIASCOPE. New Series. No. 10, 4s.*

EPISCOPE. New Series. No. 11, 4s.*

PANTOGRAPH. New Series. No. 12, 2s.*

COMPRESSED-AIR PAINT SPRAYING PLANT. New Series. No. 13, 8s.*

MASTER BATTERY CLOCK.* Blue-prints (2 sheets), 4s. Art board dial for above clock, 1s. 6d.

OUTBOARD SPEEDBOAT. 11s. per set of three sheets.

LIGHTWEIGHT MODEL MONOPLANE. Full-size blue-print, 4s.

P.M. TRAILER CARAVAN. Complete set, 11s.*

P.M. BATTERY SLAVE CLOCK, 2s. 6d.

"PRACTICAL TELEVISION" RECEIVER (3 sheets), 11s.

P.M. CABIN HIGHWING MONOPLANE. 1s. 6d.*

P.M. TAPE RECORDER* (2 sheets), 5s. 6d.

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.*

County Perfumery Co., Ltd., Honeypot Lane, Stanmore, Middlesex, Messrs. Jas. B. Fleming & Co., Ltd., 23, Hanover Street, Liverpool, 1.

If you are unable to obtain the foam salts from any of these sources, you will probably have to make your own, to which end we append the following formula for a foam bath salt:

	(by weight)
Sodium bicarbonate	120 parts
Starch	70 parts
Saponin	20 parts
Tartaric acid	70 parts
Powdered soap	225 parts
Borax	40 parts

The above ingredients must be finely powdered and all made quite dry by placing in a warm oven for a few days. The ingredients are then ground together and the mixture is placed in a perfectly dry, tightly-corked bottle.

For use: Mix 6 ozs. of the powder into four pints of water, and then drop the product quickly into two gallons of hot water contained in the bath.

The foaming salts may be perfumed, if desired, by adding a few drops of perfume to the mixture during grinding.

Bubbles in Flexible Mould Making

WHEN pouring bot-melt compound around a plaster model annoying air bubbles result on the mould surface.

Could you suggest any way to obviate this by impregnation or sealing off, or stoving in gas oven?

I use a resin and accelerator as a sealing coat, with a film of oil, but the bubble trouble persists.—P. Johnson (S.E.22).

THE bubbles about which you complain are due to moisture existing within the porous plaster and being expelled by the pouring over it of the hot-melt compound. We think you will get rid of the trouble quite simply. Merely put the plaster cast away into a warm oven for three or four days previous to the pouring and have the plaster cast warm when the pouring is done.

On the other hand, your use of an oil film and resin as a sealing agent may be causing the trouble. In such an instance discontinue their use and employ as a sealing medium for the plaster a solution of 10 parts of gelatine in 90 parts of hot water. This solution should be brushed on to the plaster hot (it will congeal to a jelly when cold) and, of course, after this treatment, the cast should be oven-warmed for a day or two to drive off every trace of moisture.

Plastic Coating

I WISH to cover blocks of moulded "Dunlopillo" air-cell rubber with a coating of plastic by spraying, dipping or other suitable method.

The plastic after application would need to be flexible, durable and thick enough to smooth out surface irregularities in the mouldings. Can you help?—H. S. Copping (Middlesex).

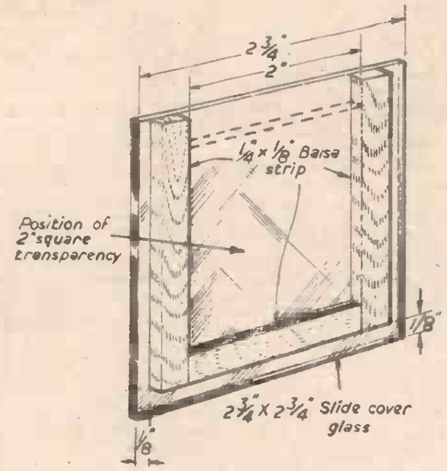
OBTAIN from one of our advertisers a quantity (about ½ lb.) of polyvinyl acetate resin. Dissolve about 20 parts of this in 80 parts of warm methylated spirit. This will produce a thickish, transparent varnish which can be applied by brush in one or more coatings to the rubber article. If the individual air cells are too deep and extensive to be filled in with a varnish, they should be packed with "Vinamould" beforehand. This is a solid material, obtainable from Vinyl Products, Ltd., Butter Hill, Carshalton, Surrey. The material can be coloured by working various mineral pigments into it.

Transparency Viewer

I AM interested in making a viewer as described by Mr. Dewynter on page 401 of the May 1957 issue but it appears to me that no provision has been made for a 2in. square transparency to be placed exactly in the centre of the 4in. square housing. Can you explain this?—A. J. Stael (Middlesex).

THE viewer was originally made for 16 on 120 slides mounted in 2¾in. x 2¾in. cover glasses which drop into the front part of the ⅝in. x ¾in. shaped wood.

Later the viewer was used for viewing 35 mm. transparencies in the standard 2in. x 2in. frames.



Details of transparency holder

These were viewed by cementing three pieces of ¼in. x ⅛in. balsa wood to a 2¾in. x 2¾in. cover glass, placing same in viewer and then dropping the 2in. x 2in. slide in position between the balsa strips as shown in the sketch.

Curing Condensation

CAN you suggest a cure for fogged shop windows please?

During cold weather I must have some warmth in the shop for the comfort of the staff, but then the glass becomes almost opaque and the goods displayed simply cannot be seen.—J. V. Williams (Liverpool, 15).

IN two quarts of hot water dissolve one ounce of finely shredded hard soap. Add to the water, also 10oz. of glycerine and, if possible, ½oz. of Turkey Red Oil. The addition of this latter ingredient is not essential but it helps very considerably in aiding the uniform spread of the solution.

The window is properly cleaned and dried in the normal method on its inside, after which a clean soft cloth is saturated with the above solution, wrung out and then wiped over the cleaned inside window surface. This simple treatment, renewed at fortnightly intervals, will go a long way towards preventing the fogging or dimming of the window.

Rewinding Hair Dryer

I HAVE an old 110 volt A.C./D.C. Hair Drier minus the heater element. Could you give me the data for the heater element and also the information to enable me to use this apparatus on a 230-volt A.C. mains?—G. F. Wilson (E.17).

IN order to use the hair drier on 230 volts, you should rewind each armature and field coil with twice the present number of turns, using wire having half the cross sectional area of the present wire (approx. 71 per cent. of the present diameter). The present coil span, connections and lead between armature slots and commutator segments should be carefully copied.

For the 230-volt heater you could use 20 feet of 32 s.w.g. Brightray (nickel-chrome) resistance wire.

Information Sought

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

Special Projector Screen

I WISH to construct a projector screen of the type where the projector is used from the side and the image reflected through a translucent screen from the rear. I desire the final picture to be about 2ft. 6in. x 1 ft. 9in. Can you help?—H. L. GODDARD (Portsmouth).

Removing Damp Marks from Paintings

PLEASE tell me if there is any method of dealing with old prints and water colours which, due to having been stored in a damp place, have become marked and some of them slightly discoloured. I think in the trade they are called "Foxed" or "Fox" marks. There are also some with dirty finger-marks.—E. B. TAYLOR (Kendal).

Fumeless-Paraffin Heaters

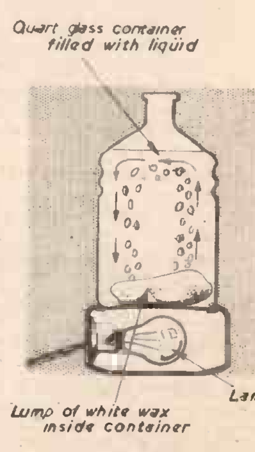
PLEASE give me details of the construction of fumeless heaters working from a paraffin lamp; also, how the condensers are constructed without the use of water.—T. C. DALBY (Herne Bay).

Chemical Distiller

I WISH to make a small tap-water distiller unit. This consists of a small plastic bottle which is filled with some sort of chemical crystals which, after a short amount of use, turn colour, from a light grey to dark brown, the unit then has become useless. Please inform me what the chemical crystals are and where they could be obtained?—R. E. RAYNER (Cambridge).

Lamp Device

PLEASE give me details of the lamp device shown in the sketch so that I may make one for myself. The heat of the lamp causes small globules of wax to break away from the lump at the bottom of the container and to rise to the top. Here they appear to partly solidify, fall again to the bottom and merge again with the lump.—J. G. BARRATT (Canada).



Main details of the lamp device

GALPIN'S

ELECTRICAL STORES

408 HIGH STREET, LEWISHAM, S.E 13.

Tel.: Lee Green 0309. Nr. Lewisham Hospital.

TERMS CASH WITH ORDER (No C.O.D.)

All Goods sent on 7 days' approval against cash.

P.M. EXTENSION SPEAKERS, 8in., 3 ohm coil, in first-class condition, 10/-, post 1/6.

EX-GOVT. ROTARY CONVERTORS 24 volts D.C. Input 50 volts 50 cycles, 1 phase at 450 watts. OUTPUT (complete with Step Up Transformer) from 50 volts to 230 volts, £13/10/- each or **CONVERTOR** only £9/10/- each.

EX-NAVAL ROTARY CONVERTORS 110 volts D.C. Input. Output 230 volts 50 cycles 1 phase 250 watts capable of 50 per cent. overload, in good condition, guaranteed weight approx. 110 lb., £13/10/- each.

½ H.P. D.C. MOTORS, 110 volts, 3,000 r.p.m., new, large size, 35/-; starters to suit N.V.R., 25/-.

ASSORTED RESISTANCES. Wire ends, all new, plain, wire, silver and gold tipped. 12/6 per 100.

THREE PHASE TRANSFORMER. 2,000 watts, double wound, 110-220 and 440 volts. Any combination of connections. New, £25.

LARGE METER movements, fairly low F.S.D. average 6 in. deflection, very high quality, 7/6. P/P. 1/6.

MOVING COIL meters, all 2 to 3 in. dia., damaged cases or glasses, 3 for 10/-, guaranteed one sound meter; 6 for 18/-, two sound meters, no junk, all are, or suitable for, M/A meters.

MAINS TRANSFORMERS all 200/250 volts primaries (New) Heavy duty Output combination of 0/5/12/18/24/30/36 volts 4/5 amps., 38/6 each. Ditto 6/8 amps., 51/6 each. Ditto 15 amps. Output, 75/- each. Another with combination of 0/6/12/18/24 volts 6/8 amps., 51/6 each. Ditto 10/12 amps., 58/6 each Ditto 25/30 amps. Output, 85/- each.

MEDIUM SPOT WELDER TRANSFORMERS, Input 200/250 volts. OUTPUT combination of 0/2/4/6/8/10/12 volts at 50/70 amps., £6/7/6 each. Ditto 120/150 amps. Output, £8/10/- each.

ELECTRIC LIGHT or POWER CREDIT METERS, 10 amp. load, 25/-; 20 amp. load, 47/6; 30 amp. load, 57/6. All carriage paid.

PREPAYMENT 1/- SLOT METERS, Set at 2d. per unit. 10 amp. load, £4/2/6; 20 amp. load, £5/2/6 each. Carriage paid. Fully guaranteed.

PREPAYMENT METERS, 6d. slot only. Set at 4d. per unit. 5 amp. load only, 50/- each. Carriage paid

AUTO WOUND Voltage changer TRANSFORMERS. Tapped 0/110/200/230/250 volts 200 watts, 48/6 each; 350 watts, 57/6 each; 500 watts, 76/6 each; 1,000 watts, £6/5/- each; 2,000 watts, £11; 3,000 watts, £15 c/p.

GOOD FILM for cutting, Panchromatic, very fast. Clearance Prices, all 5½ in. wide 24 ft., 5/-; 47 ft., 7/6. Large reduction for quantities.

P.O. COUNTERS, 9999, 400 ohms, 7/6. Post free.

ROTARY CONVERTORS. Input 24 volts D.C. Output 50 or 100 volts A.C. 500 cycles 1 phase at 300 watts, £8/10/- each.

SELENIUM RECTIFIERS. Full wave, bridge connected, 6 or 12 v. output, 2½ amps., 15/6; 4 amps., 25/-; Transformers to suit either 25/-.

Any **TRANSFORMERS** made to order within 7 days from date of order. Numerous other items in stock. Please ask for quotation.

Clients in Eire & Northern Ireland, please ask for quotation as to carriage charges. The above charges only apply to England.

Open all day Saturday. Splendid odd bargains for visitors.

Over 75 years experience and world-wide reputation for quality

THORNTON

DRAWING INSTRUMENTS

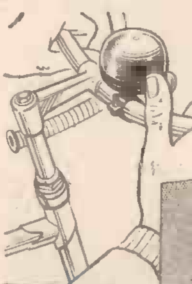
MINERVA SERIES PROFESSIONAL QUALITY
TECHSET SERIES STANDARD QUALITY
KINWEST SERIES SCHOOL QUALITY

JAYWESS SERIES
STUDENT QUALITY

Write for illustrated leaflets and address of your nearest stockist to:

A. G. THORNTON LTD.
P.O. BOX 3. WYTHENSHAWE. MANCHESTER

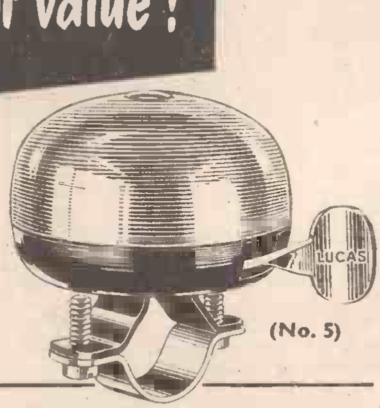
MANUFACTURERS OF FIRST QUALITY DRAWING INSTRUMENTS
P.I.C. SLIDE RULES AND DRAWING EQUIPMENT



It's O.K. for sound -

it's a K.O. for value!

Attractive chromium plated finish
Two screw fixing
Simple and ingenious action
A Quality Bell at a competitive price
Price 2/6

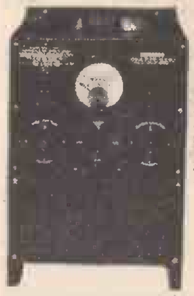


(No. 5)

LUCAS "FLICK-RING" BELL

JOSEPH LUCAS (CYCLE ACCESSORIES) LTD · CHESTER ST · BIRMINGHAM 6

BATTERY CHARGERS



Output up to 22 v. 10 amps controlled by two 4-position rotary switches for fine and coarse control. Input 200/250 v. A.C. 50 cy., fused for A.C. & D.C., clear, scaled ammeter. Brand new, £17.10.0. carriage 15/-.

VACUUM PUMP. Brand New. 7 cu. ft. per min. 10 lbs. per sq. in. at 1,200 r.p.m. Rotary Vane type. 22/6 each, post 2/9.

VOLTMETERS, for A.C. Mains 50 cy. reading 0 to 300 volts with clear 5in. dial only, 60/-; 2¼in. Flush, 25/-; 0/15 volts A.C./D.C. 2¼in. Flush, 15/6, post 1/6.

AMMETERS.—2in. Flush Moving Coil D.C., 50-0-50. 12/6 ea. 2¼in. Flush Moving Iron D.C. 0/25. 7/6 each, post 1/6.

CIRCUIT TESTER in wood case 9in. x 6in. x 4in. 2¼in. Flush round meter 50 milliamps, basic movement 10 m/A., with leads, 10 ohm potr., provision for 1.5 v. batt. Ideal for conversion. 17/6, post 2/6.

PORTABLE BLOWER.—200/250 v. A.C./D.C. 300 watts with switch and leads. 1½in. outlet, £5. Carriage 7/6.

BULKHEAD FITTING. 9in. diam., flat tripod type, suitable for lamps up to 100 watt, complete with pushbar switch lampholder. Ideal for farm buildings, garages, greenhouses, etc. Brand new, 17/6, post 2/6.

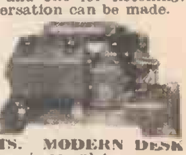
CHARTBOARDS.—With pantograph arm, perspex scale, protractor head as used in the R.A.F. for navigation purposes, 17in. square. Brand new, will make a useful drawing board, 25/-, post 3/-.

VENT-AXIA FANS, EXTRACTION OR INTAKE.—Brand New. Silent running 230/250 volt A.C., 130/-. 12 volt D.C., 90/-, post 3/-.

ROTARY CONVERTER.—Input 24 v. D.C. Output 230 v. A.C. 50 cycles 100 Watt. 92/6; also available in metal case with switch, 105/-, carriage 7/6.

TELEPHONES SOUND POWERED. No batteries required. Just connect with twin flex for clear speech. Transmitter/Receiver Units, 4/6 ea. Twin Flex, 4½d. yd. Post 1/-. If 2 units are connected in series and one used for speaking and one for listening, perfect 2-way conversation can be made.

GEARED MOTOR for the model maker, small and very powerful, 12/24 volt D.C., 4/8 r.p.m., 35/- post 2/6.



TELEPHONE SETS. MODERN DESK TYPE.—£8.17.6 per pair complete.

WALL TYPE also available. 2 complete units £5. Batteries 5/6. Twin Wire 5d. per yd.

MOTOR.—12 volt D.C., 1½in. x 2in. approx. 3,000 r.p.m. with speed regulator in end cap. A precision job, 12/6, post 1/6.

TERMINAL BLOCKS.—2-way fully protected No. 5C/430, 4/- doz., 50 for 15/-, or 100 25/-, 3-way, 8/- doz., 30/- for 50, post 1/6.

VARIABLE RESISTANCE.—160 ohms, 2 amps. on 10½in. Twin Ceramic formers with control handle. Suitable for dimming, etc., 35/-, post 2/9. Also 500 ohms 1.5 amp Log, 50/-.

CROSS POINTER METER with 2 separate 100 microamp movements. Brand New, 22/6, post 2/-.

VOLTMETERS, D.C.—0-20, 0-40, or 0-300, 2in. Flush, 10/6 each, post 1/6.

CHARGING RECTIFIERS.—Full Wave Bridge 12 volts 2 amps, 13/6, 4 amps, 22/6, 2 amp. Transformers, 24/-, 4 amp. 27/3, post 2/-.

BALL RACES.—No. EE2, ¼in. x ¼in., 2/6, 7/8in. x 5/16in., 3/- ea.; 1in. x 3/8in., 3/6 ea. Less 6d. ea. in doz. lots, post free.

THRUST RACES.—13/16in. x 3/8in., 1/6. 15/- doz., post free.

A.C. MOTOR.—230 volts, 50 cy., 1/50th h.p., 3,000 r.p.m. Series with governor, 60/-, post, 3/-.

A.C. MOTOR. 1 third h.p. 1,425 r.p.m., ½ shaft, Ball Bearings, 220/230 volts. Continuous rating. Brand New. £6.10.0, carr. 10/-.

WILCO ELECTRONICS

Dept. P.M., 204 LOWER ADDISCOMBE ROAD, CROYDON

THE Cyclist
Editor: F. J. CAMM
VOL. XXV AUGUST, 1957 No. 421

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.

MOPEDS RECOGNISED!

WHEN Mopeds were first introduced to this country just after the war, they were sneered at and spurned by those who presumed to lead cycling opinion. The fact that they do not necessarily reflect real cycling opinion troubled them not at all. R. C. Shaw, for example, secretary of C.T.C., was permitted to contribute an article to a cycling journal under the title of "Neither Fish nor Flesh," in which he poured contumely upon this development of the bicycle, and later in reply to criticisms and suggestions that the C.T.C. should take the new vehicles under their aegis, stated that it was the "law of the land," that the C.T.C. could not do so. Readers will remember that we challenged him on this point, for the terms in which he phrased it were obviously intended to give the impression that there was some law which said that the C.T.C. could not do so. No doubt what he meant, but failed to make clear, was that under the present articles of association, the C.T.C. could not do so. It is, however, quite possible and legal to have articles of association amended and indeed many years ago an attempt was made by members of the C.T.C. to allow motorists to become members. The attempt, however, failed.

The journal we have mentioned has not adopted a friendly attitude towards these new and popular vehicles, though I expressed the view at the time that the C.T.C. might one day eat its own words—as the periodical concerned has, indeed, now done, for it has changed its title to include Mopeds.

Since they were introduced, these lively little vehicles which owe their origin to Continental manufacturers have continued to gain in popularity and to-day there are many thousands running on the roads and English manufacturers have not been slow to enter the market. It is generally known that the sales of bicycles on the home market have declined during the past few years and one would have thought that cycling bodies and periodicals would have welcomed their introduction as a means of sustaining the industry in full employment. Anyone with sound judgment on the trends could not have reached any other conclusion than that Mopeds this time were here to stay. Their opposition to them is further evidence of their lack of judgment and inability to analyse tendencies. Their judgment was wrong over mass-start racing and on many other important matters they have been compelled to bend the knee. On matters of cycling policy they have been similarly wrong and it is little wonder, therefore, that their words carry little weight in official circles. No doubt they had in mind the earlier abortive efforts to market motor-assisted bicycles. They failed because of their crudity and the fact that they had not been designed by those who understood the principle of stresses in bicycle frames. The Wall auto wheel, for example, which was an additional motorised wheel attached to the rear and which really converted the bicycle into a three-wheeler, abrogated all of the rules regarding stability and steering. The wheel was off-set and rendered the bicycle dangerous, especially on greasy roads. The Johnson motor-wheel was a better approach to the problem; in consisted of a horizontally opposed two-cylinder two-stroke motor cycle engine with flywheel magneto, which was attached above the rear wheel and drove it by a vertical chain drive. It was, however, about two horsepower—too powerful for an unsprung machine like a bicycle.

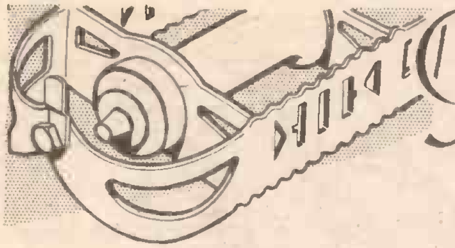
However, the Moped is now recognised and it will, therefore, be interesting to see what further feats of gymnastics will be performed by the boneless wonders of the cycling world who have opposed it. By this time they are, of course, skilled in verbal gymnastics and dialectics. Will they still continue to use such terms as "buzz bikes" and refer to them as "neither fish nor flesh?" Will they still refer to them as "bicycle-assisted motors?" The situation is most interesting as well as being most amusing.

ANOTHER B.L.R.C. VICTORY

IN another matter the past-minded Pundits have lost the battle they have waged for over 15 years, for the R.T.T.C. has now agreed to permit amateurs to race against independents in events under the jurisdiction of the B.L.R.C., N.C.U., or overseas organisations affiliated to the U.C.I. It is a distinct victory for the B.L.R.C. and it must cause those unworthy opponents, who have done their best to kill it, to bow their heads in shame.

The new ruling means that amateur cycle racing in Great Britain takes on a new form and a new lease of life. The new form is more in keeping with modern times and with what is going on on the Continent. The N.C.U. had previously agreed to allow amateurs and indepents to race together—a further B.L.R.C. victory—and so the R.T.T.C. and the N.C.U., who have consistently opposed the B.L.R.C. with sneers and denegration, have at last been made to look ridiculous and to capitulate to the B.L.R.C.

Ever since the League was formed we have consistently supported it. We have defended it in print and out of print, in speeches and in interviews with the Minister of Transport. We prepared the now famous memorandum which removed the scales from the eyes of the Minister and exposed the subterranean methods which had been adopted by the N.C.U. and R.T.T.C. as well as by some cycling journalists. As a result the Minister never implemented his threat to ban cycling racing. It was left to us to point out that he had no power to do so and that he would need to seek fresh powers. We are certain that, but for our timely intervention and continued advocacy of the League's cause, which has been espoused in this journal and elsewhere, mass-start racing would have been banned. In the result the N.C.U. and R.T.T.C. have lost considerable face and prestige, whilst the prestige of the B.L.R.C. has risen enormously, after passing through the refining furnace of insincere opposition. The League is now the most powerful cycling body in this country and its victory demonstrates that it is run by determined men who believe in their cause and are prepared to fight for it.



Pedal Maintenance

A Complete Guide Including Replacing Pedal Rubbers and Spindle Straightening

THE pedal is one of the most vital parts of a cycle and, unfortunately, one most liable to accidental damage. If the machine falls heavily on its side or the rider goes too near a curb, so that the pedal bumps, it is easy for the pedal spindle to be bent out of truth. Another common cause of pedal trouble is the loss of the pedal cap. When this is missing dirt and water penetrate into the bearings and in a very short while completely ruin the ball races. Nothing is more annoying than a pedal which "twists" under the foot at every revolution of the cranks, or which grates or "knocks."

There are two types of pedal, the rubber pedal, usually seen on roadster machines, and the rat-trap type favoured by the sporting cyclist. So far as the spindle assembly is concerned both these types are identical. The sectional view in Fig. 1

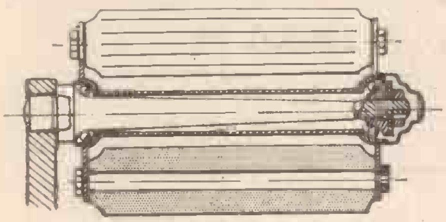


Fig. 1.—Sectional view of a rubber cycle pedal.

shows the standard arrangement. The spindle screws into the end of the crank, the left pedal by means of a left-hand thread and the right pedal by means of a right-hand thread. Two flats are positioned on the shoulder next to the threaded portion to allow the pedal to be tightened into the crank. On the other side of this shoulder is a ball track and from this point the spindle tapers down to a threaded portion at the other end. The other ball track is provided by means of a threaded cone, which is locked in position with a keyed washer and a nut. The spindle shell, ball cups and pedal frames are all formed in one piece and should not be dismantled. A hub cap protects the bearings against the incursion of dust and rain, etc.

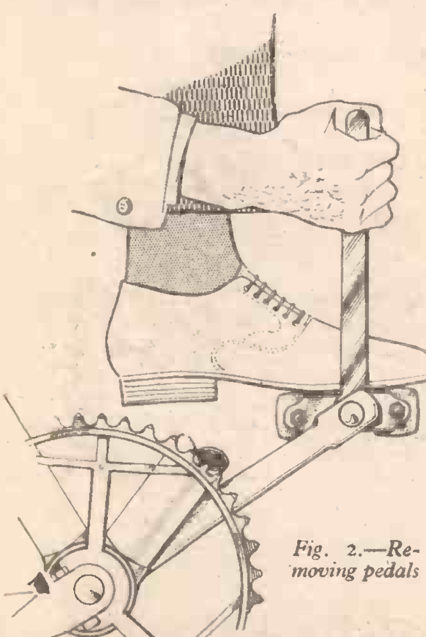


Fig. 2.—Removing pedals

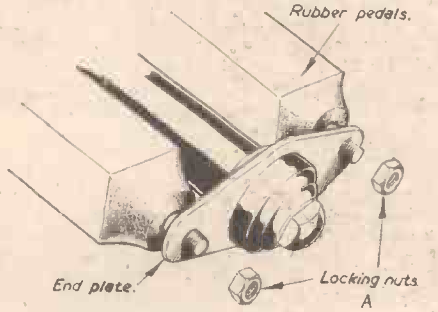


Fig. 3.—Removing pedal rubbers.

Removing the Pedals

Pedals often become jammed into the cranks very tightly and will probably resist all efforts to unscrew them with a spanner or adjustable wrench. Whenever possible it is best to get them off with a special long-handled cone spanner. Hold the machine upright by one hand on the saddle, place a foot on the pedal to hold it firm; then use the other hand to screw the pedal out (see Fig. 2).

Dismantling

Hold the pedal in the vice by means of its flatted shoulder. Unscrew the dust cap and the locking nut underneath and then slide off the washer, which will either have a small projection engaging in a slot in the spindle or have flats to stop it turning. The cone can be removed next and the balls will fall out immediately it has gone. This completes the dismantling.

Clean the spindle and ball cups in paraffin and inspect the balls and cones for wear. There will be no difficulty about replacing the balls, provided care is taken to replace the same number of new ones the correct size. It is often possible to obtain cone replacements if this is necessary.

In the case of rat-trap pedals this may be an opportunity to tighten any loose rivets. Support the inside of the plate and hammer the burred-over ends of the rivets until the plate is held tightly again.

Reassembly of the pedal and adjustment for free running without "play" follows the usual procedure.

Replacing Pedal Rubbers

Worn pedal rubbers should be replaced before they are worn right down to the centre rods. Pedal rubbers are available in many standard sizes, and provided the correct size replacements are purchased no trouble should be experienced. Undo the nuts (A) in Fig. 3 and prise the end frame away from the cup. It will now be found a simple matter to remove pedal rubber and centre rod in one piece.

The centre rods are pulled out and replaced in new rubbers and the pedal reassembled, tapping the end plate into place with a light engineers' ball-pened hammer.

Straightening the Spindle

If the pedal spindle is bent it will probably be noticed while it is being unscrewed from the crank, and it is a good idea to screw it into the crank so that it may be checked in this way. As can be seen in Fig. 4, the tip of a bent spindle will describe a circular path.

The best method of straightening is to clamp an old crank into the vice, as shown in Fig. 5, screw the pedal spindle into it until, due to its eccentricity, it leans away from you. Screw the cone on to the other end and then by means of a length of tubing straighten it by pulling forward. Pull it a little at a time and check repeatedly, by rotating it in the crank end, until the tip no longer describes a circular path.

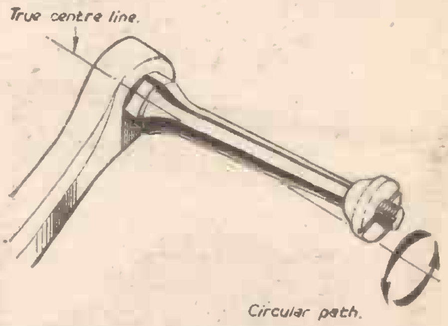


Fig. 4.—A bent spindle tip describes a circular path.

Oiling

The pedals should be included in the weekly cleaning and oiling. The machine should be laid first on one side and then on the other and oil squirted through the oiling holes in the end caps. The pedals should be rotated while the machine is lying down, so that the oil will run into the bearings at the crank end of the pedal.

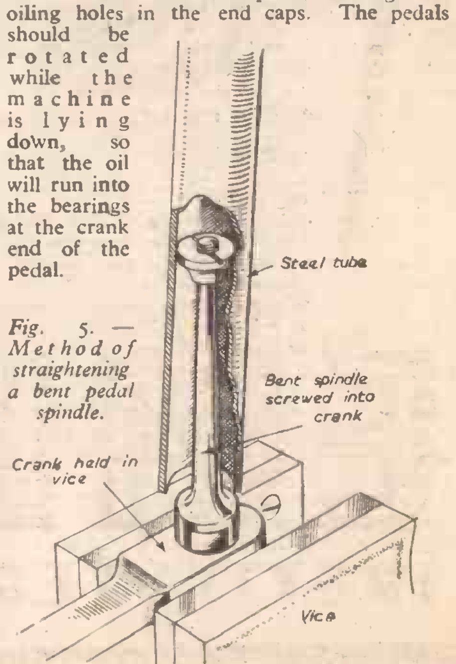


Fig. 5. — Method of straightening a bent pedal spindle.

Published about the 30th of each month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by W. Speaight & Sons, Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia), Ltd. Sole Agents for South Africa—Central News Agency Ltd. Subscription Rate (including postage): For one year, Inland 18s. 6d. Overseas 17s., Canada 17s.

"Practical Mechanics" Advice Bureau. COUPON
This coupon is available until August 31st, 1957, and must be attached to all letters containing queries, together with 6d. Postal Order. *A stamped addressed envelope must also be enclosed.*
Practical Mechanics. August, 1957.