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NEWNES

PRACTICAL MECHANICS

1/3

EDITOR: F. J. CAMM
MAY 1957

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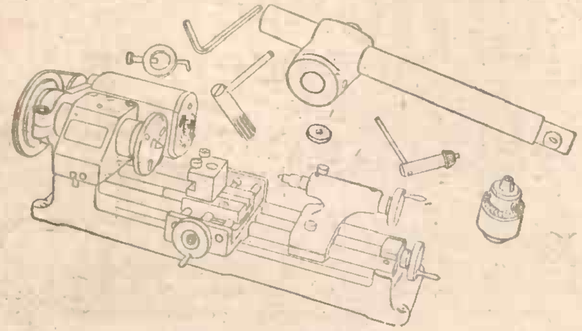

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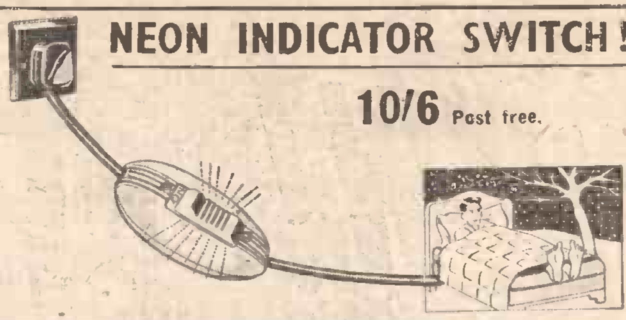

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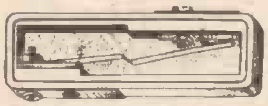
THE 'MAGSTAT'



This is a precision bi-metal thermostat for the control of alternating currents of up to ½ amp. at 240 volts. The temperature range lies between minus 50 deg. F. and plus 250 deg. F. An ingenious magnetic snap action is incorporated which gives freedom from radio interference. The operating temperature is altered by rotation of the adjustment screw, clockwise for increase and anti-clockwise for decrease. Dimensions 2in. x ½in. x ⅞in.

PRICE : 5/6 each. Post 3d.

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(TELEVISION SUPPRESSOR KIT) For the suppression of Domestic Motor Driven Appliances. Comprises two chokes and two condensers mounted on a card with wiring instructions. Ideal for Vacuum Cleaners, Hairdriers, Sewing Motors, etc., up to 1 amp. Price 3/6. Post Free.

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PRICE : 35/-. Post 6d.

Model PJ. Miniature Thermostat for control of domestic Electric Irons and special-purpose machines where space is limited. Capacity: 5 amps., 250 volts A.C. ⅜in. x ⅝in. x 11/16in. Single screw fixing. Price 9/3. Post 3d.

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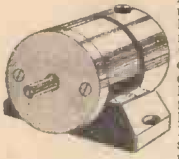

Powerful electric motor, size 3" long by 2¼" diameter with speed varier suitable for operation off standard A.C. mains. Ideal for driving fan, model, car heater, dryer, etc. Don't miss this snip. 12/6, plus 2/- post and ins.

SUPPRESSOR CONDENSER

Stop your drill or other appliances interfering with your or your neighbours' radio or television. Simple instructions given. 2/6 each, 24/- dozen.

FM TUNER

This is a high fidelity unit which although moderately priced has a performance equal to the highest priced. Its stability is very good and extremely good results have been received with the simplest of aerials as far away as Eastbourne. The unit is made up ready to work and has its own power supply for A.C. mains. Demonstration at all our branches. Price 12 gns., post plus insurance 5/-.

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Fits into the pocket. Size only 4½" x 3" x 1¼". weight only 10 ozs. Works anywhere. Uses deaf aid or ordinary earpiece. Ferrite rod aerial. No external aerial required. Uses 2 transistors. Self-contained batteries. 1/- battery lasts months. All parts including data but not battery, case or earpiece, £2.17.6. Case now available 2/6.

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3-speed Gramophone Motor. Latest rim drive 3-speed motor with metal turntable and rubber mat. Small mod. makes speed easily variable for special effects and dance work. **Hi-Fi Pick-up.** Using famous Cosmocord Hi-G turn-over crystal. Separate sapphire for each speed. Neat bakelite case with pressure adjustment. **Special Snip Offer this Month**—The two units for £4.10.0 plus 5/- post and ins., or made up on boards as illustrated £5.10.0 plus 5/- post.

THE OCTAVIAN
High Fidelity Amplifier

3-valve, 4-watt, with frequency response better than 40-15,000 c.p.s. Control panel size 8" x 2½" comes fixed to chassis and is intended for independent mounting. Separate base and treble controls giving fullest variation of cut and lift. Separate switch, absolutely no mains hum. Remarkable value at 7 gns. or £1 deposit plus 3/6 post and packing.

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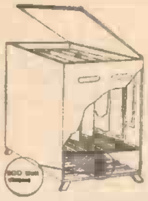
500 WATT ELEMENT



Totally enclosed in metal case. Size approx. 24" x 4" x 4". These elements are ideal for airing cabinets or similar devices, suiting A.C. or D.C. mains—200-250v.

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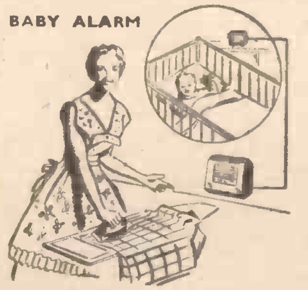
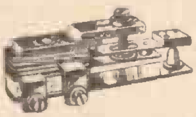
BABY ALARM



Unlike most baby alarms, this not only enables you to hear baby but also to talk to him. Price complete with one microphone and 100ft. twin flex, £6.19.6, carriage 3/6, additional microphone, 19/6.

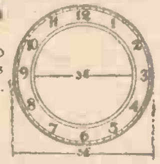
THERMOSTATS



Useful for the control of appliances such as convectors, glue-pots, vulcanisers, hot plates, etc. Adjustable to operate over the temperature range 50-550 deg. F. 1½ amp., 3/6 ; 5 amp., 8/6 ; 2 amp. QMB, 5/6 ; 15 amp. QMB, 15/-.

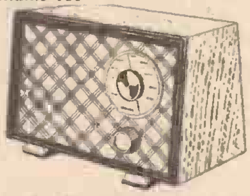
CLOCK CASE

Also suitable for barometer or other instrument. Nicely polished. Price 4/6, post and packing 1/6.



Clock numerals to suit these cases etched on metal, 2/6.

THE SKYSEARCHER
An all mains set for 19/6



This is a 2-valve plus metal rectifier set useful as an educational set for beginners, also makes a fine second set for the bedroom, workshop, etc. All parts less cabinet, chassis and speaker, 19/6. Post & ins. 2/6. Data free with parts or available separately 1/6.

ECONOMY THREE

A 3-valve battery version of above. All components less cabinet, chassis and speaker, 19/6, plus 2/6 post and insurance. Data free with parts or available separately 1/6.

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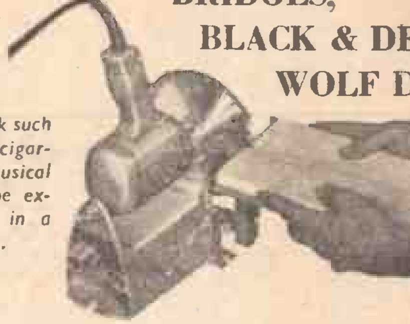

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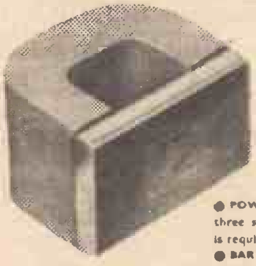
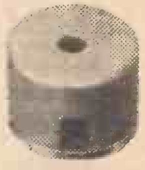
wide range of types and sizes always in stock



POWER MAGNET

BAR MAGNET

- **POWER MAGNETS** .... Alcomax magnets in three sizes. Use where extra performance is required.
- **BAR MAGNETS** .... In pairs. For general purposes. 2" and 3" sizes available.
- **POCKET MAGNETS** .... Useful to every engineer for hundreds of uses in workshop or home.
- **MINOR MAGNETS** ..... Ideal for the model engineer. Compact yet powerful.
- **POT MAGNETS** .... In three sizes. Powerful Alcomax assemblies for holding and lifting. Mild steel pot can be machined.
- **BUTTON MAGNETS** ... For magnetic indicators, doorcatches and as magnetic collectors. In three sizes.



BUTTON MAGNET

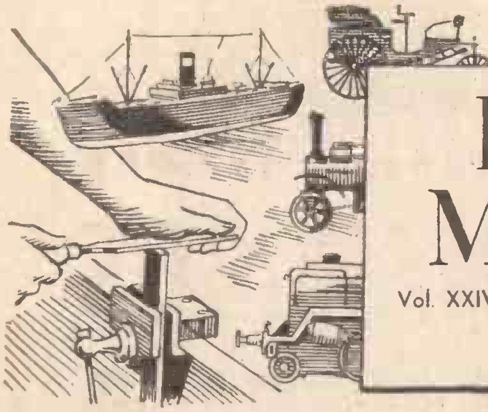
POT MAGNET

MINOR MAGNET

POCKET MAGNET

Made by James Neill & Company (Sheffield) Limited and obtainable from your usual tool distributor

PM37



Practical Mechanics

Vol. XXIV. No. 279 MAY, 1957

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

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CONTENTS:

CONTRIBUTIONS

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

FAIR COMMENT

THE ELECTRIC WATCH

SOME years ago I dealt with the experiments which were then being conducted in Switzerland and America with battery-operated watches. One would have thought, in view of the necessarily minute size of the power unit, namely the battery, that such experiments would have been conducted with pocket watches. Such, however, has not proved to be the case, and the very first battery-operated wrist watches, gent's size, are now on the American market, where demand greatly exceeds the present manufacturing capacity. The watch is no larger than an ordinary wrist watch, it is powered by a tiny circular layer laid battery which, it is claimed, will actuate the movement for one year, whether the watch is worn or not. Platinum alloy permanent magnets are used in the construction. Pulling the hand-setting mechanism out to the setting position stops the watch, and when in this position, the balance wheel is not in contact with the electrical system and thus no current is used. When the watch is put away or not in use, current should be conserved in this way.

The watch may be set to the exact second according to the time signal. The button is pulled in to the setting position, stopping the watch with the second hand at 60 well in advance of the time signal, after having set the hour hand and the minute hand to say 9 o'clock. As soon as the last pip of the time signal is sounded, the button should be pressed down to start the watch. The tiny battery or energy cell may be easily replaced when it runs out.

Elsewhere in this issue I deal in greater detail with this important horological development which in time must replace self-winding watches and most watches operated by mainspring. The science of electronics marches on!

NATURAL GAS

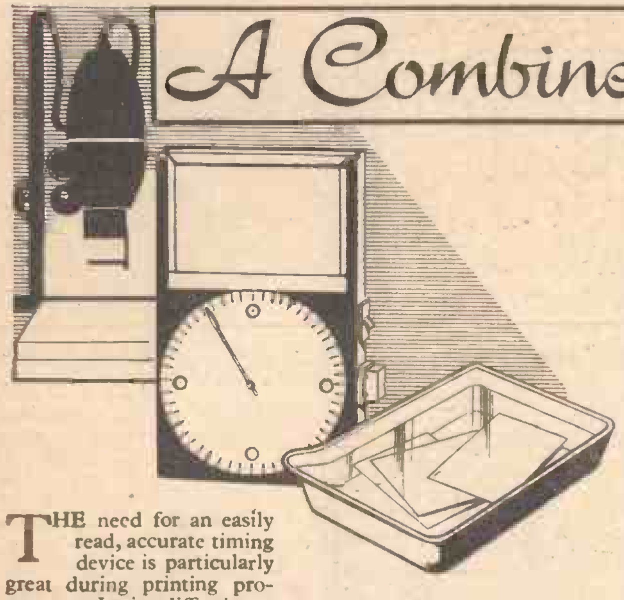
GAS engineers are investigating the possibility of shipping refrigerated natural gas to Britain from the Middle East oilfields where, at present, it is wasted.

It was stated in Parliament that the prospects were most interesting, and that the Gas Council was arranging for a trial shipping. The natural gas is, of course, methane, that has a heat value double that of ordinary town gas which is made from coal. To be transported economically it would need to be liquefied. The difficulty which presents itself is that the liquid boils at 260 degrees below zero and a power refrigeration plant would be needed in tankers to maintain it at this temperature. The methane can be stored at ports where it would be returned to gaseous form and then piped all over the country.

THE SECOND "HOW-TO-MAKE-IT" BOOK

OUR second "How-To-Make-It" Book is now available at 15s. or 15s. 9d. by post! It contains articles in common demand which have been included in past issues long since out of print.

The contents include: A reflecting enlarger; one-stringed fiddles; folding steps and an extending ladder; an electric guitarette; a miniature billiards table; a synchronous electric clock; a glove puppet theatre; an automatic garden sprinkler; a midget camera; a potter's wheel; a catamaran; a rowing machine; an aqualung; home-made fishing tackle; installing a tropical aquarium; a snow scooter; underwater photography; a pair of skis; projecting time on the ceiling; a harpoon gun; small wind-power plants; an electric hedge trimmer; bathroom scales; a folding. outboard motor-boat; flash photography; gas-fired pottery kilns; a back projection episcope; motorising your lawn mower; a skeleton synchro-electric clock; a viewer and printer for 35 mm. film; a cycle trailer; an electric imitation coal fire; a mechanical potato peeler; a home-made duplicator; making rubber stamps.—F. J. C.



A Combined Safelight & Timer

A Useful Piece of Darkroom Equipment

By J. C. LOWDEN

THE need for an easily read, accurate timing device is particularly great during printing processes. It is difficult to read a watch in the weak illumination of the safelight, whilst at the same time giving full attention to the print. Most amateurs are compelled to use make-shift darkrooms where there are very few power sources, and the model described works from the same source that would, in any case, be taken up by the safelight. It has the advantages of an audible interval signal and interchangeability of safelight screens.

While the dimensions of the device are not critical, it should be remembered that commercial safelight screens are sold in standard sizes, alteration of which might not be an easy matter. The model described will accept a 7in. x 5in. screen.

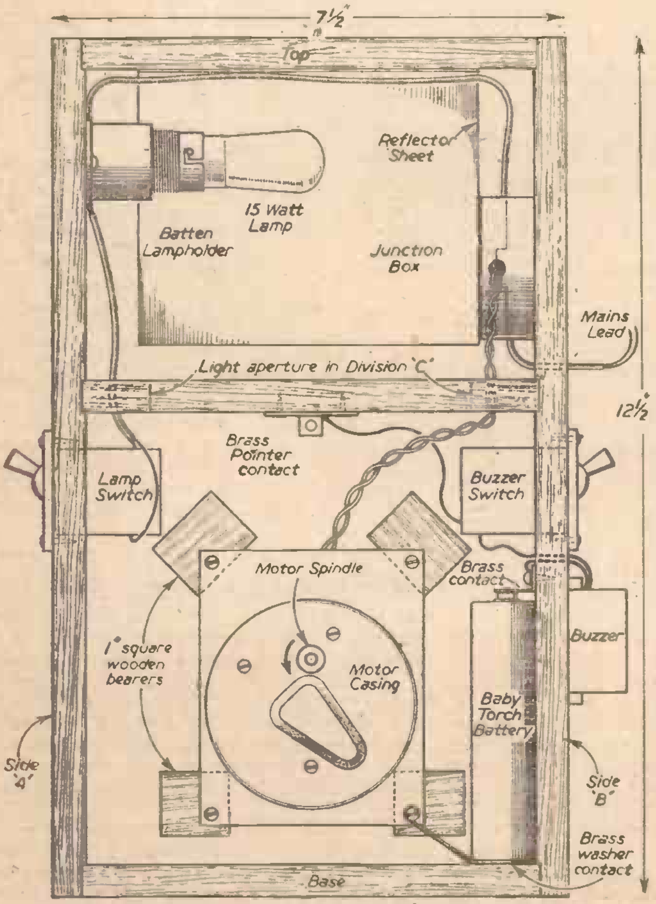


Fig. 1.—General arrangement of Safelight and Timer.

The Wooden Casing

This is built throughout in plywood, as being the easiest to handle and the most readily to hand. Half-inch laminated wood is used for the carcase, the back being a single sheet of 4 mm. three-ply. The joints are simple rebates, secured by the "glue and screw" method. Dove-tail joints could be used if preferred. The central division "C" is glued into the groove on each side of the box.

Whatever method of jointing is used, it will be found advantageous first to assemble the box "dry" for trial, then to dismantle it. As much of the wiring and fixing as is possible should be done before final assembly, thus avoiding much tedious work inside the limited space of the box. Fig. 1 shows the general structure of the box, and Fig. 3 the layout of the two sides A and B.

The Motor

It is advisable to ensure that this surplus item is available before commencing construction. The suppliers are Messrs. Rogers, 31, Nelson Street, Southport, who advertise in this journal. It is listed at 21s., post free. It is also available from other surplus equipment stores.

The motive power of the timer is supplied by this small, mains voltage motor, giving exactly one revolution per minute. The motor mechanism is completely enclosed in a smart black metal casing, mounted on a rectangular central flange. Fixing holes are already drilled in each corner of the flange and the protruding motor spindle is already "flatted" to provide a bearing surface for a grubscrew. Two plastic-covered flex leads are fitted, and no adjustments or modifications are needed. The motor unit is self-starting, completely silent and its overall dimensions are 3in. x 4in. x 2in. It is synchronous with the mains, thus giving great accuracy in timing. The motor is shown in Fig. 2.

Electrical Components

Two switches, AM/5c/543, price 9d. each, are required; a junction box, AM/5b/565, price 9d. and a Mini-buzzer, price 4s.

All these components were supplied by Messrs. Milligan, of Hartford Street, Liverpool, who advertise in this journal. The same firm can also supply the motor unit, but with a certain amount of additional equipment fitted. This equipment is not necessary for use in the timer described, but it can be removed very easily, and may well be put to some other use. The motor unit listed by Messrs. Milligan is priced at 22s. 6d.

All these prices are exclusive of postage.

Also required are one standard B.C. Batten lampholder, one Phillips 15-watt sign lamp, and plastic-covered flex for wiring up.

The Bearer Blocks

Since the motor flange is in the centre of the casing it is necessary to raise the unit on four

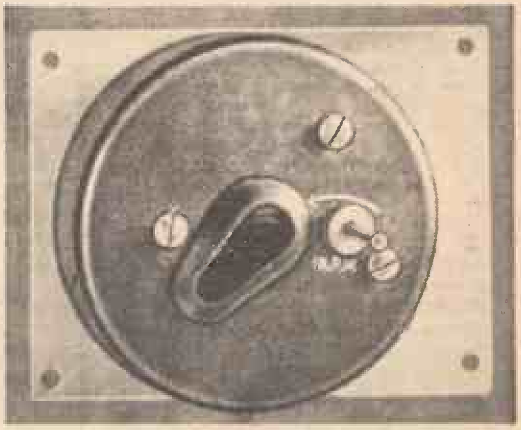


Fig. 2.—The motor unit as received from the suppliers.

bearer blocks. These are four pieces of 1in. square section wood, each 1½in. long. The lower bearer blocks are easily positioned, and the end of the lower bearer block nearer to side "B" should be adjusted so that exactly 1in. is left between the end of the block and the inside of the box. This space will accept, as a firm fit, the buzzer battery.

The rear half of the motor behind the flange is not regularly shaped, and the two upper bearer blocks need to be angled slightly. They are easily located by "trial and error."

Once the approximate position of the bearer blocks is found they are fixed to the back of the box by screwing through from the rear, using countersunk screws.

Locating the Motor Unit

The motor unit must, of course, be placed so that the spindle is in the dead centre of the motor compartment, which is a true square. The spindle must, therefore, be at the intersection of the diagonals. It is a great help in positioning if the Perspex dial square is cut exactly to the size of the motor compartment. The spindle hole, ¼in. clear, is then drilled, and one fine screw hole at each corner. The spindle is eased through the central hole and the motor gently moved over the bearer blocks until the dial is accurately positioned. The dial square is then screwed to the wooden casing, and then the screws removed again. The screw holes remain to show the correct position when the dial square is replaced.

The dial square is now gently freed from the spindle without disturbing the motor unit and the motor firmly screwed to the bearer blocks, using No. 8 round-headed woodscrews.

The Pointer

The pointer is made from copper steam tubing, $\frac{1}{8}$in. diameter, $3\frac{1}{4}$in. long. This tubing can be bought at most model engineering shops.

The method of securing the pointer to the motor spindle was a simple one. An old broken three-point plug yielded three square terminal blocks, ready drilled, tapped, and fitted with a grubscrew each. A small threaded stem protruding from the block, on the opposite face to the grubscrew offered a ready means of securing the block to the end of the pointer. Once having found such a useful piece of scrap it may be soldered to the pointer tube and fitted over the spindle, secured by the grubscrew.

The other end of the tube is then flattened and the flat part sawn down to take the contact spur which is a scrap of brass inserted into the sawn slit, and firmly soldered into position. This spur, when first fitted, should be about $\frac{1}{4}$in. long, in order that it may be adjusted later.

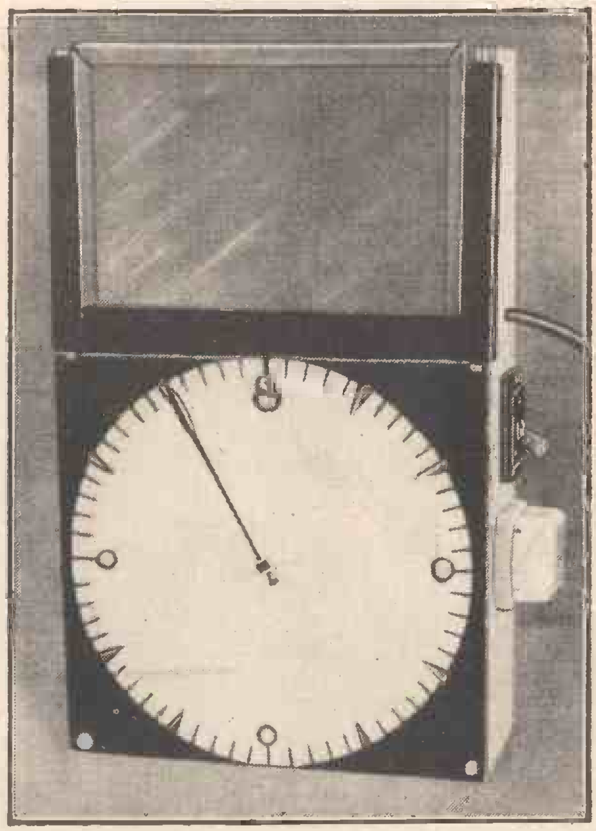


Fig. 5.—The completed unit, showing dial layout.

The Dial Square

Perspex 1/16in. thick is used for the dial. To cut it use a sharply-pointed knife and a steel straight edge, cut heavily along the line once or twice, after which the Perspex may be snapped cleanly. Perspex of $\frac{1}{8}$in. or greater thickness can be sawn with a coping saw, hacksaw or similar frame saw and the edges filed smooth.

When buying the Perspex choose a translucent type. The deep red shade makes an excellent dial needing no screening. For the model described a white translucent sheet was used. The rather brightly lit dial has no effect on contact paper and is safe for bromide, provided the light does not fall directly upon the sensitive surface. For the faster chloro-bromide papers and ortho films and plates, however, the dial light is made safe by placing a slip of red translucent Perspex over the light aperture in the central division "C" in Fig. 4. The Perspex is held in position by a piece of aluminium, bent at right angles and screwed to the back of the box.

Perspex is readily available from several advertisers in this magazine.

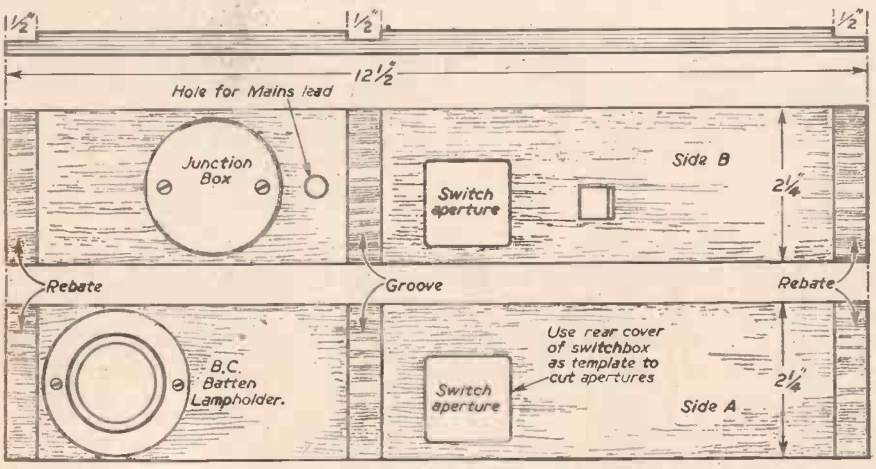


Fig. 3.—Details of the sides.

Marking Out the Dial Square

When purchased, the Perspex has a super high gloss finish which makes marking out very difficult. If this gloss is removed by lightly rubbing with the very finest grade of sandpaper a perfect marking surface remains.

After planing flush with the outer edges of the motor compartment, the dial is lightly sanded, and then drilled for the spindle at the intersection of the diagonals. The dial circle is pencilled in, using compasses, and the markings set out with a protractor. In the model described the "cardinal points" are marked by half-inch circles, the five-second intervals by triangles, and the individual seconds by single strokes, as shown in Fig. 5.

The pencilled markings are then blacked in, using "Joy" Camera Black, liberally thinned with turps. A fine sable brush is best for this job, and with care it can be fitted in the compasses and the outer circle drawn accurately by this means.

When the dial is fully marked, the "waste" may be fully blacked in order to localise the light. It is also of great value if the pointer and the five-second markings on the dial are treated with luminous paint. There are several excellent proprietary brands available.

The Internal Contact

This is to complete the circuit by which the interval buzzer is actuated. To make the contact a further piece of the invaluable "scrap" plug is utilised. The earth pin was separated from its square terminal block. In this case the earth pin itself terminated in about $\frac{1}{4}$in. of thread which screws in to the block. The earth pin was sawn off, leaving a "cheese head," across which a saw cut is made, as a screwdriver slot.

The internal half of the contact is made up by soldering the square terminal block to a strip of scrap brass, ready drilled to take two fine screws. (See Fig. 6.) The threaded hole faces the Perspex dial, the grubscrew being at the rear. The contact is then screwed to the underside of the division "C," exactly in the centre, above the motor spindle.

The Perspex dial square is now drilled to accept the contact screw. The location of this hole needs a little care, but if the dial is screwed into position, with the motor spindle through the central hole it should not be unduly difficult to hit it first time without elaborate plotting. When the hole is drilled the contact screw is screwed into the contact block. The pointer is then fitted and the length of the contact spur adjusted to provide a firm but not too heavy contact.

Interval Signal Wiring

The interval signal wiring is in the motor compartment and may well be treated first.

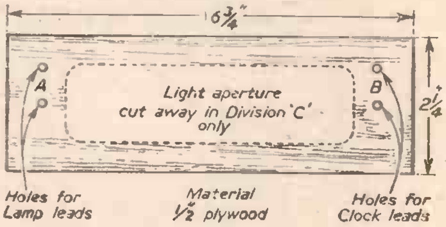


Fig. 4.—Shape and dimensions of top, bottom and division "C."

The Mini-buzzer is powered by one Ever-Ready Baby Torch Battery No. 1839. A short wire lead is screwed firmly under the head of one of the woodscrews securing the flange to the bearer block, and the other end taken to a small brass washer, screwed to the floor of the box at the corner near side "B" (Fig. 1).

A small rightangle contact of scrap brass is screwed to side "B," directly above the washer, and at such a height that the lower surface presses firmly on to the top terminal of the battery. A fine wire lead is taken from this contact through a hole in the side of the box and connected to one terminal of the Mini-buzzer. From the remaining buzzer terminal another lead re-enters the box and is connected to one pole of the buzzer switch. From the remaining pole of the buzzer switch a lead is taken to the internal pointer contact. The Mini-buzzer is then screwed to the side "B," using the woodscrew provided.

The circuit is tested before use by placing the pointer upon the motor spindle, switching "on," and making contact with the contact spur and the internal contact.

The Light Compartment

A lead from the mains enters the light compartment through a hole drilled in side "B." The Ex. A/M junction box is screwed to side "B" directly above this entry. The current is distributed through this box, one pair of leads being taken down for the motor supply. Another pair of leads is taken across the box to side "A," where they are connected to a standard B.C. Battern lampholder. To give control over the lighting the lamp switch is interposed in the circuit.

As mentioned before, as much as possible of this wiring should be done before assembling the box. After wiring is complete the lampholder, junction box and switches are screwed securely into their proper positions.

The Reflector

This is simply a piece of sheet aluminium bent as shown in Fig. 8, and screwed to the back and top of the box as can be seen in Fig. 7. It serves the dual purpose of protecting the leads to the lamp as well as utilising the light to its best advantage.

Ventilation

There has been no indication of excessive warmth in the box, even after lengthy periods of use, and it has not been found necessary to embody any elaborate system of ventilation.

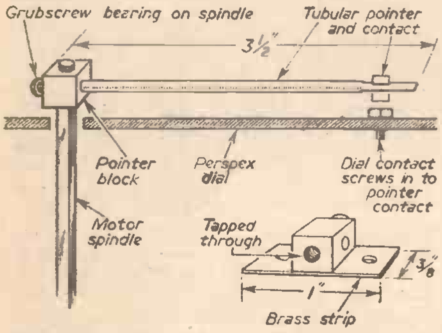


Fig. 6.—The pointer and pointer contacts.

The Safelight Screen Holder

This is a simple frame made of two 5in. lengths of ½in. rightangle aluminium of the lightest gauge, as sold in most hardware stores. The parts are connected at their lower ends by a strip of the same metal, ¾in. wide and 7in. long. This frame takes little or no strain, and "Solderine" made an adequate joint.

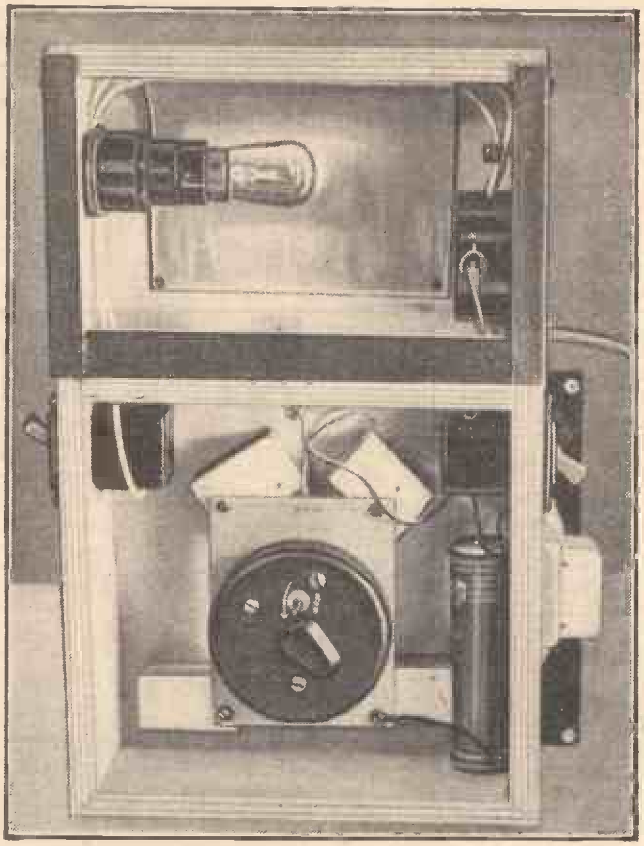


Fig. 7.—A view of the inside of the unit.

The outer webs of the side frames are screwed to the outside of the lamp compartment, leaving space for the safelight screen to be slid down; as different makes of safelight screens vary in thickness, it is not possible to give an exact measurement for this clearance. The completed timer is shown in Fig. 5.

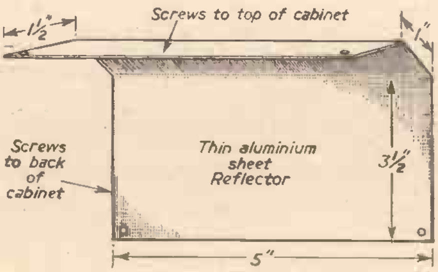


Fig. 8.—The aluminium reflector.

The Safelight Timer in Use

The model may be used for a variety of darkroom uses, provided the appropriate screens are fitted. Few amateurs nowadays develop rollfilm by any means other than a tank, but plates and cut film are still very popular, and the usual practice is to develop these in open dishes.

The timer really comes into its own during printing processes. As the pointer moves in an anti-clockwise direction a little mental readjustment is called for but it soon becomes quite logical.

Assuming the correct printing time to be 15 seconds, the paper is then set on the enlarger easel, the Buzzer switched "on" and the enlarger switched on when the pointer reaches "three o'clock," indicating that fifteen seconds are left "to go." Full attention may then be given to the print and any "shading," etc., that may be necessary. The brisk buzz of the Minibuzzer gives an unmistakable signal to switch off the enlarger at the right moment. This facility is especially valuable to one who requires to make a number of copies, each required to be the same.

Most print developing is done by visual inspection, but where a worker wishes to time his development, the timer is equally useful. It is also likely to be of value in the case of a photographer using certain of the new neg. pos. colour printing processes, where the paper needs to be treated in two or more baths for fairly precise times at fixed temperatures.

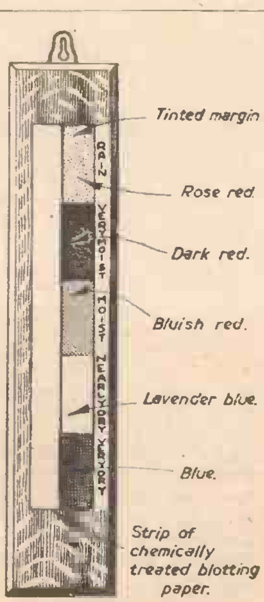
A Chemical Hygrometer

A HYGROMETER is an instrument which indicates the relative humidity of the atmosphere and thus serves as an approximate guide to the kind of weather to be expected.

There are many types of moisture recording instruments. Perhaps the simplest is made by balancing a little dried salt on one pan of a pair of scales. The magnesium chloride which occurs as an impurity in common salt readily absorbs atmospheric moisture, and consequently in wet or damp weather the salt, due to this acquired moisture, increases in weight. The increase is recorded by the scales and forms a direct reading of the relative humidity of the atmosphere. In another type, a strip of absorbent material is held under tension. The length of this strip (often made of tracing linen) varies slightly according to the amount of moisture in its neighbourhood. This variation is magnified by a system of pulleys or levers operating an indicator over a dial.

The hygrometer described here changes colour according to surrounding humidity. Its action is purely chemical and relies upon the colour changes induced in salts of cobalt by the presence of more or less water in the air. Make up the following solution:—

Cobalt chloride, 1 ounce; common salt, ½ ounce; calcium chloride, 75 grains; gum acacia, ¼ ounce; water, 3 ounces.



The complete hygrometer.

In it soak thoroughly a strip of white blotting paper about 6in. long and ½in. wide and hang it up to dry. Cut a piece of stout white cardboard 8in. by 2in. and fasten the dry blotting paper centrally to it with a touch of glue. Punch a hole in one end of the card and hang it. An approximate weather forecast will be arrived at as follows:—

Rose red, rain; dark red, very moist; bluish red, moist; lavender blue, nearly dry; blue, very dry.

To make a more elaborate job, draw a small margin alongside the blotting paper and of the same length. Tint this margin with water colour paint, starting at one end with blue and working through the above colours to rose red at the other end. To obtain a good match between your colouring and that of the hygrometer, apply gentle heat to the latter, when it will run through its whole range of colours from red to blue. It can be stopped at any stage by removal from the source of heat, and the colour will remain constant for the brief period occupied in matching it. Against this coloured margin should be written in neatly the significance of the various tints.

WATER SKIS *and* SURF BOARDS

By T. H. E. MARSH

Make These in Time for Your Summer Holiday

WATER SKIS may vary in size according to the weight of the skier or the purpose for which they are intended, but generally the sizes given will suffice for an average person. The larger sizes should be adopted by beginners or heavier persons who may graduate to the smaller skis as they gain experience in the art of keeping balance. But first a word of warning. Do not attempt water skiing or aquaplaning unless both you and your motor boat pilot can swim and have taken lessons in life saving. This warning may appear out of place here, but the writer would like to make it quite clear that when indulging in this fascinating sport one may quite unexpectedly receive a ducking and this can be at least somewhat disturbing for a beginner skimming over the waves at high speeds.

All the equipment detailed below may be made of hickory, birch or ash which must be of good quality, well seasoned and free from knots, shakes, splits and blemishes. A pair of skis, of the type in Fig. 1, suitable for a beginner are made from two planks, each 6ft. long, 6in. wide and ⅝in. thick. For the more experienced skier 5ft. 6in. long and 5in. wide would be faster on the bends and turns. After planing all over until smooth, the toe end must be bent up as shown. The bend starts about 1ft. from the end of the plank and the offset should be about 6in. Before bending, the plank must be soaked in boiling water until soft enough to bend readily. Or the end 15in. or so may be wrapped over with a few rags and boiling water poured continuously over them until the plank is soft.

Bending Skis

To bend, the end may be fixed in a vice with the free end roped to a hook in the floor, or two pieces of wood about 2in. square and 6in. long can be screwed firmly to the skirting board about ¾in. apart as shown in Fig. 2. Put the soft end of the plank between them and fix the free end to a hook in another wall with a rope. Or the free end may be held in place by a pile of bricks.

The ski must be left overnight to ensure that the set is permanent. Fig. 2 shows this method of bending. Another convenient bending fixture is to use any suitable railing to clasp the soft end and a rope or pile of bricks to hold the free end until set.

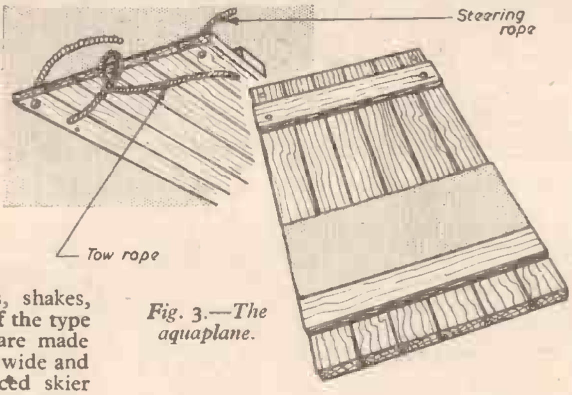


Fig. 3.—The aquaplane.

The fixings for the feet can be cut from a double thickness of a car inner tube and fixed to the ski with the foot in place using round-headed brass screws and large washers. The big toe of the foot should be on the line of balance of the ski.

To obtain a grip, or to produce some resistance to the water for turning, a keel is required on each ski. This should be a piece of hickory about 10in. long and ½in. thick tapering from 1in. deep at the end to about 1/16in. deep at the front. This must be firmly screwed, as shown in Fig. 1, to the heel of the ski on the centre of its width. Again use brass screws, but this time use them with countersunk heads.

The skis may now be completed by thoroughly glasspapering all over to remove all roughness and finishing with two or three good coats of outdoor varnish or clear cellulose lacquer.

When a full experience has been gained with these skis, a shorter and wider pair may be made and used for faster turning and stunting. These are to the general design shown in Fig. 1, but are only 4ft. 6in. long and 7in. wide. The keel is the same as before and again the toe must be on the balance point.

The Single Ski

Much better sport may be had from skiing on a single ski, Slalom style, as this requires more skill in balancing. The two feet are placed one behind the other. The ski itself is generally the same as for double skis, but must be about 5ft. 6in. long and 8in. wide and ¾in. thick. The plank must really be a piece of first-class timber, or it may split in use with the possibility of disastrous results. The keel must be somewhat larger than for ordinary skis so that a larger area is available for water resistance on turning. An ample keel could be made from a piece of wood 12in. long and ⅝in. thick tapering from 2in. deep at the heel to about ¼in. at the toe end.

The toe of the leading foot must be on the balance line of the ski just as before. A further grip for the trailing foot is required and this should be a single loop of double inner tube fixed as indicated with dotted

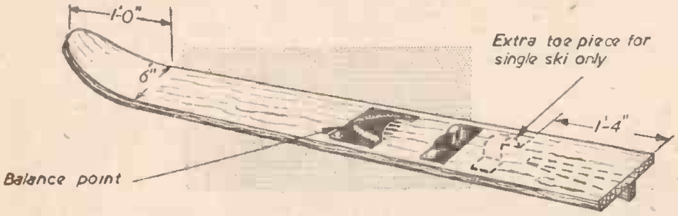
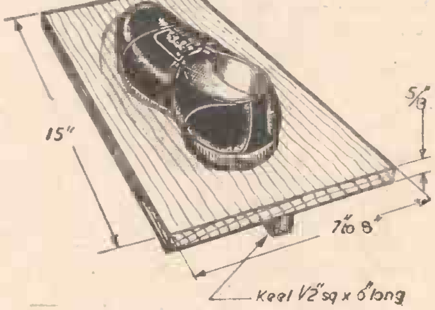


Fig. 1.—(Left) Water ski.

Fig. 4.—(Right) Shoe ski.



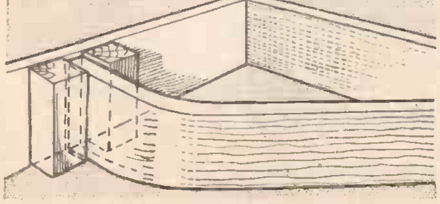


Fig. 2.—Bending the ski.

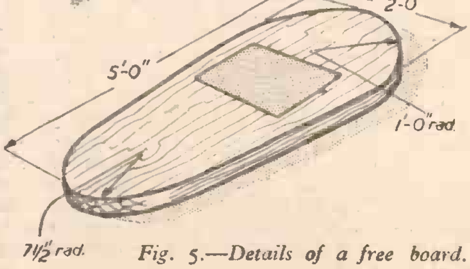


Fig. 5.—Details of a free board.

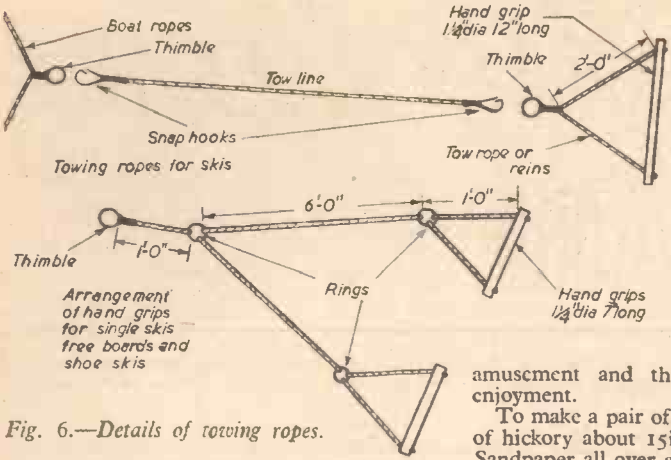


Fig. 6.—Details of towing ropes.

lines in Fig. 1. It should be positioned about 16in. from the rear end of the ski. A heavy person should make his ski about 6ft. long.

Aquaplaning

To make a suitable planing board, first obtain 5 pieces of sound tongued-and-grooved timber, each 5ft. 6in. to 6ft. long and 6in. wide by ⅝in. thick, and 3 pieces 2ft. 6in. long by 6in. wide and ⅝in. thick, plain without tongues and grooves. Make up just like a barn door as shown in Fig. 3, using 1¼in. brass countersunk screws. A piece of rope or coconut matting is used to sit upon, it should be not less than 24in. × 30in. and must be screwed into place. The tow rope is fixed underneath the board with its ends threaded through holes in the board and the cross member with the knots on top. The tow rope must be taken from the bottom as shown in Fig. 3, or the aquaplane will tend to ride under the surface of the water if the rope is taken from the upper side.

The tow line must be fixed centrally on the length of the tow rope so care must be taken to ensure that the connecting loop or ring is central. The steering rope is, of course, taken from the top of the board down through holes in the board and fixed with the knots underneath.

Shoe Skis and Free Boards

Fun and aquatics at aqua shows, swimming galas and water sports meetings may be had with shoe skis and free boards as shown in Figs. 4 and 5. When using shoe skis one appears to be almost skimming over the surface of the water without any support at all. More spills and duckings are provided for the spectator's amusement and the competitor's sporting enjoyment.

To make a pair of shoe skis obtain 2 pieces of hickory about 15in. × 8in. × ⅝in. thick. Sandpaper all over and screw a pair of shoes of the sandshoe type to them in the centre using countersunk brass screws and large washers driven into the ski from the inside of the shoe. A disc of rubber must be cemented inside the shoe to cover the screws and prevent the feet being hurt by them. A keel, made from ½in. square wood 6in. long, must be screwed to place as shown. The toe end of this keel must be rounded off quite smooth. In use a high speed of travel and a fairly steep angle will require to be kept between the surface of the water and the ski if the skier is not to sink. Quite a heavy spray is sent up when using these shoe skis and it is quite spectacular to watch a skier being towed over the water with the spray mounting 2 or 3 ft. on either side of him.

Free boards take even more skill to ride properly and to avoid landing in the water since there is nothing to keep the feet fixed to the free board. Fig. 5 shows a free board of snow shoe pattern, but they may be made in almost any shape to suit the whim or fancy of the user. The best material to use is outside plywood about ¾in. thick. Outside plywood is waterproof and is resin bonded, not glued. Water would soon dissolve glue and allow the plywood to peel.

A piece of rope or coconut matting or even a piece of carpet or cork about 15in. square, suitably fixed, will assist in obtaining a foothold but it is not absolutely necessary. A circular free board or flying saucer provides ample amusement and is most easy to make. In fact just purchase a circle of resin bonded plywood 3ft. 6in. diameter and ¾in. thick, sandpaper and varnish and all is ready for the water.

Tow Ropes and Lines

The only other pieces of equipment required are the tow ropes and lines, see Fig. 6. The tow line is best about 75ft. long although the actual length is not very important. It should be, like all other ropes, of good quality line about ¾in. to 1in. circumference and should for convenience be fitted with a snap hook at each end. The boat rope should be short to prevent fouling the propeller and it should have a thimble bound into its centre to receive the snap hook on the tow line.

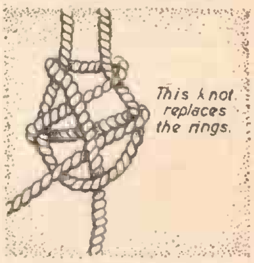


Fig. 7.—Double sheet bend.

Tow ropes or reins for skiing are made with a hand grip 1¼in. diameter × 12in. long. The rope being passed through suitable holes in the ends and properly knotted. A thimble should be bound with fine whip-cord into the centre of the rope which will require to be about 5ft. long before knotting.

For single or Slalom skiing, separate hand grips must be provided each 1¼in. diameter and 7in. long, as shown in Fig. 6, and seven pieces of rope are required for the complete set of reins—4 off at 1ft. 6in. long, 2 off at 7ft. long, and one at about 1ft. 9in. long. Either rings or thimbles may be used, properly bound into place.

If the skier cannot make a successful job of the binding and placing of the rings and thimbles, they may be replaced by a double sheet bend, shown in Fig. 7.

BOOKS Received

"Model Yacht Construction and Sailing," by C. E. Bowden. 5s. net. 137 pages. Illustrated. Published by Percival Marshall & Co. Ltd.

THIS book deals with the whole craft of making and sailing boats and includes notes on fibreglass hull construction and the wing sail. All the chapters are plentifully illustrated and there are many photographs. The section on radio control deals only with commercial transmitters and receivers, but there is something here to interest all model yacht enthusiasts.

Centenary edition of "Scouting for Boys," by Lord Baden-Powell. 12s. 6d. net. 397 pages. Illustrated. Published by C. Arthur Pearson Ltd., Tower House, Southampton Street, London, W.C.2.

"SCOUTING FOR BOYS" was originally published in fortnightly parts in 1908, and this facsimile edition, produced to mark the centenary of Baden-Powell, includes all these parts specially bound into one volume. During the last 50 years this book has been constantly revised, but the fact that it has changed very little from the original is an indication of the agelessness of Scouting. This is a book to be read and treasured by Scouts the world over.

"Atoms at Work," by John Mander, M.A., 10s. 6d. net. 118 pages. Illustrated. Published by George Newnes Ltd., Tower House, Southampton Street, W.C.2.

ATOMS, atomic energy and fission are now terms firmly established in our vocabulary. Atomic energy is a complicated and highly scientific subject, but here is a book which makes it plain for the man in the street. It is entirely non-mathematical and explains in elementary language the facts about energy and life, energy from atoms, the finding, mining, and refining of uranium, reactors, nuclear power, radio-isotopes, radiation and materials, and radio-active tracers. It is most entertainingly written and can be understood by everyone, even juniors. It is the first book to deal with this topic authoritatively yet at the same time simply.

At Scout Headquarters, on 14th February, C. Arthur Pearson Ltd., original publishers to the Boy Scouts Association, were the hosts to distinguished members of the Movement and Press, when in B.-P.'s room, The Hon. Robert Baden-Powell was handed a copy of his grandfather's famous book, "Scouting for Boys," by the grandson of the original publisher, Mr. Nigel Pearson (left in photograph). The occasion marked the centenary of Lord Baden-Powell, and publication of the centenary edition.

A DIVING RAFT DESIGN

Details for Construction and Installation in Sea or Lake

By K. VERDEN

DIVING rafts have, no doubt, been seen and used by many readers. The design is merely a flat-boarded surface raised slightly above the water. The construction is not difficult and the emphasis is on rigidity and massiveness rather than on a carefully made article.

I had some old and heavy pieces of 6in. x 3in. wood about 12ft. long, and these appeared ideal for the main frame and cross members.

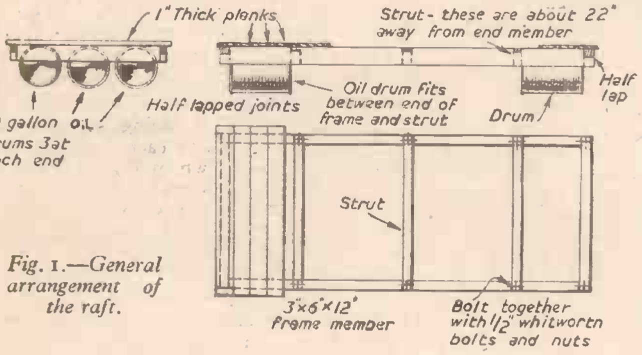


Fig. 1.—General arrangement of the raft.

As the raft is afloat for several months and is not likely to receive any attention during that period, and as the timber is very little use for other articles after such a spell in the sea, there is no need to plane the surfaces. Provided any old nails are pulled out and any broken strips of wood likely to cause injury are removed there is no need to prepare the timber, and one can go ahead with the jointing prior to bolting the framework together.

The Design

Fig. 1 illustrates the simple frame, the joints of which are half lapped. No great accuracy is required; the grooves and cuts were made with a saw and the wood only roughly trimmed with a chisel, to remove ragged edges rather than to make the parts fit correctly. When all the pieces have been so treated holes are drilled and the entire frame bolted securely with ½in. Whitworth bolts and nuts. When fitting these the wood should be counterbored sufficiently to ensure the heads are beneath the surface of the timber. This makes the later assembly of planks easier and is also a form of safety measure. Some large thick washers are needed, and one under the bolt head and another beneath the nut are useful in preventing the heads from biting deep into the timber; the inclusion of these washers distributes the pressure, and though they also sink a little you can still turn the nut and so make a tight joint (see Fig. 2).

A rigid frame is essential—the sea, of course, administers a severe buffeting on occasions, but those using the raft usually do more damage than the elements, so include three cross-members as shown in Fig. 1 and bolt these in the same way. There is no need to weaken the frame by cutting a groove halfway down the timber, fitting as in Fig. 1 overcomes this problem and also preserves the strength of the frame.

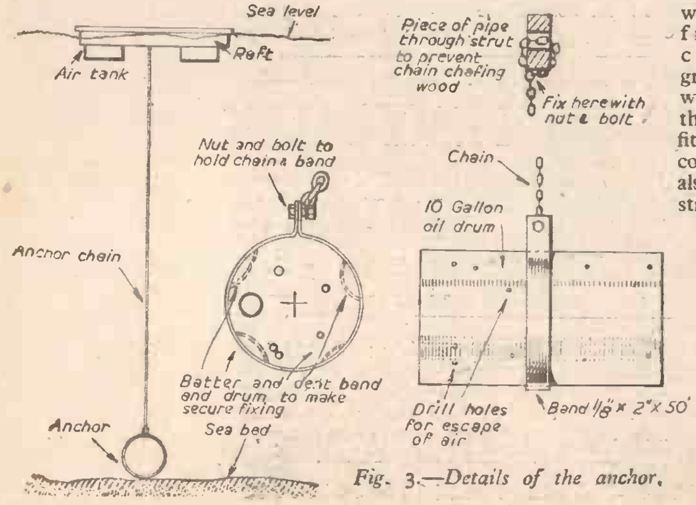


Fig. 3.—Details of the anchor.

There is little point in using brass nuts and bolts even if you can obtain them, because corrosion sets in anyway, and any subsequent dismantling means you must literally chop the wood to free the bolt. Steel bolts and nuts serve just as well and rusting does not matter.

Space the cross-members to give a gap of 22in.; this will allow the oil drums to "fit" without difficulty. These are 21in. long and 14in. diameter. I used the 10-gallon type for a raft of 12ft. long x 5ft. wide, and this is quite adequate.

The Planking

Here again old boards only are required about 1in. thick. After sawing to length, the rough edge created by the saw is smoothed down to prevent splinters, and then each is nailed in position.

Close-fitting joints are unnecessary—obviously you cannot keep water off the raft and the air-filled oil drums will lift it sufficiently off the water's surface to ensure it remains reasonably "dry" in calm seas. Nails about 3in. long ensure that the planks cannot be pulled apart.

Oil Drum Assembly

Six of these are required and they are arranged in sets of three each end, as shown in Fig. 1. The inch gap between drums and supports does not give them sufficient room to move about and yet enables them to fit easily. Brass bands are bent to fit round each drum in the other direction and these in turn are nailed to the framework. The material from which these bands are made is not important. I used brass simply because it was available, but steel about ⅛in. thick is not difficult to bend and is probably easier to obtain. Drill the bands after bending, a pencil mark where the hole is eventually to appear is sufficient to indicate the position, and once the band is completely drilled it takes but a few minutes to attach it to the frame.

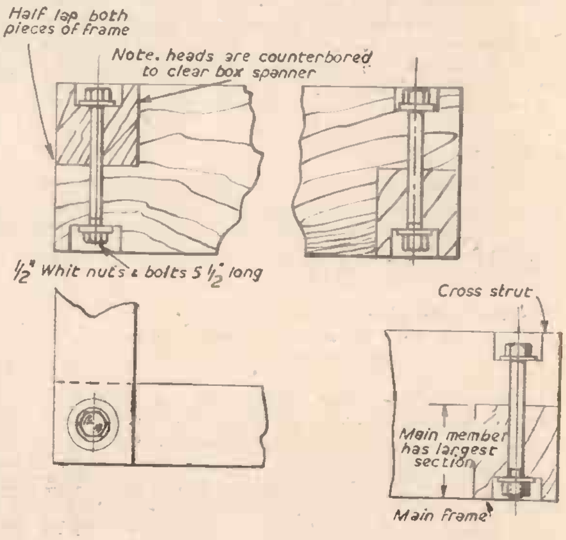


Fig. 2.—Method of jointing and bolting the frame.

The reason for working in this way is that an assembled raft with drums attached underneath is not the easiest of articles to convey to the seashore. If the drum assembly is left until the beach is reached the complete raft is fairly easily handled and the drums can pack in odd corners of a lorry or trailer.

The Anchor

First of all determine the depth at high water, and the only way to do this is to row out in a boat at that time with a long line and weight—we used a $\frac{3}{4}$in. nut tied to a length of string—and lower this over the side until it touches bottom. Allow a few feet because the tides vary, and try to manœuvre the rowing boat to the approximate position you propose to moor the raft because the sea-bed is far from level.

It you fail to carry out this simple instruction the raft will drag its anchors and will either drift away or come inshore so close that you cannot dive from it. If a lake mooring is anticipated you need not worry about it floating away. An extra 10ft. of chain means it can move very little; do not, however, cut this chain too short.

The anchor is another oil drum. I used only one, but you may find that two are preferable if the sea is rough in your area. A band was wrapped round the centre and distorted badly by some severe blows with a hammer, the idea being to prevent the band from slipping off due to tidal action. Though readers can perhaps think of other methods this proved effective and did not come adrift.

The bung was not, of course, fitted to the drum pouring hole, and to prevent air from being trapped and so reducing the weight in the "anchor" a series of holes was drilled in the ends and sides—a dozen is sufficient about $\frac{3}{16}$in. diameter.

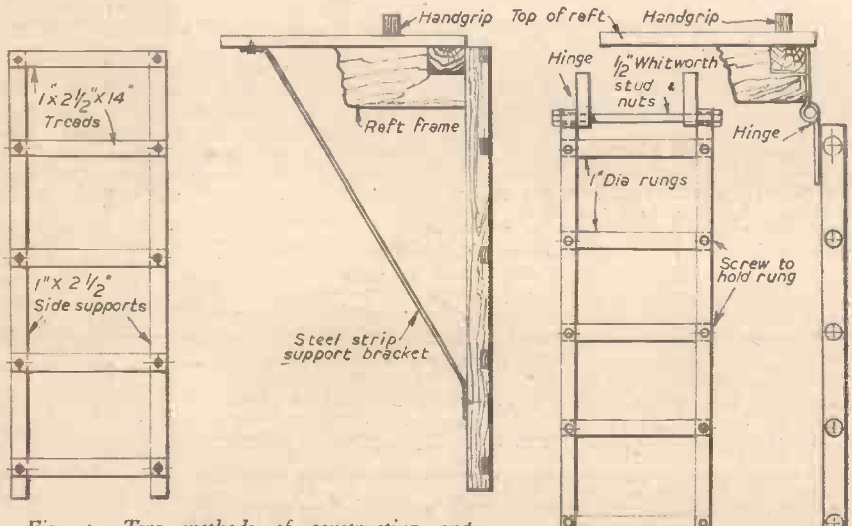


Fig. 4.—Two methods of constructing and attaching the ladder.

The anchor chain was made up of about 1in. links, roughly about the size of those chains that stretch across from post to post between gardens, and this is held to the band by means of a $\frac{1}{2}$in. Whitworth nut and bolt. Tighten the nut well and burr over the thread, then this cannot come undone while the drum is under water.

A similar fixing is made to the raft, using one of the cross braces for that purpose. A 1in. hole drilled through the timber, as shown in Fig. 3, with the chain looped round and finally bolted makes a secure mooring at that end, but leave this until the site is reached because an anchor is just as difficult to stow as the air tanks. A steel bush is useful to prevent chafing.

The Ladder

Scrambling on a raft of this description is great fun, but there are occasions when a swimmer appreciates a simple ladder secured to one end or side. About five rungs are enough and they are all below water, so there is no need for elaborate and careful construction. The two vertical members are eventually bolted to the raft, but first, on the beach, each rung is half lapped into them. The latter are smoothed, or round timber is used and inserted into holes drilled in the sides. You can, if you wish, further strengthen this ladder by the addition of two bent steel struts as shown in the detailed drawing, but if your site is tidal and the raft is likely to touch bottom, then the latter struts are not practicable and you must make a folding type of ladder. This is accomplished by hinging the top members, and when the ladder does come into contact with the sea bottom it will fold flat and so do no harm. Simple hinges are made from steel strip about $\frac{1}{8}$in. thick with a $\frac{3}{8}$in. bolt as a pivot pin, as shown in Fig. 4. Some care is necessary in negotiating a ladder of this description.

Matting

A layer of thick, coarse matting is nailed to the top surface and this gives an excellent foothold. Old domestic mats may last a season, but they damage easily and there is, of course, little respect paid to them under such conditions. The type of matting laid on cricket pitches is ideal and there is no need to use new material. Nail this matting to the sides of the raft as shown in Fig. 5, not on the top as there is less risk of protruding nail heads scratching a swimmer as he climbs aboard. Use plenty of nails. You can also attach lengths of rope by knotting both ends and securing them with staples to make handholds, about 10 or a dozen, spaced on the four sides, are enough.

The provision of a lifebelt on the raft is perhaps worth while and a simple box in one corner can house this item.

Assembly

On arriving at the beach the air tanks are fitted securely by means of the bands. The bungs, of course, must be in position. You might with advantage braze a metal bung in place instead of relying on the cheap sheet metal type supplied with the drums as this does ensure that water cannot enter and cause the raft to list.

Once these details are in place and the anchor attached the raft is again set the correct way up and floated to the site. Do not forget that until the spot is reached you should stow the anchor on the deck, otherwise it will sink and make further movement awkward. When in position drop the drum overboard and it will fill and sink in a matter of seconds.

Bolt the ladder in place—not an easy task, but one which you cannot easily accomplish ashore without damaging the rungs and side members. However, if you have assistance with one person on the raft and another in a small boat it does not take many minutes.

When the season ends and the raft is removed to shore once again the procedure

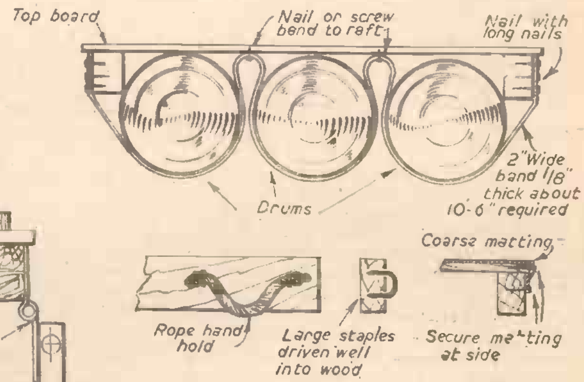


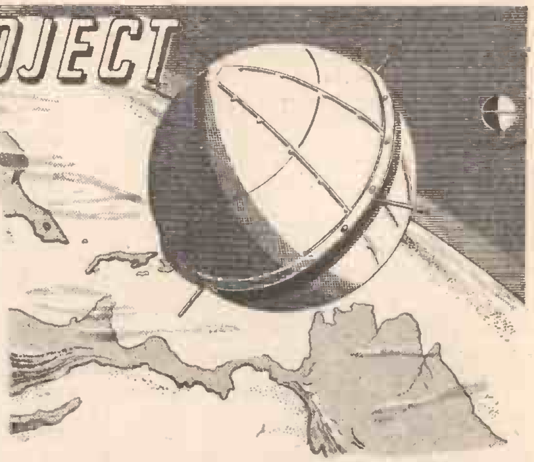
Fig. 5.—Fitting the drums, the rope handholds and the matting.

is reversed. I found the process of lifting the anchor a little difficult, but it was finally accomplished in this manner.

A length of stout rope is towed behind a dinghy—one end is held ashore while the rope is paid out over the stern. The boat encircles the raft and comes back to the person holding the end. The rope is now round the anchor chain and two or three people can haul the anchor along the sea-bed to shore bringing the raft with it. Once the latter grounds it becomes much easier to pull the chain underneath, or if you can tip it slightly, then you might unscrew the nut and bolt if two spanners are applied and not too much corrosion has taken place.

If you cannot free the anchor in this way saw through the wood into the hole in the cross brace and let the chain go. It means a new brace next year, but major overhauls are needed with this type of equipment anyway.

THE SPACE SATELLITE PROJECT



Some Recent Gleanings on the Subject

By FRANK W. COUSINS, A.M.I.E.E., F.R.A.S.

THE Russians and Americans have reached accord in one field of human endeavour—the satellite programme for the International Geophysical year 1957 to 1958. They are to work together in elaborating each country's programme and they hope to standardise the means for observing the satellites once they are launched. This good news was announced at the termination of the great 50-nation Barcelona conference. *The Times* special correspondent, writing from Barcelona on September 16th, 1956, reported that the Russian satellite, like its American counterpart, is being designed for the measurement of pressure and temperature as well as for the observations of cosmic rays, micrometeorites, the electromagnetic field and solar radiation.

Both countries have agreed that the same or similar telemetering systems will be used in the satellites to transmit the information back to the earth. Common equipment is to be installed round the earth for keeping watch on all satellites as they move in their Keplerian elliptical orbits in outer space.

The Americans confirmed at the Barcelona conference that "up to 12 satellites" may be launched during the year. Dr. F. Whipple, a leading figure in the American satellite team and director of the Astrophysical Observatory of the Smithsonian Institution, is committed to make one successful satellite flight at least. The first launch will almost certainly take place before January, 1957.

The first satellite will be launched into an orbit lying between 40 deg. on either side of the Equator (see PRACTICAL MECHANICS, November, 1955 and April, 1957). The tracking is to be both optical and by radio. The optical camera is of the Schmidt pattern, described in PRACTICAL MECHANICS, April, 1953. According to Dr. Whipple "it will be able to track a tennis ball in a given orbit." The camera has an aperture of 20in. Approximately a dozen cameras are to be made and each one is reputed to cost $70,000. Very generously the Americans have offered half of the cameras to countries along the first orbit but outside the Western Hemisphere.

A "Bulletin for Visual Observers" is obtainable from Dr. Fred Whipple, Director, Smithsonian Astrophysical Observatory, 60, Garden Street, Cambridge, 38, Mass., U.S.A. This might be of interest to any of the readers of P.M. living in areas where the satellites will be visible.

The Vanguard Rocket

In October, 1956, for the first time in history, space flight and satellites figured in the august proceedings of the International Astronautical Federation with astronautical engineers delivering papers.

The most interesting details, relevant to our present enquiry were those given by Mr. N. E. Felt on "The Vanguard Satellite Launching Vehicle." The Vanguard is a three-stage vehicle with no fins. Guidance and stability are to be attained by using a gimballed rocket motor. The vehicle has a total length of 72ft., diameter 45in., and a take-off gross weight of 22,600lb. The first stage is being built by the famous Glenn L. Martin Company and it will be powered by a rocket motor using liquid oxygen and petrol as propellants.

The second stage uses white fuming nitric acid and unsymmetrical dimethyl-hydrazine. The motor in the second stage is gimballed as for stage No. 1.

The third stage is a solid-propellant rocket and this will contain the 20in. spherical satellite, which is shielded by a cone to reduce and, if possible, prevent aerodynamic heating.

Orbit Details

The Earth Satellite as designed by Dr. Herbert R. Pfister is shown in Fig. 1. This model, now on display in the Hayden Planetarium, New York, is 18in. in diameter and weighs 25lb. "Exact" figures quoted are not in full agreement but to aid the imagination it is not far from fact to say that any one of the satellites will have a speed in orbit of 18,000 m.p.h., 300 miles above the earth and will circle the earth for 15 days to a year before losing speed and disintegrating in the more dense atmosphere as it spirals inward.

The satellite will orbit the earth once every 90 minutes. The earth rotates "under" the satellite orbit and the orbit is displaced westward some 20 deg. during each 90-minute revolution. The satellite will travel over a band from 35 to 45 deg. south latitude to the same north latitude.

The intended orbital distance of 300 miles above the earth may not be attained. Slight accumulated errors of height, angle and velocity will transpire to give an elliptical orbit having a nearest approach of not less than 200 miles and a furthest extension of not more than 1,500 miles.

For a 300-mile distant orbit of circular form the life of the satellite is calculated to be approximately one year. For a 200-mile distant orbit, 15 days, for 100 miles, less than one hour.

Satellite Construction

The satellite is to be a highly polished

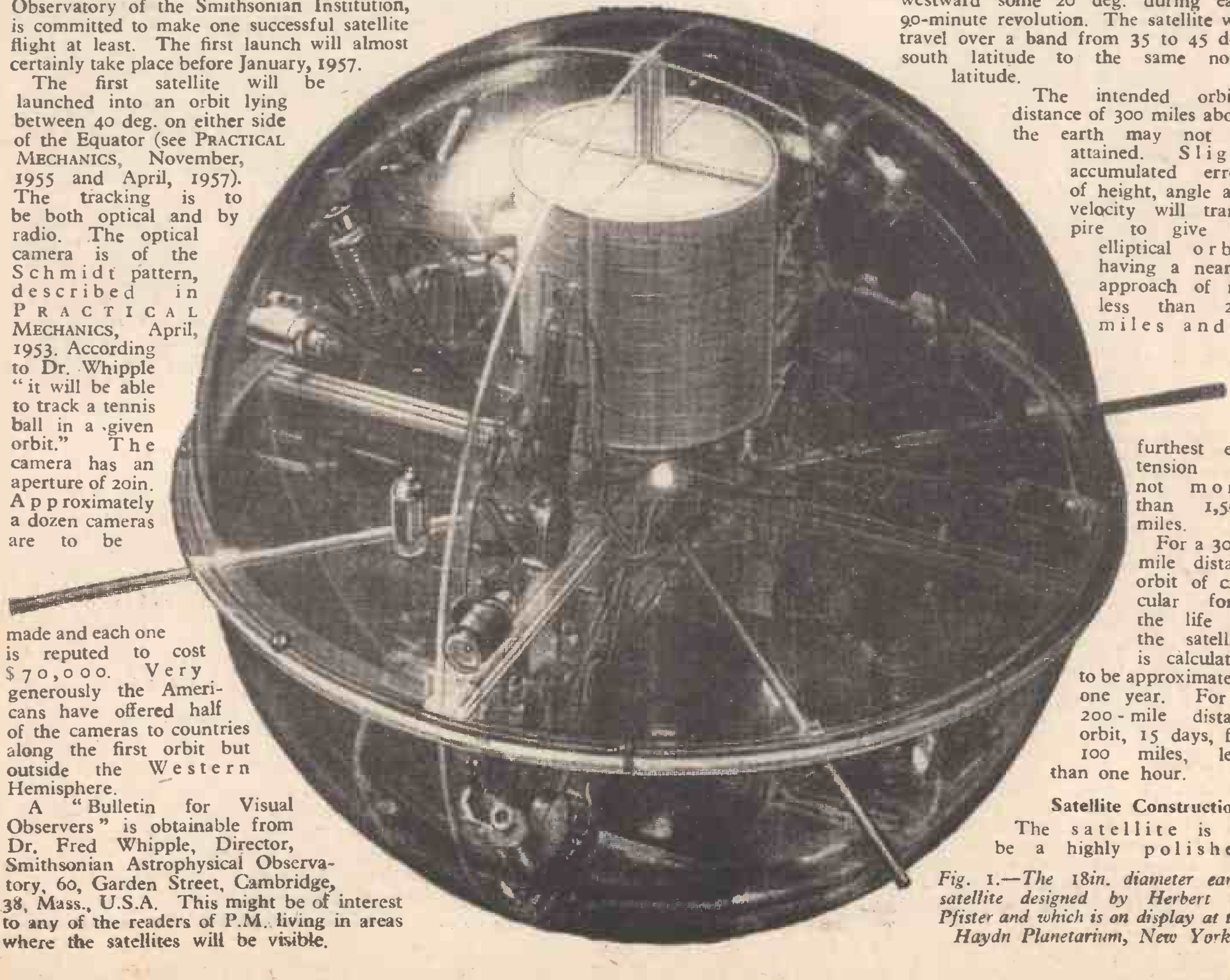


Fig. 1.—The 18in. diameter earth satellite designed by Herbert R. Pfister and which is on display at the Haydn Planetarium, New York.

sphere of 20in. diameter, weighing 21½lb. Mr. Robert L. Stedfeld gives the following information.

The shell of the satellite will account for half the all-up weight. The remaining 10lb. will include a radio tracking oscillator and transmitter, telemetering equipment, antennas and instrumentation.

The shell, *per se*, will be of magnesium metal formed into two hemispheres. The first shell has been spun from AZ13B magnesium alloy of 0.064in. thickness. The outer surface is to be contour machined and highly polished to a 4 micro-inch finish, to aid optical tracking when it is in its orbit.

The Instruments

A minitrack radio tracking system will be incorporated.

Miniaturised instruments have been developed.

(*a*) A pressure gauge comprising a bellows-actuated potentiometer to determine whether a meteorite punctures the satellite's skin. With a range of ± 15 p.s.i. the cylindrical gauge is only 1in. long, 1in. in diameter and weighs 1½oz.

(*b*) An erosion gauge which is a semi-transparent Nichrome ribbon evaporated on glass is placed on to the satellite's skin. It measures erosion caused by, *inter alia*, dust. As the ribbon wears away its resistance increases.

(*c*) A temperature gauge containing semi-conductor thermisters, able to measure changes in temperature from −140 deg. C to +150 deg. C.

(*d*) A Submeteoric Collision Microphone, which is a very small microphone behind a sounding diaphragm on the satellite's surface. A memory device stores the information until it can be transmitted.

(*e*) Lyman-Alpha equipment, which is used to detect and transmit ionization produced by far ultra-violet solar flare radiation.

Meteor Penetration

The question of meteor penetration of the satellite skin has been discussed by Dr. Ovenden. He makes the following observations. "Some 75,000,000 meteors enter the earth's atmosphere every day. With radar we can observe small meteors, down to a few tenths of a millimetre in diameter. All these observations (plus our knowledge of shooting stars) lead us to a law of meteor distribution. It is a simple law. It says that small meteors contribute just as much matter to the total meteor population as do large meteors, their smaller mass being just compensated by their larger numbers. Using this law we can estimate the number of meteors smaller than those that we can detect directly. According to these figures a small satellite with a skin about .01in. thick and a diameter of about 3ft. should be punctured by a small meteor once every few months."

If the satellite gets into the 300-miles distant orbit the pressure gauge and Submeteoric Collision Microphone should not be unduly busy.

Analysis of Future Trends

Prior to the establishment of a manned satellite, the work to be achieved in the coming experiments is of inestimable value. The environmental hazards of cosmic radiation, meteors, solar heat (and the absence of it) and weightlessness will be able to be calculated from precise information.

The second problem for a manned satellite is the one of safe return to the earth's surface. The relative speed of five miles per second between the orbiting vehicle and the earth's surface must be brought to zero. Obviously this will be done by allowing the satellite to transfer its energy to the atmosphere. But the process must be controlled with precision lest the satellite absorbs too much energy in the form of heat.

Mr. T. R. F. Nonweiler has addressed himself to the study of skin heating, and in a paper presented to the International Astronautical Congress entitled "Skin Heating During Re-entry of Satellite Vehicles to the Atmosphere" he makes the following observations. Particular attention to the flight plan and overall design can greatly simplify the problem of kinetic heating. Nose temperatures need not be greater than 1,000 deg. C. The greater the skin thickness the lower would be the maximum temperature, but in practice there would always be a limit to the allowable thickness. The emissivity of the outer surfaces will need to be made as high as possible.

Moon Satellites

The next logical step after the small satellites have given up their data will be the setting up of Moon satellites. Mr. R. W. Buchheim has calculated their orbits. For a stable retrograde orbit (opposite in direction to the Earth/Moon system) an initial accuracy of altitude and velocity 20 times greater than that required by the Vanguard project is necessary. For a direct orbit, that is one in the same direction of rotation as the Earth/Moon system, this accuracy would again need to be doubled. Mr. Buchheim has shown that satellites of visual magnitude 10 to 6 would have to be 132ft. to 832ft. dia., and assuming the skin to be made of aluminium foil 0.0001in. thick the weight would be 79lb. to 3,140lb. A rocket vehicle with an overall weight of about 1,000,000lb. would be needed to project a 500lb. pay-load from the earth on to a trajectory of the type required.

It is a sobering thought in the dawn of the Geophysical Year to record that the prophetic dreamers—*Ziolkovsky*, 1903, in his "The Exploration of Cosmic Space by Reaction Machines," *Goddard*, 1919, in his "A Method of Reaching Extreme Altitudes" and *Oberth*, 1923, in his "The Rocket into Interplanetary Space" had the main concepts fully clear in their minds. The main concepts of fundamental character propounded were (and still are):

(*a*) Escape from the earth is possible by the application of a moderate acceleration over a substantial period of time.

(*b*) Such acceleration can be produced in vacuums by a rocket.

(*c*) The rocket must have high thermal efficiency, i.e., high velocity of ejected matter, and consist mainly of propellant material.

(*d*) High thermal efficiency is to be obtained most readily from the chemical combustion of liquid fuel.

It is clear that man is still a long way technically from desporting himself in space. But even the most ardent critics of space travel have to admit that the sounding board is now ready. It is with great excitement that we await the correlated data from the midget spheres.

Painting from a Balloon

FROM France comes news of a novel way of painting ceilings of large halls and cupolas or naves of churches; it was instituted by a Paris firm of decorators for painting the cupola of the new church of Yvetot. The idea is of a small platform fixed on the top of a balloon inflated with hydrogen. The painter is hoisted to the roof by pulley and cable and lowered into the 4ft. square platform. He can be moved from place to place by a man on the ground holding a guide rope.

New Magnetic Observatory

HARTLAND has been chosen for the site of a new Magnetic Observatory (erected as part of the Royal Greenwich Observatory), because artificial magnetic disturbances in the vicinity are few. Electrification of the railways and the spread of industry has caused the Observatory to be moved twice, first from Greenwich to Abinger in Surrey, and now to Hartland in Devon.

Instruments are being installed that will record continuously fluctuations in the direction and intensity of the Earth's magnetic field. These variations are closely associated with "magnetic storms," auroral displays and phenomena occurring on the Sun.

Water-repelling Treatment for Masonry

A NEW treatment which makes brickwork and masonry completely water-repellent has been perfected in the Evode, Ltd., Laboratories, Common Road, Stafford. It is a colourless solution based on a silicone resin and is called Evosil. One treatment, it is claimed, will last many years, but the material is not intended to remedy existing defects, such as bad jointing, cracks, etc.

Weather Charts by Radio

A MUFAX Chart Recorder, for displaying facsimile picture transmissions of weather charts, is now on exhibition in the Science Museum.

The recorder, which has been lent by the makers, Muirhead and Co. Ltd., reproduces a whole chart in 35 minutes or less, depending on the speed setting, and throughout the recording the progressively growing chart is visible on a flat platen.

The exhibit can be shown in operation and will normally be used to record the transmissions broadcast from Dunstable Meteorological Station at 12.10 hours and 16.50 hours.

Bridge Has Ray Warning

SO many accidents have occurred to high vehicles trying to pass under a 9ft.-high bridge in Burton-on-Trent that a special ray warning device has been installed.

Nothing happens so long as the ray is unbroken, but should a vehicle over 9ft. high cross it, a large illuminated sign will appear, saying, "Stop, you cannot pass under bridge," a klaxon horn will sound, and a red light will be directed towards the vehicle.

Germs Survive 50 Years

WHEN bacteriologists made tests of the soil in the Antarctic last year, they found tetanus germs left by the horses in Captain Scott's expedition 50 years ago. They had lain dormant for half a century.

New American Aircraft

THE Bell X-2 supersonic aircraft is powered by the first throttleable rocket engine to be developed in the U.S. and has flown at over 1,900 m.p.h. (faster than the muzzle velocity of many projectiles!).

To avoid serious loss of strength in the airframe due to heat build-up caused by air friction, the plane was fabricated with a skin of heat-resistant stainless steel on its wings and tail.

Throwing a Line of Life

Use of the Schermuly Pistol Rocket Apparatus To-day

Fig. 1.—Firing a Schermuly rocket pistol.

THE saving of life at sea is one of the proudest traditions of our country as a maritime nation. Perhaps, then, it is logical, certainly appropriate, that a British idea, the Schermuly Pistol Rocket Apparatus, should have become virtually the world's standard line-throwing equipment. Nothing has been more successful in cheating the sea of its prey. Nothing has a finer record of saved lives to its credit. Stories of the use of rocket apparatus have a thrill and dramatic quality that is hard to beat. One of these comes from the National Safety Association of Iceland.

Fig. 2.—A rocket line being fired from the Wolf Rock Lighthouse to a Trinity House relief launch during a gale.

The Apparatus in Use

A fierce gale howled along that treacherous iron-bound coast. Great seas roared out of the murk in never-ceasing thunder to break in a smother of white foam all along the wind-swept shore. The watchers of the Safety Association were on the alert. One of them reported on a trawler which was in distress and finally ran aground 140 yards from the shore, in a most difficult position and some seven miles from the nearest habitation.

Obviously no rescue boat could live, even if a boat could be obtained, in that heaving maelstrom of waters. The only hope was to get a line aboard and word was sent out for the rocket apparatus of the Association.

The hardy men who formed that rocket squad had the greatest difficulty in reaching the scene of the disaster, even with their light equipment. They found the wreck in such a position that the rocket could only be fired from a low, wave-swept rock. A rope was hastily tied round one of the men, who waded out through the breaking waves to clamber on to that slippery, well-nigh submerged foothold. There he stood, or clung, frequently being half covered by successive incoming waves. It seemed impossible that he could maintain his position with sufficient steadiness to fire his rocket between the doomed trawler's deck and the wireless aerial that stretched between her masts.

Away went the rocket carrying its thin line—the harbinger of life to those dark figures clinging to the decks of the stricken ship. Well and truly sped the life-saving missile, to be seized by the drenched crew, whilst the heroic fellow who fired the shot was hauled from his precarious position.

A thicker rope followed the one that was first carried by the rocket pistol, and soon the breeches buoy was rigged and man after man of the crew was hauled to safety. Less than 15 minutes later the luckless trawler gave a final roll and disappeared beneath the relentless waves that had driven her to destruction.

Nothing but a Schermuly Pistol Rocket could have been used or aimed with sufficient accuracy from such an insecure foothold, and something like 60 lives had been saved previously by the actual pistol rocket apparatus used on that occasion.

Another Tale of Rescue

But the story of the Schermuly does not end there. A Norwegian-American liner lost

Fig. 3.—A lifeboat throws a line of life to a vessel in distress.

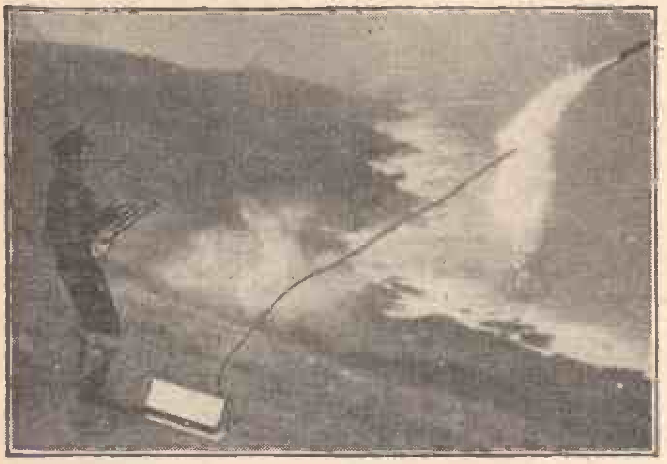


Fig. 4 (Left).—A coastguard using the Schermuly pistol.

Fig. 5 (Right).—The Thames police help a crew in distress. A drawing of an actual incident at Erith.

its rudder in the North Atlantic. A Force 8 gale with a heavy sea was driving over the scene as another vessel with its stern against the wind manœuvred towards the helpless ship. Slowly, surely, the rescuer bore down upon the hulk until the distance between the two on that heaving waste of water was some 200 metres. Then the captain snapped "Fire!" and the rocket from the Schermuly equipment carried by the helpless vessel landed on the forecastle of the rescuer with the line lying over the ship from stern to bow. It would be hard to say more for the accuracy and reliability

Fig. 6 (Left).—Policewomen receive instruction from a Thames Police Officer as part of their general training.

of the famous Schermuly equipment under really difficult conditions.

Lighthouse Relief

The difficulties of relief to such a light as the Wolf Rock, that lonely light that lies between the Lizard and the Scilly Islands in one of the most exposed positions round our shores, are very great when successive gales blow out of the west. Even the difficulties of getting fresh food and equipment to the men who man that solitary lighthouse are considerable. Figure 2 shows a picture of the way the line-throwing equipment helps to that end. The launch from the Trinity House tender is in the foreground. The rocket fired from the light lands a line across the launch, and up go the vital supplies so necessary to the men responsible for that desolate outpost of the sea. That is another phase of the marine application of the Schermuly apparatus. The Schermuly Pistol Rocket Apparatus is used by our Royal Navy and the navies of several other countries, as well as being carried in all British ships and a large proportion of the ships of some 23 other nations. It is used by the Coastguard Service (Figs. 1 and 4), the Royal National Lifeboat Institution (Fig. 3), Trinity House and their equivalents in some 14 other countries overseas.

Some Other Uses

It figures also in all sorts of other, sometimes quite unexpected, connections. The rocket pistol has been used to throw a rescue line to bathers and to boats in danger (Fig. 5). In that application the rockets carry a buoyant head and floating lines. As can be seen in Fig. 6, the London Police receive instruction in its use.

The Schermuly is a standard rescue equipment for London and very many of the provincial fire brigades (see Fig. 7), but even that is not all. Engineers use it for casting lines over ravines. The Forestry Commission use the rocket pistol for getting lines over high trees from which they want to obtain the seed pods.

Wherever you want to throw a line, for almost any purpose, there a Schermuly Rocket Pistol can be used with success, because of its reliability and accuracy. Incidentally, the manufacturers of the equipment produced the grapnel rocket line throwers which were used by the allied troops in scaling the cliffs of Normandy during the D-Day landings. They have just produced another equipment which is lighter, stronger and more compact than anything yet evolved. They call it the "International" Set. It employs "Viking" nylon sheathed line, specially developed for this work.

The line-throwing idea of British seaman William Schermuly has become accepted the world over. He fought for it for over 30 years and died 19 days after the Bill, which made it compulsory on British ships, came into force. Thousands living to-day owe their lives to the dogged perseverance and ingenuity of its originator whose son, Captain Schermuly, directs its development to-day.

This article was reprinted from "Rope Talks" by permission of the Editor.

The photographs are by courtesy of Schermuly Pistol Rocket Apparatus Ltd.

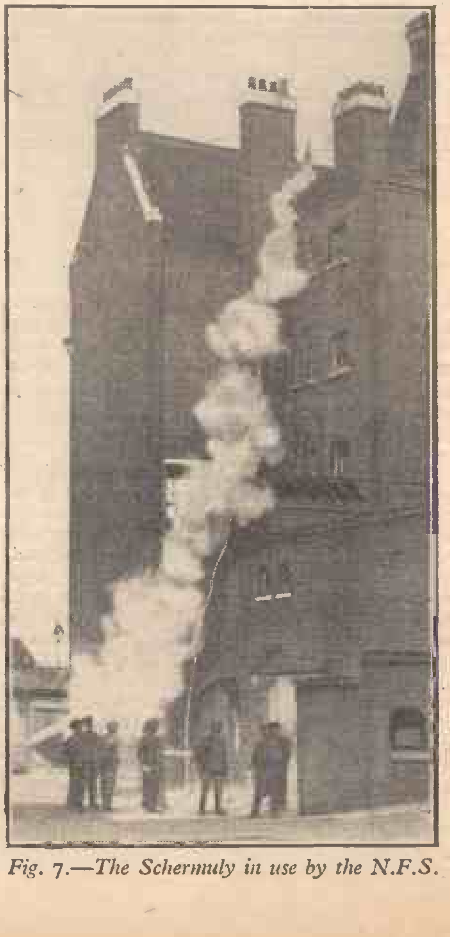
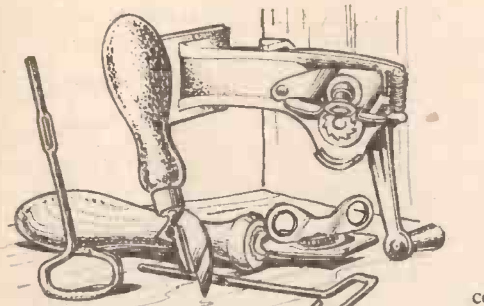


Fig. 7.—The Schermuly in use by the N.F.S.



CAN OPENERS

A Discussion on the Types Available and Using the Empty Cans

By F. DANIELS

THE traditional type of can opener, of the type shown at C in Fig. 1., has probably been responsible for more lacerated fingers than any other item in household use.

The makers of some rectangular cans, such as those used for sardines and corned beef, provide a small projecting tag at one end of the lid, or on a "belt" round the tin; and sometimes a key to operate on the tag comes with the tin. This type of key, T-shaped with a slot in the stem, as illustrated at A in Fig. 1, is familiar enough, but for a few pence one can buy a much better version, as illustrated at B in Fig. 1. It gives much more leverage, is therefore easier on the fingers, and it is not liable to break. The slot does not run centrally down the stem but runs diagonally out, so that it is open at one end; this enables the key to be drawn out of the coiled-up lid or belt after it has done its job.

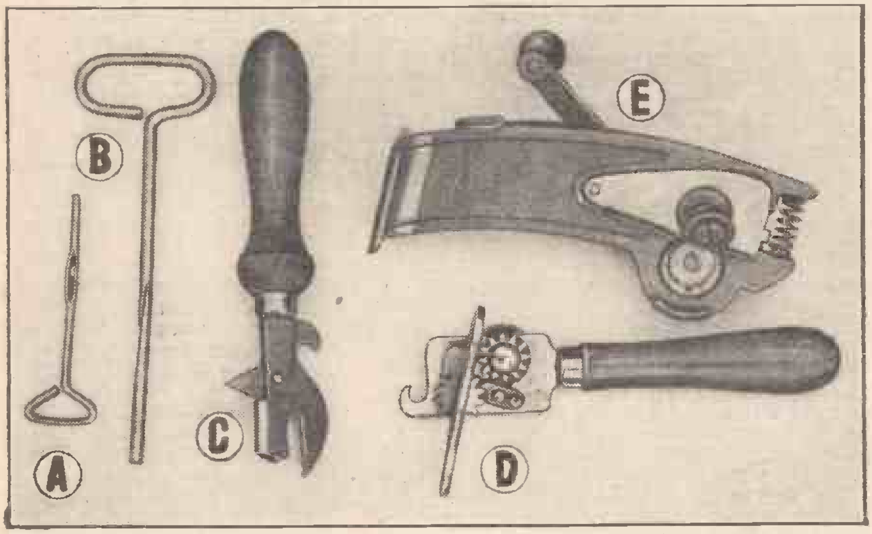


Fig. 1.—A selection of can openers. A—a sardine tin key. B—A larger and improved version. C—The traditional can opener. D—Serrated wheel type. E—An improved design.

Even with this type of key, however, success is by no means certain, and in any case it is really better to have the entire lid removed from a sardine tin, and if the small end is cut out of a corned-beef tin, in addition to taking off the other end or the "belt," it enables the contents of the tin to be pushed out whole and without any bother.

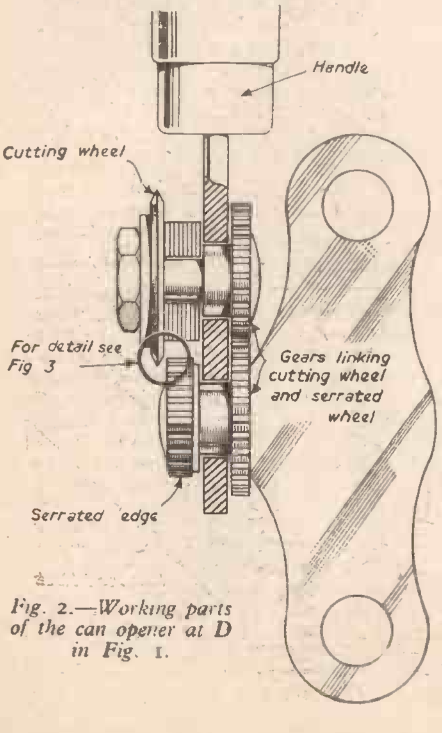


Fig. 2.—Working parts of the can opener at D in Fig. 1.

A Different Principle

What is really required, then, is some tool which will cut the end out of any and every shape of can, cleanly and quickly, and without danger to the operator's fingers or temper. D in Fig. 1 is rather interesting as an early example of an entirely new line of approach to the problem. It works on the principle, which still holds the field, of using a serrated wheel, working on the lip of the can, to rotate the can against the pressure of a cutting wheel, as shown in Fig. 2 and 3; but it has three weaknesses:

(1) It needs three hands—one to hold the handle (vertically), a second to turn the wing nut, and a third to hold the tin!

(2) The wing nut gives insufficient leverage, and considerable strength of thumb and fingers is therefore needed to operate the tool.

(3) The cutting edge of the cutting wheel is too far from the edge of the tin to have an efficient "scissors" action on the lid of the tin.

The Modern Answer

There are on the market to-day several makes of can opener, broadly similar in general layout to E in Fig. 1, which have met the first of these weaknesses by being designed for fixing to a wall, door, or other vertical surface, and which can then be provided with a good, long operating handle, which gets over the second weakness. The third weakness rendered the opener useless as can be seen in Fig. 3, and some slightly differing remedies are worth studying.

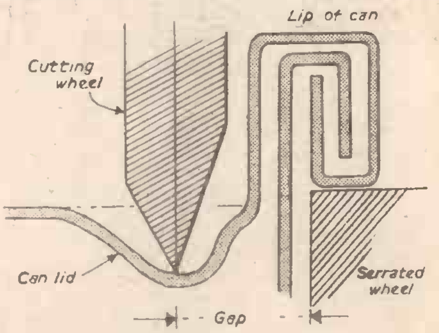


Fig. 3.—Enlargement of detail inside circle in Fig. 2. The gap between cutting wheel and serrated wheel is so wide that the can lid bends instead of shearing.

The basic difficulty about getting a good "scissors" action between the cutting wheel and the serrated wheel is the fact that the cutting wheel has to work inside the curve of the edge of the can, and reach down about 5/32in. to penetrate and cut the lid, as shown in Fig. 4. This shows the gap that must exist between a vertical cutting edge of 15/16in. diameter, as used on opener D, if it is to work insider a corner of ½in. radius. The dotted lines show how the gap can be reduced simply by tilting the cutting edge, and reduced again by decreasing the diameter of the cutting edge itself.

Fig. 5 shows the working parts of can opener E (Fig. 1). A lever rotates the bush, through which the spindle of the serrated wheel passes eccentrically, and this lowers the serrated wheel, so that the lip of the tin can be put between the two wheels. Returning the lever raises the can into the cutting position, as seen in Fig. 6, forcing the cutting wheel through the lid of the

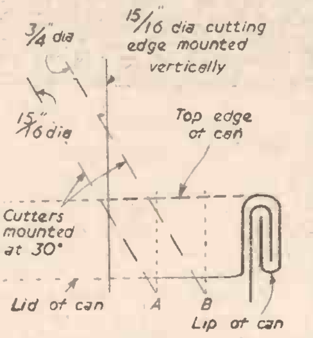


Fig. 4.—showing how the distance of the cutting edge from the serrated wheel, when working round a corner of ½in. radius can be reduced by inclining the cutter as at A and by reducing the diameter of the cutter as at B. The geometry has been omitted.

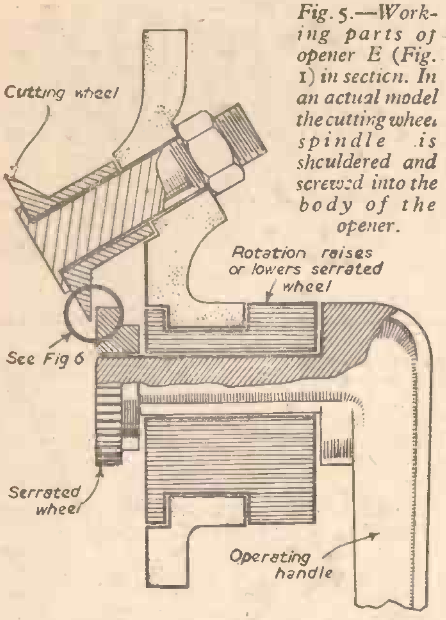


Fig. 5.—Working parts of opener E (Fig. 1) in section. In an actual model the cutting wheel spindle is shouldered and screwed into the body of the opener.

can (ready for cutting to start) at the end of its stroke. The fact that in this and other openers the axis of the cutting wheel is set out of parallel with that of the serrated wheel in the horizontal plane, as well as in the vertical plane, is being ignored for present purposes.

The particular opener illustrated at E in Fig. 1 and in Fig. 5, is believed to have been off the market for a good number of years, but one which is superficially identical is available. An important difference between the two is that instead of the cutting wheel being mounted on a plain spindle it is mounted on a threaded one, which can be turned by screwdriver after loosening a lock-nut, the object being to adjust the gap between cutting wheel and serrated wheel if this becomes necessary. Experience shows that adjustment does become necessary, possibly as a result of warping of the die-cast body of the opener, and the facility is therefore really essential. This type of opener is simple and relatively inexpensive and does its job.

Other models are constructed of sheet steel and are more expensive but embody additional features. In the first place the bracket is more elaborate, so that after use the opener can be folded back against the wall, although it can still be taken off its bracket entirely for cleaning or for separate storage if desired. Then again, a feature of pioneer model D (Fig. 1) is retained, in that the cutting wheel is linked by gearing to the serrated wheel and is, therefore, positively driven, instead of being allowed to "float." This probably makes for better results when the edge of the cutting wheel gets chipped, so that replacement of the wheel can be delayed.

The arrangements for getting a good "scissors" action show two interesting alternatives to the scheme dealt with in Figs. 5 and 6. The one shown in Fig. 7 uses a wheel with its longer and flatter bevel outwards. This seems designed to have the effect of pressing the cutting wheel rather more inwards (i.e., towards the serrated wheel) as it cuts.

An arrangement which takes that idea a step farther is shown in Fig. 8. In this case it is the cutting wheel, instead of the serrated wheel, which is mounted on a movable spindle, and the movement is at right angles to the spindle of the cutting wheel, instead of in a vertical direction. This means that the cutting wheel is continuously self-adjusting. When pulled down to start a cut it ends up as close to the edge of the tin as is possible, and is maintained in that position by the reaction of the tin lid to the cut.

One model has a magnet on it, for the purpose of lifting off the lid of the can when it has been cut round. This brings out the point that whereas an ordinary (hand) opener *raises* the lid as it cuts (or gashes!), the wall-mounted types *depress* it, and a magnet is certainly the easiest way to lift it out; any odd magnet tied by a short piece of string to the bracket of the opener would serve.

Using the Empty Tins

So far this subject has been viewed purely from the housewife's point of view, with the idea of doing an awkward job quickly and neatly. There is, however, another aspect of the matter, in that the cut edge of the tin itself is so neatly smoothed down that it becomes practicable to wash the tins

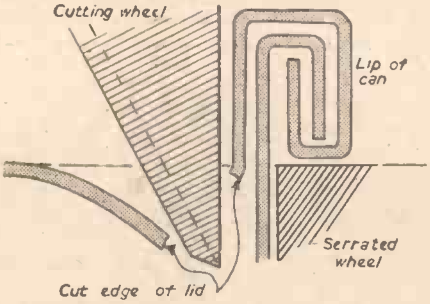


Fig. 6.—Enlarged detail from Fig. 5, showing how cut edge of lid is flattened against side of can.

when empty, and put them to other uses, without the risk of torn fingers. They could be used for holding small "working stocks" of paint. While not much use for long-term storage, as they rust fairly readily, they are very handy for temporary storage, e.g., for holding screws and small parts when dismantling something which is to be reassembled fairly soon. Flat oval tins come in handy for holding small quantities of liquid for which a broad brush is to be used, while if one is applying a thing like

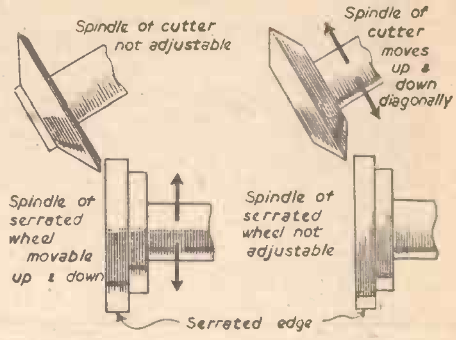


Fig. 7.—This arrangement probably gives a slight undercutting effect to neaten the cut edge of the lid.

Fig. 8.—In this case one would expect the neatening effect on the cut edge of the lid to be even more pronounced.

tar it is better to be able to use a tin and then throw it away, instead of having to use a paint kettle and then clean it out!

Then there is the matter of disposal of slack coal. One cannot afford to waste it. Real use can be made of it by filling it into a tin, which is placed on the fire-stool when lighting the fire, as shown in Fig. 9. As the fire burns up, the slack will give off gas which burns, and will ultimately leave a lump of coke, which can be tipped out (using tongs) on to the fire to burn normally.

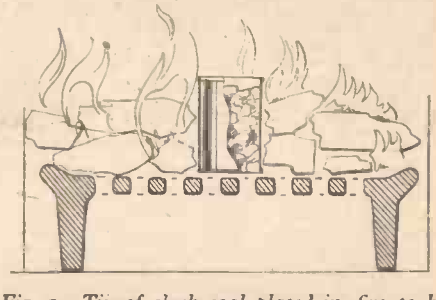
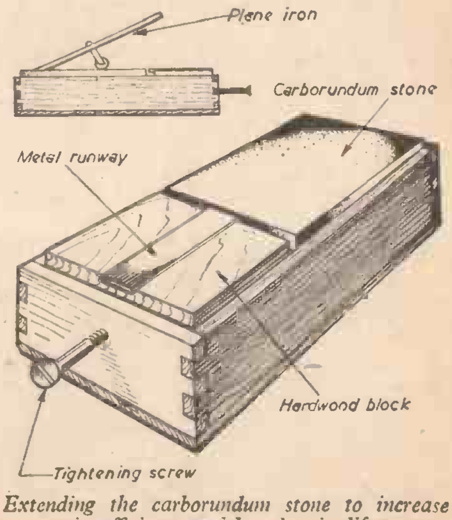


Fig. 9—Tin of slack coal placed in fire to be coked and burnt.

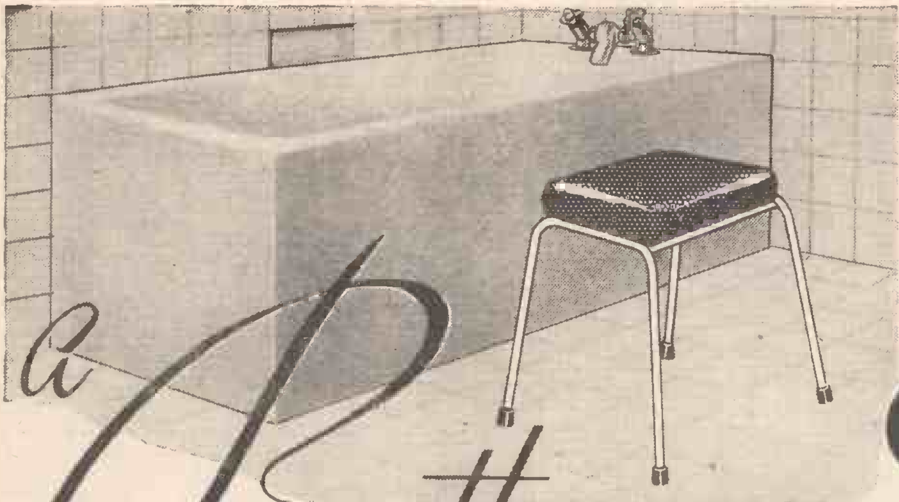
Sharpening Plane Irons

By L. R. MORTIMER

It is difficult to get a keen edge on a plane iron, as it takes a good deal of practice to maintain the correct angle throughout the stroke when sharpening. To overcome this, Stanley Planes Ltd. produce a useful gadget which automatically ensures the correct angle when grinding or honing. The only disadvantage of this otherwise very useful tool is that only half the stone can be used since the gadget consists of a wheel that runs on its surface. To avoid this, a box can be made to hold the stone and also a wood block which need be only half the length of the stone. Hardwood should be used, otherwise the wheel soon wears a groove, or, alternatively, a piece of brass can be inserted (e.g., a piece of "runner railway" curtain rod can be used, the edges of which fit into grooves cut in the top of the wood block). To ensure smooth running, the block should abut tightly against the stone; this can be done by making the block slightly longer at the top than at the bottom and also by the insertion of a screw at the end of the box for tightening up. If a brass run is used, it should overlap by about 1/32in. The hole for the screw should be slightly smaller than the shank for the screw, which will then tap its own thread. The total length of stone and block should be ¼in. less than the interior of the box so that the stone can be easily extracted. A hinged cover completes the job.



Extending the carborundum stone to increase its efficiency and lengthen its life.



A Bathroom Stool

The Bending of the Tubing is Carried Out on a Simple Bending Wheel Which is Also Described in This Instructive Article

By K. VERDEN

THERE is nothing original about this design, and at the same time nothing complicated, but to the amateur acquainted with metal bending there is one apparently difficult operation which needs a little thought in order to effect a satisfactory conclusion.

Fig. 1 illustrates the assembly of this stool.

Two curved tubes form the legs and these are joined at the top by another pair of straight tubes. On these is secured the seat—a simple wood affair with only a small amount of packing underneath a Tygan covering.

Incidentally, these legs are not perfectly vertical—they slope outwards towards the feet about 2in. in both directions. By this is meant that the spacing increases both between each pair of feet at either end and between each pair of legs. This tapering gives the stool a nicer appearance than if vertical legs were used and the additional spacing of the feet ensures a greater stability to what, after all, seems rather a flimsy piece of furniture.

Having reviewed the design, the next step is to decide on what material to use for the legs, and this will depend on the finish you wish to finally attain.

For instance, if a plated finish is desired, then copper tubing is the obvious choice because plating is much more effective on this metal than any other. Though the initial cost is greater, the plating does not peel in the manner which I feel all readers of these notes are well aware.

If you are satisfied with a painted finish, then bright steel tubes are used because the paint adheres to these just as well as the copper variety.

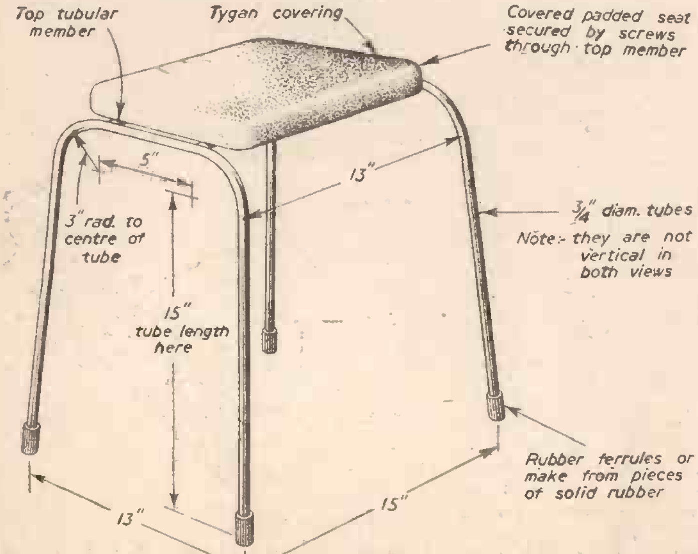


Fig. 1. (*Left*)—*An assembly drawing of the stool.*

Bending the Tubes

The method you adopt for the bending of these legs will depend solely on whether you possess a small centre lathe in your workshop, so just for those readers' benefit I propose to give details of a simple tube bending accessory.

You often read in text books that to bend a tube satisfactorily filling with resin or lead is necessary; but if a pair of bending rolls are turned, as indicated at Fig. 2, this practice is unnecessary.

Readers can note that each roller is grooved to take half the tube diameter—in other words the periphery is completely supported and cannot distort. So I advise those with a lathe to carefully make a tool for these grooves, and just in case some feel a little dubious over their ability to grind such a member, let me explain that if you possess a tool holder similar to that shown at Fig. 3 there is no need to grind the radius. The tool is merely a slice turned on from a bar of high speed or cast steel to $\frac{3}{8}$in. diameter. Silver steel of this diameter, if you have any, will also make a good tool, so turn the clearance angle as I have shown. Heat to a bright red colour and plunge into water.

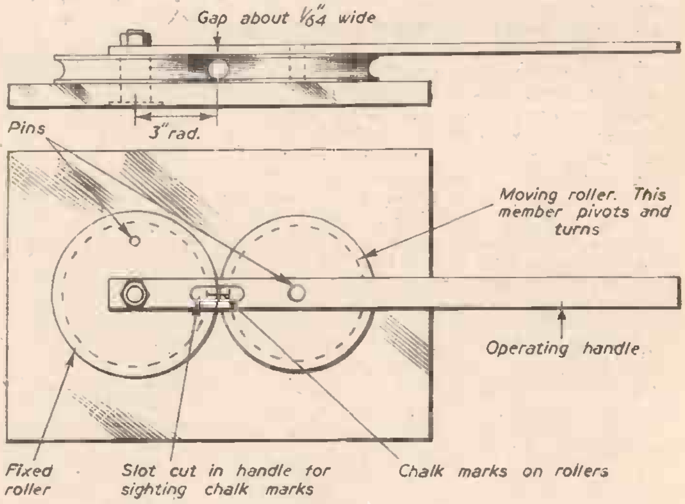


Fig. 2. (*Above*)—*The rollers for bending the tubes.*

You may find that with such a broad cut, chatter is set up, especially if your machine is a small one, so rough turn the form before applying the tool and run the lathe slowly during the process.

Experimental Bending

Some readers have never bent a piece of tube before, so now is the time to carry out one or two brief experiments and also gain a little experience prior to bending the tubes for this stool.

When you are satisfied that the result of

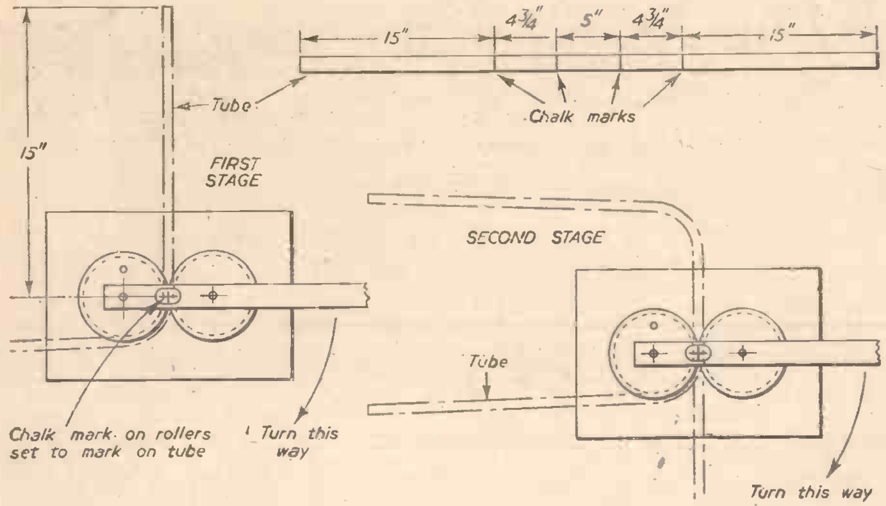


Fig. 4.—Brief sketches showing the tube in position ready for bending.

your efforts will produce a perfect bend, cut two pieces to length according to the desired height of your stool. This length is calculated assuming a 3in. radius through the centre of a tube ; thus each bend requires $\frac{\pi \times D}{4}$, where π is 3.14, D is the diameter, or 6in. in this case, and 4 is equal to a quarter of the circumference. Thus, $\frac{3.14 \times 6}{4} = 4.71$, say 4¾in.

The two vertical legs equal 15in. and the top piece 5in., so the total length of each tube is $4\frac{3}{4} + 4\frac{3}{4} + 15 + 15 + 5 = 44\frac{1}{2}$in. If you lengthen or shorten the legs and keep the same radii, then a small adjustment to the 15in. figures will produce the dimension for you.

Measure off the height of 15in. on one tube and make a chalk mark to indicate where this occurs. Make another 14½in. away and both these marks show where you must commence the bends.

Fig. 4 shows the tube in position ready for the initial operation and the final bend, and I believe the notes on the drawing are sufficient to explain the set-up.

Pull the handle round carefully and fairly slowly—at least do not make a quick grab shall we say, but a steady pull results in a perfect bend in three or four seconds.

Next move the tube to second position and again repeat the process, setting the chalk mark on the wheel centre line. Treat the other tube in the same way and check to see they have both the same leg length. You may find the tubes stretch a little or perhaps the setting is not quite so accurate as you may have imagined, but an eighth or so is of no consequence and you can file this off when the tubes are welded or brazed.

The Second Method

For those readers who do not possess a lathe, an easy way out of this difficulty is to take the tubes already cut to the length of 45½in. along to a plumber and ask him to bend them for you for a fee. This takes only a few minutes as he possesses suitable hand-rollers for this type of material, and half-a-crown or so should cover the labour involved. Incidentally, if you care to examine these rollers while watching the tubes being bent, you can observe that they are similar in principle to the gadget I have drawn in these notes.

Welding the Tubes

If steel tubes are employed for this stool, welding is necessary, so cut the cross-members to a curved shape to fit the adjacent tube, as I show in the enlarged sketch. A half-round file soon performs this work for you, and when both ends are correct they are ready for welding. One item you should pay attention to concerns the position of these formed ends—make sure they are both "the same way round," in a manner of speaking, and that one is not filed at right-angles to the other.

Again, see that both tubes are the same length, otherwise when welding is completed the frame will look a little odd, so check them

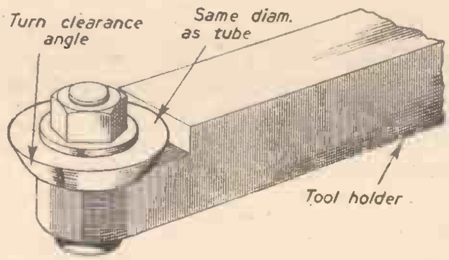


Fig. 3.—A tool holder which a lathe user can make for turning profiles similar to that needed for the machining of these grooves in the rolls.

carefully with a steel rule and endeavour to maintain an accuracy of $\pm 1/32$in.

If you use copper tubes then brazing instead of welding is specified ; both methods, of course, give a strong joint which will stand up to all normal requirements.

The local garage will readily weld or braze these pieces together, but to ensure they do not have the legs at different angles, make them a stiff cardboard template and they can set the second leg properly after welding the first member to the cross-bar.

The Seat

The seat is made from a wood and plywood frame and is secured to the frame with the aid of four woodscrews passing through the tubes, as indicated in the cross-sectional sketch at Fig. 5. Half lap the frame and screw the plywood to the lower face.

One of the best materials for this type of seat is two thicknesses of coloured sponge rubber sheeting which can be purchased quite cheaply—one sheet making the two layers easily. Cut them the same size as the plywood and cover over with Tygan or other suitable material, preferably one with a plastic base, in view of the damp conditions this stool encounters.

For the same reason use only brass screws and make sure when painting that the surface of steel tubes is completely covered.

Painting

If any rust is present on the tubes, obviously you must remove this before commencing to paint, so apply some smooth emery cloth until a bright surface results. I would still perform this simple task even if the metal is bright because I believe the application of emery cloth lightly scratches the surface and so provides a "key" for the undercoating.

Apply two coats of aluminium paint or other suitable primer and then add the top coat of the desired colour.

If plating is preferred this again is a process which the reader must send to a firm who specialise in this type of work, and as this means further expense this, I am afraid, is one of the reasons why I suggest you paint the legs rather than have them plated.

Conclusion

The rubber ferrules on the bottom of these feet are for protection against scratching either the bathroom linoleum or rubber flooring, and you can purchase them usually from a shop that deals in walking sticks. Alternatively, it does not take very long to make four from a thick piece of hard rubber—cutting it down to fit into the hole of each tube tightly. About ¾in. protruding is sufficient, and if they are smeared with Bostik before insertion, then they should never pull out.

One point I forgot to mention regarding the frame is the removal of excess welding prior to the painting operation. Sometimes this is very hard and will soon ruin a new file, so use your old and partly worn members instead. If, however, you possess a portable hand grinding wheel, apply this carefully round the edges, blending them until both tubes appear to run into each other.

If this welding material stands out prominently through the paint, it gives an unsightly appearance.

Half-a-dozen drawing pins with small heads are useful for holding the sponge rubber in place while the covering is tacked to the wooden frame. Leave them there, as they do not create any hollows in the padding.

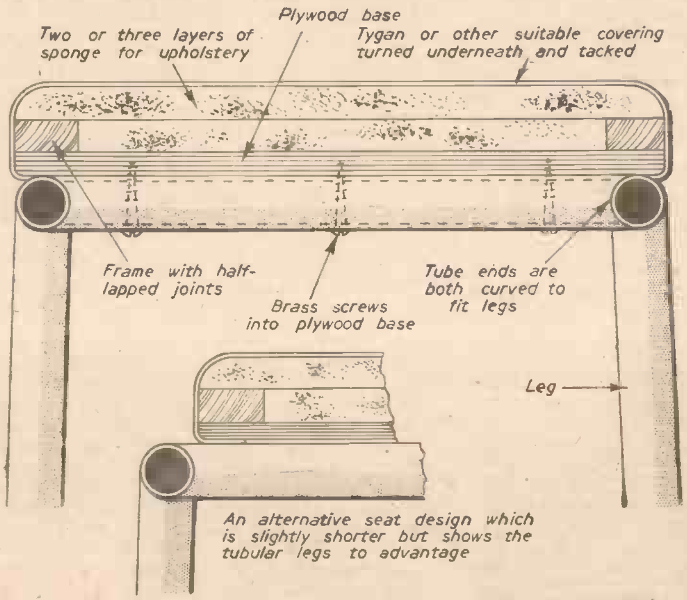
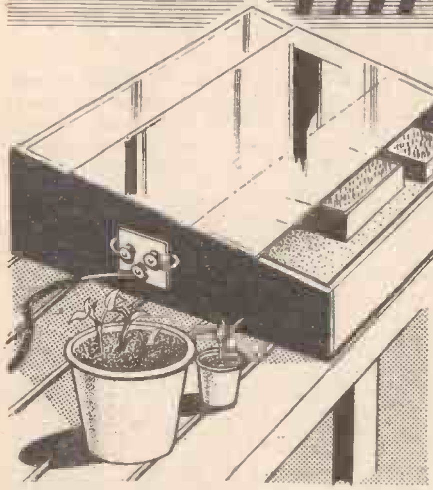


Fig. 5.—A cross-section through the seat illustrating the method used for attaching it to the frame.

An Electric Propagator

This Article was Received from S. Moxley in Reply to a Request in Our "Information Sought" Column



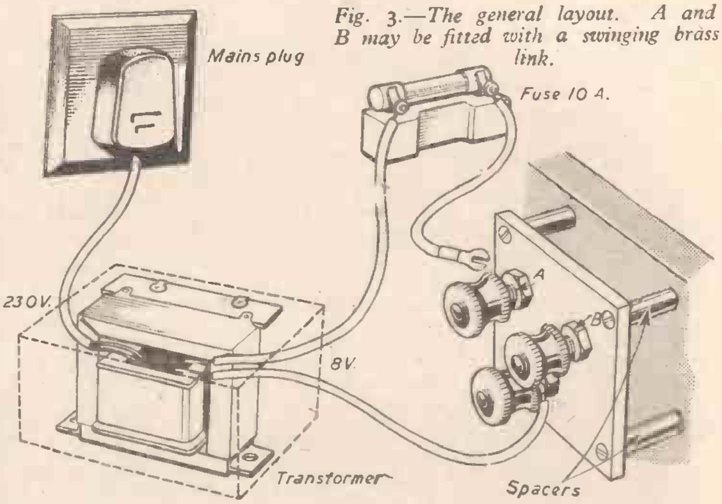


Fig. 3.—*The general layout. A and B may be fitted with a swinging brass link.*

THIS propagator has been in use for a full season and is now in its second. It can be raised to about 20 deg. above the greenhouse temperature and is easily controlled; it keeps a very level temperature, more level than the greenhouse itself.

The apparatus consists of a frame, open top and bottom, which is placed on the staging (with a loose bottom of any sort under it) and is closed by three sheets of standard cloche glass lying loose on top (see Fig. 1). The two short sides are cut so as to give the glass a slope of about one in 10, which allows the water to run to the bottom side, or outside if the glass is tipped for ventilation.

The electric heating element is fed from an 8-volt transformer and the wire used is a brown plastic covered iron wire sold at a well-known departmental store in the garden section for 1s. 6d. a coil. It was found by experiment that about 21ft. of this wire connected across the terminals of the transformer gave a sufficient heat, and would blow a 2-amp. fuse wire in the circuit but would not blow a 5-amp. fuse wire.

Heater Element

A loose frame to lie inside the propagator was made from roofing lath, studded with nails along two sides to make winding the wire easy (see Fig. 2) Three 21ft. lengths of wire were used so as to give three different heats. One wire was wound over the frame to give a fairly equal distribution of heat and then a pair of wires together wound to give double heat. The terminals were arranged so that all three wires could be connected to obtain the highest heat.

With all three wires the load is about 20 watts, but full load is seldom needed; the cost is very small, it takes several days to use 1 kilowatt.

The body frame dimensions were regulated by the width of the bench and the sizes of cloche glass available. One-inch wood was used, treated with green Cuprinol.

In use, the heater element is placed loosely in the bottom of the propagator with about 1in. depth of sand below it. Over this is enough peat moss (about 1in.) to bury the wire and on top of this the seed-boxes are placed. Peat moss can be dribbled down between the boxes, but this is not essential. Ventilation is arranged by sliding the glasses apart so as to leave narrow gaps, or by tilting the lower ends with pieces of wood, which has the advantage that water runs down and drips outside.

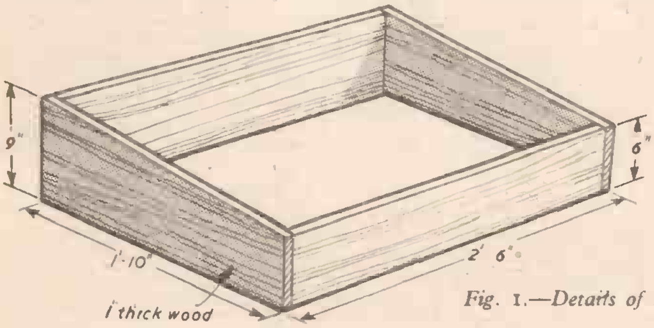


Fig. 1.—*Details of the frame.*

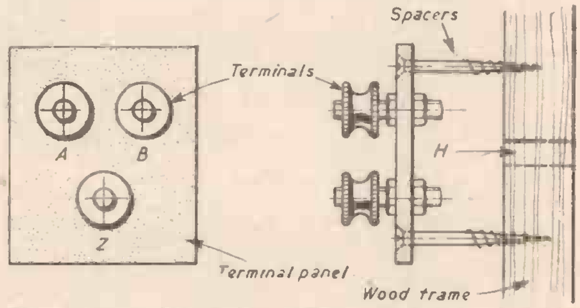


Fig. 4.—*The terminal panel. Distance pieces are not shown.*

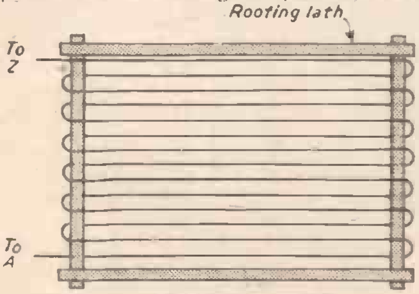


Fig. 2.—*The heater element.*

The Terminal Panel

The best position for the terminals is at one side so that they escape the drip of condensed moisture from the glass. *One warning*: do not place terminals in the wooden sides of the box, with the wires to the frame connected inside and the wires from the transformer outside. The current is heavy though the voltage is small, and a bad connection at the terminal can heat the whole terminal so hot as to char the woodwork from inside to outside. Bring the frame wires out through ample holes in the sides and mount the terminals on a strip of insulating material fixed an inch or so away from the wood, as shown in Fig. 4.

No thermostat has been fitted as it did not seem worth while to do so. Control is very easy with either one, two or three wires in circuit. Dampness is provided by keeping the peat moist.

Any voltage below 24 volts can be used with such a propagator, but not mains voltage. The advantage of the lower voltage is safety where water is bound to be slopping about. For 24 volts the wires (unless of another kind) would have to be 63ft. long. For a smaller size propagator (half-size) a 5-volt, 3-amp. transformer should be sufficient. A damp-proof transformer made for the job is ideal, but not necessary for experimental purposes, but if an ordinary transformer is used it should be boxed and damp-proofed. For 5 volts the wires would be 13ft. long. Details of the circuit are given in Fig. 3.

The New Elect

A Brief History of Timekeeping and a Description o

TIMEKEEPING has come a long way since man kept track of the hours by observing natural actions of known duration: the movement of the sun, moon and stars in their orbits; the consumption of certain substances by fire; the measured flow of water and sand.

Undoubtedly the first, and basic, device for telling time was a primitive form of sundial which ultilised the movement of shadows caused by the sun. Refinements of this device prevailed for centuries and are still in limited use to-day.

But the sundial depended on clear sunny weather. It did not tell time at night or on cloudy days. So early man, using the sundial as a measure, established the burning rate of ropes and rude candles and then knotted or marked them. Then, as they burned, they showed the passage of hours in the night.

Water Clocks

As civilisation advanced, so did the methods of telling time. The first recorded instance of time-telling by measured flow occurred in China over 4,000 years ago. The Yellow Emperor, Hwangti, invented a water clock that was a rare combination of ingenuity, simplicity and efficiency. It consisted merely of a pierced brass bowl floating in a basin of water. Hours were calculated by the amount of time it took the bowl to submerge.

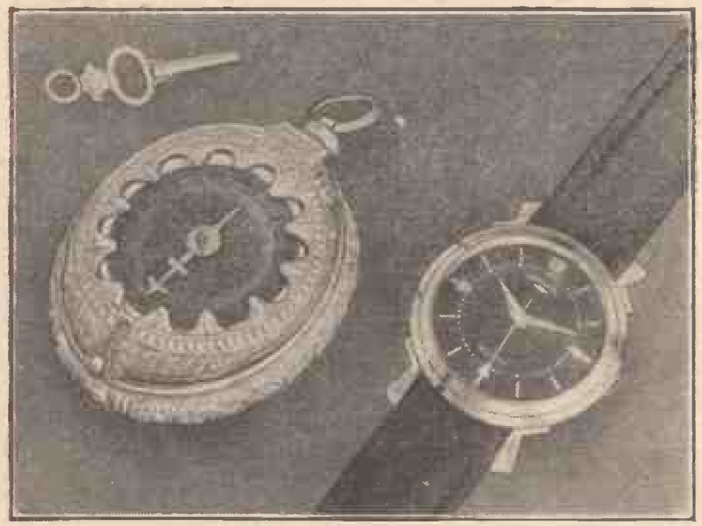


Fig. 1.—The first watch (the Nuremburg Egg) and the first electric watch.

Later, the Greeks developed and refined the Clepsydra, or water clock, which kept track of time with only periodic attention. In other parts of the world, forerunners of the hourglass, using sand instead of water, were being devised.

Numerous ingenious modifications of the basic water-metering system were invented, many of them converting the flow of water into mechanical energy which was used to operate simple machinery. In some cases small water wheels, run by escaping water, turned axles which wound or unwound cord at a more or less even rate, indicating time elapsed. In others, a float was attached to a pully which turned a hand on a dial as the water level lowered. However, all such devices were, by the nature of their motive power, self-limiting, since water is an unstable medium. While they might be refined infinitely, they could not be basically improved.

One such advanced form of the Clepsydra was responsible for the first known historical mention of the word "clock," when it was presented to the King of France by Pope Paul I in A.D. 760.

Use of a Spring

During the Crusades, clumsy mechanical time contrivances, operated by weights, were brought to Europe from the East. These, however, were totally unreliable and were merely curiosities and playthings for the nobility.

Then, starting in 1480, all previous timekeeping devices were challenged and superseded by the invention of a Nuremburg locksmith, Peter Henlein, who constructed a portable, mechanical, spring-driven time-timepiece.

This mechanism and its later counterparts were known, because of their shape, as "Nuremberg Eggs," (see Fig. 1). They were made of iron, enormously heavy, with a single hand to tell the hours—and they were not very accurate. Because of their great weight, the wealthy used "bearers" who consulted the dial and spoke the time when asked to do so. Nevertheless, they were the first all-weather, independent, portable time-measuring instruments to appear, and were the ancestors of all horological devices developed from the fifteenth century to this one. It should be noted, too, that although the "Nuremberg Eggs" paved the way for vast improvements in clocks, they were, themselves, the first watches.

The first important change in these primordial watches came in 1530, when brass was substituted for iron in their construction. It proved both lighter and more efficient.

The first wrist watch appeared in 1571. "A wristlet in which was a cloche" (The Elizabethan spelling of clock) was constructed by Bartholomew Newsam, official clockmaker to the English court, and presented to Queen Elizabeth. The relatively rare watches of this period were not distinguished by great accuracy. They varied as much as one hour in twenty-four. What they lacked mechanically, however, was offset by their elaborate cases which were executed by the foremost jewellers and metalsmiths of the time.

Fig. 2.—Over 400 years of electric watch power in the form of 384 tiny energisers.

Mechanical improvements continued to be made and pocket-size watches, in oval shapes, were regularly produced, although in small numbers and only for the wealthy. In 1635, Paul Veit, a young French watchmaker, made the first watch with an enamelled dial, and in 1670 two of London's leading watchmakers, Knibb and Quare, added the first minute hands to watches.

The Balance Spring

Up till now the most important deficiency in both watches and clocks was that their coiled mainsprings exerted diminishing power as they ran down. But in 1685 Dr. Robert Hooke, an Englishman, invented the balance spring which remedied this and represented a gigantic stride forward in making watches more dependable and accurate.

Early in the eighteenth century repeating watches—now circular in shape instead of oval—were developed. These struck the hours and were therefore known as "blindman's watches."

The combined impact of the minute hand and the increased accuracy supplied by the balance spring gave watches a new and practical importance. Doctors were among the first to see their value, and in a comparatively short time watches were in widespread demand.

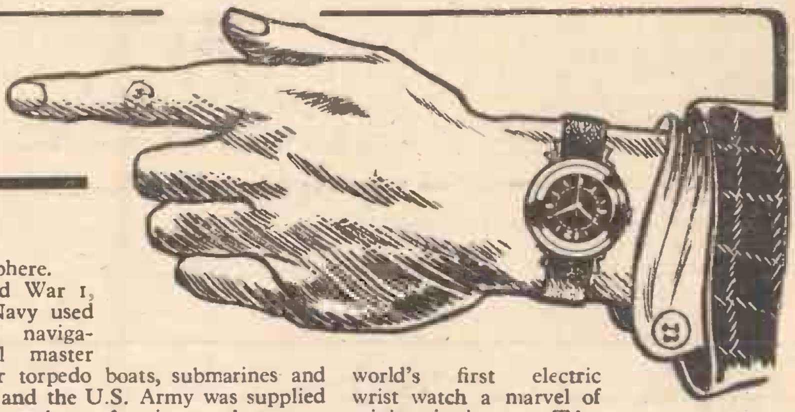
John Harrison, of London, constructed the first marine chronometer, to be used for navigation. At the end of a five-month voyage in 1762, this new timepiece, which was not a clock but a large watch, was in error just over a minute, a record that would be good even to-day.

America's watchmaking industry started in 1809.

During the next century and a half, the best scientific and artistic brains contributed to the development of the industry. Progress was measured by the fact that watches became smaller in size and greater in accuracy. At the same time they were more efficiently produced. These efforts have been crowned by the ladies' watches of to-day, the ultimate in small

Fig. 4.—

tric-Watch



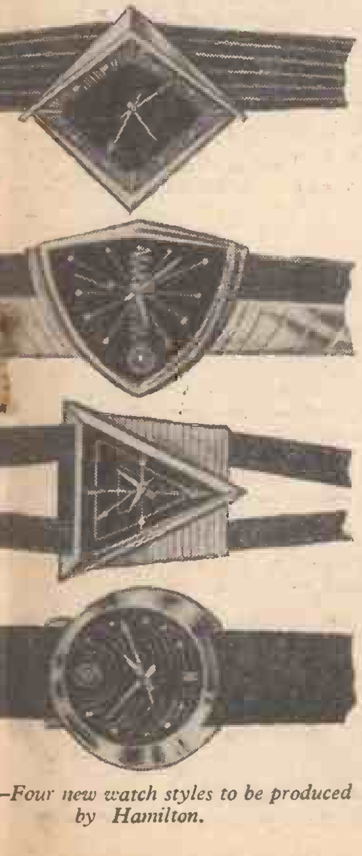
of the Latest Revolutionary Development

size, modern design and high accuracy.

The Hamilton Watch Company

The Hamilton Watch Company was formed in 1892 by a group of Lancaster investors to meet the demand for really high-accuracy watches. The first watch was by present standards bulky and unimpressive, but its accuracy was at the time unheard of, and it rapidly became the standard railway watch throughout the country.

Fig. 3.—Movement of the world's first electric wrist watch (right) is shown with a movement of a manually wound watch.



—Four new watch styles to be produced by Hamilton.

Commander Richard E. Byrd depended on a Hamilton when he flew over the South Pole. Captain Bob Bartlett carried one on his hazardous voyages through the Arctic ice fields in the schooner "Morrisey," and the famous Swiss physicist, Auguste Piccard, used Hamiltons in cosmic ray measuring devices on his balloon ascent ten miles into the stratosphere.

In World War I, the U.S. Navy used Hamilton navigational master watches for torpedo boats, submarines and destroyers, and the U.S. Army was supplied with great numbers of wrist watches.

In the second World War, the world's supply of marine chronometers, handmade in Switzerland, was cut off when the Nazis took over Europe. Hamilton filled this gap with the first mass-produced chronometer. These, and Hamilton navigational master watches, were responsible for the precision with which the complicated timetables for "D" day, and other amphibious operations, were carried out.

The Hamilton Electric Watch

No larger than a conventional wrist watch (see Fig. 3) the electric watch incorporates the first basic change in watch construction in almost five centuries.

It became available to the U.S. public in January. The first model, cased in 14 carat gold, retailed for $175 (about £62 10s.) and a gold-filled model at $89.50 (about £30). Four new styles soon to be produced are shown in Fig. 4.

The radical structure of the electric watch completely eliminates the mainspring, an integral part of portable timekeeping devices since it was invented in 1480 by Peter Henlein of Nuremberg, Germany. The new watch is claimed to be the only one in existence which runs without winding or without periodic agitation.

Wire five times finer than human hair, an energiser the size of a shirt button, permanent magnets smaller in diameter than the metal in an ordinary paper clip, screws barely visible to the human eye—80,000 would weigh one ounce—all combine to make the world's first electric wrist watch a marvel of miniaturisation. The electric watch is powered by a tiny motor of incredible efficiency. Its movement, shown in Fig 3, will run for at least 12 months powered only by the tiny energiser shown in Fig. 5, which was deliberately developed to release its power in the most miserly fashion possible, to accommodate the minute needs of the delicate movement.

Fig. 5.—The energiser compared with a shirt button.

The resulting gold-plated energiser is designed for long life and minimal power. It is 400 times more efficient, in terms of space, than the mechanical energy stored in a mainspring. In the course of one year it must open and close the circuit 75 million times. The second hand must be pushed forward 75 million times and the balance wheel must oscillate 150 million times.

The electric watch would run for more than 20 years on energy that would operate a 100-watt bulb for no longer than one minute. A handful of energisers would power a watch for 400 years. (Fig 2.)

The chemical energy stored in the energiser is converted into electrical power as it releases a stream of electrons through a coil of fine wire fixed on a balance wheel. The electrical energy through interaction with permanent magnetic fields causes the balance wheel to oscillate. This oscillation is the mechanical energy which runs the watch.

The result is a precise miniature power plant built into the balance wheel (Fig. 6), which in turn powers the gears and turns the hands of the watch. In the past the balance wheel only controlled the power furnished by a mainspring. In the electric watch it furnishes its own power as well as controlling it.

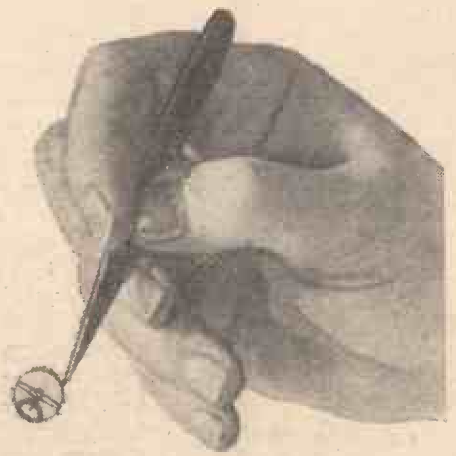


Fig. 6.—The miniature power plant built into the balance wheel of the electric watch.

The essential difference between the Hamilton motor and the conventional electric motor is that the power plant, combined with a balance wheel, permits the flow of energy to be strictly controlled and the speed of the hands to be held to an accuracy of more than 99.995 per cent. Combined with simplified construction and built-in shock resistance, the motor provides incredibly long life for the watch.

The coil is made of wire five times finer than human hair and enough of it for 1,000 watches would weigh only two ounces but would stretch from Dover across the English Channel and well into France. Six ten-thousandths of an inch in diameter, the wire is worth many times its weight in gold.

The tiny magnets developed expressly for the electric watch are of platinum alloy and are, ounce for ounce, the most potent and most expensive magnets in the world.

An even smaller motor was perfected for an earlier version of the watch. It had an armature the size of the head of a match, but its use turned out to be impracticable.

The electric watch is almost completely free from disturbance by stray magnetic fields. The television service engineer, a doctor with an electrocardiograph or any of the increasing number of people who work with or around magnets will be able to wear this watch with no interference.

Tests show that the day-to-day accuracy of these new electric watches is far greater than that of automatic or manually-wound watches.

Before the electric watch, so-called automatic timepieces were dependent upon the wearer as part of the power system. Power was furnished by agitating the whole watch instead of turning the stem. Hamilton's electric watch is truly automatic—does not have to be worn regularly or agitated at any time to function properly.

The electric watch is less complex than the old automatic because there is no winding mechanism or mainspring. The result is simpler and more efficient operation.

Recasting Printing Rollers

A Simple Method for Home Use

By T. HURLEY

ROLLERS for small printing machines can be easily re-cast at home with the minimum of equipment.

The Mould

This should be prepared from drawn duralumin tubing of internal diameter equal to the required external diameter of the finished roller. Sufficient tubing should be cut to enable the composition on the roller

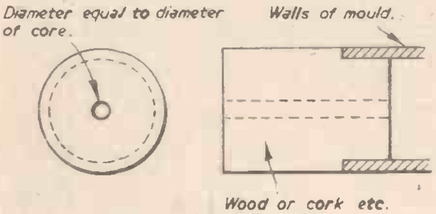


Fig. 1.—End pieces.

to be a little longer than is required. This is to allow for shrinkage when the roller is setting, and also for trimming to exact size after the roller is withdrawn from the mould.

The cut ends of the tubing should be carefully rounded, making sure that there are no burrs as these will damage the surface of the roller as it is withdrawn from the mould. The inside of the tubing should be thoroughly cleaned and polished.

End pieces (Fig. 1) which will support the core of the roller and which will prevent leakage of the molten composition, should be made from carefully drilled cork or wood. They should be made to fit snugly into the mould, and should enter a sufficient distance to prevent them from being easily dislodged.

Preparation of the Roller Core

The old composition should be stripped off and the metal roller core thoroughly cleaned. If it is intended to re-cast, using the old composition, the composition on the roller should be cleaned with the usual cleaner before it is stripped off the core.

Narrow insulating tape should be wound spirally round the core, starting and finishing within ¼in. of the intended finished length of the roller (Fig. 2). Strong, thin string may be used instead but this must be firmly secured at each end.

The core should then be set ready in the mould after thoroughly oiling the interior of the mould and the end pieces (Fig. 3). No oil should be allowed to get on the core. This oiling ensures easy withdrawal of the roller from the mould and no harm is done to the composition as the oil can easily be wiped off before the roller is used.

Composition

Most printer's rollers are made from a mixture of glue and treacle, or glue and glycerine. A small amount of Lysol or carbolic acid is often added for protection against attack of mould, which would damage the roller.

All composition should be cooked in a water jacket glue pot or similar arrangement. This prevents burning.

Suitable formulae are:

(a) 1 part by weight best Scotch glue.
2 parts by weight treacle.
Old roller composition.

Cover the broken glue with water and allow to stand overnight. Pour off the surplus water and melt in the glue-pot. When the glue has melted, stir in the broken pieces of old composition. When these have melted, continue cooking until all scum and bubbles have risen to the surface. Skim off and then add the previously warmed treacle. Continue to heat until the mixture is free from bubbles. It is then ready for pouring.

(b) 1 part by weight glue.
1½ parts by weight glycerine.
1 part by weight water.
½ part by weight sugar.

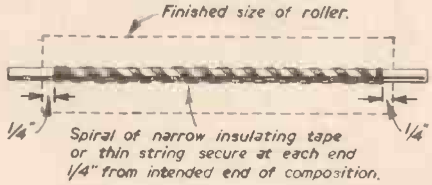


Fig. 2.—Preparing the metal core.

Mix cold and allow to stand overnight. Heat in the glue pot until scum and bubbles rise to the surface. Thoroughly skim and then the mixture is ready for pouring.

Pouring

Set the mould upright as in Fig. 3. Pour the hot composition slowly and carefully into the open end of the mould. Fill almost to the top, and then gently insert the top end piece, making sure that in so doing the bottom end piece is not pushed out of position. Leave for at least 12 hours to set thoroughly.

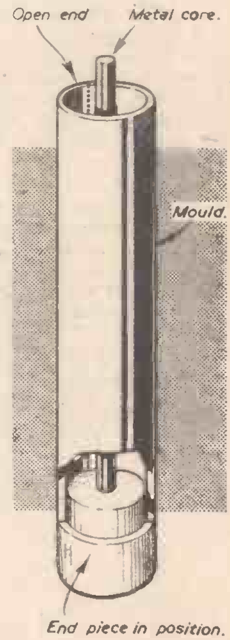


Fig. 3.—(Right) Ready for pouring.

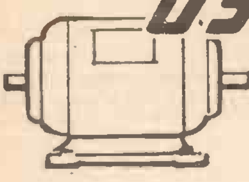
Finishing

Withdraw the roller from the mould by removing the end pieces and pulling steadily and firmly on the metal core. The roller should slide quite easily from the mould. If the oiling has been thorough and there are no burrs on the end of the mould, the roller surface should be perfect.

Trim the composition to the correct length, fit the bearing wheels and the roller is then ready for use.

Care of Rollers

If Lysol or carbolic acid has been added to the composition there should be little fear of decomposition due to fungus attack. A further protection is a coat of printer's ink, which should *not* be of the quick drying type. This protective coat of ink should be removed from the roller just prior to printing and the rollers should always be left with their coating of ink after use. Quick drying ink should *always* be removed as this hardens and causes damage to the rollers.



USING D.C. MOTORS ON DIFFERENT VOLTAGES

By J. L. WATTS

How to Adapt a Spare Electric Motor to Suit the Supply Available

IT often happens that a reader is in possession of an electric motor of different voltage to that available. Best results, of course, are obtained when a direct current motor is used on the supply for which it was designed, and usually a good deal of design and experiment has been carried out to make the motor most efficient on its rated voltage. However, it is often possible to obtain quite satisfactory results on a supply of different voltage by simple modification.

Desirable Features

If the windings are not to overheat and deteriorate rapidly they should not be allowed to carry more than the designed value of current. In order to limit the possibility of insulation failure the normal voltage across the insulation of the machine should not be appreciably exceeded. The centrifugal forces acting on the rotating parts are proportional to $speed^2$, thus it is inadvisable to run a motor at a greatly increased speed. For most efficient results the magnetic flux density in the machine should be as near as possible to the designed value. These factors have been taken into consideration.

Types of D.C. Motors

Direct current (D.C.) motors are of three types, all of which have a commutator and brushes. Fractional horsepower motors are often of the series type, as is also the so-called "universal" motor which is designed for use on either D.C. or single-phase A.C. The field coils of the series motor are wound with a comparatively small number of turns of thick conductors and are connected in series with the armature. The motor usually has only two terminals, with one lead from each terminal to the interior of the motor, as in Fig. 1. The lead from one terminal may pass to one field coil, with a lead between the two field coils and a lead from the second field coil to one brush holder, the other brush holder being connected to the other terminal, as in Fig. 4. A more common arrangement is shown in Fig. 1 in which the armature is connected between the two field coils.

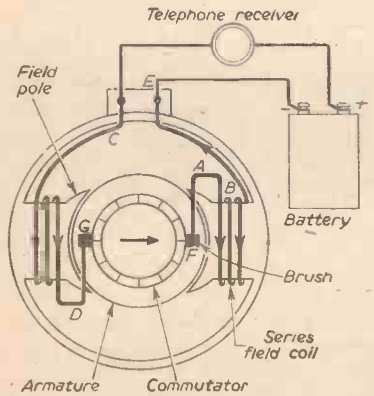


Fig. 1.—Connections of a series motor and method of test.

If the interior wiring cannot readily be traced the circuit can easily be tested as indicated in Fig. 1. A telephone receiver or a voltmeter in series with a battery is connected across the motor terminals. A click should then be heard in the telephone receiver, or an indication should be given on the voltmeter, showing that the circuit is complete. The test should then be repeated with the brushes raised from the commutator. If the motor is a series machine no click will then be heard in the receiver, or no indication will be obtained on the voltmeter. If a click is still heard in the receiver, or the voltmeter still gives a reading, the motor is a shunt or a compound motor.

A shunt motor has field coils which are wound with a large number of turns of fairly thin wire, which coils are connected across the brushes or terminals when the motor is running. A small motor may have only two terminals, in which case the terminals F_1 and A_1 in Fig. 2 will be a single terminal, whilst F_2 and A_2 will be another single terminal. There will then be two leads to each terminal. In some cases the shunt motor will have three terminals, in which case F_1 and A_1 will be a single terminal. A more common arrangement is for a shunt motor to have four terminals, two for the armature and two for the field windings, as in Fig. 2. A compound motor has a series coil and a shunt coil on each field pole, as in Fig. 3; the two coils on each pole may appear to be a single coil, in which case it will have four leads, two thick leads for the series coil and two thinner leads to the shunt coil. Compound motors are, however, rare in small sizes.

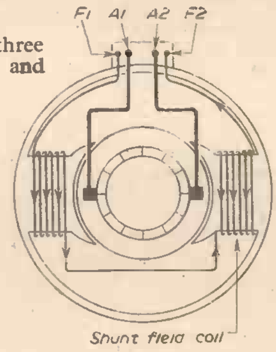


Fig. 2 (Left).—Connections of a shunt motor.

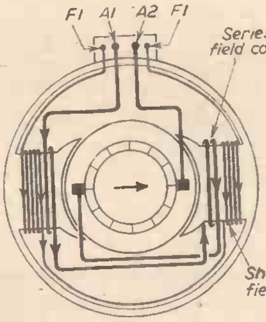


Fig. 3 (Left).—Connections of a compound motor.

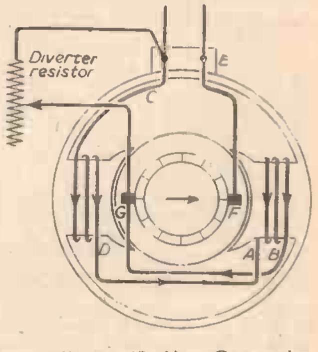


Fig. 4 (Above).—Use of a field winding diverter with a series motor.

Running a Series Motor on Reduced Voltage

The motor will usually work quite satisfactorily without any modification, provided it is not overloaded. The starting torque of the motor will, however, be reduced practically in proportion to the $voltage^2$. The motor will usually develop its normal full-load torque (turning moment) without overheating, whilst the speed on full-load torque will be reduced practically in proportion to the voltage. The horsepower of a motor is proportional to speed × torque, and thus will be reduced practically in proportion to the voltage. Thus, if a ¼ h.p. 220 volt motor is used on 110 volts to drive a load which requires normal torque it will run at about half its usual speed and should develop about 1/16 h.p. without overheating.

Use of a Series Field Winding Diverter

If it is necessary for a series motor to run at its normal speed on half voltage this can often be achieved by connecting a diverter resistor in parallel with the series field windings as a whole, as indicated in Fig. 4. If the series field coils are connected on either side of the armature, as in Fig. 1, they should first be reconnected on one side of the armature. If it is necessary to reconnect the field coils in this way, care must be taken that the relative direction of current through the two field coils is unchanged. Thus the lead B from the right-hand field coil in Fig. 1 should be reconnected to the brush holder G, previously connected to the lead D from the left-hand field coil, the leads A and D should be connected together, whilst the terminal E should be connected to the brush holder F. These alterations will be clear after comparing Figs. 1 and 4. Whilst this will raise the speed

Diameter of wire (inch)	S.w.g.	Current (amps.)	Resistance (ohms per foot)
0.080	14	8.7	0.103
0.072	15	7.5	0.128
0.064	16	6.4	0.162
0.056	17	5.3	0.211
0.048	18	4.3	0.287
0.040	19	3.4	0.414
0.036	20	2.9	0.510
0.032	21	2.4	0.645
0.028	22	1.9	0.843
0.024	23	1.5	1.14
0.022	24	1.3	1.37
0.020	25	1.13	1.65
0.018	26	0.99	2.04
0.0164	27	0.9	2.46
0.0148	28	0.8	3.02
0.0136	29	0.75	3.58
0.0124	30	0.68	4.30
0.0116	31	0.64	4.91
0.0108	32	0.6	5.67
0.0100	33	0.56	6.61
0.0092	34	0.52	7.81

Table 1.—Characteristics of 80 per cent nickel-20 per cent. chromium resistance wire.

the motor will overheat if used on its rated load torque, and the horsepower will still be reduced practically in proportion to the voltage. In any case it should be remembered that the speed of a series motor varies considerably on a varying load.

Reconnection of Field Coils for Normal Speed on Lower Voltage

If the motor is to be used on a voltage of less than its normal value, a reasonably high speed can often be obtained by reconnecting the series field coils in parallel with each other, and in series with the armature, as shown in Fig. 5. In this case also care must be taken not to alter the relative direction of the currents through the field coils. When used on half voltage with the normal value of motor current the motor may then run at about its normal speed, but the full-load torque and horsepower will be about half the rated value.

Rewinding a Series Motor for a Lower Voltage

If it is required to use the motor on reduced voltage at normal speed and without reduction of torque and horse-power, the only safe method is to rewind the armature.

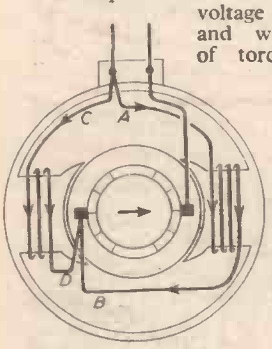


Fig. 5.—Reconnection of series field coils in parallel.

Each armature coil should have a smaller number of turns, the number of turns being reduced in proportion to the voltage. Thicker wire should be used, the cross sectional area of the wire being increased in inverse ratio to the voltage, which means that the diameter of the wire must be increased in inverse ratio to the square root of the voltage. Thus, if a 220-volt motor is to be converted for use on 110 volts, each armature coil should have half the original number of turns, using wire having twice the original cross sectional area, or approximately 141 per cent. of the original diameter.

When an armature is rewound it is most important that the original coil span and connections, and the lead between the armature coils and commutator segments, should be copied exactly. The field coils could be similarly rewound with fewer turns of thicker wire for use on a lower voltage. However, if the motor is to be used on half the original voltage the same effect can be obtained by rewinding the armature as described, and at the same time reconnecting the field coils in parallel with each other and in series with the armature, as in Fig. 5. When a motor has thus been rewound it will naturally take an increased current to develop its rated horsepower on the reduced voltage. Thus, if the voltage change is very great it may be necessary to fit larger brush holders and brushes to carry this current.

Operation of a Series Motor on a Higher Voltage

It is often possible to run a series motor on a higher voltage than that for which it was designed. In order to avoid risk of breakdown of the insulation between the copper segments of the commutator it is, however, advisable that the voltage between the brush holders should not be much above normal. The usual method suggested is to use a resistor in series with the motor, as shown in Fig. 6. In this case if a motor, designed to take a full-load current of 1 amp. at a voltage V, is used on a higher voltage V_1, the series resistor should be designed so that the volt drop across the series resistor is equal to $V_1 - V$. The ohmic value of a resistor is equal to volt drop divided by the current (amps.). Thus the series resistor should have a value of $\frac{V_1 - V}{I}$ ohms.

Resistance Elements

Nickel-chrome wire is suitable for the series resistor and could be wrapped round a piece of mica or other heat resisting support. Table 1 gives suitable currents for various sizes of this wire, together with the approximate resistance per foot. Knowing the current I (amps.) to be carried by a resistor the size of wire can be ascertained. It is then a simple matter to calculate the length of wire required to give the desired resistance. The wires will carry more than the current values given in Table 1, but if used for higher currents than those specified the wires will tend to heat up appreciably. A radiator element or a lamp can often be used as a series resistor. Table 2 shows the safe current and approximate resistance of various elements and lamps.

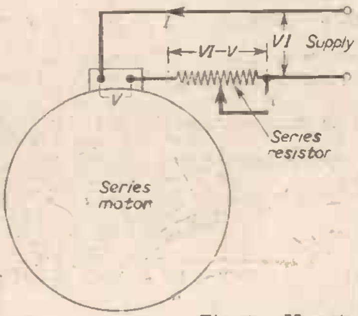


Fig. 6.—Use of a series resistor with a series motor.

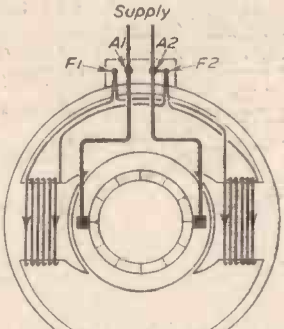


Fig. 7 (Above).—One method of using a shunt motor on half voltage or less.

Fig. 8 (Right).—Method of using a shunt motor on increased voltage.

If two elements, or lamps, are connected in parallel with each other the current can be doubled, but this connection halves the resistance. The volt drop across a resistor, element or lamp is proportional to the current. Referring to Table 2, if a series resistor is required to carry 2.5 amps. and to have a resistance of 48 ohms, two 600-watt 240-volt elements could be connected in parallel, and so on. When carrying 2.5 amps. the volt drop across the parallel elements, equal to current × resistance, would then be equal to $2.5 \times 48 = 120$ volts. With a given current the volt drop across an element wire is proportional to the length of wire. Thus, if a 57.5-ohm resistor is required to carry 2.08 amps., half of a 500-watt, 240-volt element could be used. When carrying 2.08 amps., however, the coiled wire would heat to normal radiator temperature. For a lower operating temperature the whole length of a 1,000-watt, 240-volt element could be used.

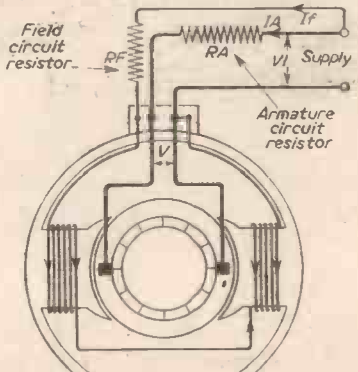
Rating of element or lamp (watts)	Current rating (amps.)	Approx. resistance (ohms)
100	4.16	57.5
750	3.12	77
600	2.5	96
500	2.08	115
150	0.625	364
100	0.416	580
75	0.312	728
60	0.25	960
40	0.167	1440
25	0.104	2300
15	0.0625	3640
10	0.0416	5800

Table 2.—Current rating and approximate resistance of 240-volt elements and lamps.

When used with a series resistor the motor can be run at its normal speed and develop its normal torque and horsepower. However, the series resistor method is not advised for operating a series motor on an appreciably higher voltage, unless the load is practically constant, because the voltage applied to the motor will increase on reduced load, with increase of speed and considerable increase of centrifugal stresses on the rotating parts.

Rewinding a Series Motor for Higher Voltage

If a series motor is required to drive a varying load on a voltage which is appreciably higher than the rated value it is advisable to rewind each armature and field coil with a larger number of turns in proportion to the voltage, using smaller wire having a cross-sectional area inversely proportional to the voltage, i.e., wire diameter inversely proportional to the square root of the voltage. However, a limiting factor is the number of commutator segments. Trouble may be experienced with a motor which has been rewound for a higher voltage if the number of commutator segments is too small. Much depends on the quality of the insulation between the commutator segments; in general it is advisable that the voltage divided by the number of commutator segments should not be more than about 10. This is sometimes a serious factor when considering the use of a 12-volt motor on 230 volts, for instance. For such a large voltage difference it is often best to supply the motor from a low-voltage battery which is charged from the D.C. mains through a resistor. When a motor has been rewound for a higher voltage it is often a good plan to cut away the brush faces so that each brush covers a reduced periphery of the commutator.



A Shunt Motor on Reduced Voltage

A shunt motor can be run from a supply of lower voltage without alteration. In this case the speed will be reduced, but to a lower degree than the voltage, as will also the safe load torque. The horsepower will be reduced in proportion to the voltage. If the motor is to be run on half voltage the two field coils could be reconnected in parallel with each other, as in Fig. 7, making sure that the relative direction of current in the two field

(Concluded on page 401)

coils is unchanged. In this case the full-load torque will be unchanged, the speed will be half the rated value, as will also the horsepower.

The parallel connection of the shunt field coils can also be used to run the motor on more than half voltage, but in this case a resistor should be connected in the field circuit, as between the terminals F_2 and A_2 in Fig. 7. If a motor which was designed for a voltage V is to be run on a lower voltage V_1, the field circuit resistor must be capable of carrying twice the rated value of field current, since the resistor will then have to carry current to the two field coils in parallel. Since the volt drop across each field coil is normally equal to $\frac{V}{2}$, when in series, the shunt field circuit resistor must have a volt drop of $V_1 - 0.5$ V and must have a value of $\frac{V_1 - 0.5\,V}{2 \times I_f}$ ohms, where I_f is the rated field current in each coil. If the field current is unknown the correct resistor may have to be found by trial and error, but care must be taken not to use too low a value of field curcuit resistance, otherwise the field current will be excessive and the field coils will overheat. When used with the correct resistor giving the normal rated current per field coil, the speed of the motor and the horsepower will be reduced in proportion to the supply voltage, but the motor will develop its rated full-load torque without overheating of the armature. If it is required to obtain the rated horsepower and torque and speed on reduced voltage, each armature coil should be rewound with fewer turns in proportion and larger cross sectional area inversely proportional to the voltage, as advised for a series motor. The shunt field coils should be similarly rewound, or they could be reconnected in parallel for use on half voltage, or could be reconnected in parallel with a shunt field circuit resistor, as described above, if used on more than half voltage. It may be necessary to fit larger brush holders and brushes after rewinding if the voltage change is large.

Field Circuit Resistor for a Shunt Motor on Higher Voltage

When operating a shunt motor on more than its rated voltage a resistor R_F must be connected in the field circuit as in Fig. 8. The field coils should still be connected in series with each other, thus the resistor R_F should be designed to carry the normal field current I_f. If the motor is rated for V volts and is to be used on a higher voltage V_1 the volt drop across R_F must be equal to $V_1 - V$ volts, thus its ohmic value must be equal to $\frac{V_1 - V}{I_f}$ ohms. With the correct field circuit resistor, to limit the field current to the normal value so as to avoid overheating of the field coils, the motor will develop its normal full-load torque, but the speed and horsepower will be increased in proportion to the voltage.

Armature Circuit Resistor for a Shunt Motor on Higher Voltage

It is, however, inadvisable to use the motor on a much higher voltage without modification of the armature circuit as well as the field circuit. If the load has a constant value requiring an armature current of I_A amps, a resistor R_A may be connected in the armature circuit, also as in Fig. 8. The volt drop across R_A should be equal to $V_1 - V$ volts, thus the ohmic value of R_A should be equal to $\frac{V_1 - V}{I_A}$ ohms. A series resistor in the armature circuit will result in the motor speed varying considerably on a varying load and is not advised if the motor load is not steady, since the motor speed and the voltage applied to the commutator will increase considerably if the motor is run unloaded. When used with resistors in the field and armature circuits as described the motor will develop its full-load torque, whilst the speed and horsepower will also have their rated values.

Rewinding a Shunt Motor for Higher Voltage

For best results in the case of a motor which operates on a varying load or is to be used on a much higher voltage than normal, it is best to supply the machine, without modification, from a battery of suitable voltage, if practicable, or to rewind it. The armature could be rewound with more turns of wire in proportion to the voltage, using wire of smaller cross sectional area in inverse ratio to the voltage as advised for a series motor armature. The field coils could be similarly rewound, or could be connected through a field circuit resistor as described above. In this case the motor speed, horsepower and full-load torque should be unchanged and have their normal values, but it may be advisable to cut the brush faces so that each brush covers a reduced periphery of the commutator.

By I. G. DEWYNTER

A COLOUR transparency can be seen at its best only by projection, but this necessarily means an outlay of about £10, even for the cheapest and lowest-power projector. The best substitute is a viewer for use off the mains, the illuminant being a 40-watt small round bulb. This should be of the pearl type so as to obtain as even and diffused a light as possible. This lamp, combined with a ground glass screen between the bulb and transparency, gives good, even illumination.

The body of the viewer is constructed of ¼in. plywood and for use with 35 mm. or 16 on 120 colour slides should be made to the dimensions shown in Fig. 1. Magnification is obtained with a 3½in. single condenser lens mounted as in drawing. In my own case this lens just drops into place as it is normally used in my enlarger and a permanent fixing was not required. However, if the lens is for use only with the viewer, it can be held in position by fitting another piece of thin plywood over the outside of the lens. The ground glass is a focusing screen cut down so as to fit into the grooved wooden guides which are fitted to the sides of the viewer body. The rear part of the viewer is covered in with sheet tinplate cut from a cocoa tin. This forms an efficient reflector and is screwed to the edges of the side members of the body. It can easily be removed for lamp replacement. Holes are drilled in this cover to reduce the heat of lamp house to a minimum.

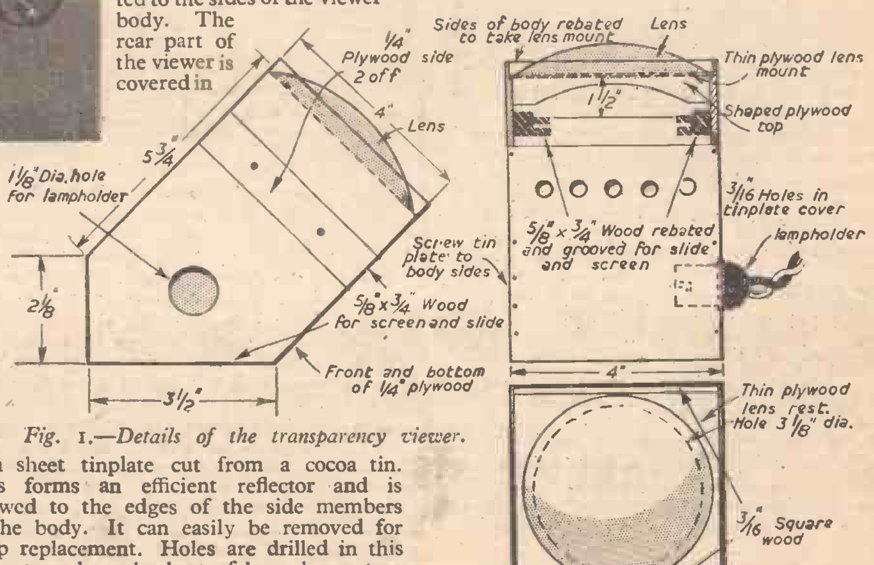


Fig. 1.—Details of the transparency viewer.

The distance between lens and slide is important so as to obtain magnification without distortion. In my own case this distance is 1½in., but check with the particular lens you intend using before fixing into body.

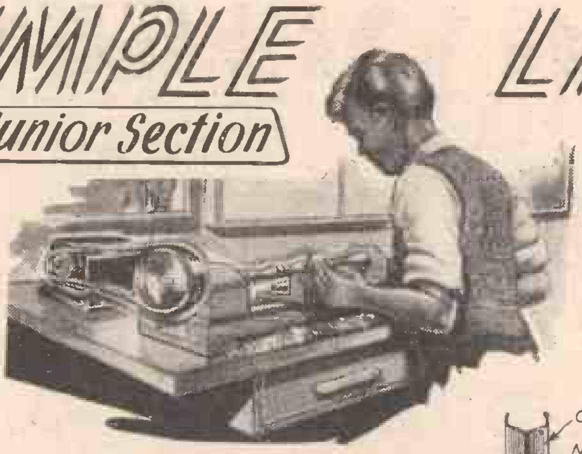
To ensure no possibility of the viewer tilting forward due to the weight of the lens a small piece of metal bar was screwed into the back end of body.

The whole job was painted with Berlin black, a matt-finish paint. The interior of the body, as far as and including the grooved wooden guides, was similarly treated.

Total cost of viewer is approximately £1. The lens cost 14s. 6d. (3½in.), ground glass 1s. 6d., lamp 1s. 11d., lampholder and flex 2s. The body was constructed of odd pieces of ¼in. plywood.

Making a SIMPLE LATHE

Our Junior Section



Details of an Easily-made Tool for Beginners

IN addition to the fun entailed in making this lathe it will provide useful groundwork for making and using a real lathe in later years.

The principal material used is wood, and for the bed, base strips of 1in. x 1in. are suggested with $1\frac{3}{8}$in. x $\frac{3}{4}$in. pieces screwed to them to form guides. The length is a matter of personal preference, but 20in. is a convenient size. Needless to say, a little time spent in checking and planing the parts will be well repaid. Before fitting together go over the work with beeswax and turps and then rub up to a polish; this will have the double advantage of reducing liability of swelling through damp and of giving a better sliding action.

Screw two pieces of $\frac{1}{2}$in. thick wood across the bottom at each end, taking every care to keep the sides of the bed parallel. These pieces can measure 4in. x $1\frac{1}{2}$in. and will, with $1\frac{3}{8}$in. material used as guides, give a $1\frac{1}{4}$in. runway (see Fig. 1).

The Headstock

This is in two halves (see Figs. 2, 3 and 4). The bottom half is a piece of 4in. x $1\frac{1}{2}$in. x 4in. wood and is screwed to the guides square with one end.

Obtain a piece of steel rod 5/32in. or 3/16in. thick and 5in. to 6in. long, and a piece of tube that is a tight push fit over it. A piece of tube only 1in. in length is required, but it must not be a free fit on the rod as this will be too slack for a satisfactory bearing.

Obtain two good stout mirror plates and open out the centre hole to a drive-on fit over the tube. Tap the plates gently on to the ends of the tube and secure the assembly temporarily to a block of waste wood, as shown in Fig. 2. Run solder all round the inside face, heaping it well up so as to afford a good rigid hold. When set, with a hacksaw cut across the centre of the tube and unscrew each half from the wood.

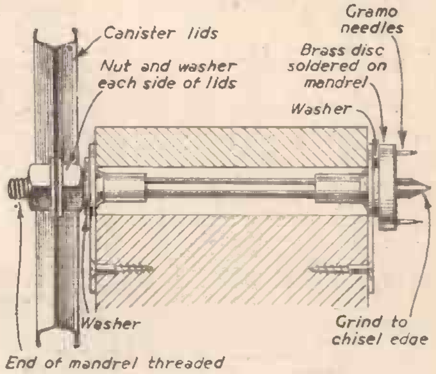


Fig. 4.—A sectional view of the headstock showing mandrel and chuck details.

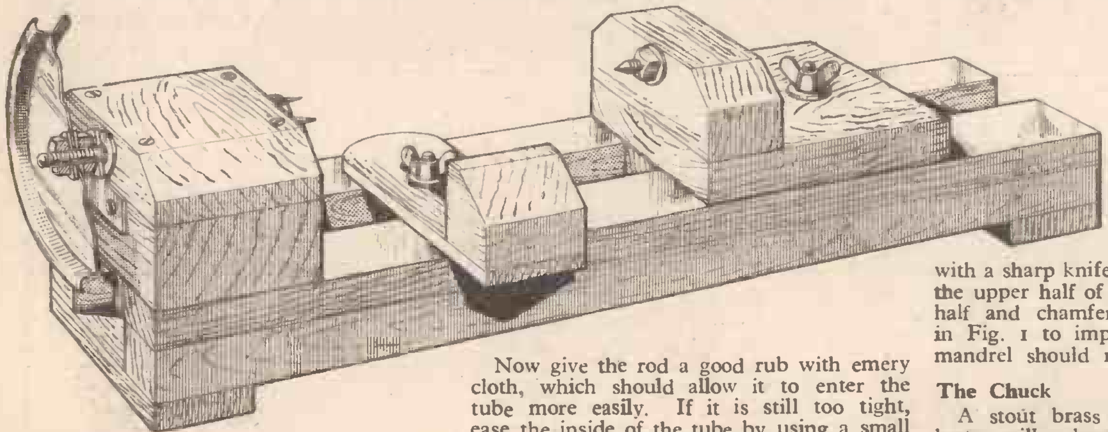


Fig. 1 (Left).—A perspective view of the finished lathe.

Now give the rod a good rub with emery cloth, which should allow it to enter the tube more easily. If it is still too tight, ease the inside of the tube by using a small round file that is too small to jam inside and wrap emery cloth round it. It is an advantage to put the file in a hand-drill and rotate it that way. Test the fit at frequent intervals. Directly it is a smooth running fit, stop before the stage is reached where "shake" is present.

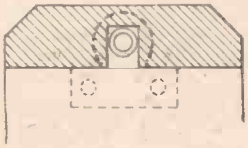


Fig. 3. — Upper half of headstock slotted.

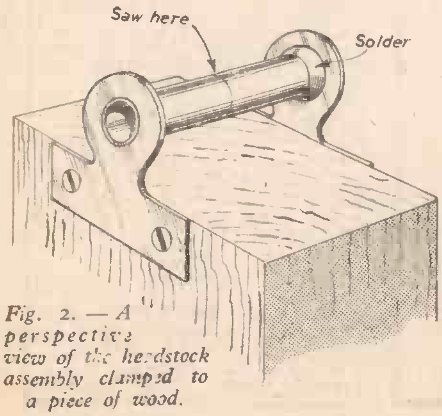


Fig. 2. — A perspective view of the headstock assembly clamped to a piece of wood.

Lining Up the Mandrel

If you have a long piece of the same steel rod as is to be used for the mandrel, this is ideal, but lining up can be achieved quite well with a piece of wood dowelling. Put whichever you are using through the two bearings, plates outward, and fit the latter against the two faces of the bottom half of the headstock. Centre the left-hand one on the wood and screw it very carefully in place. Now support the rod or dowel at the opposite end of the bed, in any rough form of temporary jig, seeing that it comes central in the runway and parallel with the face of the guides. While this is held firmly in place, the second bearing should be slid up against the right-hand face of the headstock and carefully screwed into place.

Remove the rod and fit the upper half of the headstock. This is simply a piece of 4in. x 1in. wood with a groove cut right across the underside deep enough to clear the brass tubes. It will be necessary to shape the groove a little at each end with a sharp knife to clear the solder. Screw the upper half of the headstock to the lower half and chamfer off the edges as shown in Fig. 1 to improve its appearance. The mandrel should now be accurately centred.

The Chuck

A stout brass disc is required next, or better still a heavy washer with a hole the same size as the rod. If a suitable washer cannot be obtained, a plain disc will have to be drilled accurately in its centre so that it can be tapped into position on the rod. When in place it must be tapped lightly sideways if necessary until it runs true

(*Concluded on page 405.*)

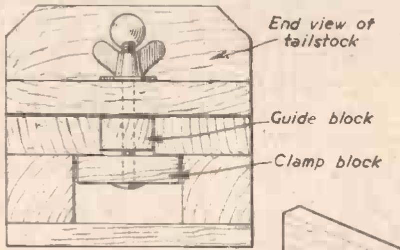


Fig. 5.—Details of the tailstock.

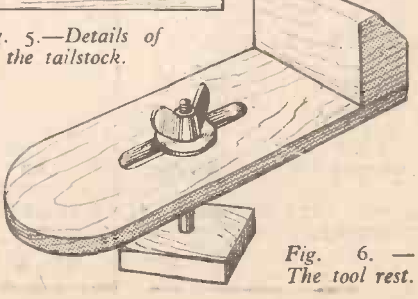


Fig. 6. — The tool rest.

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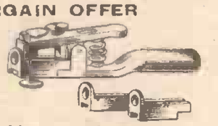

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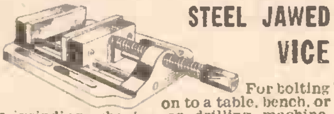

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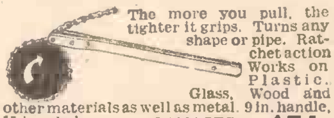

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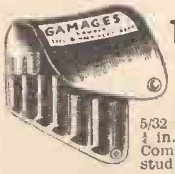

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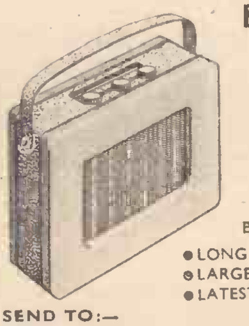

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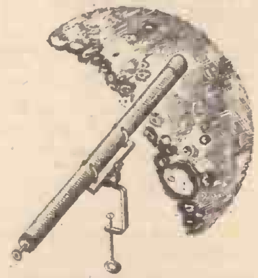

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vertically. Solder in place immediately. Drill and solder in place two gramophone needles to form the chuck (see Fig. 4) and grind the end of the spindle to a chisel edge.

Thread the other end of the mandrel to a distance of 4in. from the chuck. Put the mandrel through the bearings with a spacing washer between chuck and front bearing. Make a driving pulley with two canister lids put face to face; if you make the hole a slack fit for the rod, you can get the pulley to run perfectly true by tightening the outer nut nearly home and tapping lightly on the rims till true, then finally tightening the nut (see Fig. 4).

The Tailstock

This has a 6in. x 4in. x 1in. body with a piece of 1½in. x 1½in. wood across the left-hand end (Fig. 1). Underneath is fixed a guide block, a sliding fit in the guides and a little less in depth to allow the clamp block to grip the guides securely. Run the stock along the guides until it touches the chuck and allows the point of the latter to mark. Using this point as a centre, drill a hole the same size or a little smaller than a ¼in. coach bolt. Before fitting this bolt a nut should be run up to the head of the bolt and a short point ground on its tip. When the nut is removed on the completion of grinding, it will clear the thread and eliminate the effect of any damage caused. The bolt should then be screwed through the hole in the tailstock body and finally locked into position with a nut and washer, as shown in Fig. 1. A clamping block is fitted, as shown at Fig. 5, so that the tailstock may be held at any point. When the carriage bolt centre is fitted, slide the stock up to the chuck and see if it centres truly. If not, unscrew the cross-piece of wood from the stock base and either pack it with paper or thin card or take a shaving off the underside, as requisite, or move to one side or the other.

The tool rest is put together as shown at Fig. 6. The drive for the lathe can be from a small electric motor such as a sewing machine or vacuum cleaner motor, if available, or in some cases the domestic sewing machine treadle stand can be pressed into service. An old motor wheel with belt rim can sometimes be utilised either treadle driven or turned by handle by a second person.

The Tumbling Ladder Man

He Descends in a Series of Somersaults

Fig. 1.—Tumbling ladder man.

SHOWN in Fig. 1 is an ingenious toy that never fails to amuse both youngsters and grown-ups. A side view of the man, who is actually "two," one on each side, is shown in Fig. 2. All the dimensions given must be strictly followed and it is suggested that a hard wood such as beech or some similar type should be used. It is not

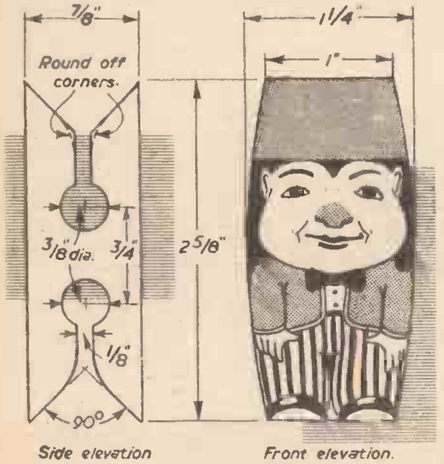


Fig. 2.—Details of the figure.

essential that the sides be curved, but this improves the appearance of the figure. Strict adherence to the dimensions given will ensure that the figure goes through his performance without a hitch. Make all the surfaces smooth with glasspaper.

Suggestions for painting the figure are also given in Fig. 2. Bright colours should be used and both sides of the block painted. As the man has to perform a series of somersaults the two figures must be drawn reversed, i.e., the head of one must be at the end of the block where the feet of the other are.

The Ladder

Fig. 3 shows a portion of the ladder. The rungs are strips of wood ¼in. wide and 3/32in. thick. Glue and pin them to the cheeks. Make the ladder as high as you like. Space all the rungs accurately to the dimensions given in Fig. 3. Mount the ladder on a block as shown in Fig. 1, giving it no more inclination than that shown, and less if necessary. Test with the man, before fixing the ladder.

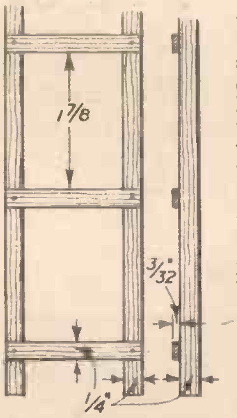


Fig. 3.—Ladder details.

How to Operate the Device

The man may be started on the topmost rung and will descend head-over heels, one rung at a time, until he reaches the bottom, showing each side alternately. Fig. 4 shows the toy in action.

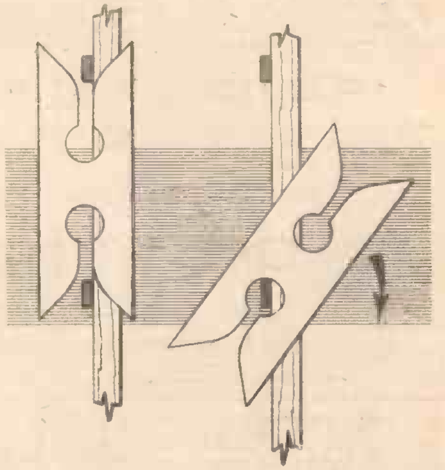


Fig. 4.—The toy in action.

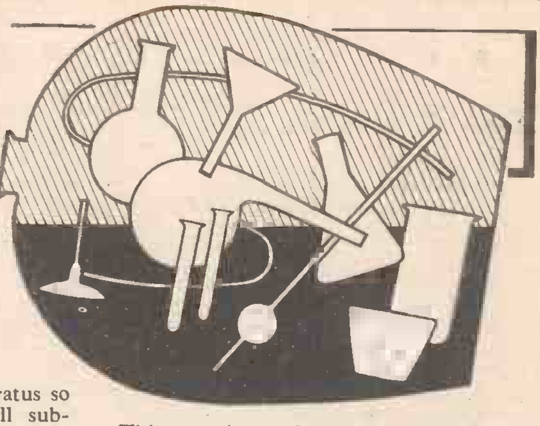
If you are unequal to copying the grotesque figure shown in Fig. 2, you might cut out suitable figures from an illustrated magazine or from the advertisement pages of a newspaper, colour them and stick them on to the wood block.

Flying Saucer Photographs Can be Faked

Details of an Interesting Example

THE camera cannot lie, or can it? The photograph on the left shows two flying saucers, one hovering and one coming in to land on a mountain top, but the whole thing was faked by one of our younger readers. The flying saucers were superimposed on a landscape print by means of a specially cut stencil and an air brush, final details being inserted with a fine paint brush. The result was photographically copied.

THE JUNIOR CHEMIST



No. 6.—Making Hydrochloric Acid and Experiments With It

IN many of the preceding experiments hydrochloric acid was used. Probably this is not the first time it has been met —most soldering jobs are accomplished with a flux of "killed" spirit of salts, that is, commercial hydrochloric acid neutralised with zinc scrap. A soldering aid is but a minor application of the acid, however; industrially

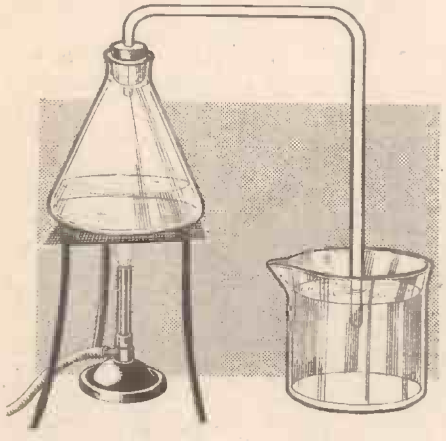


Fig. 1.—Apparatus for making hydrochloric acid.

it is used as a cleaning agent for metals and in the manufacture of chlorides and heavy chemicals. As one would imagine, hydrochloric acid does not occur naturally in the free state like oil or coal, but is manufactured from its naturally occurring compounds (chlorides), the commonest being ordinary salt (sodium chloride). Corrosive and poisonous as the acid is, it is somewhat surprising to learn that the gastric juices of the stomach contain about 0.2 per cent. which acts as what is called an enzyme activator aiding digestion.

You can make your own hydrochloric acid for future experiments by following these instructions.

The apparatus required is similar to that used in the preparation of oxygen (January, 1957, issue) but is even more simple. A flask is fitted with a good cork bored for a bent delivery tube. About an ounce of common salt is placed in the flask and two ounces of concentrated sulphuric acid poured on to it. The cork with the delivery tube is now inserted tightly into the flask neck and gentle heat is applied, the apparatus being rigged up on a wire gauze over a tripod. This is clearly shown in Fig. 1. Bubbles of gas will be seen to come off the salt, and in a little while white fumes will issue from the delivery tube. The fumes are due to hydrogen chloride—a colourless gas in dry air, but one which forms a fog of tiny hydrochloric acid drops in slightly moist air.

Obtain a large glass bottle (a Winchester is ideal) with two well-fitting corks. Dry the inside of the bottle and fill it with the gas by passing the neck of the delivery tube into the neck of the bottle. The gas is heavier than air and soon fills the bottle, displacing the air by virtue of its weight. When the bottle is full (indicated by white fumes rolling down the outside), cork it securely and place it aside for the time being.

Place a jar of water near the apparatus so that the delivery tube outlet is well submerged beneath the surface of the water (see Fig. 1). No bubbles will be seen rising to the surface—the gas is dissolving in the water as quickly as it comes over. When the chemicals in the flask are exhausted (denoted by sucking back of the water through the delivery tube), remove the jar of gas solution and then turn off the Bunsen. The gas solution in the jar is hydrochloric acid. The residue in the flask is white and consists of a mixture of sodium sulphate and sodium acid sulphate; this is useless and may be washed away.

In making our specimen of acid, the hydrogen of the sulphuric acid and the chlorine of the salt combine to give hydrogen chloride sodium sulphate. You can liberate from the solution of hydrogen chloride either the chlorine or the hydrogen.

Fig. 2.—When hydrogen burns water is formed.

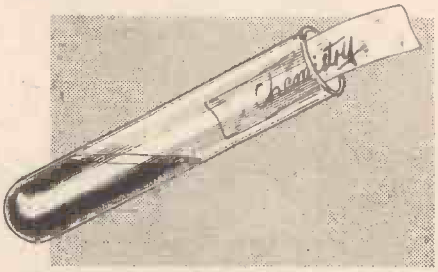


Fig. 3.—How writing can be removed.

Hydrogen from Hydrochloric Acid

Quarter fill a test tube with acid and add one or two fragments of zinc scrap (see Fig. 2). A violent effervescence takes place, gas being given off very vigorously, and the tube becomes hot. Hold a match to the mouth of the test tube, the mixture of hydrogen and air explodes with a characteristic shriek and a blue flame runs down the tube. With a little manipulation the quantity of hydrogen coming over may be controlled so that it is kept burning at the mouth of the tube. It is only when mixed with air or oxygen that hydrogen is explosive, and whether it burns quietly or explosively, the product is water. You can prove this by holding a cold plate against the mouth of the test tube when the hydrogen is burning. As the flame plays on the cool surface droplets of water will run off.

This experiment demonstrates the dangers of fire on a hydrogen-inflated airship.

After all action in the test tube has subsided a clear liquid remains. This is zinc chloride solution and may be used for soldering purposes. Thus starting with common salt and sulphuric acid we have obtained hydrogen gas and zinc chloride.

Fading Ink

Write a few lines in ink on a scrap of paper. When the ink is dry, dip the paper in water and push it into the test tube (Fig. 3). The writing will disappear.

A Coloured Fountain

It was for this experiment that a large bottle was filled with hydrochloric acid gas (more correctly—hydrogen chloride). Take a 10in. length of glass tubing and draw it out to a fine jet. Bore the spare cork so that this tube is a good fit and, having removed the first cork from the Winchester, insert the second with the jet pointing inwards. Fill a small bowl with water and colour it with blue litmus solution, then quickly invert the bottle of gas over it with the projecting glass tube well submerged. In about half a minute the blue solution will be drawn up the tube and out of the jet inside the bottle where it will play like a fountain (Fig. 4). Simultaneously the colour will change from the blue to red.

The keen experimenter will be interested to hear the explanation. Hydrogen chloride is remarkably soluble in water and the resulting solution is an acid. When you invert the bottle of gas, the little water in the bottom of the glass tube takes up a large quantity of gas. A corresponding reduction of pressure inside the bottle causes water to be drawn in, when more gas is dissolved and more and more water drawn in as the experiment continues. The fountain plays until the jet is submerged. The colour changes because litmus is red in presence of acid.

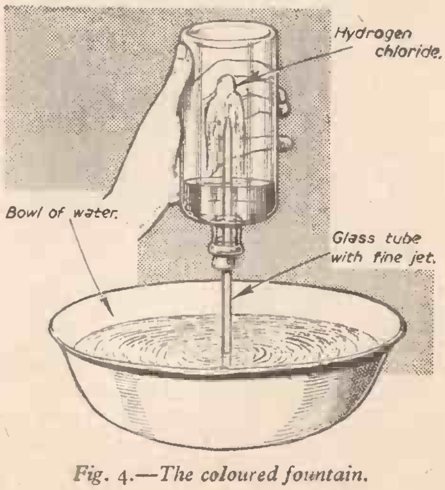


Fig. 4.—The coloured fountain.

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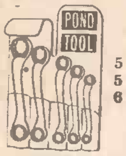

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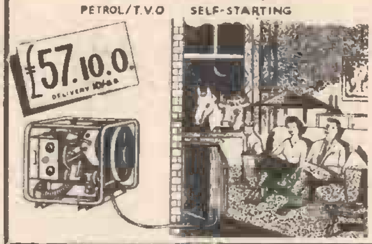

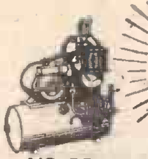
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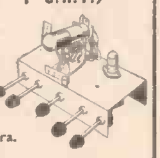
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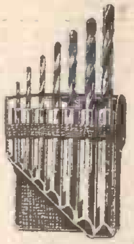
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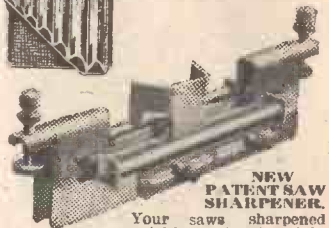
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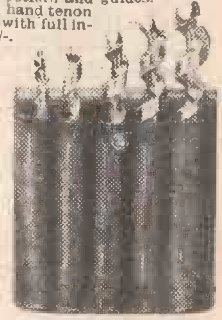
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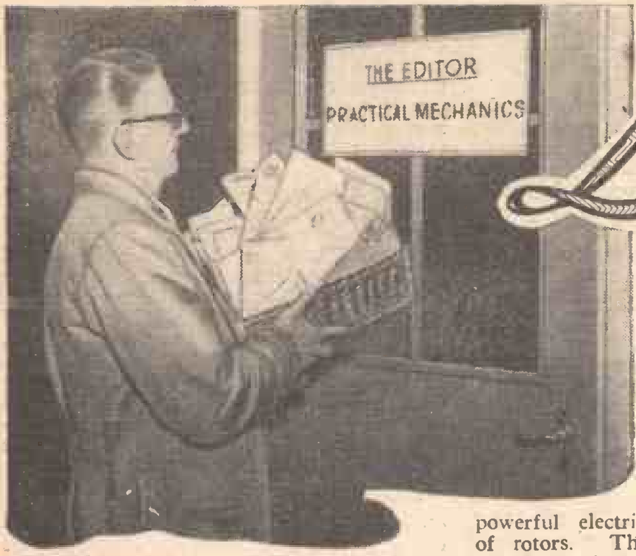


Letters to the Editor

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

Canals of Mars

SIR,—I strongly challenge Mr. R. W. J. Anstee's letter in your issue of March, 1957.

I am dumbfounded to read that Dr. Slipher has found that the canals of Mars are constructed by intelligent beings. I am in close touch with astronomical circles and no such news has reached me. I am, however, fully aware of the distorted and garbled accounts given by journalists to the Press based on quite small scientific comment. It is news to read that Dr. Slipher is in charge of observations of Mars—which observations? And how does he know intelligent beings constructed the canals and that they (the beings) may now be extinct? What instrument is used to measure the "extinctness" of intelligent beings when one sees or photographs a line on a distant planet?

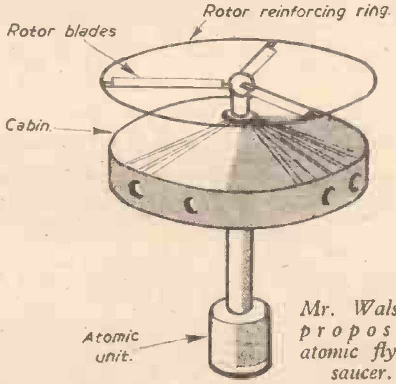
What point does Mr. Anstee seek to prove when he tells us of men on Earth living under different atmospheric conditions? Surely we all know this to be true. Hillmen do not breath under the same conditions as men on the plains. How does this help us with the space visitor problem? Where do our visitors come from? Mars? There is no oxygen there. Mercury, where the temperature is near to that of melting lead? Jupiter, where the atmosphere is full of methane? How do people on Earth react to methane? Let Mr. Anstee ask the National Coal Board who have an interest in methanometers to save the lives of miners.—FRANK W. COUSINS (Greenford).

SIR,—Dr. R. S. Richardson, the Mars expert at Palomar Observatory, has publicly stated that: "Astronomers hope to obtain photographs which will show markings on Mars so clearly that we can determine whether the canals are natural or artificial. On a planet as smooth as Mars it seems reasonable to suppose that real canals would be built along what are called "great circle" paths—the name sailors give to the shortest distance between points on the surface of a sphere. If photographs show that the canals always lie along these paths, it would be an indication that they are the work of intelligent beings. In conclusion Dr. Richardson said, "It is conceivable that some form of life, quite different from ours, might have developed on Mars."—W. J. ANSTEE (Bristol).

Atomic Flying Saucer

SIR,—The recent article on "Space Visitors" by "Theorist" (PRACTICAL MECHANICS, December, 1956) has inspired me to submit for examination the accompanying sketch of a flying saucer type of machine which I am convinced has tremendous power of ascent.

The proposed machine is equipped with a powerful electric motor driving a system of rotors. The power supply is derived indirectly from the energy of a small plutonium reactor. This reactor, in the case of the machine being manned, would be situated at a distance from the crew cabin. As the single-rotor system provides little or no horizontal stability (altitude being the chief aim) the launching would have to be carried out in calm conditions. An unmanned machine of this nature could possibly be used in the launching of an artificial Earth satellite, where, when the maximum altitude was reached, a timed mechanism would allow the satellite to be projected into its orbit.—P. WALSH (Ireland).



Mr. Walsh's proposed atomic flying saucer.

Author's Comment

Mr. Walsh's idea of an atomic/electric/mechanical power unit for an aircraft presents many difficulties. The generation and harnessing of power to drive the rotor system would alone be a complex three-stage sequence. Further, the use of highly radioactive materials in a power unit would demand heavy shielding, thus increasing the overall weight enormously—a major bogy at all times when operating directly against gravity. The use of atomic energy for air or space flight requires that the energy be translated into terms of thrust as simply and directly as is possible. The suggested use of rotors on any machine intended for extremely high altitude work is, of course, quite unacceptable.

The machines described in "Space Visitors" which prompted Mr. Walsh's speculations almost certainly utilise some form of electro/gravitic power supply.

Steam Cars

SIR,—In the January PRACTICAL MECHANICS you asked for readers' views on steam cars. Here are mine.

The steam car is simplicity personified—completely silent and the nearest approach to automatic traction that could be devised. Remember the steamers Doble, Serpolette, White and the wonderful Stanley?

The Stanley, even in its most original form, i.e., before a condensing radiator was fitted, was very efficient. It had 32 moving parts—including the four roadwheels—and generated 600lb. superheat steam pressure—considerably more than railway engines. Gear ratio was 1 to 1 and with large road wheels, it did 800 revs. per mile irrespective of speed. The engine could be lifted by one man and it used little oil. In 1906 a Stanley did 127 m.p.h. To drive it was a sheer delight with the advantages of immense power and complete silence, no gears, no clutch, immense braking power and long life. I think a good steamer would wipe the I.C. engine off the road!

There was a rumour that the Singer people were experimenting with a steamer and I wrote to them with the intention of getting in early but did not get the courtesy of a reply.—R. F. MACDONALD (Johannesburg, S.A.).

Space Visitors

SIR,—In the February issue (PRACTICAL MECHANICS) Mr. B. L. Kershaw endeavours to explain the unusual phenomena described in my article "Space Visitors" (December issue, PRACTICAL MECHANICS, 1956). He says that "all but one were meteors or foo balls." This does not agree with established opinion relating to these natural phenomena. Take the meteorite theory which he applies to the Mantell Tragedy.

Mr. Kershaw invokes the presence of a Mach cone trailed by a fast low-flying meteorite. It would be unlikely to expect any visible evidence of such a cone, but I assume he requires the presence of a vaporisation trail—for there had to be *something* for the flyers to see and pursue. Unfortunately for such an explanation, such a trail would traverse the sky horizontally or trace out a declining arc. This phenomenon did not exist.

The thing which Captain Mantell described as a large disc of metallic nature came to a halt above the airfield then *ascended*, slowly at first, then with increased acceleration. Meteorites do not ascend. Nor in this tragic incident was there the slightest evidence of meteorite impact or disintegration.

The "foo ball" phenomenon is not denied and no doubt certain aerial manifestations can be attributed to it. But to present it as the explanation of such objects as the vast and illuminated disc which at close quarters swept round the plane piloted by Captain Adams, or the cavalcade of entities sighted by Captain Howard, is simply overworking the phenomenon. The suggestion that "the small lights seen by Captain Howard accompanying his airliner were probably his own lighted cabin windows" is completely out of keeping with the stated facts. They were not small lights. They were *dark* objects silhouetted against the setting sun—the smaller ones moving freely about the larger parent body.

As a further point of interest relevant to the main topic I should like to mention that Rear-Admiral Delmer Fahrney, former head of the United States Navy's guided missiles programme, held a Press conference in Washington on January 17th this year. He stated that objects are entering Earth's atmosphere "at very high speed." There were signs that "an intelligence" was directing these objects. He was quite sure that "no agency in this country (U.S.A.) or Russia is able to duplicate at this time the speeds and accelerations which radar and observers indicate these flying objects are able to achieve."

In the March issue (PRACTICAL MECHANICS) Mr. F. W. Cousins raises certain objection regarding my January, 1957, article on "Space Visitors."

I make no reference to the planet Venus possessing the lowest temperature in the solar system. His objection must be intended for my description of Mercury. If so, I find it futile to wrangle over the firm scientific opinion which holds that Mercury is at one and the same time the hottest and the coldest of the solar planets.

The described radio emissions from Jupiter cannot, as he states, be attributed to violent atmospherics. The periodicity and short duration of the emissions can in no way be reconciled to the axial rotation of atmospheric circulation of Jupiter.

I state that the presence of ice-caps on Venus must largely disprove the "dust bowl" theory relating to that planet. If Mr. Cousins insists on torrid desert zones he must still remember that somewhere between torrid and frigid zones there will exist *temperate* zones amicable to the life force. The manifestation of this force is the main theme of the discussion.

Re his adamant denial that oxygen exists in the Martian atmosphere: while research by eminent investigators indicates that the oxygen content of the Martian atmosphere must be small compared with that of Earth, it does not deny its presence. It sets a maximum limit. That is all. Even this upper limit is flexible for the method of investigation, that of spectral analysis, is least effective when dealing with gases which are abundant in Earth's atmosphere, because the effects of the two atmospheres are superimposed. The co-existence of oxygen atoms and molecules in the Martian atmosphere could lead to the formation of ozone.

The ruddy colour of certain Martian regions is suggestive of completely oxidised rock. The presence of free oxygen and carbon dioxide (of which Mars has an abundance) virtually demands the existence of vegetation. Conversely, the prevalence of vegetation will supplement the oxygen content of the atmosphere.

The lichens postulated by Mr. Cousins would almost certainly be obliterated by drifting dust. Larger and more virile plants must be postulated to fit the observed conditions.

As Mr. Cousins apparently doubts the high probability of plant and animal life flourishing side by side, I invite him to find the line of demarkation between the two forms. He will have quite a search.

The assumption that the Martian polar caps are H_2O frost instead of ice and snow is untenable when we consider the vast changes which occur in regions adjacent the respective poles when summer melting takes place. The canals become more pronounced and the areas of pale green take on a richer tone. As the change must be attributed to the growth of foliage, it implies the presence of water in good quantity from the polar regions.

Magnificent work has been done by Dr. E. C. Slipher and his colleagues whilst studying Mars at the Lamont Observatory, Bloemfontein, during a recent six-months spell. Using the most modern "television" type apparatus he produced 1,400 photographs of Mars. Dr. Slipher ultimately expressed the view that the Martian canals are the work of intelligent beings.

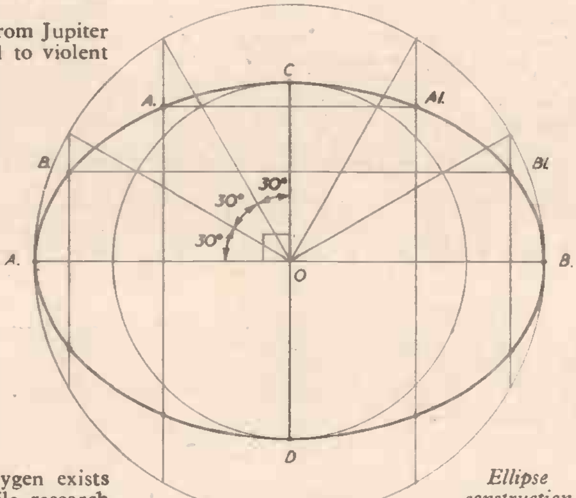
"THEORIST."

Constructing an Ellipse

SIR,—With reference to the simple ellipse construction in the February, 1957, issue, I would like to suggest another method, not so exact, but just the thing for a fast, simple construction.

Make A B diameter of large axis; C D diameter of small axis.

Construct a 30° ∠ and 60° ∠ as shown to perimeter of concentric circles. Drop four perpendiculars from outer perimeter



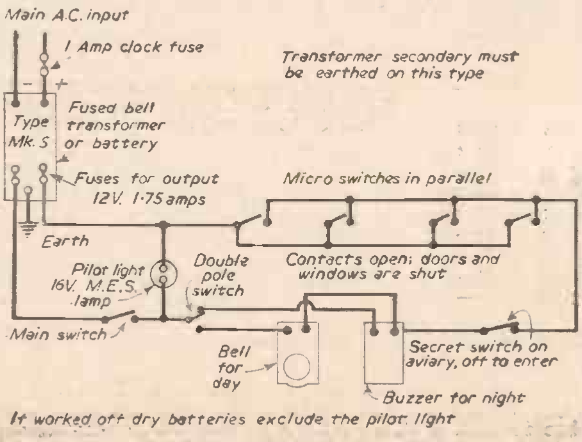
Ellipse construction method.

then, where parallels A-A_1, B-B_1, intersect perpendiculars, mark points.

Join A B A C A_1 B_1 B to obtain ellipse.—A. M. WESTOBY, T. D. JOYCE (Hull).

Electric Alarm

SIR,—*Re* "Information Sought" Electric Alarm, December, 1956, issue. Being a budgerigar fancier myself, I sympathise with Mr. Major-Dunkley's problem, and I agree with Mr. A. Strang (February issue) to use his 500-volt transformer would be most dangerous.



Mr. D. G. Salmon's alarm circuit.

Mr. A. Strang's alarm circuit would not be very satisfactory when worked off dry batteries as the magnet relay will be taking current all the time the alarm is in operation, causing the battery to become flat in a very short time. I suggest he uses the simple alarm circuit I have fitted to my aviary, this can be worked from dry batteries or suitable mains transformer. If worked off the dry batteries, the pilot light should be excluded. The cable from the aviary to the house must be of a good plastic type which can be buried under the ground or in a pipe, so that it cannot be cut by any would-be intruders. Also I would suggest that if he uses a transformer he keeps it in the house and not in the aviary, as damp may affect the windings, and mains voltage must never be allowed to flow through the underground cable. It is also most important that when using a transformer the secondary winding must be earthed.—D. G. SALMON (Reading).

Dangerous Chemicals

SIR,—With reference to the article "The Junior Chemist" (No. 3), (February issue). Although a warning about chlorine gas was given, no such warning about oxalic acid was given. Oxalic acid is *very poisonous* and must not be placed in the mouth. About *one gram* is fatal.—E. J. NORRIS (Ebbw Vale).

SIR,—In a recent article in your magazine it was stated that oxygen could be prepared from a mixture of potassium chlorate and manganese dioxide.

Two letters in *The School Science Review* recently pointed out the very real danger in this method. Briefly, unless the manganese dioxide is pure, serious injury can result. Commercial grades of manganese dioxide are often made from pyrolusite which is liable to contain impurities. A purer alternative is a precipitated grade which can be obtained from Messrs. Griffin and George Ltd.

Also, it is recommended by Messrs. Griffin and George that the proportion of one part of pure precipitated manganese dioxide to 15 parts of potassium chlorate by weight be used. This avoids any rapid evolution of oxygen and removes the necessity of excessive heating.—J. EDWARDS (Bolton).

Water Tank Repairs

SIR,—We read with interest your reply to an equiry "Water Tank Repairs," page 318 of the March issue and would like to bring to your notice one of our products, namely, Adup Bilge Seal. This is a heavy bituminous compound designed to act as a seal of the bilges of sail yachts and small craft, but is also an excellent material for waterproofing tanks, etc.—PLOW PRODUCTS LIMITED.

Free Energy from Water

SIR,—I read your comments on the above in the February Editorial with interest and remember that many years ago a man claimed that he could drive a car on water. I believe that he followed this with a successful demonstration. An account was published in several daily papers, but when he subsequently refused to divulge the process it was thought to be a fake.

I designed apparatus myself for the same purpose, but could find no one who would take any interest in it—petrol was 10d. a gallon at the time!—C. V. THOMPSON (London, W.14).

TRADE NOTES

New Photographic Apparatus

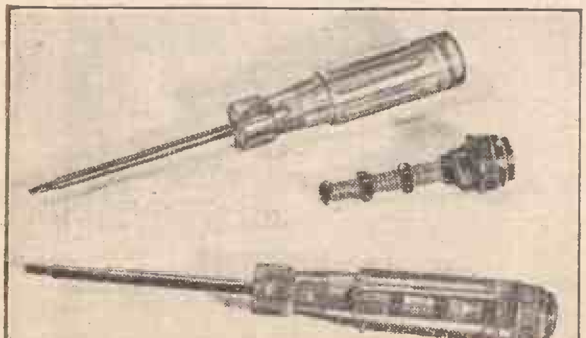
TWO new items have been received from Johnsons of Hendon, Ltd. For the beginner there is the Exactum Dish Pack which contains, as can be seen from the photograph, three different coloured dishes, each 3½in. by 4½in., 2 forceps and a transparent 1oz. plastic measure. The dishes have a shaped lip at one corner for pouring and have ridges moulded underneath so that gentle pressure at one end will enable them to be rocked. Included with the pack is a small booklet, entitled "How to Start Printing Your Own Photographs." This is written primarily for the absolute beginner and explains thoroughly all the processes in contact printing. The dish pack retails at 7s. 6d.

The second item is the Grippa-lite, also shown in the photograph below. This consists of a strip metal stand, the two halves of which are held together by spring tension. The spun alloy reflector is extendible for a few inches and adjustable to any angle. This is achieved by the heavy gauge wire stem being clamped between two small circular plates. The stand is designed to grip on the back of a chair or table edge, etc. The price is 22s. 6d.

The Exactum Dish Pack and the "Grippalite."

The Stead Fusedriver

THIS is a combination of an insulated screwdriver blade and a hollow handle which contains 5 amp., 10 amp., and 15 amp. fusewire. As can be seen from the photograph the end of the handle, with a bobbin attached, unscrews and allows access to the fusewire. This is an ideal tool to keep permanently in the location of the fuseboxes. The retail price of the fusedriver is 2s. 9d. and it is made by J. Stead & Co. Ltd., Manor Works, Cricket Inn Road, Sheffield, 2.



Two views of the Stead Fusedriver, one with fuse spool extracted.

The clippings bag in use with the Wolf hedge trimmer.

New Wolf Accessory

FOR use with the Wolf Cub hedge trimmer, this latest accessory is a rot-proof canvas clippings bag. It is supported behind the trimmer blades by means of a metal frame which holds the mouth open so that clippings fall into the bag as they are cut. This bag will eliminate the collecting and sweeping up of trimmings after cutting—a tiresome chore on lawns and flower beds.

The retail price of this exclusive Wolf attachment is 19s. 6d. It is shown in use in the photograph.

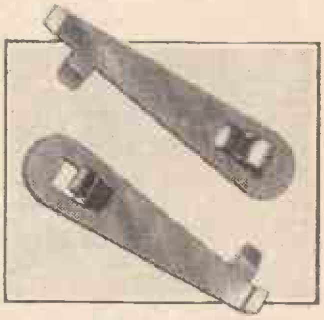
A complete hedge-trimming kit is also being marketed which includes a Wolf Cub power unit (the ¼in. electric drill), Hedge Trimmer Set No. 14, 30ft. T.R.S. extension cable complete with 3-pin weatherproof plug and socket and the new clippings bag. This kit will retail at 14 guineas.

Philplug Screwfix

PHILPLUG PRODUCTS, LTD., of Lancelot Road, Wembley, Middlesex, are marketing a new material to fix nails and screws into any type of masonry. With Screwfix, they state, the size of the hole is not important and the use of tools and plugs of various sizes is unnecessary. After making the hole moisten Screwfix, roll in the hand to make a plug, and ram it to the back of the hole; continue until the hole is filled. It becomes an integral part of the brickwork or masonry and hardens as the screw is tightened, forming a moulded thread. It will carry full weight immediately. Screwfix is made from asbestos fibres and cementatious powders and is obtainable in three sizes, prices ranging from 1s. 3d. to 8s. 6d., or in household sets, including materials, to fix approximately 50 screws, piercer and rammer and "U" clips, price 3s. 6d. Larger sets and kits are available.

The Drydex Large "Penlight"

A NEW fountain-pen-size chrome-finished torch has been introduced by Chloride Batteries Ltd., Clifton Junction, Manchester. It sells at 6s. (battery 7d. extra).



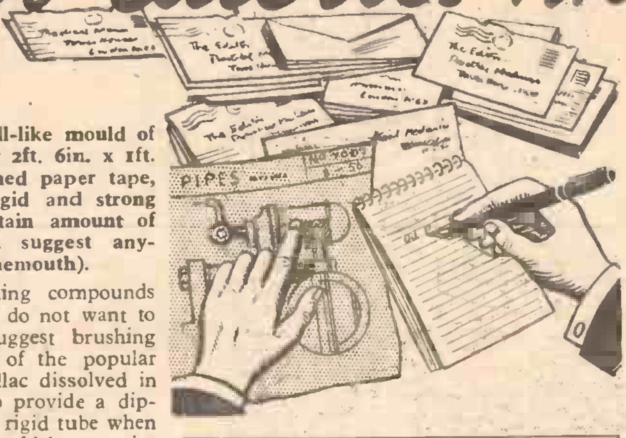
New offset screwdrivers

Off-set Screwdrivers

FROM the Elms Garage, Rednal Road, West Heath, Birmingham, 31, comes details of a single off-set and a double off-set screwdriver. These two useful tools, illustrated above, are designed to reach any awkwardly-placed screw. They are claimed to be indestructible and retail at 1s. each. A bottle cap remover is also incorporated.

Mr. F. J. Camm's latest book, "The Elements of Mechanics and Mechanisms," which costs 30s. or 31s. by post. It will interest all those whose job it is to design mechanisms and appeals to professionals and amateurs. A large number of perspective drawings illustrate the various mechanisms and methods of obtaining particular mechanical movements.

Your Queries Answered



Stiffening Compound

I HAVE made a thin, shell-like mould of an object approximately 2ft. 6in. x 1ft. 3in. x 1ft. 0in., with gummed paper tape, and I wish to make it rigid and strong enough to withstand a certain amount of rough handling. Can you suggest anything ?—C. F. Potter (Bournemouth).

THERE are many stiffening compounds you could use. If you do not want to mix your own, I would suggest brushing on to the paper tube one of the popular resin-containing glues. Shellac dissolved in methylated spirits would also provide a dipping solution, giving a fairly rigid tube when dry. Yet another method would be to paint on an enamel containing a synthetic resin such as "Bakelite" Used on one occasion, for making cloth rigid, was a solution of an urea formaldehyde resin, which is afterwards cured slowly at around 80 deg. to 90 deg. C. You can also buy in model shops a dope for the paper wings of model aircraft, which produces useful results.

Air-conditioning System

I WISH to install an air-conditioning system for a bedroom, the air in my locality not being all that could be desired, mostly on account of gasholders situated some quarter-mile from my house and at a lower level. I intend to use a Vent-Axia (9in.) exhaust fan at a high level in the room, and an intake through an air-filter at a low level. Would you be kind enough to give me details of a suitable filter, also your views on the scheme.—H. Taylor (Birmingham 8).

YOU have obviously given your air pollution problem some thought, and are prepared to go to some expense. I am afraid the fans would not deal with gas works smells, which are mainly due to sulphuretted hydrogen from the coal carbonisation plant. The odorous gas, however, is amenable to extraction by activated charcoal. I would suggest you fit a large container of this absorbent at the inlet of the low level fan. A five-gallon drum filled with activated charcoal should do, the air inlet to the drum being covered by a metal gauze, and also the outlet into the fan. Vokes Ltd., of Surrey, make felt type industrial filters, and they would possibly give you advice about dust extraction. Carbon would serve as a dust and gas extractor, but for dust alone you need only felt.

Cutting Glass Tubes

I HAVE some test tubes approximately ⅞in. diameter by 6½in. I wish to make them into tubes with both ends open. Could you kindly give me a method of severing the glass, leaving a "clean" cut to take a cork ? —L. D. W. (Manchester).

THE usual method of cutting tubes is to make a nick on the glass with a small file or a carborundum stone. A piece of red hot metal wire or glass rod is then held against the glass. A crack will then develop which tends to run around the tube. Sometimes this crack will cease before it has moved right around, in which case touch the glass with the hot wire or rod just beyond where the crack ceases to "encourage" it further.

Another, but less reliable, way is to immerse the tube in cold water up to the level at which you want to cut the glass. Soak a string in meth. and tie it around the tube. A crack may develop right round the tube. Whichever way you employ rub down the sharp edge of the glass with a fine file, a "Carborundum" stone or emery paper.

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.

Curing Porous Cottage Walls

MY cottage is built with local red sandstone and from lime from the fells. I am troubled with dampness, which does not rise from the ground but seems to be due to the porosity of the stone and to impurities in the building lime making the interior walls hygroscopic. Is there any remedy ?—V. Screeton (Cumberland).

YOU are quite correct in your diagnosis of the cause of the dampness of your house walls. Being of sandstone they have absorbed their full measure of water from their surroundings. In the days when your cottage was built this was a common trouble and builders endeavoured to overcome it by making the walls thicker and thicker. This policy, however, merely aggravated the trouble, for the thicker the walls became the more damp they absorbed ; so much so, that throughout the year the walls were permanently damp-ridden. Ordinarily speaking, the cure of damp, porous walls of this description is impossible. Nevertheless, given the willingness to make a fairly heavy expenditure, the trouble can be eradicated. There are certain solutions of silicon esters with which the stonework can be treated inside and outside. These solutions congeal within the pores of the stonework and fill them up with silica, which is decay-resisting, heat-resisting, water- and damp-resisting. Unfortunately, these silicon ester treatments are expensive, although, no doubt, with the aid of the requisite solution you could apply the treatment yourself.

Before considering the matter any further we would advise you to write to Silicaseal Ltd., Westgate Hill Grange, Newcastle-on-Tyne, 4, for particulars of their stone waterproofing solutions, the price of which, we understand, are around 30s. per gallon. The stonework of your cottage will need liberal treatment with a solution of this nature, but the firm above quoted will send you full particulars of the requisite solution to use and its best type of application. It would, we may add, be quite impossible for you to make up any solution on these lines for yourself.

Picture Frame Moulding Materials

I REQUIRE information on the composition of the material used for making up the ornamentation on the corners of picture frames and the procedure for gilding on same. I think it is made of whiting, linseed oil, glue and resin, but in what proportion and what is the method of "cooking" ?—James Manning (Plymouth).

YOU are correct about the main ingredients for such a moulding, referred to in the trade as "Composition." Take one pound of glue, half a pint of linseed oil, one pound of resin, and add to this as much gilder's whiting as will make the whole in a stiff dough. Add the resin to the oil first, and then put in the melted glue, kneading in the whiting until you get a smooth dough.

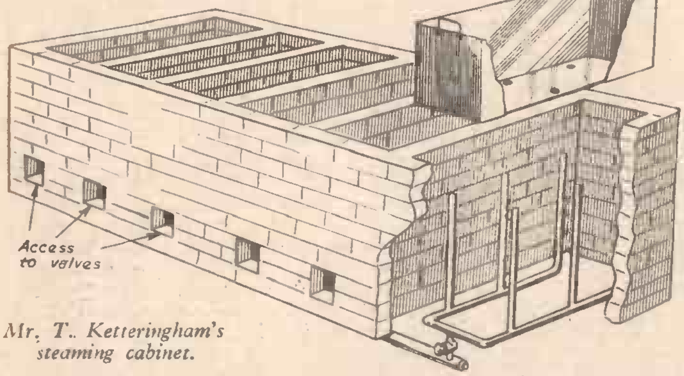
If you do not want to use all of the composition at once you can let it set into bricks, which can be softened by heat later when you want to undertake more moulding. When the moulding is hard on the picture you can paint it without any special preparation. "Gold" paint can be bought at any paint shop.

Steaming Cabinet Modification

THE sketch overleaf shows a system of steam cooking known as a Steaming

Cabinet. Low pressure steam, at 15 p.s.i., is supplied to each of the six compartments.

The present system of cooking with low pressure steam is successful, but bacteria are suspected in the cooked potatoes. To overcome this it is proposed to cook the potatoes with high pressure steam (about 30-40 p.s.i.). It is required to use the H.P. steam only for 10 minutes at the commencement; then change to L.P. steam for several minutes, turn off the latter, turn on the H.P., and so on, until the potatoes are cooked.



Mr. T. Ketteringham's steaming cabinet.

How can I arrange the steam piping to the "steaming cabinet"? I do not want to get the L.P. and H.P. steam systems mixed, as the former is exhaust steam from the steam engine (back pressure steam) and the latter is direct steam from the boiler.

Can you give me the correct layout, and a special type of 1in. steam control valve, if any, for our proposed new arrangement?

It will be required to turn on the L.P. in compartment 1, when at the same time H.P. steam may be wanted in compartments 3 and 6, owing to the staggering of the various cookings required at different times for use in potato mixers and driers.—T. Ketteringham (Wisbech).

THE circuit layout necessary for your projected purpose will be fairly straightforward and should not give rise to much difficulty of construction. We cannot draw the actual layout for you since this will be governed by the structural and dimensional details of the plant.

You will require two steam mains supplying each section of the entire plant. The steam mains, one for H.P. and the other for L.P. steam, may run parallel and, in fact, may be in actual contact. To conserve heat, they should be well lagged with asbestos. One of the mains (2in. diam.) will carry H.P. steam. The other will take the L.P. steam, and, naturally, will be controlled by separate main valves from the steam source. The steam jet assemblies in each section of the steaming plant or cabinet need not be interfered with. But connections from each of these assemblies will have to be taken to the L.P. steam main and to the H.P. steam main. This means that there will be two steam pipes connected to each steam jet assembly, instead of the single pipe used at present. Each connection will have its own simple "on and off" steam cock or valve.

In our opinion, a 2in. steam main will be adequate up to, say, 60 p.s.i. pressure and will not give rise to unequal steam pressures in the various sections of the installation.

The pipes should be of mild steel. Particulars of such pipes can be obtained from Messrs. Stewarts & Lloyds, Ltd., Brook House, Upper Brook Street, London, W.1.

Working to the above arrangement, each section of the plant will be equipped with two steam valves, one controlling H.P. steam and one controlling L.P. steam. The operator will be able to allow H.P. and L.P. steam to enter any given section of the plant either separately or together, and, of course, quite independently of the other sections. The steam supplies to the L.P. and H.P. mains will, also, be controllable from the main valves supplying the steam from its respective sources.

You will not require any special type of steam control valve. You will merely need an ordinary steam cock of simple design. It is essential, however, that all exposed runs of steam pipe should be well lagged with asbestos wrappings, otherwise much heat may be radiated by the pipes and thus wasted. Asbestos lagging material may be obtained from Asbestos & Engineering Products, Ltd., Winchester House, Old Broad Street, London, E.C.2, or from Dick's Asbestos, Ltd., Cory Buildings, Fenchurch Street, London, E.C.3.

Distilling Alcohol

(1) CAN you explain briefly the principles of distillation? I believe the boiling point of alcohol is about 175 deg. F., so assume that the liquid to be distilled is maintained at this temperature to drive off the alcohol. If this is correct how can one tell when the process is complete?

(2) Can you suggest a book on the subject?

(3) Is there a simple method of determining alcohol content?—R. T. Cotton (Palmers Green).

(1) WHEN one heats a mixture of liquids with differing boiling points the temperature of the mixture will rise steadily to the boiling point of the liquid with the minimum boiling point, and remain there until all of that liquid has boiled off. The temperature then climbs to the boiling point of the liquid with the next higher value, and once again the temperature remains more or less constant until that, too, has been boiled off, when there is a further rise of temperature. With a water-alcohol mixture the temperature rises to the boiling point of the alcohol which is distilled off, and when that is complete the temperature rises to the boiling point of water. The halt of temperature at the B.P. of alcohol is automatic, and when the thermometer once again begins to climb that means that the alcohol has been removed, and water only is left.

(2) Any intermediate chemistry book will cover this subject.

(3) The usual way of determining alcohol content is by observing the density of the mixture with a hydrometer.

Fluorescent Light Phenomenon

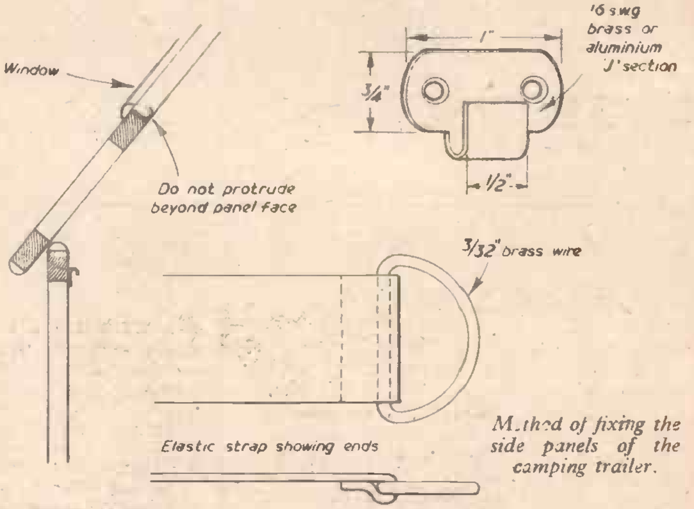
WHEN water falls from a tap and when machinery turns in a fluorescent light, bands of coloured light appear, usually orange, but sometimes, in the case of machinery, red and blue. Can you explain this phenomenon?—J. K. Shephard (Hendon).

YOU will find also that if you wave your hand in the light from fluorescent tubes you get coloured bands. It would take some time to explain the phenomenon in detail, but, briefly, it is due to interference and diffraction. The fluorescent light is pulsing at the mains frequency of 50 cycles and this, coupled with the movement of the droplets of water, or the rotation of the machinery parts, sets up an interference effect. When the wave pulses of light are passed on to a surface in rapid movement the light is split into its component colours. You can read more of this interesting effect in text-books on light or physics.

Camping Trailer—Fixing Side Panels

PLEASE tell me how, on the Camping Trailer, in Jan. and Feb., 1957 issues, the side panels are fastened to the bed extension sides. I can see how the sides are attached to the roof.—N. Hanrahan (Stockton-on-Tees).

FASTENING the side panels of the camping trailer is effected by means of



Method of fixing the side panels of the camping trailer.

elastic straps made up of 1in. wide elastic doubled for extra strength. Make them to suit as per sketch, giving them a medium tension.

Information Sought

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

Relining a Potato Washing Machine

I HAVE a potato washing machine, the inside of which is lined with a ¼in. thickness of carborundum or emery. The revolving plate is also lined in the same way. This carborundum has become badly worn; can you tell me how to reline it?—D. Lowe (Blackheath).

Celestial Bed

THIS device was invented by a Dr. Graham in the eighteenth century. The bed was suspended to enable it to oscillate and was electrostatically charged, insulation being effected by means of six glass pillars. It was claimed to cure sterility. Can you supply mechanical details?—R. J. B. (London).

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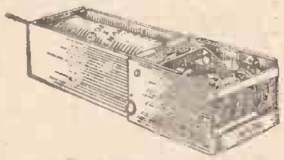

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THE Cyclist

Editor : F. J. CAMM

VOL. XXV MAY, 1957 No. 418

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
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WHAT I THINK By F. J. C.

The Jealousies Continue

THE N.C.U. is making intense efforts to regain its lost power and to retain its authority and, with that end in view, it has recently remodelled its policy towards racing, and has decided to allow the first category amateurs to race in events with independents. The R.T.T.C. saw in this an attempt to undermine its own authority, and in a statement said: "In view of the further complications which will arise in cycling sport owing to this decision a special meeting has been called for May in order to obtain the views of clubs on this new development. In the meantime it will enforce its own rules. The N.C.U. is, of course, the older body. It is 79 years old, and although there is considerable change in the personnel, and there appears to be a desire to profit from the lessons of the past and to forget it, there is still a tinge of the old policy in its methods. It is endeavouring to temper the wind to the shorn lamb. It has at least accepted some of our advice and infused some new blood into its management.

Some Basic Facts

THE British Cycles Industries Association has recently published some basic facts. In support of its statement that the bicycle is the safest vehicle on the road to-day, it says: There is an estimated total of 12 million bicycles in use in Great Britain at the present time. In 1956 only 49,169 cyclists were involved in accidents. The proportion of accidents to total cyclists is therefore less than 1 in every 240.

Comparatively, out of 6,716,000 motor vehicles in use, 274,251 were in the same year involved in accidents (1 in 24).

So few are the accidents for which cyclists are responsible that for more than 30 years cycling clubs have insured their members, young and old, against third-party risks entirely free of charge. The Cyclists' Touring Club provides this cover to £10,000 anywhere in the world.

Casualties to cyclists in 1956 were substantially lower than in 1955 (49,169 as against 60,178). In the same period casualties to motorists and their passengers rose from 151,472 in 1955 to 157,013 in 1956.

Fewer cyclists are now involved in accidents than before the war in spite of the fact that motor traffic has more than doubled.

	1938	1956
Motor vehicles in use:	3,084,895	6,716,000
Total cyclist casualties (killed and injured):	67,128	49,169

Fatal accidents to cyclists are much less than half what they were in 1938:

	1938	1956
Fatalities to cyclists:	1,401	650

Child cyclist casualties are much reduced.

	1938	1956
Fatalities to child cyclists:	205	119

Child cyclists are now so numerous that nearly half the country's children who are eligible to ride, i.e., between the ages of 7 and 15, do so. The estimate of the number of child cyclists given by the Royal Society for the Prevention of Accidents is 3,115,000. The total number of children between 7 and 15 in the country is 7,250,000.

Casualties to child cyclists in 1956 numbered 11,945. This is less than 1 in 259.

Selling Cycling

THE series of television programmes being put out on the ITV channel jointly by the manufacturers and the retailers are a move in the right direction of popularising cycling. They should do much to offset the adverse publicity of the accident statistics published by the Ministry of Transport monthly. The programmes are drawing attention to the health-giving aspect of regular cycling, and stating that it is the easiest form of travel; not quite, however, as the beginner soon discovers, until his muscles have been played in to the unaccustomed movement and the saddle has been "broken in." Most saddles to-day are designed for those who wish to ride fast, and they are more of a perch than a seat as beginners soon learn. Most of those whom the industry wishes to attract will be potterers and utility cyclists. They want a seat not a saddle and I suggest that the makers get down to the problem of producing a real seat instead of a perch.

One more point: although the retailers are interested in this publicity project, it is as well to point out that many of them are in need of a course on how to sell cycling. To many cycling is hard work, because they have been sold the wrong type of bicycle. A sale at any price seems to be the motto. The dealer could do much by supplying a cycle suited to the individual. It should not be too much trouble for him to change a sprocket if the gear happens to be too high or too low. He should study his clients, and adjust the handlebars, even changing them if they are the wrong type, and also the saddle. Board-hard saddles are uncomfortable, especially to a newcomer. Many a cyclist has been lost to the fold because of this.

The B.A.R. Concert

THE B.A.R. and Champions Concert will be held at the Royal Albert Hall this year on November 30th, and we hope that, remembering past experiences, the R.T.T.C. will take great steps to eject any hooligans who attend with the object of spoiling the evening's entertainment. These few uncouth hooligans, mostly from the North, should be immediately expelled if they do not behave themselves.

Cycling Museum

THE Pedal Section of the Montagu Motor Museum at Beaulieu, Hampshire, was opened on April 14th, when many prominent cyclists were present, including Reg. Harris and Eileen Sheridan. This pedal section will enable cyclists to study historic cycling exhibits and it will provide a ride with an object. It costs 2s. per head to view the exhibits, this being a special price to members of cycling clubs. We hope that greater accuracy in labelling the exhibits will be enforced than was the case with those of the self-styled cycling historian, the late H. W. Bartleet. Many of his claims relating to those machines were not only spurious, but he knew them to be spurious.

The Cycle Industry

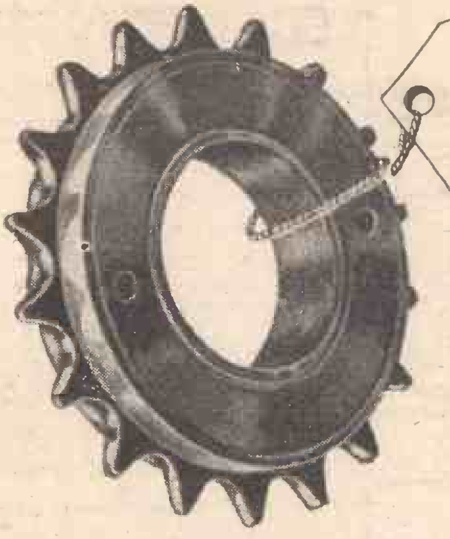
A RECENT press release from the bicycle industry draws attention to the present state of it. The statement says:

"A prominent feature of the modern industrial scene is the variety of burdens under which an industry labours. These burdens are not of that industry's seeking and are beyond its control to remove. The position of Britain's cycle industry is a case in point. It is the world's greatest producer and exporter of bicycles. Since the war it has made outstandingly successful efforts to answer the calls of successive governments to export, and has been earning consistently each year in the neighbourhood of £28 millions in foreign currency. At home it has provided an article, both in the lean years and in those of plenty, which has played a major part in the transport and mobility of the working man (and of his wife) and which has given the means of recreation to millions.

"But at home production is running at only about 60 per cent. of 1938. The reasons for this are that in Britain, Government legislation, in the form of purchase tax and high hire-purchase deposit and repayment requirements, prevents the development of a flourishing home market, while overseas an ever-increasing number of countries are closing their doors to British imports in order to restore their economy or to foster national manufacture. However, the cycle industry recognises clearly the vital point in this situation.

"In order to continue to compete successfully abroad, the quality of the product must be maintained and improved while prices must be kept down. This can only be done if the industry can depend on a healthy home market which allows production to be maintained at a high level.

"The situation within the cycle industry has reached a critical stage. Representations to secure some relief from taxation and other restrictions are now being made by the industry to the Chancellor of the Exchequer and to the President of the Board of Trade."



THE FREEWHEEL

Removal : How It Works : Dismantling and Reassembly

UNLIKE the fixed wheel, the freewheel sprocket drives only one way and is, therefore, much more difficult to remove. On the front of the freewheel body a narrow rim projects with two notches in it, and it is these that must be used to unscrew the freewheel from the hub. Using a hammer and punch inserted in these notches is not a good method as, in the majority of cases, all that is achieved is to cut away the rim between the two notches.

A Special Tool

A tool for freewheel removal is available and is shown in Fig. 1. It is passed over the wheel spindle and the two projecting tongues engaged in the slots in the freewheel body. The tool is then locked in place with a wheel spindle locking nut. The sprocket is removed by placing the tool between the jaws of a vice and turning the wheel until the freewheel loosens. Finally, the tool can be used as a key to turn the freewheel off the hub. The thread is right-handed.

The use of this tool, although an improvement over the hammer and punch method, is not always successful with a really obstinate freewheel, and often one merely breaks off the projecting tongues of the tool. There is no invariably successful method of freewheel removal and in some cases even the well-equipped cycle engineer is forced to dismantle the freewheel, hold the body in the vice and remove it forcibly, with inevitable damage.

How It Works

A standard type of freewheel is shown diagrammatically in Fig. 2 and a sectional view also shown. (A) is the body of the freewheel and (B) indicates the notches used for removing it from the hub. The outer half of the ball race (the front ring) is lettered (C) and the inner half of the race, which simply drops into position, is shown at (D). The slots in which the pawl springs lay are lettered (E) and the pin for anchoring them (F). (G) indicates the actual pawl and (H) is a cutaway portion of the freewheel body in which the pawl rests. (I) indicates the ratchet teeth and (J) the pawl spring. (K) shows the position of one or more thin packing washers which are inserted between the two halves of the race.

As can be seen from Fig. 2, the springs keep the pointed or driving ends of the pawls pressed into the vertical sides of the ratchet teeth and when the sprocket is turned in a clockwise direction by the action of pedalling, the drive is transmitted to the hub. When pedalling stops, however, the outside part of the hub is held stationary by the chain and the body part of the freewheel continues to rotate clockwise. The pawl now slides up the long shallow slopes on the ratchet teeth and clicks over the vertical end of each tooth, thus making the ticking sound with which every cyclist is familiar. Some freewheels have an extra ball race on their other side.

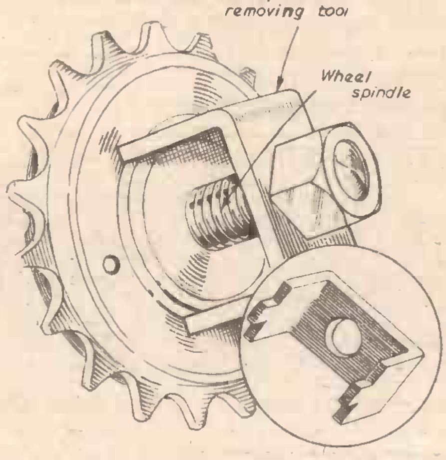


Fig. 1.—Freewheel removal tool (inset) and how it is used.

Dismantling

There are several makes of freewheel available, but basically they all follow the same principle of design. The first step in dismantling is to tap off the front ring, using a small hammer and a sharp punch for the purpose. Two small holes are usually provided to take the tip of the punch and the direction to unscrew engraved on the face of the ring. When this has been taken off, the one or two paper-thin packing washers are lifted out carefully and these followed by the balls and bottom half of the race. The toothed ring is lifted off next, but before doing this it is essential to make some arrangement for catching the pawls and springs, which will otherwise spring to some obscure corner of the workshop floor. It is a good idea to hold the freewheel inside a large paper bag while the outside ring is lifted off.

Worn Parts

The ball race is next reassembled, not forvery much wear, but the pawls and ratchet teeth may. Worn pawls and damaged springs may be replaced immediately without much trouble, but if the ratchet teeth are worn a new freewheel is indicated. A freewheel that has been kept well oiled should not be badly worn.

Finally, the chain teeth should be inspected for wear.

Reassembly

All the parts should be clean and free from oil. The rear part of the ball race may be put in place on the body and the pawl springs and their pins put in place. Replacing the pawls and the outer ratchet ring is a little tricky and some ingenuity must be exercised. One method is to hold the pawls in place with thin-bladed screwdrivers while the ratchet ring is lowered carefully into place over the body. An alternative way is to fit the pawls and springs and hold them in place by means of a sliding noose of thin cotton while the ring is being positioned. The ball race is next reassembled, not forgetting the thin packing washers between the two halves of the race. The last part to be replaced is the front ring, which is tapped firmly into position and adjusted so that the chain tooth ring is free to rotate without binding and without there being too much play.

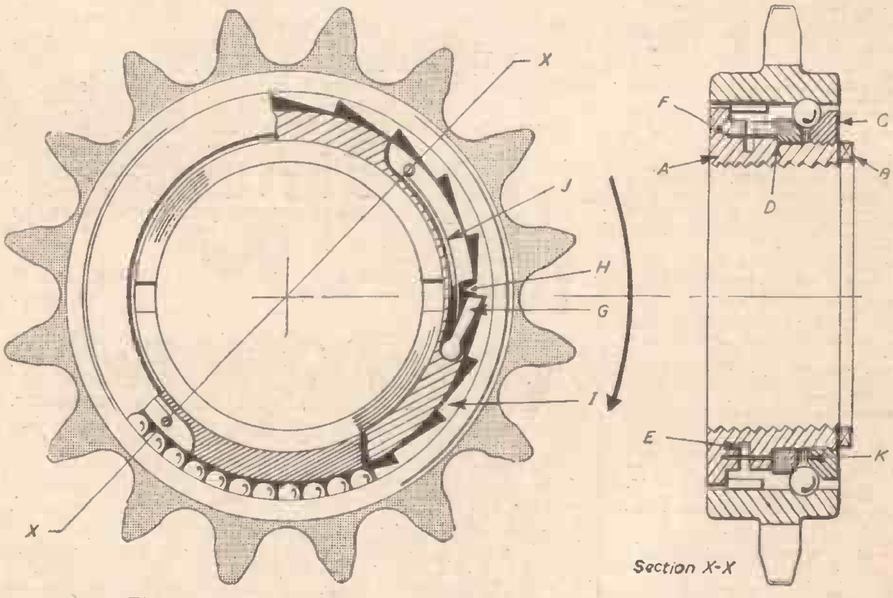


Fig. 2.—A freewheel cut away to show assembly and a sectional view.

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3,000 High Speed Toolbits, ground finish, slightly below 3/8" square, 3" long, actual present day value 47/- per doz. A most useful bargain, 25/- per doz. 13/6 half doz., 2/6 each.

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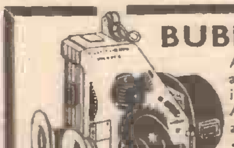

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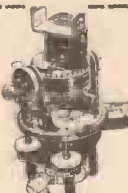

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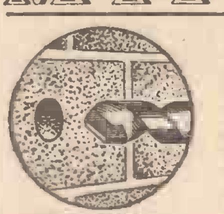

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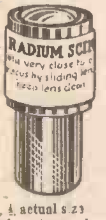

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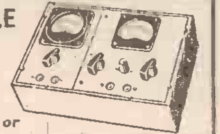

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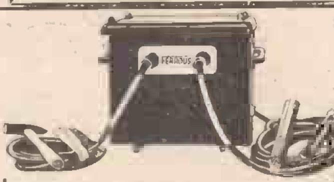

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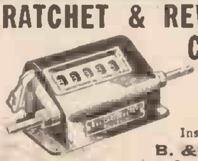

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