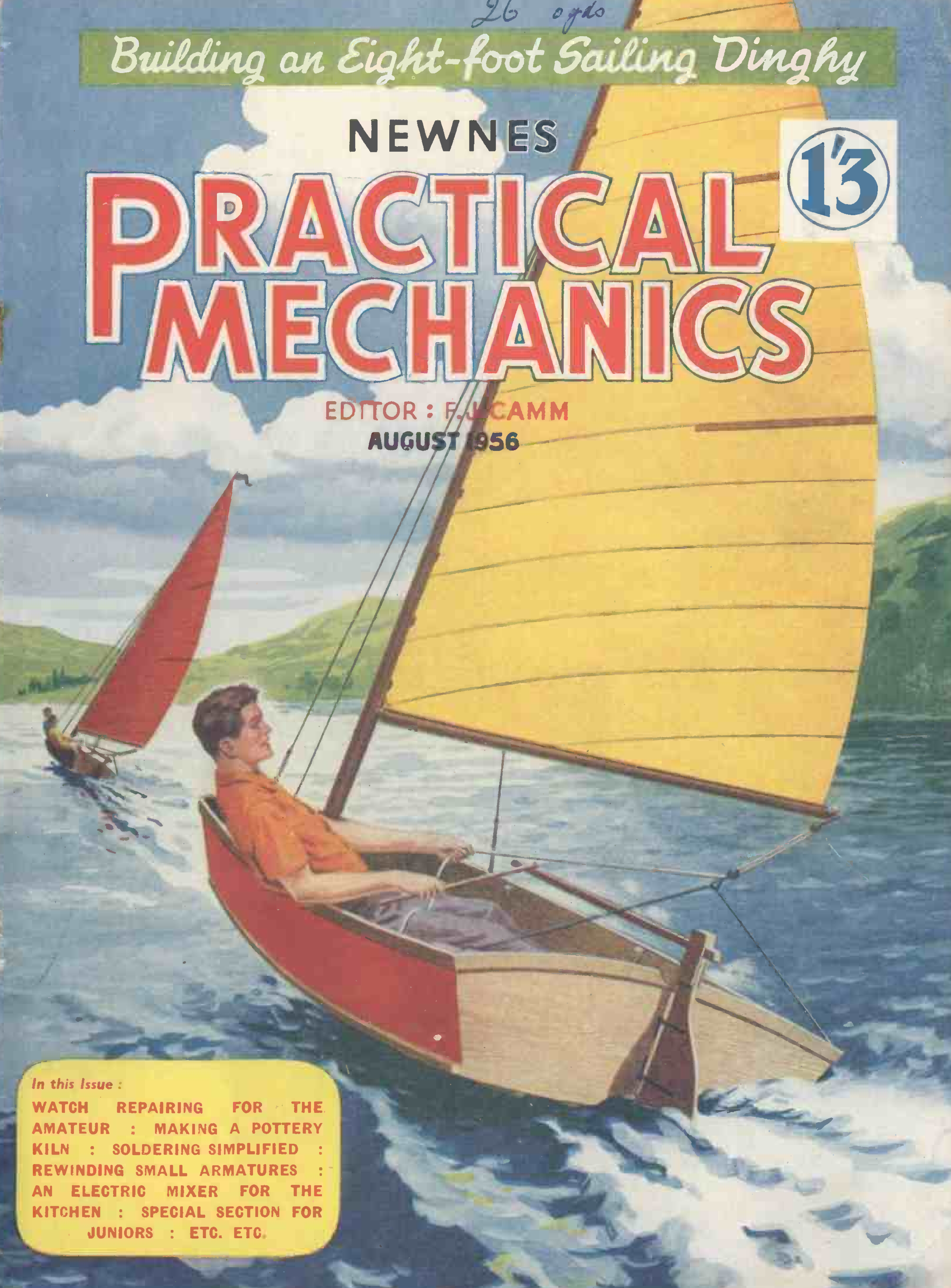

Building an Eight-foot Sailing Dinghy

NEWNES

# PRACTICAL MECHANICS

1'3

EDITOR : F. J. CAMM

AUGUST 1956

*In this Issue :*

**WATCH REPAIRING FOR THE AMATEUR : MAKING A POTTERY KILN : SOLDERING SIMPLIFIED : REWINDING SMALL ARMATURES : AN ELECTRIC MIXER FOR THE KITCHEN : SPECIAL SECTION FOR JUNIORS : ETC. ETC.**


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Side 1. as illustrated. Scales giving quantities of welding rods used and current consumption according to size, type and total length of welds. Side 2: Particulars relating to fillet and butt-welds.

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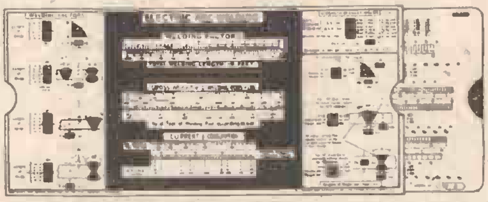
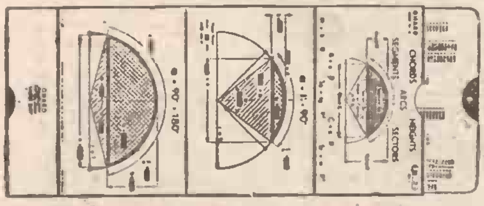


**MODEL M.2. Arcs, Chords, Heights, Segments and Sectors**



of circles with radius (r=1) and the angles at the centre of the circle from 0° to 360°. 2,642 values. Standard Qual. (glazed).

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(B.S.W., B.S.F. & B.A. sizes), also principal dimensions of bolts and nuts, as well as of socket screws.

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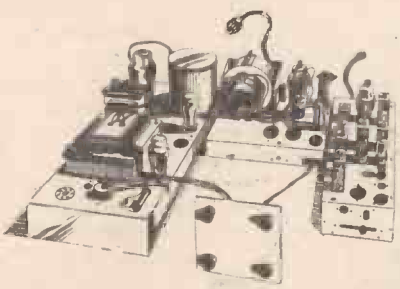

**T.V. 12in. CHASSIS. 97/6.** Complete chassis by famous manufacturer. R.F. E.H.T. Unit included. Drawing FREE. Easily fitted to Table or Console model, owing to this chassis being in three separate units (Power, Sound and Vision, Timebase) inter - connected. THIS CHASSIS IS LESS VALVES AND TUBE, but see our catalogue for cheap valves. Our £5 Tube fits this Chassis. List of valves by request. Carr. 5/- London. 10/- Provinces. Channels 1—5.

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*Whenever you wish*
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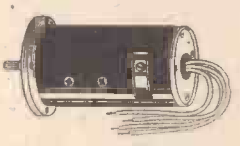
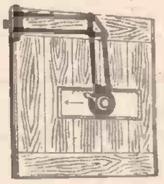
GM.27

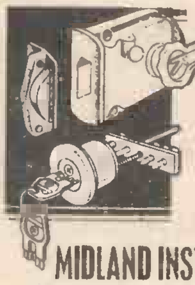


**HUGHES 12-VOLT SHUNT MOTORS,** taking 1.25-amps., and up to 2-amps on load, speed 5,000 r.p.m., external reversing terminations, size 3⅜in. long, 1⅞in. dia., weight 20 oz., oil impregnated bearings, ¼in. dia. shaft, a superior and powerful motor, original cost over £7, ideal for boats and other models, stirrers, car heater blowers, small power tools, etc., etc., new unused, 10/-, post 1/4 ; 2 for 20/-, post paid, ditto fitted reduction gears, with final drives of 160 or 320 r.p.m. (state which required), 12/6, post 1/6 ; 2 for 25/-, post paid.



**NAVIGATORS CHART BOARDS,** selected 7-piece polished wood size 17in. x 17in. x ⅞in., fitted brass parallel motion drawing arm hinged to board edge slide with lock screw, free arm end fitted protractor scale marked in degrees, also ruled transparent perspex straight edge size 10in. x 3in. x ⅛in., each with locking device, board back has felt or rubber feet, with pencil holder, an ideal draughtsman's board, new and boxed, value 70/-, our price 25/-, post 2/6 ; 2 for 50/-, post paid.

**"BAMBI" GARDEN SPRAYERS,** made by Fisons Pest Control, Ltd., consists of the special glass container holding 4 pints, marked in ½ pints, filler cap is a ½ or 1oz. measure, adjustable webbing to sling on shoulder or back, so that both hands are free, 40in. flexible tubing to the polished brass syringe, with nozzle that gives a finely atomized spray. Scrap those messy old-fashioned sprayers now in general use, that require buckets, hoses, etc., invest in a "Bambi", value to-day 45/-, our price new and boxed 20/-, post 3/- ; 2 for 40/-, post paid.

**"K" TYPE CYLINDER LOCKS,** deadlocking and thiefproof, has 7 concentric tumblers, instead of the usual 5 in line, interchangeable with ordinary cylinder locks, latchbolt reversible to suit right or left-hand doors, no need to specify, finish black crackle and bronze. Complete with 2 keys and all fittings, instruction booklet, new, boxed, list price 18/9, our price 5/-, post 1/4 ; 2 for 10/-, post paid.

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## Wolf Cub £5.17.6

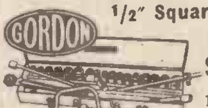
**or 8/- deposit and 6 m'thly pymts. of 20/6.**
This wonderful Electric Drill is also the power unit for ALL Cub equipment. Drilling capacity : Mild Steel, 1/4" ; Hard Wood 1/2" ; with 210 watts input on full load. Complete with 1/4" three-jaw chuck and Allen key and 5ft. of cable. TV Suppressed. State Voltage. ALSO Home Workshop Outfit (drill, saw, lathe, sanding and polishing kit), £17.19.0 or 40/- deposit and 8 monthly payments of 44/-. *Send for Illus. Brochure of Wolf Cub equip.*

## CHILTON ELECTRIC HOME HAIR CLIPPER

Keep short hair-styles smartly trimmed yourself with the Chilton. Gives the professional comb-and-scissors action Slip comb off and use to tidy neck hairs. Useful for children's hair, also for men too busy to visit barber. Plugs into lampholder. Complete with plug. A.C. only, 210/250v. £4.14.6 cash or 2/6 deposit and 6 monthly payments of 17/-. 12 months' guarantee. ALSO hand clippers 16/-.

**2/6 DEPOSIT**

## 1/2" Square Drive SOCKET & ATTACHMENT SET 488

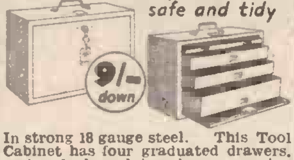



**25/- DEPOSIT**

In finest-grade Chrome-Vanadium steel, heat-treated and heavily plated. Complete in sprayed metal box, with 6 Whitworth Sockets 3/16" to 1/2" and 10 American Sockets 7/16" to 7/8" Screwdriver Bit, Draglink Adjuster, Reversible Ratchet, 1/2" Square Driver, 5" Extension Piece, 10" Extension Piece Universal Joint, 12" Tommy Bar, Sliding "T" piece. Speed Brace. Deposit 25/- and 6 monthly payments of 23/6, or for Cash £7.12.3. Sent on payment of deposit. *List Free.*

## TOOL CABINET

*Keeps tools safe and tidy*




In strong 18 gauge steel. This Tool Cabinet has four graduated drawers, spring lock and two keys, carrying handle. Finished olive green. Overall size 16¼" x 8" x 10¼". Safe, strong, good value at 60/-, or 9/- down and 4 monthly payments of 14/-.

## FOR YOUR ELECTRIC DRILL

**SET OF 5 WOOD BITS** High-speed, all steel, in neat blue plastic wallet. Comprises 1/4", 5/16", 3/8", 7/16" and 1/2" bits, 1/4" shanks. **15/-**

**SET OF 4 CARBIDE TIPPED MASONRY DRILLS** For brick, tile, etc. Up to 3,000 r.p.m. Nos. 8, 10, 12 & 14. Or offered separately: No. 8 8/6. No. 10 8/9. No. 12 8/9. No. 14 9/9. *All Post Free.* **32/6**

## YOURS for 14 days FREE

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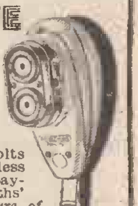

Try this wonderful **PHILISHAVE** Electric Shaver **FREE** for 14 days. Send only 5/- deposit (returnable). Two rotary-action, 6-bladed cutters genuinely shave, don't just snip at the hairs. For 110/250 volts AC/DC. Cash £7.14.2 less deposit. Or 5/- plus 8 payments of 20/6. 12 months' guarantee. *Illus. Brochure of this and other Shavers free.*

*Send for list of other Bargains.*

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It's no longer a "circus act" when tackling those awkward jobs in home or workshop—use a Mole Wrench. This versatile tool—it serves as super pliers, clamp, vice, etc.—has a grip exceeding one ton, locks on and leaves both hands free to work. Compact and simple to use, the Mole Wrench is a "first-rate third hand" to handyman and engineer alike. *From leading Ironmongers, Cycle and Motor Cycle Accessory Dealers.* 7in., 12/6 ; 10in., 15/-.

**MOLE**

Trade Mark

**SELF-GRIP WRENCH**

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# Model Engineer Exhibition AUG 22-SEPT 1

## NEW HORTICULTURAL HALL · SW1

Every kind of land, sea and air model, all incredibly detailed and accurate, can be seen at this fascinating Exhibition, as well as many kinds of amateur craftsmanship. Model makers from all over Europe, including the Soviet Union, will be competing for the numerous awards offered by the Organisers and Friends of the Exhibition. The *Model Engineer* Students' Cup attracts many fine exhibits from boys under 18 and you will see some wonderful entries for the Duke of Edinburgh Trophy. Then, of course, there are the Club Stands, the Trade Stands with the latest trade products, and the Special Attractions.

*The Exhibition will be open from 11 a.m. to 9 p.m. (Sunday excepted). Admission 3s. Children 1s. 6d.*

## SPECIAL ATTRACTIONS

Demonstrations by craftsmen of the skills needed in model making. Miniature coal-burning locos on the live steam track. Radio-controlled vessels on the marine tank. A racing car track with miniature petrol-engined racers. Two intricate model railway layouts. A full size model of locomotive cab with all the usual controls. A steam-driven fairground round-about.

HOW TO GET THERE : *Buses :* 10, 11, 24, 29, 39, 46, 76, 134 *to Army & Navy Stores.* 2, 2a, 36, 36a, 57, 69, 169, 181, 185 *to Rochester Row.* 10, 46 *to Horseferry Road. Underground to St. James's Park.*

# INTERESTING BARGAINS

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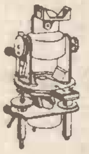

Supplied in good condition in sturdy box with instructions for use in Astro Navigation and star identification—also instructions for conversion to Dumpy Level, 25/- post free.

### RUDE STAR FINDER & IDENTIFIER

Ex. R.A.F. Navigators' equipment. Consists of star base and 7 templates covering lats. 0-70 N. and S. Makes star finding and identification relatively easy. With maker's instructions in leatherette wallet. 5/- p. & p. 9d.

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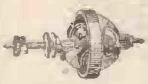
| Boost | ... | 6— +24 p.s.i. |
| Air... | ... | 0— 80 p.s.i. |
| Air... | ... | 0—1,000 p.s.i. |
| Hydraulic | | 0—1,000 p.s.i. |
| Air... | ... | 0—2,000 p.s.i. |


**6/-** each post free.

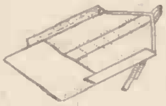
### GOVERNOR UNITS



Precision made mechanism, designed for Aircraft, with many other mechanical adaptations. 4in. overall, brand new, 3/9 post free.

### TOOL ROLLS

Approx. 15in. x 8in. with 6 divs. and pocket. Stock-soiled clearance price 3 for 2/6 or 8/- doz., post free.



### NEW NYLON PARACHUTE CORD

Approx. ¼" diam., the thicker cord used for the giant cluster parachutes, very strong and durable supplied in any continuous length up to 280 yds. ; 6d. per yd., p. & p. 8d. any order.

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Brand new, double thickness parachute webbing 1¾" wide, 13½ft. long, hook one end, loop the other, 7/6. p. & p. 1/3.

### TRIPODS

Light (5lb.) wood tripods 38" legs, brass top, which can be adapted to take any instrument or camera or can be easily converted into a useful ARTIST'S EASEL, ex. govt. and complete with handy carrying sling. 15/-, p. & p. 2/6.

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Tough transparent TUBULAR film. Sold by the yard in these widths and any length you wish. 2" 4d., 4" 6d., 6" 9d., 12" 1/-, 18" 1/6, 24" 2/-, 36" 3/-, 48" 4/-. Prices per yd., please add 6d. p. & p. to total of order. Tubular film opens up to double stated width, thus 48" tubular makes 96" sheet.

Effectively sealed into bags by the heat of a match. There are innumerable applications in industry and home for protection against dust and damp with POLYTHENE of which Mothproof Bags are something we all need. SAMPLE FREE. S.A.E. please.

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12 pint with precision screw cap. Swiss made, used previously for Vitamin A, make excellent water carriers, require washing out. 10/3 each, p. & p. 1/6. or 3 for 27/6 p. & p. 2/6.

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Sizes ⅜in., ⅝in., ⅞in., 1¼in. Handy assortment of six dozen retail value 20/-, 7/6 p. & p. 1/3.

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Ex M.O.S., 20 Gauge 18/8, stainless steel. Complete with outer lid as illus. plus inner anti-splash lid, both lids locked secure by depressing handle. Size 16in. x 11in. x 11in. Cap. 6 gal., 57/6, carr. paid.

### ELASTIC SHOCK CORD

Cotton covered, ¼" diam., 1/- per yd. ; ⅜" diam., 1/8 per yd. Postage 6d. per order.

### GROUNDSHEETS

Familiar ex.-service cape type, all in good condition, 7/6 each, p. & p. 1/6, or 3 for 21/- post free.

### DIAL THERMOMETERS

100/300 degrees Fahrenheit. Brand new, clearly marked 4" dial, sensitive metal clad element projects, 8" from back, suitable for dipping into liquids, or affixing to ovens and tanks. Exceptional value 35/-, p. & p. 2/6.

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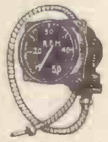
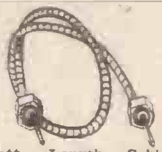
Brand new, calibrated 1000/5000 r.p.m. 3" dial operates 4 : 1 ratio, 20/- post free. Makers' price about £7.10.0. Flexible drives to fit, patterns A, B, C, D, E as advertised below.



### NYLON BRAID

3/4" wide, soft, easy to handle, and ideal where lightness plus strength is required. 32 yds. breaking strain 1,900 lbs., 32/- post free. 64 yds. breaking strain 1,360 lbs., 50/- post free.



### FLEXIBLE DRIVES

| Patt. | Length | Cable | Outer | Price |
|---|---|---|---|---|
| A | 9" | .25" | .43" | 2/6 |
| B | 18" | .25" | .43" | 7/6 |
| C | 30" | .25" | .43" | 12/6 |
| D | 60" | .25" | .43" | 15/- |
| E | 72" | .25" | .43" | 20/- |
| F | 92" | .23" | .45" | 22/6 |
| G | 240" | .14" | .33" | 30/- |
| H | 36" | .50" | .94" | 45/- |

Patt. H is heavy duty drive with base plate and bearings. P. & P. 1/6 per drive extra ; 3 or more post free. Post free with rev. counter.

### MOTOR CYCLE COVERS

GIANT BOMBER WHEEL COVERS, will give complete protection, tea-cosy fashion, to 250, 150 machines and scooters, etc. Made to the usual high standard of all R.A.F. equipment. Will remain completely waterproof for years. 17/6, p. & p. 2/6.

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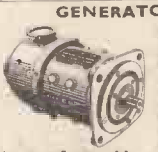

12 volts 750 watts. Can be used as generator or motor app. 1 h.p. without modification. Weight 26lb. ; body 9" x 5" dia. ; splined ⅜" drive shaft. Many uses, lighting sets, battery chargers and all types of portable power supply. Brand new in well-made wooden case, 75/- carr. 7/6.

### NEW AIRCRAFT FUEL TANKS

Length 66" ; depth 14" ; width 24". Weight 60lb. Capacity 80 gallons. 2 apertures 1¾" diam.

Brand new bullet-proof self-sealing rubber tanks, made of ¼" sponge rubber probably cost over £100 each ; a real opportunity for the bargain hunter with ideas, at 25/- each, carriage 10/-.

### TRANSPARENT PLASTIC SHEET

Clear as glass, flexible, does not crack, non-flam., suitable for side screens, horticultural cloches, display work, notice boards, and many other purposes where perfect clarity is required. Easily stitched, unaffected by sunlight, permits passage of Ultra Violet rays.

Sheet size : 50in. x 26in.

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| Thickness .010 | ... ... | per sheet | 8/6 |
| Thickness .020 | ... ... | per sheet | 16/- |
| Thickness .030 | ... ... | per sheet | 21/- |

P. & P. 1/3 per order.

Samples free S.A.E. please.

This is an entirely new British Product which has many advantages over traditional materials.

**MYERS & FOULKES** PHONE LEY 1013

DEPT. PM. 187/188 THE ARCHES, GROVE GREEN ROAD, E11.

PRACTICAL MECHANICS

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

VOL. XXIII. No. 270

Editor: F. J. CAMM

AUGUST, 1956

## FAIR COMMENT

By The Editor

### Electro-Gravitics

IN our issue dated February, 1942, we published an article from the late Mr. W. D. Verschoyle on the electro-gravitic theory, and I believe we were the first journal in this country to deal with it. The notion seemed fantastic, but later experiments in connection with the force of gravity seemed to suggest that Mr. Verschoyle's theory is likely to have practical effect, and to upset many of the established concepts concerning gravity.

My friend Swinfen Bramley-Moore, in a booklet entitled "The Apple in the Orchard," expounds his new theory concerning the law of gravity, and his views disagree with Newton and Einstein. He has gone a long way to prove that his new theory concerning the laws of gravity and planetary motion are correct.

Now what is the electro-gravitic theory? It relates to a form of lift in connection with aircraft which is not concerned with air reaction as is an aerofoil. Electro-gravitic lift is independent of the air. Whether we use aerofoil, vertical propellers or rotating cylinders the effort in each case aims at overcoming the downward pull of gravity. Each of these methods of overcoming gravitational pull gives an indirect solution of the problem, but it does not deal with direct action on gravity itself.

Electro-gravitic lift is obtained from direct action on gravity through a newly discovered method of applying electrical energy, and this is derived from experiments which Faraday initiated nearly a century ago, and which sought a connection between electricity and gravity. Both Einstein and Bramley-Moore have proved this to be so. Once this connection is known, with unlimited electrical power available, a wide field of practical utility is opened up in which its applicability to aviation is of prime importance, particularly in connection with interplanatory travel.

In the new theory gravity becomes the principal force, and the gravity field existing between the earth and any external mass of matter, such as an aeroplane, becomes the point of attack. Some new kind of ray had to be found capable of affecting this field, and this was discovered in what are known as the "Y" rays. These rays have extraordinary characteristics, but they are fairly easily generated, and it is only a matter of time before they can be generated with sufficient intensity to deal with the gravity field existing between the earth and an aeroplane weighing, say, 100 tons.

It opens up the possibility of great advances in aeronautical practice both for peace and war purposes.

Employing electro-gravitic principles the aeroplane of the future will have no wings, rotating cylinders or vertical propellers, and something like 40 per cent. of resistance to motion will thus be eliminated. Such a 'plane would need no initial high ground velocity to get into the air. It will rise up vertically from or alight anywhere on the earth's surface and proceed to its destination at speeds very much greater than any yet known. This idea is not a fantasy. As long ago as 1936, Verschoyle demonstrated a model aeroplane operated electro-gravitically, and a film of it in flight was shown in the principal London cinemas. Can it be that some of the unidentified flying objects seen in the sky are propelled by this means ? All of the reports of such objects state that they were proceeding at very high velocity.

According to a contemporary, electro-gravitics has reached the stage where profound implications for the human race begin to emerge. Perhaps the most startling and immediate implications of all involve aircraft, guided missiles, atmospheric and free space flight of all kinds. The concept of weightlessness in conventional materials which are normally heavy is difficult, but some theories which have been borne out in the laboratory prove that they can be made weightless and, in fact, can be given a negative weight.

In experiments materials have been cut in weight by 30 per cent. and have become energised at the same time. We are informed that disc aerofoils 2ft. in diameter and constructed to simulate an electrical condenser, charged with 50 kilovolts and an energy input of 50 watts, have achieved a speed of 17ft. per sec. and larger discs have been similarly successful. It seems likely that there is a relationship between electricity and gravity similar to the relationship between magnetism and electricity.

Apart from transport other possibilities are opened up. The construction of bridges and buildings would be cheapened and simplified by the weightlessness which electro-gravitics supplies. The transmission of power in cars, trains and boats would undergo a radical change. It is known that the National Physical Laboratory is investigating the problem of overcoming gravity, and further experiments are being conducted in France, America and Russia. Could it be that the builders of Stonehenge, the Pyramids and the Sphinx had discovered some such method ? For it is still a matter of conjecture as to how the large weights of material used in these were lifted, in days where there were no cranes or gantries.

Can it also be that some country has produced circular planes such as flying saucers propelled by electro-gravity ? If so that would account for the mystery, at present unsolved, of flying saucers.

Whilst I am dealing with the subject of transport, it is interesting to report that the first International Flying Saucer Sighting Day was held on June 30th, but it did not produce any spectacular results. A further I.F.S.S.D. is to be held on September 8th, when observers from all over the world will be on the watch. Something should emerge from this world-wide probe into the mysteries of unidentified flying objects, although one or two of the more youthful, but none the less enthusiastic, members of the F.S. movement are quite certain, according to newspaper reports, that they have the answer to the problem! It seems a pity that they have not disclosed their theories when talking to the press.

F. J. C.

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# An ELECTRIC MIXER for the kitchen

A Simple Single-Paddle Unit Utilising an Ex-government Gearbox and Motor

By M. KATERS

IN this mixer only one beater paddle is used, for although it might be slightly less efficient than its double paddle equivalent it is easier to construct. If one desires a double beater, then use an old commercial paddle system in conjunction with the gearbox mentioned.

A mixer consists of three main parts: the motor, gearbox and paddle system.

### The Gearbox

The gearbox is 4in. x 3in. x 2in. and has six gear ratios of 30 to 1, 187½ to 1, 750 to 1, 6¼ to 1, 25 to 1 and 4 to 1. It can be obtained from Lux Electric, Ltd., 153, Tankerville Drive, Leigh-on-Sea, Essex, at 10s., post free. From Fig. 1 the gearbox can be seen as purchased, and Fig. 2 shows it when stripped ready to use as a mixer gearbox. The diameters of the spindles are 3/16in. and 5/32in., choice depending on what speed is required for the final drive.

To determine the final speed, connect up the motor to the gearbox as purchased, and from the speed of rotation decide which spindle speed is the most suitable. To enable you to get a better idea of the speed, put a piece of sticky paper flag fashion on the spindle ends; this gives an excellent guide. The speed chosen here was 30 to 1 reduction for the 6,000 r.p.m. motor used.

Fig. 1.—Original gearbox as obtained from the suppliers.

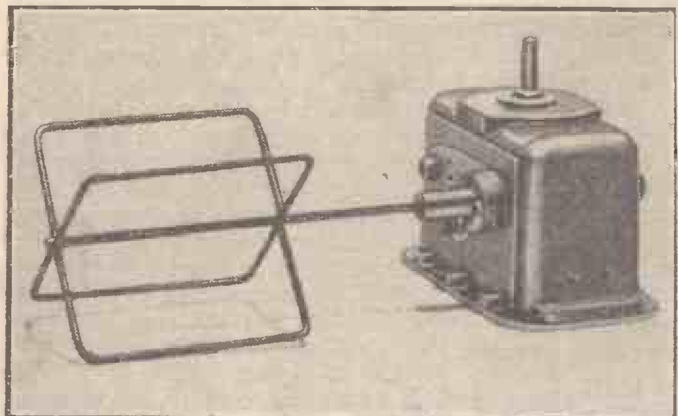


Fig. 2.—The paddle as fitted to the modified gearbox.

After deciding the gear ratio required, the unnecessary fitments and the base are removed. The fibre washer should be kept intact to be used as a seal when the gearbox is screwed on to the case. The grease packing should be taken out and the spindle split-pin removed from the shaft required. The shaft is now placed alongside the paddle pillar and used as a marker for the 1/16in. diameter split-pin hole which has to be drilled through the pillar. The gearbox is now re-assembled, using the paddle shaft in place of the original gearbox one. The result is as shown in Fig. 2. The grease is now replaced, as it not only serves as a lubricant but cuts down gearbox noise. The other spindles can either be cut short or removed.

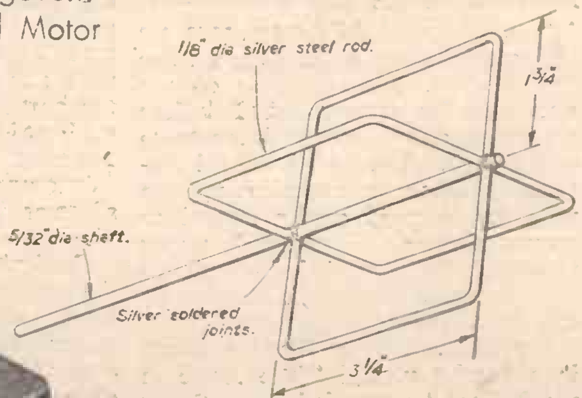



Fig. 4 (Right).—Details of the paddle.

### The Paddle

The paddle is made of silver steel rod and the shaft can be of any length up to 13in., the maximum length of the rod. The gearbox shaft was 5/32in. in diameter and, therefore, the silver-steel was of the same size. The actual paddle sections were made out of ⅛in. diameter silver steel and hard soldered to the main shaft, as shown in Fig. 4.

It is rather difficult to solder the four paddle sections to the shaft at two points only, but this can be overcome by holding them in place by means of thick cardboard. One piece of cardboard should be placed away from the end being soldered and the other in the centre. When the sections are soldered into position, the cardboard can be torn away.

(Concluded on page 462.)

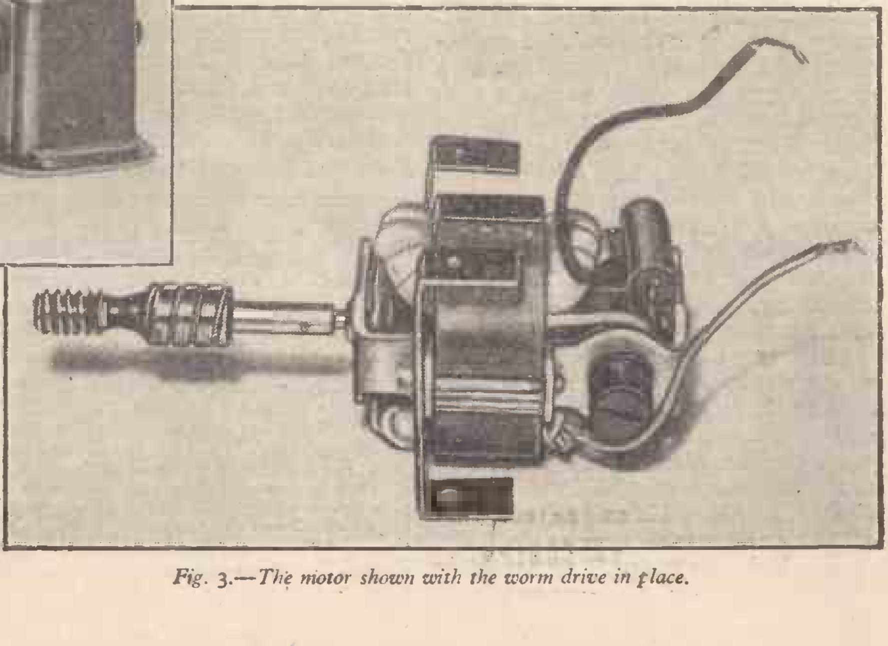
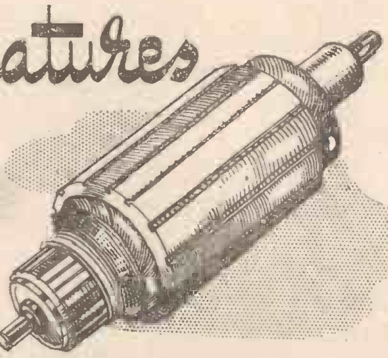


Fig. 3.—The motor shown with the worm drive in place.

# Re-winding Small Armatures



## A Simple Method for the Amateur

By "COMMUTATOR"

SPACE does not allow too deep a penetration into the theory of armature winding and many books have been written on the subject. The object is to explain as simply as possible to the home electrician a method of rewinding small armatures which have become faulty or are completely burnt out.

One or two pieces of equipment will be necessary as the work proceeds all of which are easily made and these will be dealt with as they are required. No special hand tools are necessary, the ones usually found in any handyman's workshop should be sufficient to carry out the work involved. The use of a small lathe would be an advantage, although this is not absolutely necessary, as this part of the work can be carried out by any small engineering firm.

Commence by making two wooden stands as shown in Figs. 1 and 2, the size being governed by the size of the armature to be wound. One of these stands will be used throughout the winding process and the other should be placed on one side for use later.

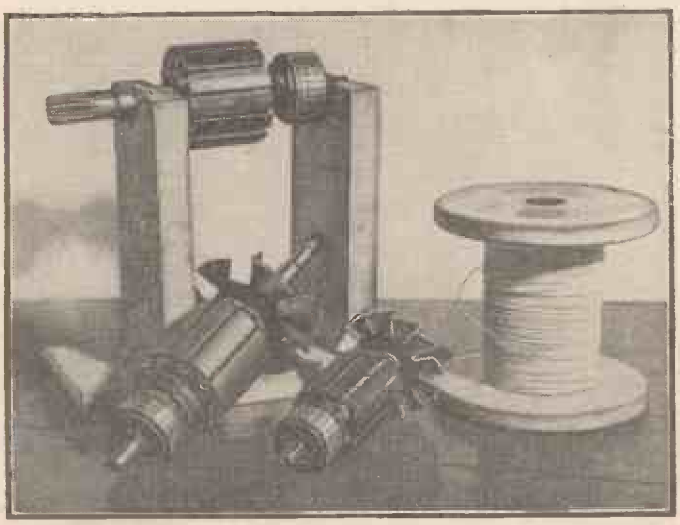


*Fig. 1 (Left).—The stand used for rewinding.*

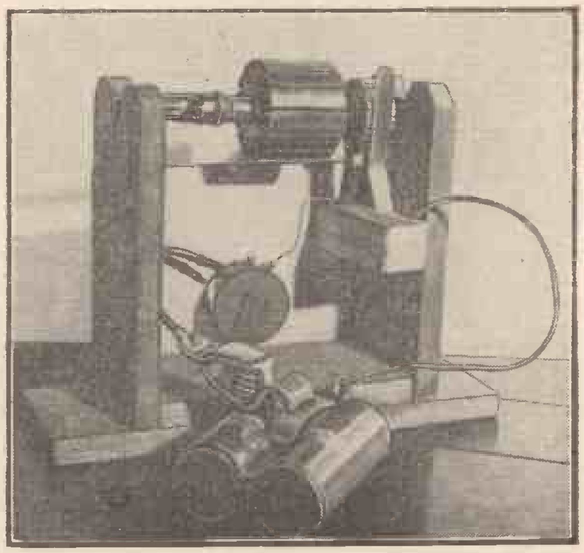


*Fig. 2 (Right).—Stand No. 2 rigged up for testing.*

### Points to Note

It is assumed that the armature to be wound has been removed from the machine, the ball races and fan withdrawn from the shaft and the armature placed on one of the stands. At this stage it is necessary to make notes (which will be referred to later) of the following points: 1. Number of slots; 2. Number of commutator bars; 3. The number of slots the last coil spans (see B, Fig. 3). It is important that these notes, together with others which will be made later, are not mislaid, otherwise it will be useless to proceed.

In order to understand what is being done, imagine the armature has 12 slots and 24 commutator bars and a coil span of 6 slots. Each bar on a commutator represents one coil and it follows, therefore, that there are two coils in each slot. The only other information required to add to the notes are the turns per coil and the gauge of wire used. It is important that details of the slot insulation are noted.

### Removing the Old Winding

First take off the binding behind the commutator, unsolder and lift all the leads that are connected to the commutator bars, remove the fibre wedges and cut off the end windings with a junior hacksaw, being careful not to damage the insulated end pieces or the shaft in the process. With a punch ground to suit the slots gently remove the remainder of the winding and slot insulation, trying, if possible, to remove them in one piece and so avoid damage to the stampings and commutator.

Now that the armature has been stripped of its windings and insulation it is cleaned and any sharp places removed with a smooth file.

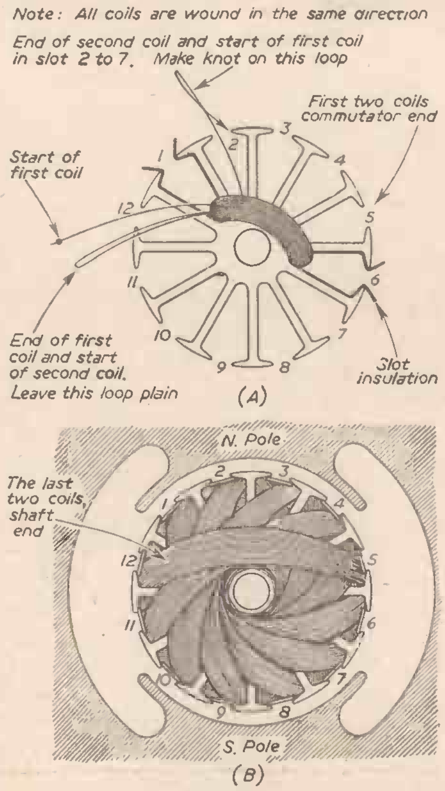



*Fig. 3 (A).—Commencing the rewinding. (B) Selecting the last coil on the old armature.*

Take the last coil (see B in Fig. 3) and carefully, over a piece of white paper, separate the wires into little heaps of 10. The reason for this is that there is less chance of making a mistake when counting large numbers of turns or pieces of wire. Multiply the number of heaps by 10 to obtain the number of turns and divide by two (being the number of coils per slot) to obtain the number of turns per coil.

In a small flame burn off the insulation on one of the wires (do not use an abrasive) and with the aid of a wire gauge or micrometer obtain the gauge of wire used on the original winding. It is important that the same gauge of wire and insulation should be repeated in the new winding otherwise many difficulties will arise due to insufficient winding space.

### Testing the Commutator

Having all the details of the original winding the next step is to test the commutator for possible faults, most armature breakdowns being caused by faulty commutators. Wind two or three turns of wire round the commutator and test through a lamp to the shaft (see A in Fig. 4) also test for shorts between bars (B in Fig. 4); any signs of shorts must be removed with a sharp pointed tool. If after this treatment the fault still persists the safest and best method is to fit a new commutator. Faults can rarely be removed from the moulded bakelite variety once the insulation has broken down. Cut and fit a sufficient number of slot insulations, in this case 12 will be needed, and allow them to protrude about ¼in. above the slot, also reinsulate the shaft if necessary with empire tape, should this have been damaged whilst removing the old winding.

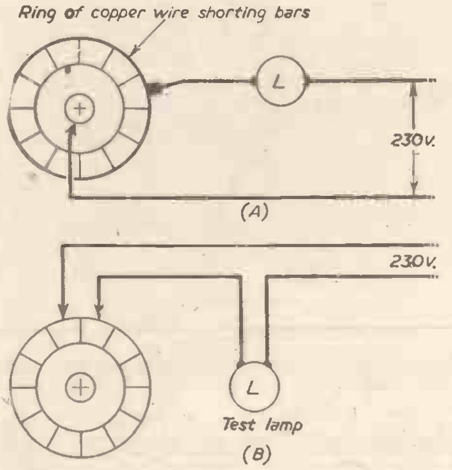



*Fig. 4 (A).—Test of insulation to metal parts. (B) Test of insulation between bars.*

### Rewinding

With the reel of wire mounted so that it can revolve freely and the armature mounted on the stand, with the commutator facing the winder, fit insulation to slots Nos. 1 and 6 (A in Fig. 3), place a knot on the end of the wire to mark the starting end, wind on the required number of turns in a clockwise direction, for one coil only, make a loop long enough to connect to the commutator and continue winding in the same slot, the same number of turns as was wound for the first coil.

The first two coils have now been wound (A in Fig. 3) on the imaginary armature being described, there are still 22 coils to wind, therefore make another loop, tie a knot on the end to denote the starting end as before, but this time, however, the winding will be in slots 2 and 7. Wind in your first coil, make a loop, wind in your second coil, make a loop, tie a knot on this loop, and start winding in slots 3 and 8 and so on until the whole 24 coils have been wound. The winding should be carried out from start to finish without a break, and the finishing end should be twisted to the starting end temporarily.

In each slot there should be two loops, making 24 in all, 12 with a knot on each denoting the first coils and 12 plain loops denoting the second coil. Where there are three times as many bars on the commutator as slots it is obvious there will be three coils per slot, or three loops to connect to the commutator bars.

At this stage it would be advisable to test the winding for continuity and also test to make certain the windings are not in contact with any metal parts.

If everything is in order cut off the slot insulation just above the stampings, turn over and under and fit the fibre wedges which were removed when stripping the armature. It is very easy to damage windings when doing this, so take every care in this operation.

Between the end winding and the commutator build up a ring of cotton tape on which to bind the connections from the coils to the commutator. Bend back all the leads out of the way before commencing, and wind the tape tightly round the shaft, finishing just below the commutator; a touch of Chatterton's compound will stop the tape from unwinding.

The next step is the connecting of the leads from the various coils to the correct commutator bars. These connections are governed by the position of the brushes when these are fixed, as in most machines. Nowadays not all machines have the same fixed position, however.

Place the wound armature between the field magnet poles (B in Fig. 3) with the last coil in the position shown and temporarily fix in this position. With a thin scriber, mark the two bars seen through the brush holder; it is to these two bars that the last two coils are connected see (Fig. 5). The rest follow on in sequence until all the 24 coils have been connected. The result will be a correctly connected armature to run in either direction.

Finish off the armature by binding the delicate leads with cotton thread; a layer of cotton tape under the binding will protect them. The winding of the armature is now complete.

### Testing

Fit to stand No. 2 two pieces of copper strip as shown in Fig. 2. Connect up as shown in Fig. 6, place the armature in the stand with the commutator between the strips, switch on the battery and with the aid of a 0-1 milliamp meter take a reading between two bars, turn the resistance until about half-scale deflection is obtained, then test each

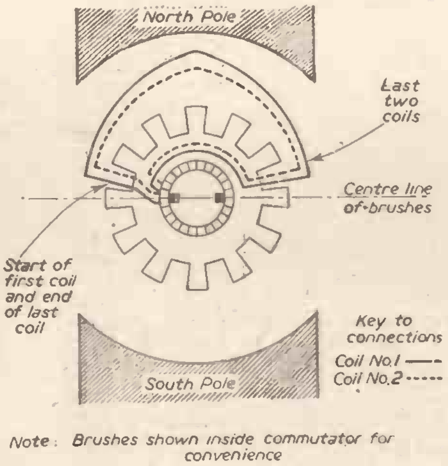



*Fig. 5.—The bars to which the last two coils are connected.*

pair of bars all the way round the commutator.

The readings should be the same or very nearly the same for each pair of bars. A sharp downward kick of the needle indicates a reversed coil. If this should happen, unsolder the leads belonging to that particular coil change them over, and resolder. If the armature has been wound without a break as described this fault should not arise. No reading on the meter indicates a shorted coil, faulty soldered joints will show a high or low reading. Any faults must be investigated and repaired before proceeding further.

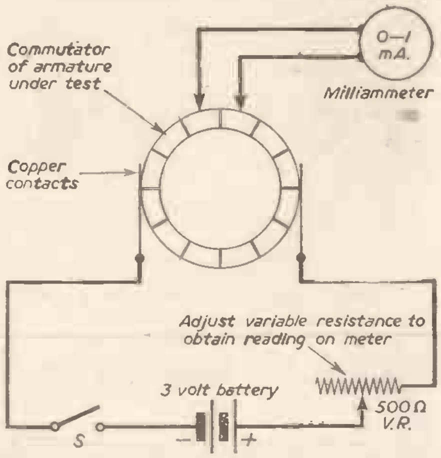



*Fig. 6.—Circuit for bar to bar test of armature.*

### Baking

When everything is found to be in order the armature must be placed in an oven to dry out any moisture. This should take about an hour, after which immerse whilst hot in insulating varnish until all air bubbles have ceased to come to the surface. Remove the armature and allow all surplus varnish to drain off. Rest the armature in the stand and place in the oven to bake at a temperature of 180 deg. F. for about six hours. When cool the winding will be very hard. Clean off varnish from shafts and take a light cut across the commutator in the lathe, polish with glasspaper, and clean out all copper chippings and foreign matter from segments. Test the winding to the shaft through a lamp as previously described, and if in order the armature is ready to be placed into service.

A few words about ovens. Ovens with naked flames are not suitable, and should not be used for this work. The fumes given off during the baking process are highly inflammable.

Air drying varnishes are available and can be used with success if the makers' instructions are followed.

*Insulating Varnish :*

The Stirling Varnish Co., Frazer Road, Trafford Park, Manchester.

*Leatheriod Slot Insulation :*

Presspahn Ltd., Wells Street, Bradford.

*Commutators :*

Watcliff Co. Ltd., Commutator Works, Lombard Road, Morden Road, Wimbledon, S.W.19.

*Instrument Wire :*

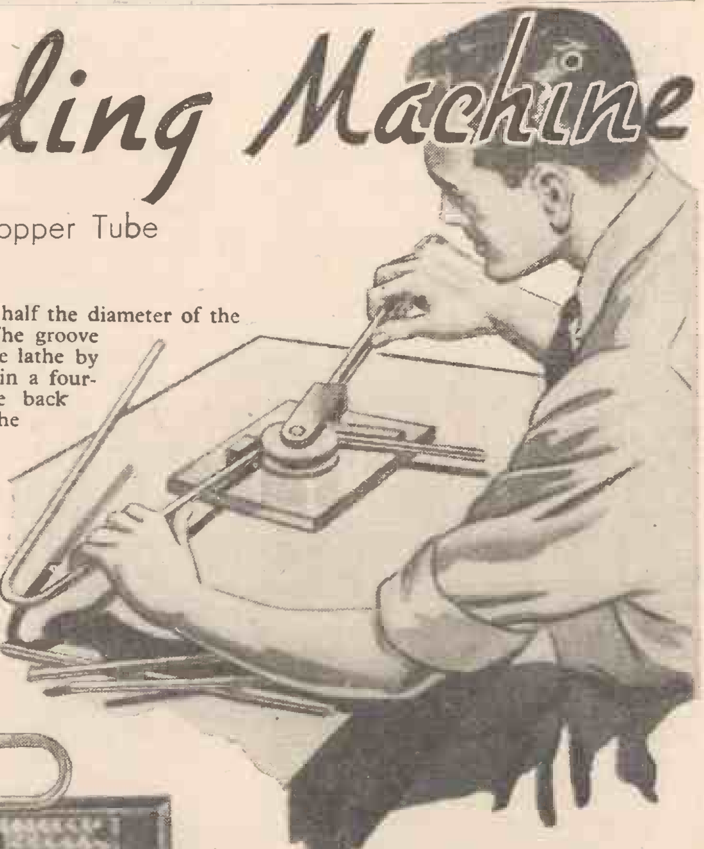
The London Elect. Wire Co. and Smiths, Ltd., Leyton, London, E.10.

The above firms supply to the trade, and may not supply individuals. Most readers, however, will know of local suppliers.

# A Tube Bending Machine

## A Unit for Bending 1in. to 3/16in. Copper Tube

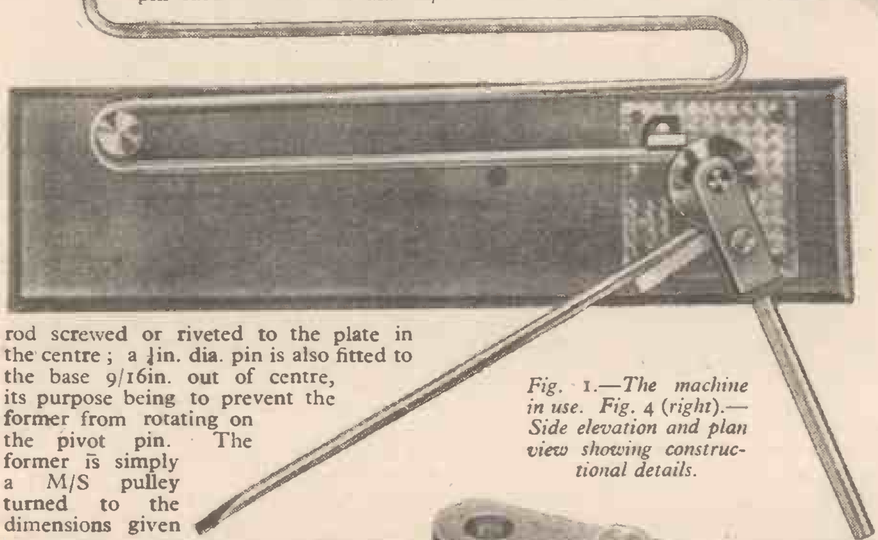
By G. W. LOUGHEAD



TUBE bending to the uninitiated is always something of a problem and it is well worth while making a tool for the job. Formers of various sizes can be made up as required to suit the diameter of the tube to be bent and a guide will be required for each former. This particular machine was constructed for forming up a coil for a domestic refrigerator evaporator and will bend 3/8in. O.D. copper tube on a radius of 11/16in. The tool in use is shown in Fig. 3, the component parts in Fig. 2 and the completed machine in Fig. 1.

### Construction

Fig. 4 shows details of the machine, which is constructed throughout of mild steel. The base is a piece of 1/4 M/S plate 4in. square with a centre pivot pin turned from 1in. dia. M/S rod screwed or riveted to the plate in the centre; a 1/4in. dia. pin is also fitted to the base 9/16in. out of centre, its purpose being to prevent the former from rotating on the pivot pin. The former is simply a M/S pulley turned to the dimensions given and it is important that the tube to be bent should be a neat fit in the groove. Finish the bottom of the groove with a 3/8in. tool, ground to the radius of the tube.



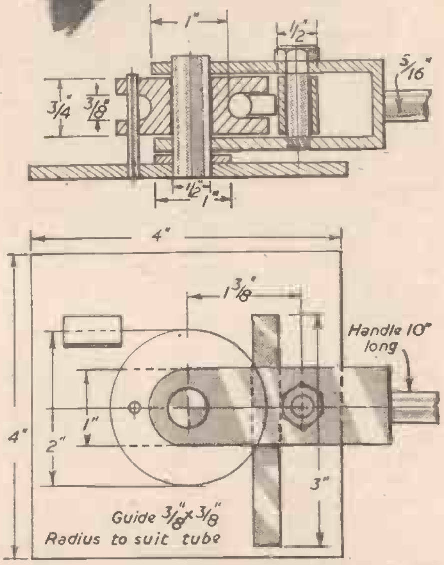




*Fig. 1.—The machine in use. Fig. 4 (right).—Side elevation and plan view showing constructional details.*

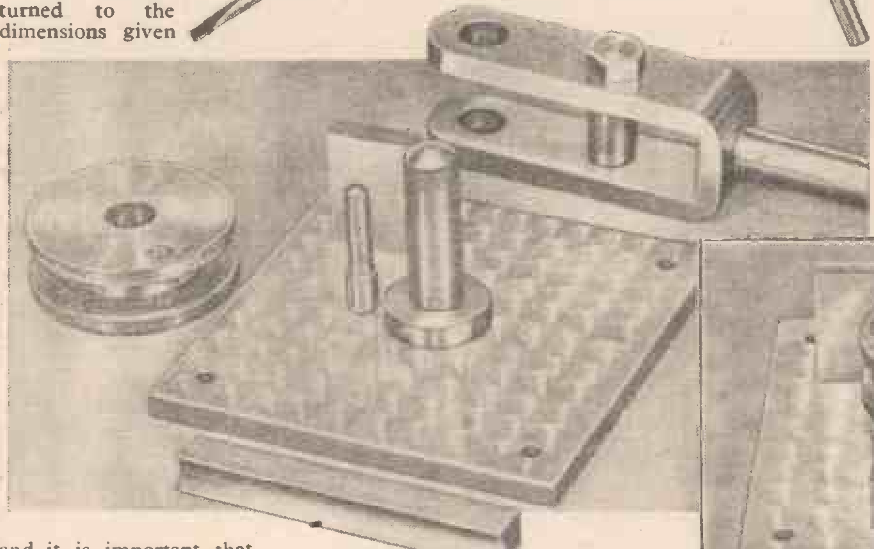


*Fig. 2.—The component parts.*

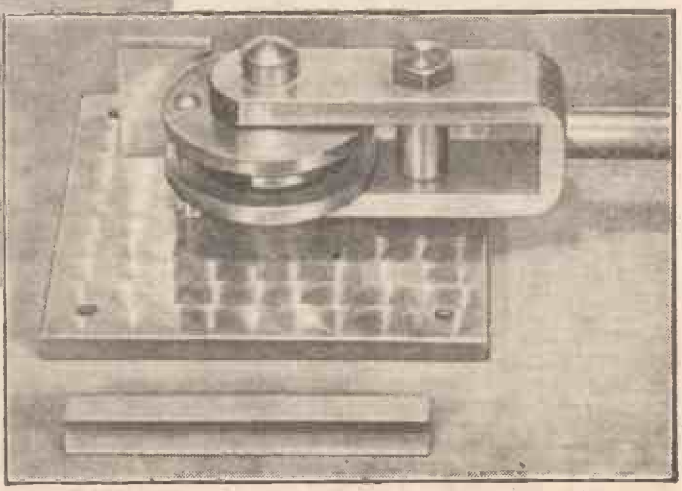


*Fig. 3 (right).—The completed bending machine.*

### The Guide

This is a piece of 3/8in. square M/S 3in. long, with a groove half the diameter of the tube in one side. The groove can be planed in the lathe by holding the section in a four-jaw chuck with the back end supported by the back centre. Lock the lathe mandrel by means of the back gear, place the tool which you used to finish the bottom of the groove in the former on its side in the tool post and traverse the saddle by hand, taking light cuts.

The fork end piece can be bent up out of 1in. by ¼in. M/S or a local garage would perhaps weld it. The handle can be screwed or welded into the fork end piece. The purpose of the roller in the fork is to press the guide hard against the tube in the former and so prevent the tube from flattening. The roller should just rotate with the tube and guide in position in the former. An angle iron stop is fitted to the base to prevent the tube from turning.

### Using the Bender

Screw the machine to the bench top, place the tube in position in the former, fit the guide in position between the tube and the roller in the fork. The bend is made by pulling the fork end piece around the former by means of its handle. Do not attempt to help the tube round with your free hand, but let the guide do the work and perfect bends will result. The machine will bend 1in. to 3/16in. copper tube with suitable formers and will produce clean full bore bends without filling.

# Making a KALEIDOSCOPE

## A Simple and Intriguing Gadget Producing an Endless Variety of Beautiful Patterns

By TUBAL CAINE

FOR the benefit of those who have never seen one of these toys the principle is that by the arrangement of a series of mirrors inside a triangular tube, it becomes possible to insert some common objects and view them as very beautiful patterns through the eyepiece. Small pieces of silver paper, coloured plastic or half a dozen beads are the favourite items to place in this device, and the innumerable patterns, which are different every time the kaleidoscope is shaken, provide a great deal of amusement.

### The Design

The dimensions are not in any way important, but the tube is made to a size which makes it convenient to handle; thus those included on the drawings will serve as a guide.

The body or tube is a long tapering box which the constructor can seal or provide with a small access door through which at intervals other pieces of material having different colours can be introduced. This design illustrates the latter type as the cross-sectional elevation at A shows.

The simplest form of kaleidoscope has two mirrors placed at an angle of about 60 degrees to each other, but as three mirrors do not unduly complicate matters and give patterns of greater beauty, this design has been adopted.

Make the sides from thin plywood about ⅛in. thick. As this toy will probably find its way into the hands of a child, there is no need for a fine finish, and painting a bright colour is preferable to a plain wood polished finish.

A ¼in. diameter hole is drilled in the small end and deeply countersunk as shown at A and B, and light is admitted by the rectangle of glass at the front end. About six tiny tacks will hold the latter, or alternatively some adhesive coloured paper produces the same result; both these methods are shown at C. However, if the glass is recessed into the framework it cannot move about and so make it more difficult to hold in position.

The angularly placed end face is covered with a dark material rather than a paint because this appears the best surface when viewed through the spy hole. A dark red, dark green or black velvet is ideal and the small square needed is not usually difficult to find about the average household.

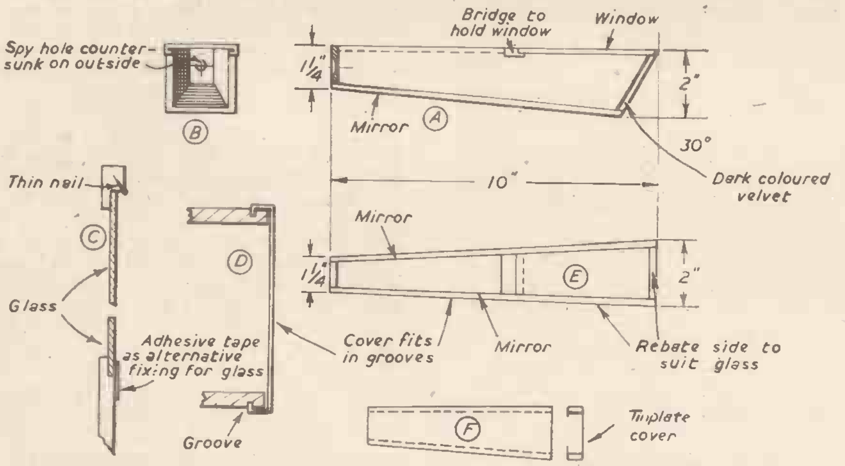
Undoubtedly most intending constructors are tempted to use any type of mirror glass they have around the house, but unfortunately this is generally far too heavy, and a glass approximately 3/32in. thick is the best.

Narrow grooves are cut for a distance along the top edges to make an anchorage for the cover (D and E). It is advisable to have a cover of the type shown at F rather than completely to box in the pieces being viewed, because then a reader can change the items at intervals.

How the box is fitted together depends to a large extent on the skill of the individual constructing it, but after glueing each side and end in position, a few patternmaker's nails spaced at intervals make a more robust job. These nails are much thinner than the average shoe brad, and they seldom split the wood even though driven in close to the edges.

The cover is merely a piece of thin aluminium or sheet tin bent to a "U" section by gently tapping the sides while the plate is clamped in a vice, but carry out this job carefully otherwise it tends to make the kaleidoscope look unsightly.

A lining of felt or some similar material glued securely to the wood makes a good backing for the glass—this also being stuck with a good proprietary adhesive. Make each glass "fit" properly: care in cutting is essential as any small broken edges are seen in the patterns and these spoil the effect. Make sure each piece butts against its neighbour, so eliminating any gaps between them.




*A.—Cross-sectional elevation; B—end view; C—methods of fixing the glass; D—method of fixing cover; E—top view; F—the tinplate cover.*

### Objects for Viewing

Anyone who is unfamiliar with the kaleidoscope will experiment literally for hours with different coloured pieces of paper, beads, flowers and even coins seeking fresh patterns, but a few notes on what to use will, no doubt, be useful.

Silver paper in various colours is an obvious choice, and one piece cut to the shape of a square—with about ¼in. sides, another a ¼in. circle, a third half-moon shaped and say three stars all perhaps slightly varying in size, are soon cut with the aid of scissors.

A shake and the paper assumes a fresh position—the pattern, of course, immediately changes and you can never again exactly reproduce it once the body is shaken. If the pieces are changed for others of a different colour, an entirely different appearance is obtained.

The coloured plastic screw tops of tooth paste tubes of three or four varying diameters and colours if viewed through a kaleidoscope are turned from a plain cap to a coloured pattern. A few beads with two or three sequins make another combination; while the petals of small flowers are usually vivid in colour and appear much deeper when seen as part of a multi-coloured pattern.

Chocolate boxes, besides providing the above-mentioned silver paper, may have various thin coloured plastic wrappings, and these too can be cut into squares or simply rolled into tiny balls.

### Extra Mirrors

For those who would still further complicate the patterns and the construction, a five, six or seven sided body is possible, but naturally more difficult to construct. Glass cutting is not easy—the fact that the sides taper suggests that a cardboard template would assist matters, or perhaps a stiff paper outline which the maker can glue on to the glass prior to cutting is preferred. The corners must match correctly as the writer mentioned earlier, and extra care at this stage is well worth while because it achieves superior results. Again an increase in the dimensions of this body is not necessary despite the increase in the number of sides—it only makes the device more awkward to handle.

# An ELECTRIC POTTERY KILN

## Notes on Building and Wiring for the Home Potter

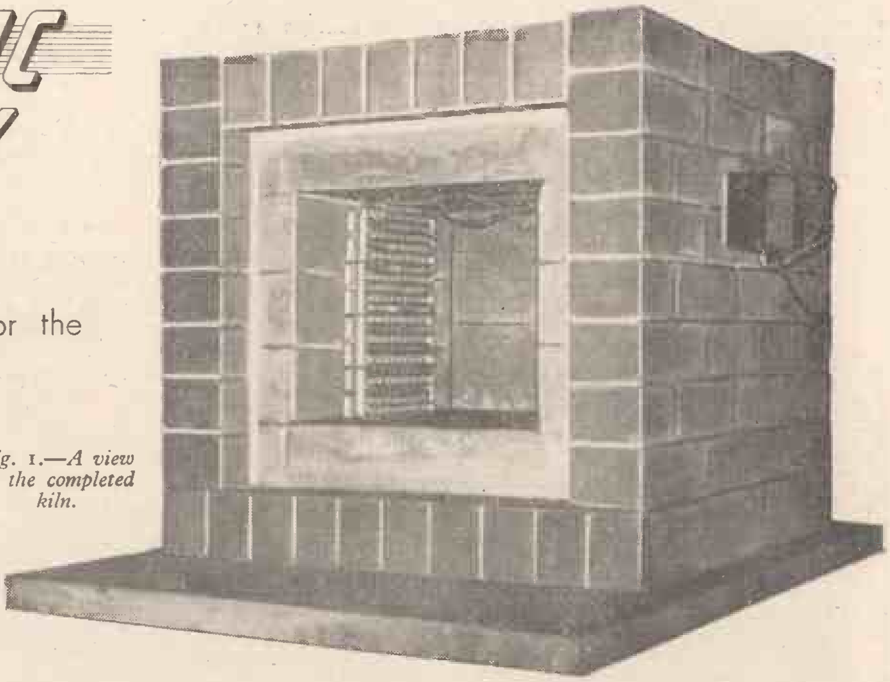


*Fig. 1.—A view of the completed kiln.*

BASICALLY the kiln consists of a common brick outer shell—approx. a 2ft. 6in. cube—with an inner lining of firebrick, the two being separated by a ½in.-thick lining of a poor heat conducting material. Thus 3in. of firebrick and at least 4½in. of common brick form every wall of the kiln.

### The Base

It was considered necessary to place the kiln itself on a base of convenient height, and this consisted of three short lengths of wall 5 bricks high. On the top of these were laid two 3ft. by 2ft. paving slabs 2in. thick. The front slab projects forward 10in. from the walls. This is useful as a shelf when loading the kiln, etc. These details may be seen in the front and side elevations in Fig. 2.

Cement mortar for building consisted of four parts building sand to one of cement. It is well mixed when dry, and water added until the whole is a jelly-like mass which retains the impressions of the mixing spade.

### Kiln Construction

On the base structure the kiln itself was built after the base had been allowed to dry and harden.

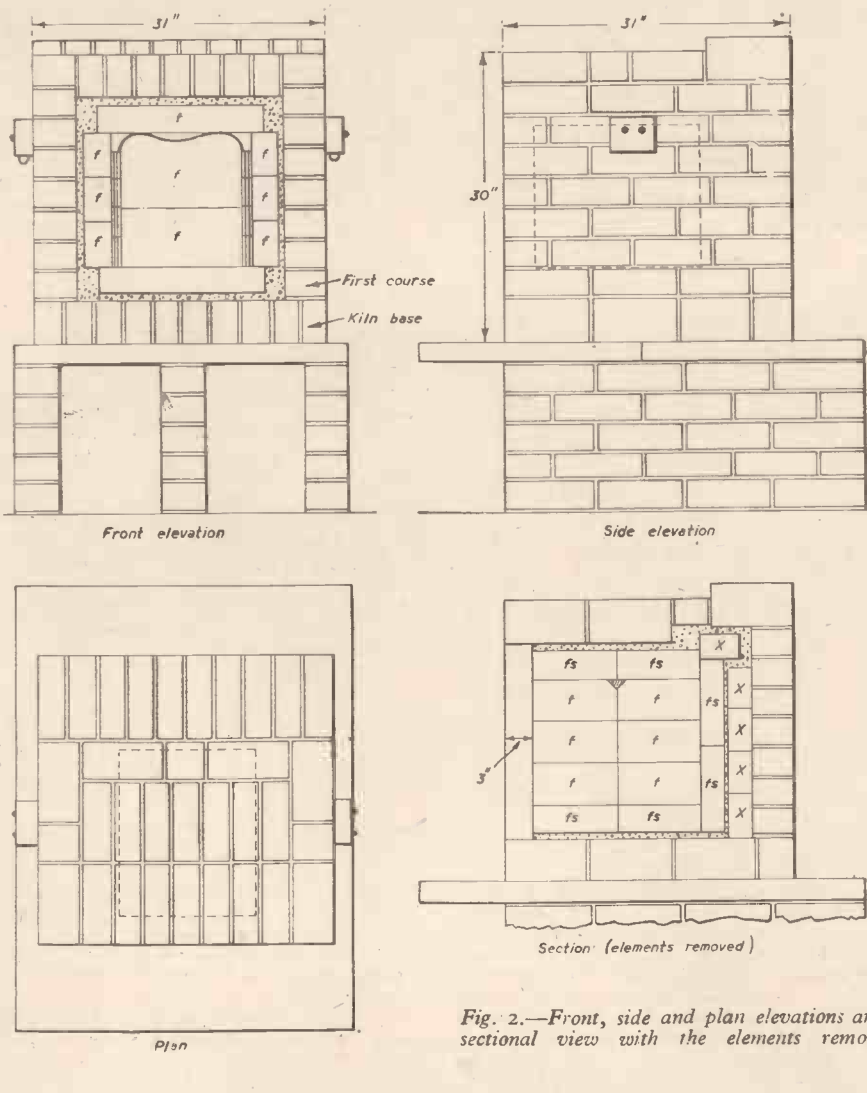



*Fig. 2.—Front, side and plan elevations and a sectional view with the elements removed.*

First the dimensions of the kiln base area were marked in chalk on the slabs, and, working to this guide, the base of the kiln proper was laid. The common bricks were set on their 9in. by 3in. faces directly on the slabs, no mortar being used between brick and slab. (Mortar was, of course, used to bond the bricks to one another.) This was to allow for any expansion of the kiln during heating. After 30 bricks had been laid (i.e., three rows of 10) the rear row half-bricks were cut with a heavy hammer and a 4in. wide cold chisel (known as a "bolster"). These were then laid so that their cut edges were facing inwards to complete the base.

Throughout all the building of the kiln itself whenever mortar was used the joints were kept as thin as possible. The mortar was made up of 10 parts building sand, two of building lime and one of cement.

Having completed the base, the first course of bricks was laid normally and carried right round the kiln. Working to this, using spirit level and home-made builders' plumb line, the second course was laid, starting with a half-brick (see front and side elevations, Fig. 2).

In this shallow brick "tray" so formed small pieces of firebrick about as large as ½in. pebbles were placed, and on these rested the firebrick base of the inner lining. Thus a ½in. space would have existed between the fire and common brick, but this was filled with a heat-resisting powder obtained from a pottery works. This powder was quickly used, and I later resorted to ordinary building sand, which I considered would provide in effect a honeycomb of air trapped between the grains, thus acting as a poor heat conductor. At full firing temperature the outside of the kiln may, in fact, be touched by hand, and at the rear is almost cold.

The firebrick base consists of two 18in. by 9in. by 3in. slabs pressed firmly together with a smear of fireclay mixed with water. No mortar was used for the kiln lining. The joints ideally would be non-existent, but were in fact made with fireclay and kept of negligible thickness.

The kiln lining is set 3in. back from the front of the common brick shell. Thus a recess is available for building in the "door" when the kiln is fired. It was considered that a permanent door was unnecessary and would involve undue complication.

Building of the outer shell and lining then continued according to the plans given in

Fig. 2. The sectional diagram (through the length of the kiln when viewed from the side) shows the method of laying the firebricks. Bricks marked " X " in the sectional drawing are common bricks used as packing and are in no way jointed to or part of the essential kiln structure. It is important to chisel away the corners of the appropriate side-wall firebricks before they are laid. This gap provides the exit for the element wires. (see shaded triangle on sectional drawing).

When the structure was finally completed the gap between lining and shell (shown shaded in the front elevation drawing) was sealed with pieces of firebrick and fireclay.

It is important to allow the side walls of the kiln to set hard before laying the bricks of the " roof."

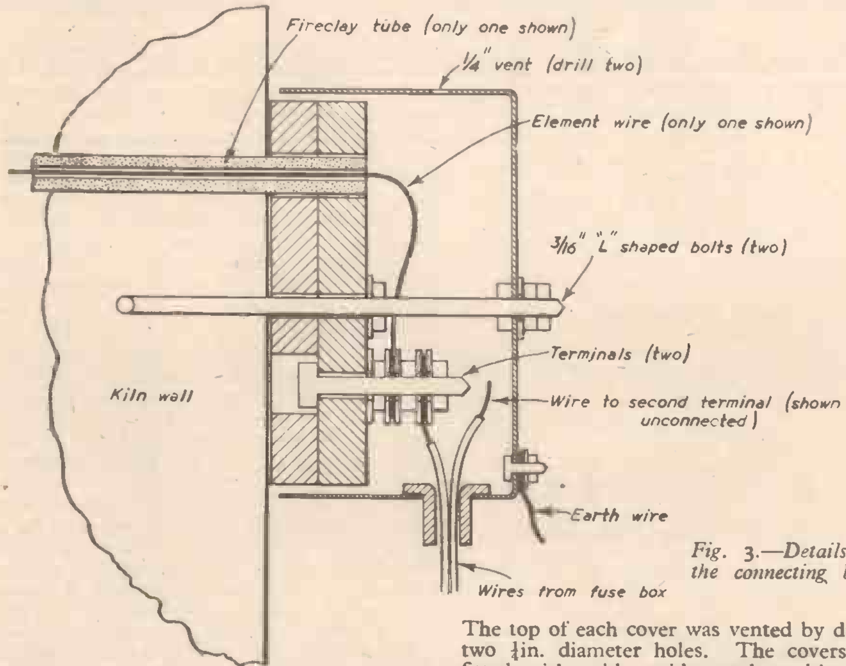



*Fig. 3.—Details of the connecting box.*

### Heating Apparatus

Heat is provided by two elements on the sides of the kiln.

Approximately 100ft. of Brightray C.18 s.w.g. wire of resistance 0.8385 ohms per yard was obtained from H. Wiggin & Co., Ltd., Birmingham, and this was wound by an electrical firm to a coil of ¼in. internal diameter. A special element wire is necessary to withstand the high working temperature involved.

The coiled wire was then divided so that the current consumption of each part equalled about 15 amps (the length used depends on mains voltage) and the coils pulled approx. ½in. open. Eight flat element holders of the normal electric fire type (9in. by 3¼in. by 1in.) were used to hold the wire, which was carefully secured in place by odd pieces of the element wire. Four holders were used for each side. At the ends of the coils sufficient wire was pulled out to enable it to lead out of the kiln.

### Fixing the Elements in the Kiln

Holes were chiselled through the outer shell on each side of the kiln to coincide with the spaces left in the lining, use being made of the mortar joints. Through each hole two straight fireclay tubes were led so that their outer ends protruded one inch. The tubes were then secured in position with fireclay and mortar. The elements were then placed in the kiln and the wires led out through the fireclay tubes, care being taken to see that the wires did not touch each other behind the elements. As the holders were in no way fixed to one another or to the kiln two pieces of nickel wire, 1/8in. thick and approx. 3ft. 6in. long, were bent (as in the front elevation in Fig. 2) and sprung into position against the flanges of the holders.

### Connecting Boxes

Two pieces of heat and electrical resistant material were made into a base 4in. square and fitted with screw terminals. They were then drilled to take bolts and to enable the fireclay tubes to project through them (see Fig. 3).

These plates were held to the sides of the kiln by means of long bolts. The bolts had been bent to an " L " shape and sunk into the mortar. Box covers were built up of thin sheet metal and made to fit over the plates. They were in turn secured by the long bolts. The top of each cover was vented by drilling two ¼in. diameter holes. The covers were fitted with cable guides and earthing connections.

### Electrical Circuit

The wiring circuit is shown in Fig. 4. Each heating element was fused and switched by a separate fusebox of not less than 15 amp. rating.

250 volt C.M.A. 3-core rubber-covered cable was used to feed the fuseboxes, and individual cables used from these to the kiln itself. No cable was allowed to touch the kiln structure.

### Current Consumption

The current used by each element approx. equals 15 amps. Thus, with a mains voltage

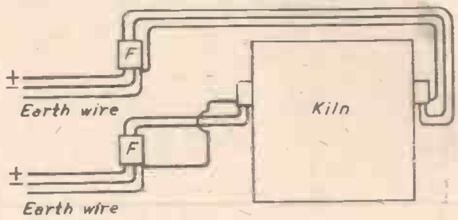



*Fig. 4.—Circuit diagram.*

of 250 volts, using the formula watts = volts × amps., we find that the total load of the kiln with both elements in use is 7½ kW., i.e., 7½ units of electricity are being used each hour.

### Operating the Kiln

After loading the kiln, the door is built up with firebricks, using clay as mortar. Common bricks may also be loosely piled in front of the door to prevent heat losses. An inspection hole is left through which the interior may be viewed, and this is closed with a piece of firebrick after the kiln has been switched on for about an hour.

Performances will, of course, vary with voltage, etc., but approx. 950 deg. C. should be obtained after about eight hours. To obtain higher temperature in the same period of time it will be necessary to shorten the length of the element wires. If this is done current used will be increased and higher rating fuse-boxes must be fitted.

### Building Materials

The following are approximate quantities. Electrical apparatus is not included.

***Base Structure***

60 common bricks.
2 concrete paving slabs, 3ft. by 2ft. by 2in.

***Kiln*** (not including door)

220 common bricks.
12 firebricks.
6 firebrick slabs, 18in. by 9in. by 3in.
¼ cwt. fireclay.
¼ cwt. cement.
¼ cwt. building lime.
5 cwt. building sand.

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# WATCH REPAIRING for the Amateur

By F. J. CAMM

The Third Article Of a Series on the Repair and Adjustment of Wrist and Pocket Watches

## Fitting New Balance Staffs

ONE of the commonest breakages encountered in the repair of watches is the balance staff. This usually occurs when a watch is dropped and the resulting damage may be that both pivots are broken off and the jewel and end stones cracked. The most satisfactory method of repairing is to fit a new staff, although in the trade there are repairers who undertake pivoting. With a high-class watch a new staff should be insisted upon, as in pivoting the balance staff, which is usually quite hard, has to be softened or blued whilst it is still in the balance. The staff is never removed if pivoting is to be done. This will destroy the compensating qualities of the balance.

The first thing, therefore, is to order a new balance staff from the material dealers, and for this purpose the make and size of the watch should be given. It is much better, of course, to remove the broken staff and send it with the balance as a pattern. The material dealers will then select one which is not "sloppy."

To remove the old staff it must be chucked from the roller end, after the roller has been removed by means of a special roller removing tool (taking care not to damage the impulse pin) and the riveting turned away with a graver held on the tee rest. It may then be lightly punched out over a stake, which is a block of metal with various sizes of holes in it. This tool, however, is not always suitable, especially if the arm of the balance is not level with the bottom of the rim of the balance, and so a special small press is available with a set of various sized punches for the purpose. It is shown in Fig. 25.

Having obtained the new staff, hold it in the tweezers and try it in the hole to make sure that it is a good drive fit.

In the case of interchangeable staffs they are supplied in a finished state, but even so occasionally they need to be corrected for height and the pivots sometimes need easing to suit the jewel hole. The new staff is riveted to the balance as shown in Fig. 25. The roller is next driven on as shown in Fig. 26, taking care to see that the impulse pin is in a position at right angles to the arm of the balance.

The next step is to test the balance for roundness and poise, and this is done in the poising calipers. If the balance is out of round it can be corrected by careful application of the tweezers, and if it is out of poise by adjustment of the loading screws, or by placing under the heads of some of the screws tiny washers sold for the purpose. It is much better, however, to effect this adjustment by means of the screws and only to use timing washers for bringing the watch to time later on.

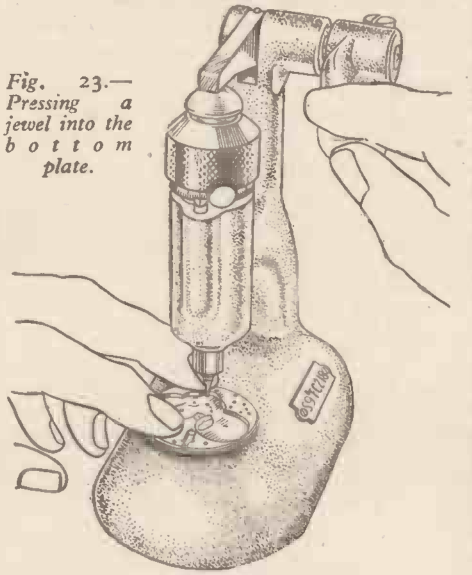


*Fig. 23.—Pressing a jewel into the bottom plate.*

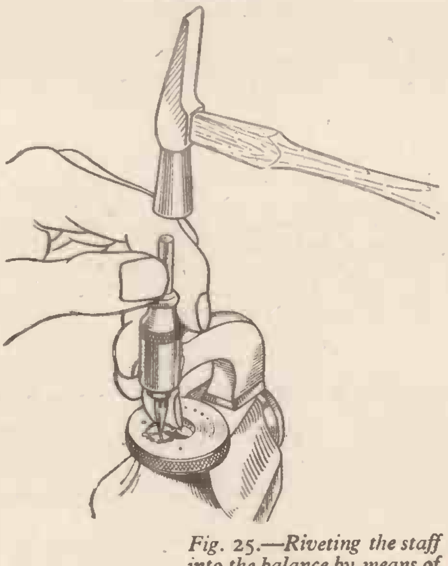


*Fig. 25.—Riveting the staff into the balance by means of a punch held in a special tool to ensure that the staff is upright.*

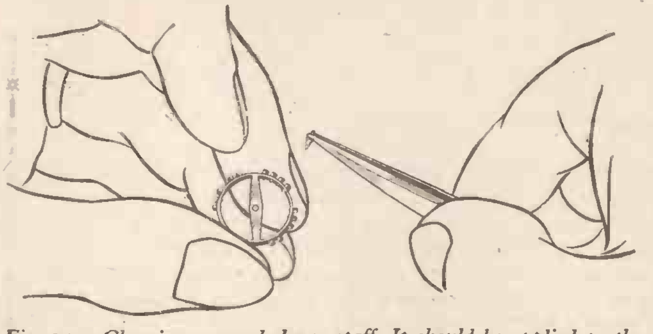


*Fig. 24.—Choosing a new balance staff. It should be applied to the hole in the arm of the balance to test whether it is a good press fit.*

Presuming that the balance is round and in poise the hair spring may be pressed on, observing that the stud which attaches it to the balance cock is in the centre of the arm, in other words at right angles to the impulse pin. Next fasten the stud and give the watch a trial run, not forgetting to oil the jewel holes and the impulse faces of the pallets before assembly. Set the second hand to coincide with another watch known to be going to time and half-wind the watch. After three or four hours observe the error. If the watch is gaining tiny loading washers can be placed under the heads of the two screws, one on each end of the balance staff. Do not place washers under the screws at the free ends of the balance rim, as this will affect compensation.

If on the other hand the watch is losing, the screws must be screwed in, if there is room for this, and presuming the hair spring to be of Breguet form, screwing each screw in precisely the same amount according to how much the watch is losing. Make the adjustment half turn at a time.

With a flat hair spring it is much easier to bring the watch to time by unpinning the hair spring at the stud and slackening out a little of the outer coil if the watch is gaining, or pulling it up a little if the watch is losing. In either of these two adjustments the watch will be thrown out of beat. That is to say it will tick unevenly. It is brought back into beat in the following way. The hair spring is released from the balance cock and the collet is turned round on the staff by placing a thin screwdriver in the slot in the collet (all collets are split), and turning the collet until the stud is again opposite the arm. You will, of course, have seen that the outer coil is passed between the two brass pins on the end of the regulator. Observe that the hair spring expands and contracts concentrically and that the body of the spring is quite flat. If not adjust it whilst

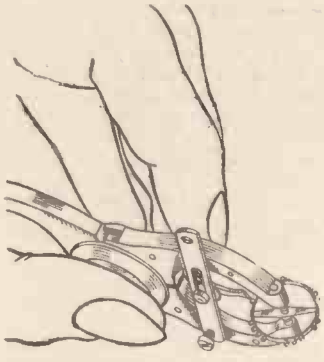


*Fig. 26.—Above: Testing the balance for roundness after the staff has been riveted in. Below: The roller must be driven on to the staff tight against the balance-arm, as shown in the right-hand sketch.*

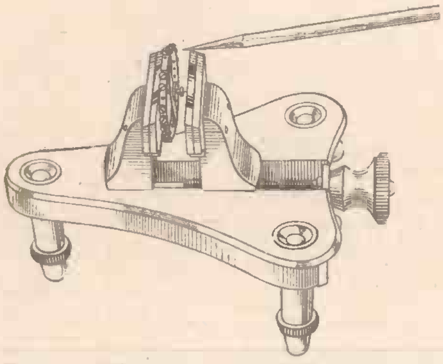


*Fig. 27.—The balance is next tested for poise on the tool shown, or in a pair of poising calipers. The poise is corrected by adjusting the screws. When in poise the balance should not tend to turn.*

in the movement by judicious use of a fine-pointed pair of steel tweezers.

In some of the cheaper watches it does not pay to fit a new balance staff because balances complete with roller, hair spring and stud are available from material dealers. Send the old balance, of course, and state the make and size of the watch when ordering.

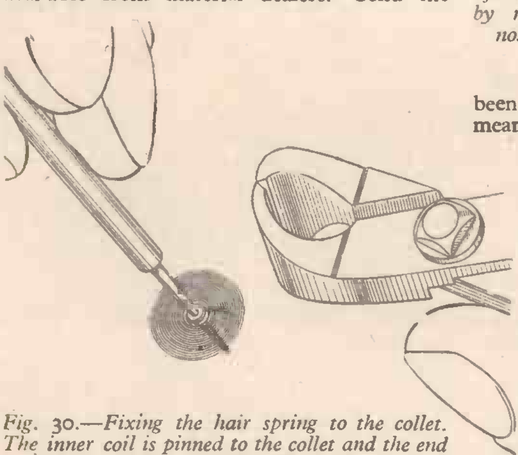


*Fig. 30.—Fixing the hair spring to the collet. The inner coil is pinned to the collet and the end cut off with the cutters.*

*Fig. 32.—A special tool for vibrating the balance and adjusting its length so that it vibrates five times to a second in the case of an 18,000 train watch. When the correct point has been found, a quarter-turn should be added to allow for the distance between the regulator pins and the stud, with the regulator in the central position.*

### Replacing a Hair Spring

The correct time-keeping of a watch depends upon the balance being perfectly poised and upon the length of the hair spring. A watch cannot possibly keep time if it is out of poise, because this will give rise to position errors, and equally it cannot keep time if the hair spring is distorted or out of true. If the hair spring is left alone there is no reason why it should ever go out of true, but there are people who, if their watch stops, think that they can persuade it to go by wriggling a pin on the hair spring and balance. The hair spring must be left entirely alone. A great amount of trouble has been given to bringing the watch to time by means of the hair spring, and the slightest bend or distortion will throw it out. There is no reason why a hair spring should break and it will therefore be found in almost every case that hair spring trouble is due to unskilled interference.

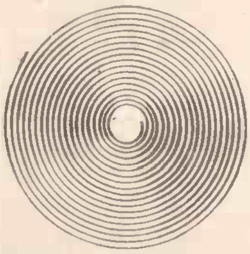


*Fig. 28.—A flat hair spring. If the hair spring is to be of Breguet form, the outer coil has to be lifted up and shaped by means of die-nosed tweezers.*

However, it is not for the repairer to question this matter. If the old hair spring can be made usable again it is best to use it. For this purpose, if it is not badly out of true, remove the stud from the balance cock and then carefully prise the collet off the balance staff and place the hair spring on a suitable broach. Place a piece of paper over the broach, but under the hair spring, and then hold the broach in the vice. Examine the hair spring through an eye glass and decide where the distortion is taking place and with two pairs of tweezers try to bring it back into form by holding the coil with one pair of tweezers at the point where the bend takes place and very gently bending the hair spring with the second pair of tweezers.

Sometimes when the hair spring has been removed the coils may become entangled by one coil slipping under another. The hair spring should in this case be removed from the stud, held on the broach as before and a broach passed between the two inner coils and gently guided round to the outside.

In the case of a broken hair spring a new one must be selected which is of the right diameter and strength and here again if the make and calibre of the movement is noted and sent to the material dealers the correct hair spring will be forthcoming. If this, however, is unobtainable because the model is a discontinued one or too old for stock to be carried, a new one must be selected in the following way.

First select one which is about half the diameter of the balance, press a piece of bees wax on to the top pivot of the balance and press it on to the centre coil of the hair spring. Then hold the outer coil in a pair of tweezers, allow the bottom pivot to rest on a piece of glass and spin the balance, counting every alternate vibration against the second hand of a pocket watch going to time. Adjust the gripping point of the tweezers until the count is 38 double vibrations (76 in all) in 15 seconds. The point where the tweezers are will represent the point where the two regulator pins will grip the coil and a further quarter turn must be allowed for the distance between that and the stud.

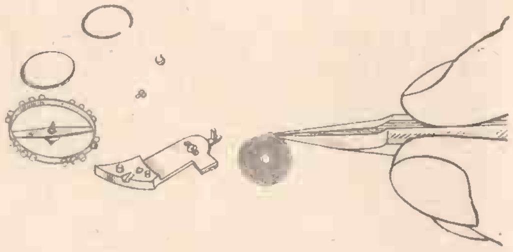


*Fig. 29.—Selecting a hair spring. It should be approximately half the diameter of the balance, and should be laid over the balance cock to ensure that the outer coil aligns with the regulator pins.*

It is important to point out that not only must the diameter of the hair spring be right, but also its thickness according to the thickness of the movement. There are two forms of hair spring, high and low. The former is used in movements of normal thickness, the latter in flat or thin movements. The diameter of the hair spring should always be checked on the balance cock.

Having selected the spring the centre should be broken down to suit the collet and the end formed so that it passes through the hole in the collet. Next file a brass pin on the end of a piece of wire so that it is a nice fit and tightly locks the hair spring to the collet; but before doing this, after trying it in the hole, almost cut through the pin at the appropriate point so that when pushed home it may be broken off. Make sure that the collet is concentric with the hair spring and correct by bending with the tweezers. A special counting tool on which the balance may be vibrated is available and it is shown in Fig. 32.

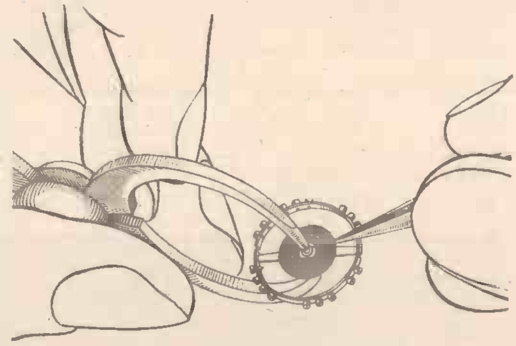
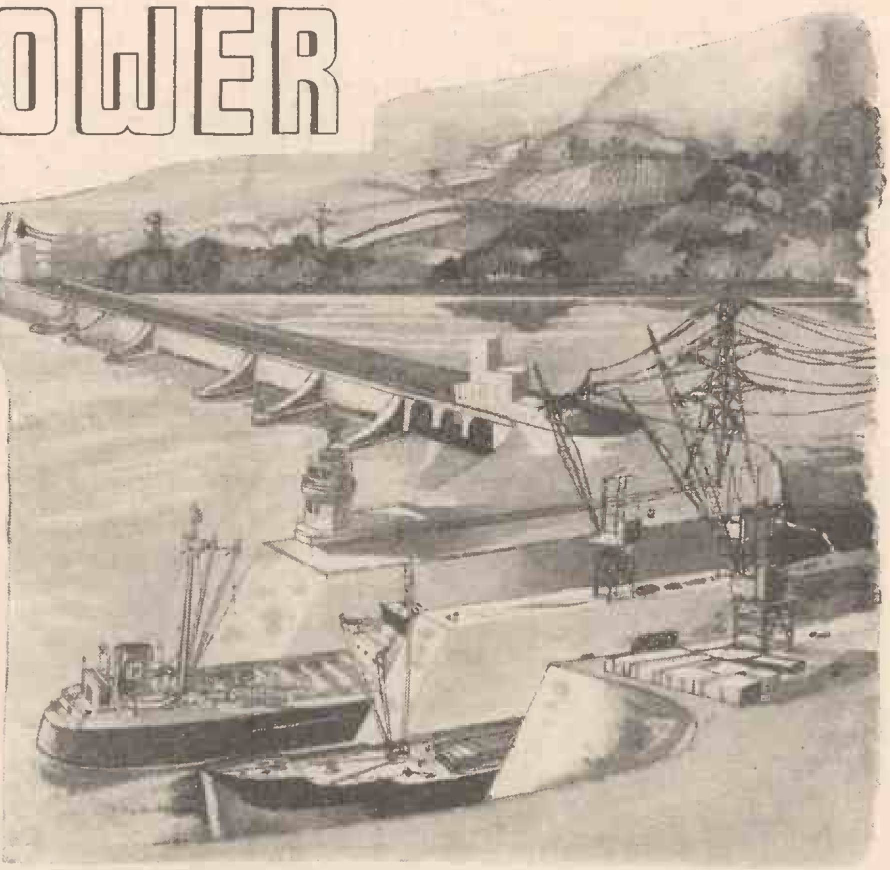


*Fig. 31.—Trueing the balance spring so that it is concentric with the balance.*

*(To be continued)*

*Fig. 33.—Forming the overcoil.*

# TIDAL POWER



## Harnessing the Energy of the Tides to Produce Electric Power

By R. N. HADDEN, D.L.C., B.Sc.

TO-DAY more than ever before the prosperity of a nation depends on the abundant supply of cheap electric power. It is, therefore, essential that all sources of energy should be utilised to the full. Unfortunately, many countries in Europe have already developed all their hydro-electric sites, while coal is becoming increasingly scarce and expensive. It is not surprising, therefore, that engineers should look to other methods of generating electricity, the most obvious way of doing this being to harness the energy of the tides.

This idea of using tidal energy is by no means new, as a scheme for a tidal power station had been suggested for the Severn Estuary even before the turn of the century. A recent survey shows that it would be possible to develop over 500,000 h.p. from this one project alone. However, French engineers must take the credit of being the first in the world to combine theory and practice and actually start the construction of a tidal power station. This station is being built on the estuary of the river Rance, near St. Malo. It has been calculated that it will be able to supply France with nearly 300,000 h.p. when working at full output. Other suitable sites are shown in Fig. 1.

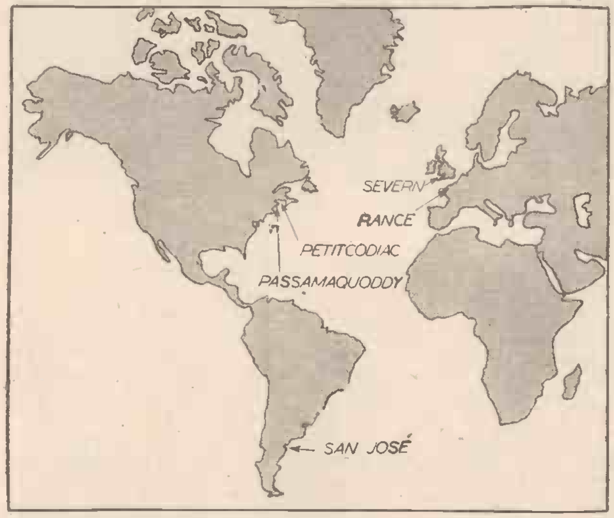



*Fig. 1.—Map showing some of the outstanding sites for tidal power stations on the Atlantic coast. The five sites between them could develop over two million h.p.*

Before describing the Rance scheme it is as well to study some of the underlying requirements of a tidal power station and some of the possible cycles of operation. The first essential is that it should be situated in a location where the rise and fall of the tide is high. Over 30ft. is considered satisfactory. The second requirement is that it should be possible to create a large reservoir or basin with the minimum amount of civil engineering work.

The simplest type of tidal power station is one which works on the single cycle system, which is shown at A in Fig. 2. In this system a dam or barrage is built across the mouth of a narrow bay or estuary to form a basin. The barrage not only controls the level of the water in the basin, but also serves to contain the power house and sluice gates. The cycle works as follows. At low tide the turbines are shut down and the sluice gates are opened, letting the rising tide fill the basin. At high tide, when the basin is full, the sluice gates are shut, thus holding the water in the basin at a constant level. As the tide starts to fall a difference of level is created between the water in the basin and the sea. When the difference of level is great enough the turbines are started up, the water flowing from the high level in

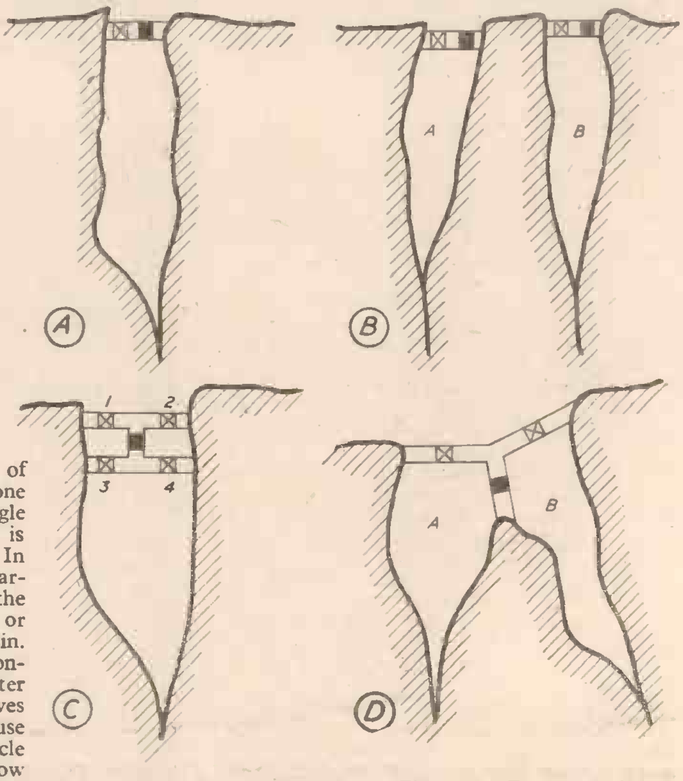



*Fig. 2.—Four possible arrangements of basins used in the production of tidal power.*

the basin, through the turbines, and into the lower level of the sea. The water flowing through the turbines causes power to be generated. This phase is continued until low tide, when the water levels in the basin and sea are again equal.

Fig. 3 shows a section through that part of the barrage which contains the turbines and generators. Water flows in from the basin through the spiral casing (A) down past the turbine runner (B), and out of the draught tube (C). The turbine runner is shaped like a ship's propeller, and it is the water

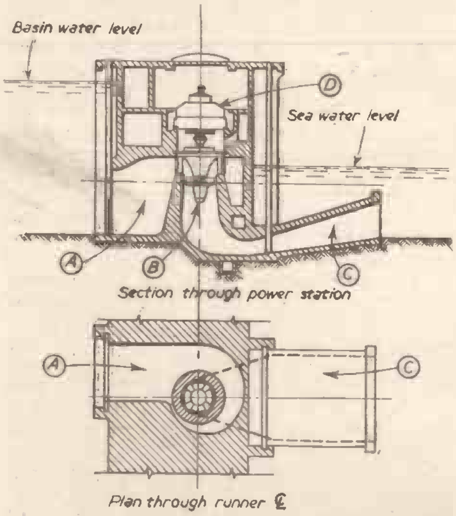



*Fig. 3.—Section and plan of turbines and generators.*

flowing past it that causes it to rotate and so produce power. The turbine runner is directly coupled to the generator (D). The function of the spiral case is to distribute water evenly round the circumference of the turbine runner. The photograph, Fig. 4, is a sectional model of a Kaplan turbine such as would be used in a tidal power station. (Photograph by courtesy of the English Electric Co., Ltd.)

It will be seen that the single cycle system produces power for about only 10 hours every day. However, this is not such a big disadvantage as would appear at first sight, as will be explained later.

Another way of working tidal power stations is to combine two single cycle systems, as shown at B in Fig. 2. In this system basin (A) produces power on the falling tide, while basin (B) produces power on the rising tide, so that nearly continuous operation is possible. This is a satisfactory arrangement, and it has the added advantage that the two stations can share some of the electrical equipment such as transformers, switch gear, transmission lines, etc. There is, however, the difficulty of finding sites close enough together to be able to operate the system in a satisfactory manner.

A cycle which gives nearly the same effect as the one just described is shown at C in Fig. 2. In this system only one basin is required, but it is necessary to have two barrages. The two barrages contain two sluice gates each, while the power house is contained in the short connecting barrage. When the tide is rising sluices 1 and 4 are opened, allowing water from the sea to flow into the basin via the turbines and so produce power. At high tide, when the water level in the sea and basin are equal, sluices 1 and 4 are shut and 2 and 3 are opened. As the tide falls water flows out from the basin, through the turbines and into the sea, again producing power. It will be seen that by this method water always flows in the same direction through the turbines. With this system of operation it is possible to produce power for 18 to 20 hours each day, though the maximum power produced is rather less than that obtained in the single cycle system. This is because there are losses of energy as the water flows on its winding course through the sluices.

The only cycle which can produce continuous power is that shown at D. This consists of two basins (A) and (B), each with a separate barrage and sluice gate. The dividing barrage between the basins contains the turbines and generators. The water level in (A) is never allowed to fall below two-thirds full and in (B) to rise above one-third full. This is achieved by opening the sluices in (A) only at high tide and in (B) at low tide. Thus there is always a difference of water level between the two basins, and it is this difference that is used to drive the turbines. Thus it is possible to generate continuous power.

The above four systems give the most convenient methods of developing tidal power, though the actual cycles would be slightly more complicated than as described due to the use of pumped storage. This, however, does not alter the basic principles involved.

From the foregoing it will be seen that the simplest tidal power station is that which works on the single cycle system, and it is for this reason that it has been chosen for the Rance project. The disadvantage that its output will not be continuous will be overcome by running it in parallel with a hydro-electric station. When the tidal station is working the hydro-electric station will be shut down, thus storing water in its reservoir. When the tidal station is idle the hydro-electric station will be in operation, using water that has been stored. In this way full use is made of all the available tidal and hydro-electric energy.

In conclusion it may be asked where does the energy of the tides come from. The answer to this is that both the moon and sun attract the surface of the sea, causing it to "hump up." As the relative positions of the sun, moon and earth change so does the position of the "hump," so causing the tides. Now, if some of the energy of the tides is extracted by a power station it is in fact the same as extracting some of the energy from the movements of the sun, moon and earth, which in turn causes them to slow up. It has in fact been calculated that if the energy of the tides were to be utilised to the full the earth would lose one whole day every 2,000 years!

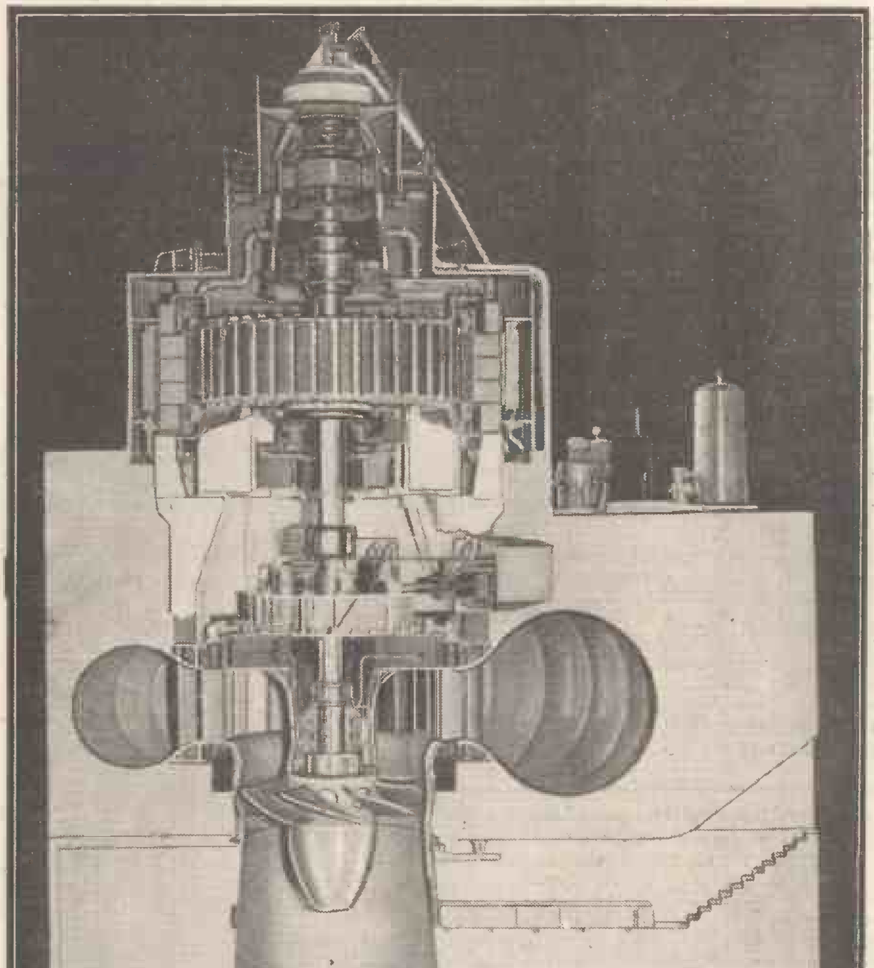


*Fig. 4.—A sectional model of a Kaplan turbine such as would be used in a tidal power station.*

# A UNIQUE WORD BUILDING GAME

By P. CREER

Making a Compact Table Game Which Might be Called "What's My Word?"

THIS game might be loosely defined as a cross between solo whist and "What's My Line" and although simple word-building is the basis of play, tactical bluff and a "poker face" play a bigger part than knowledge of the dictionary. The game lends itself to nominal stake play when this is favoured.

The board, shown in Fig. 1, is designed with a view to being rather more substantial and presentable than the customary printed cardboard type which soon becomes grubby and dog-eared.

**MATERIALS AND SUPPLIERS**

10in. Tufnol disc from K. R. Whiston, New Mills, Stockport.
Set of Plastic dial letters at 2s. 6d., from Messrs: Orrell's, Stationers, 6, Prospect Hill, Douglas, I.O.M.
Enamel colours.
The following are needed when a number of replicas are to be cast:—
Plastic Compound Px at 1s. 6d. per lb. from Quality Plastics, Shenfield, Brentwood, Essex.
1lb. Mould Compound at 6s. 6d. from Technical Products, St. Giles Close, Dagenham.
Aluminium sheet scraps.
Heat-resistant adhesive.

### Construction

The circular base may be a disc of plastic (such as Formica), hardboard or plywood. K. R. Whiston of New Mills, Stockport, supplies a 10in. Tufnol disc, ⅛in. thick, with a smooth black finish, which is very suitable. Five ½in. thick packing pieces which are marked "A" in Fig. 2 are fixed by screws or cement to the underside of the base, leaving openings for players' score cards. The rules of the game will show that there is a need for the "bidder" to keep his card from prying glances during his "bid."

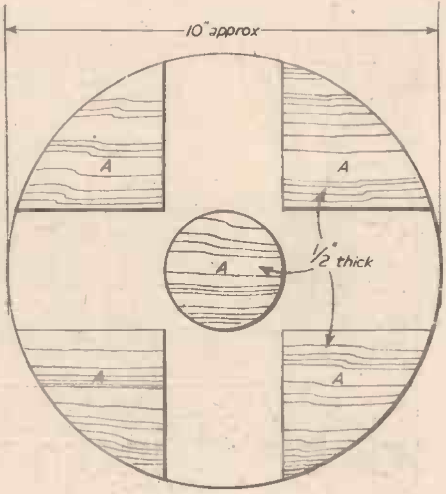



*Fig. 2.—Underside view showing five packing pieces (A).*

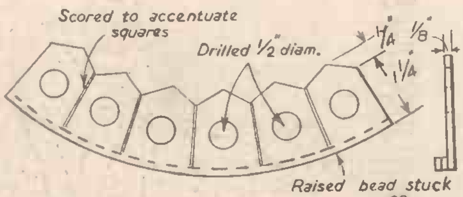



*Fig. 3 (Above).—A quarter segment (four off).*

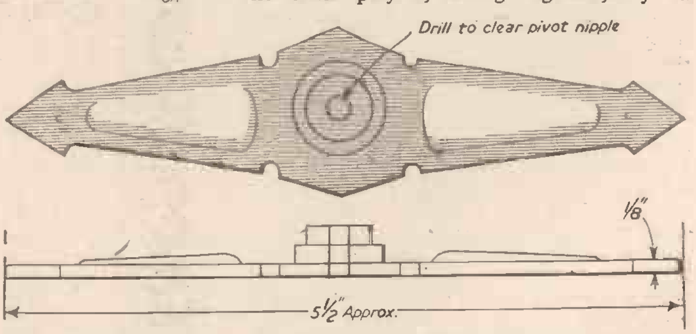



*Fig. 4 (Right).—The double-ended pointer.*

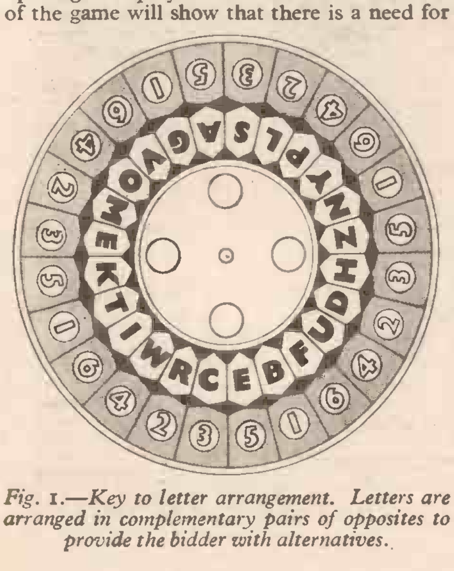


*Fig. 1.—Key to letter arrangement. Letters are arranged in complementary pairs of opposites to provide the bidder with alternatives.*

The numbered quarter segments forming the surround, the pointer and the centre panel may be made in plastic, wood or metal, and details and dimensions are given in Figs. 3, 4 and 5.

When a number of replicas are contemplated, by far the best method is to make a pattern in soft aluminium of each separate piece, i.e., centre panel, double-ended pointer, one numbered segment, and one playing piece. A single rubber mould should be run round these parts, grouped fairly closely together on a metal tray and framed, as shown in Fig. 7. One pound of mould rubber should be ample and if this is cut into small pieces it is easily melted in an old aluminium saucepan over a gentle heat. Pour in at one side of the frame so that the liquid rubber may flow around and over the patterns like a tide, covering to about ¼in. above the maximum pattern depth. Warm the tray of patterns first.

Any number of casts can now be made in this mould, using a cold-setting plastic compound of the type mentioned in the list of materials. This compound is ready for use and sets sufficiently hard for removal in about 30 minutes, although it does not attain full strength and readiness for painting until after about 48 hours.

In pattern making the raised rim beading is positioned on the quarter-segment pattern (built up in layers cemented by Durofix if only a light gauge strip is available). This gives a complete rim when the four quarters are assembled on the base. The numbers 1-6 could be fashioned in the pattern metal, but suitable printed numbers from an old calendar would be almost as effective and much easier, these being glued into the recesses after assembly. The pattern for the playing pieces is easily built up from small discs as in Fig. 6. The set of 24 moulded plastic letters can be obtained for half-a-crown, ready for sticking on, so there is little point in making these. Printed letter tabs would look something of a poor relation in this instance.

Readers will have their own ideas as to a suitable colour scheme for the finished board, but cream-coloured mountings on a dark base are most effective. The pointer might be in cream and red, the letters (supplied in cream colour) might be faced with red while the four playing pieces might have a different colour to each.

When arranging the letters on the board, the key to their sequence and their relative numbered squares, shown in Fig. 1, should be closely followed as this is an integral part of the design.

### Rules of the Game

Each player takes it in turn to make a bid—i.e., he attempts to dial, letter by letter, any dictionary word of five or more letters, while the other players, acting together, try to prevent him completing his word by "covering" with their playing pieces those letters that they guess he will need. Players' pieces move on the numbered squares, each of which squares "covers" a letter, and while a square is occupied its letter is barred to the bidder. One playing piece is the bidder's; the other three pieces are used by the opposition even though there be only one player opposing the bidder.

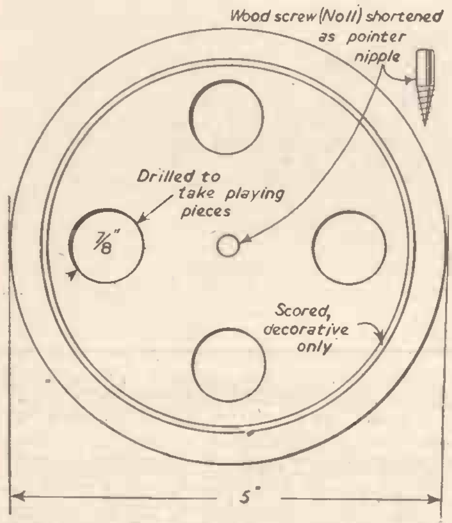



*Fig. 5.—Centre panel approx. 3/16in. thick.*

The first player to bid places his piece on any square on his side of the board and, having chosen a word (which he does *not* divulge) and the type of bid he is attempting (which he *does* declare), turns the pointer so that one of its ends indicates his first letter, which he records on his score-card. The opposition has to guess as to which of the two indicated letters is the chosen one, and then they move their pieces to cover and bar the bidder's probable second letter. (They cover, of course, *three* " probables.") The bidder then dials and records his second letter in the same manner, while the opposition guesses again and moves to head him off. Against odds of 3 to 1, the bidder will frequently find that his way is barred at about the third letter of his word. In this eventuality he is permitted to change his word if he can do so without changing any letters already dialled and recorded. For example, he might start to dial BLACK and find himself cornered at the third letter. " B—L— " could easily be continued, however, to read " BLITHE " or " BLOWN." And he may change again if he can, and it should be necessary. He must produce his record card at the end of his bid and any cheating can always be brought to light! Needless to say, a canny bidder will chose a word that permits of changes *en route*.

Two types of bid are open to the bidder. *No. 1 Bid:* In this, a word of five or more letters is called for and the bidder must declare his *first letter* just prior to dialling his second (after the opposition has moved). If successful he collects the score of points against all letters *after his fourth*.

*Bid No. 2:* Again a word of five or more letters is called for and the bidder must declare, in turn, his *first three letters*, as above. If successful in this bid he scores the points of *all* letters in his word.

When a bidder is cornered and cannot continue his word, his bid fails and each member of the opposition collects the score against his last letter recorded. These points will count as extras at the end of a game or rubber.

A bidder needs to remember that his own playing piece is always barring a letter and needs to be moved to free that letter. This move, therefore, had better be made well in advance if it is not to betray its real significance! Various other factors in this category, too, will become clear after one or two games. As mentioned earlier, " bluff " and the " poker face " play a part in successful bidding, as does also the choice of a word that will permit of changes *en route*.

The letter arrangement is expressly designed to assist the bidder by providing pairs of " possibles " throughout. Without some such arrangement, bidding would very often be extremely hard going. The scoring numbers, too, are laid out to a system.

Players will decide beforehand as to the number of rounds constituting a game or " rubber."

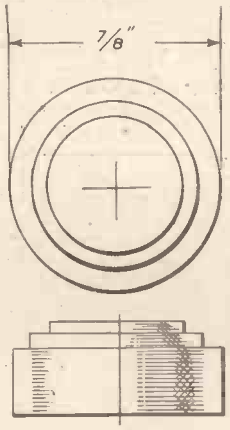



*Fig. 6.—Playing piece (four off).*

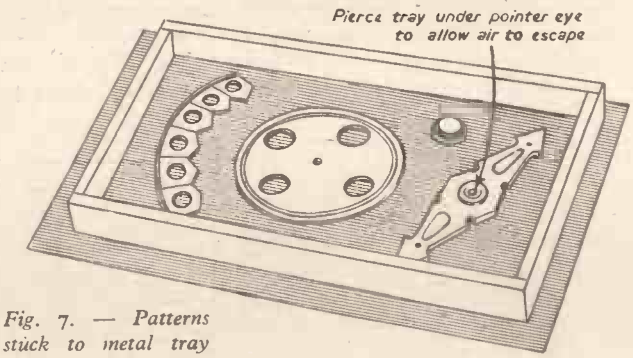



*Fig. 7. — Patterns stuck to metal tray and framed for mould making, using mould rubber mentioned in list of materials.*

# A Simple Method of Winding Wire Springs

By G. W. GIBSON

THE fabrication of a spiral wire spring is easily accomplished with simple tools, viz.: bench vice with lead or wood facings, a tap wrench and a suitable mandrel.

Place the mandrel horizontal in the vice leaving sufficient overhang at the r.h.s. to be held by the tap wrench. When the vice is tightened an impression of the mandrel is made in the vice jaws. The vice is then opened sufficiently to pass the wire up from beneath and between the mandrel and one of the jaws. When the wire is correctly positioned, leaving a convenient free length, the vice is again tightened to leave the impression of the wire. The free end of the wire is then laid along the mandrel and passed through the wrench which is then tightened on the mandrel; a few extra turns of wire round the wrench is a help as the wrench has to pull the wire through the vice. As the mandrel is rotated by the wrench the wire is drawn through its impression in the lead or wooden jaws, forming a spring, see Fig. 1.

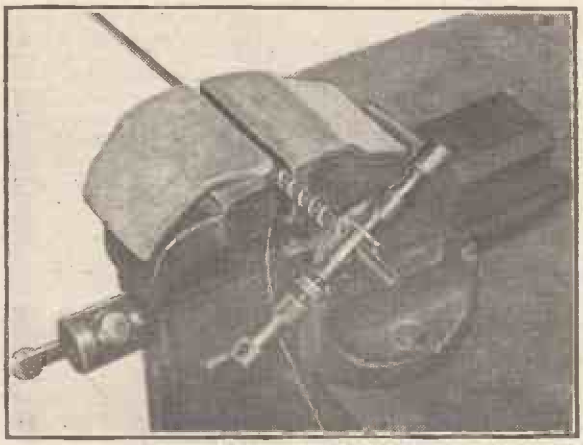


*Fig. 1.—Method of forming a spring.*

The pitch of the spring is determined by the angle between the mandrel and the wire's impressions, see Fig. 2.

T = Number of turns per inch.
D = Diameter of mandrel.
d = Diameter of wire.

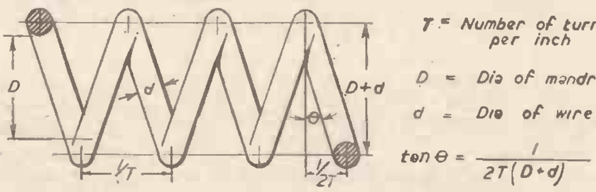
$$\tan\theta = \frac{1}{2T(D+d)}$$

The jaw opposite the one bearing the wire's impression should be displaced to the left sufficiently to clear the turns as they are wound.

Very long springs may be wound by this method, the limit being the length of the mandrel. Left and right hand may be wound with equal facility.

Lead jaws are better if small diameter wire is being used, but wood is preferable with larger wire and a saw-cut is sometimes necessary to keep the wire at the correct angle relative to the mandrel.

*Fig. 2.—Formula for calculating pitch of spring.*




If large diameter springs are being wound then a steel bar may be substituted for the wrench.


# Aqualung Modifications

## Some Alterations to the Reducing and Demand Valves

By E. T. FEARON

THE home-built aqualung described in the January, 1955, issue of PRACTICAL MECHANICS was altogether too successful. Soon after the article was published supplies of the oxygen regulator ran out, and against all expectations no further supply sources came to light. (The average British bomber during the war carried about eight of these regulators, so their disappearance is a mystery.)

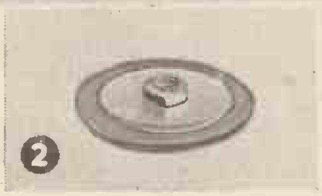




*Fig. 1.—Parts for the rubber diaphragm to replace the existing metal diaphragm in the reducing valve.*
*Fig. 2.—Rubber diaphragm and $1\frac{1}{4}$in. diameter 20-thou.-thick stainless-steel strengthening washer.*

In addition to preventing enthusiasts from starting construction, the shortage has stopped home-builders from buying duplicate regulators to provide spares for worn-out or damaged parts.

For instance, the metal diaphragm has proved to age with use and finally sometimes to fracture, although this happens so gradually as not to be dangerous. The purpose of this article is to suggest an alternative non-aging type of diaphragm, and also an alternative type of demand valve which cuts out the need for any reducing valve at all.

### Rubber Diaphragm Reducing Valve

As it would have to withstand pressures of up to 150 p.s.i., this had to be strongly supported back and front, and the unsupported area had to be as small as possible, consistent with sufficient movement of the diaphragm centre. The best design was found to be that using the parts shown in Fig. 1.

The existing metal diaphragm and its brass strengthening ring were taken out of the valve, and also the fine rubber sealing washer. The central brass stud was unsoldered from the diaphragm. The flats were then turned off a brass 0 B.A. nut, and the central hole in the saucer-shaped brass strengthening washer was enlarged to receive it. After the nut had been brazed into place the brass stud from the diaphragm was threaded similarly, 0 B.A.

The rubber diaphragm itself was punched from $\frac{1}{16}$in. good quality rubber sheet, using a punch made from a short length of steel pipe of suitable size turned down to give a circular knife-edge of $1\frac{11}{16}$in. diameter. After the rubber diaphragm had been cut in this way, a central hole was punched in it, using a cork borer of $\frac{3}{16}$in. diameter.

The support for the other side of the diaphragm was cut from a sheet of 20-thou. stainless steel. The diameter was made exactly that of the brass saucer-shaped piece: $1\frac{1}{4}$in. A $\frac{1}{4}$in. hole was drilled in its centre.

The parts were then ready for assembly. The stainless-steel washer was first put over the central brass stud, then the rubber, and then the saucer-shaped brass washer, but this time flat side towards the diaphragm. This brass washer has to be screwed on to the thread on the central stud fairly tightly. The appearance of the whole diaphragm is shown from one side in Fig. 2, and from the other in Fig. 3, after being replaced in the reducing-valve body.


*Fig. 3.—The diaphragm replaced in the valve body, showing the reverse side, strengthened by the existing brass backing plate.*

After it had been placed loosely in the position shown in Fig. 3, the steel jet-closing screw was replaced and screwed home until it tightened the whole assembly. This held the diaphragm in its correct position ready for the reducing-valve top plate to be screwed down. Before this was attempted, however, the edges of the rubber still showing were dusted with talc.

When the top plate had been screwed down firmly the jet-closing screw was backed off a few threads, to give about 30 thou. clearance at the valve seating, and tension was put on the main valve spring with its large hexagon nut.

After the valve had been replaced on the aqualung it was a simple matter to adjust this nut to give the correct pressure at the reducing valve.

### Single-stage Reducing/Demand Valve

The shortage of regulators has prompted experiments with single-stage reducing/demand valves. This idea has been made doubly attractive by tests which have been carried out to show that single-stage valves give easier breathing than any other kind of valve. (See "Neptune" issue for September/October, 1955, page 29.)

The easiest valve to modify is the older type of brass-bodied low-pressure Calor Gas valve Type E, but the Type F (mentioned in the January, 1955, article) is also suitable.

When the valve has been taken down the short lever which connects to the centre

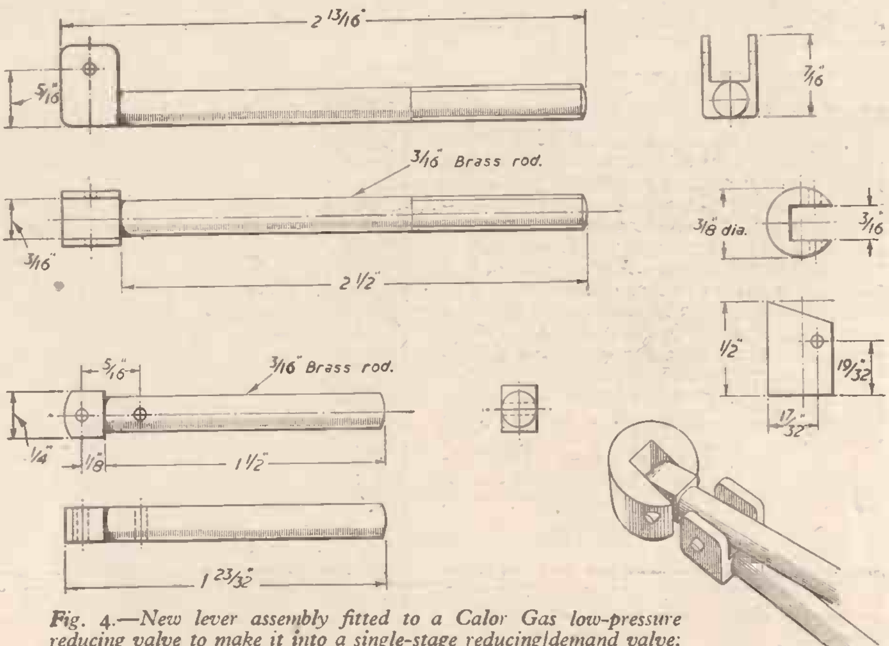



*Fig. 4.—New lever assembly fitted to a Calor Gas low-pressure reducing valve to make it into a single-stage reducing/demand valve: The measurements of the two levers and the pivot block are given.*

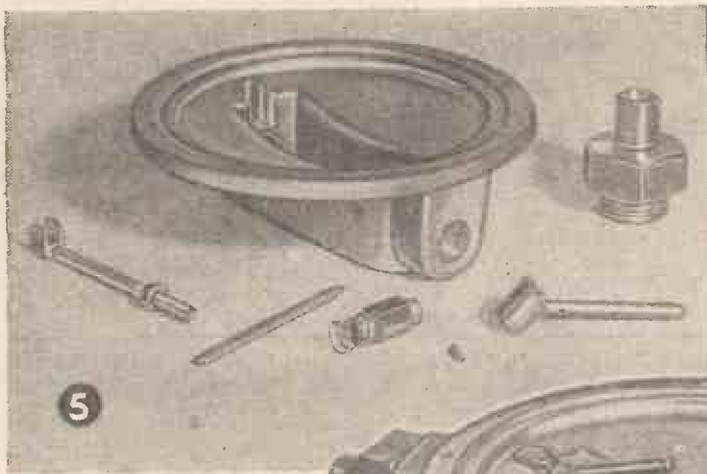


Fig. 5.—*Photograph of the components for the modified valve. The milled recess in the brass body of the valve takes the pivot block for the short lever.*

*Fig. 6. —Lever assembly fitted together and into the valve.*

of the diaphragm has to be removed, and a longer one put in its place. This lever, and the new one which connects to the diaphragm, are both made from $\frac{3}{16}$in. brass rod, like the discarded lever. Their measurements may be seen in Fig. 4.

The longer of the two new levers has to be threaded (2 B.A.) to screw into the brass pivot block in the base of the valve, and is fitted with a lock nut. Its other end is made by brazing on the fork-shaped piece shown ; this piece is drilled to take a fine stainless-steel pivot, which passes through the shank of the new short lever and is then riveted in place.

This short lever transmits the movement of the diaphragm centre to the long lever, and is supported at its fixed end by a further stainless-steel pivot held by a forked block let into the body of the valve. The valve shown in Fig. 5 was a brass type, so the recess shown in the figure was cut with a $\frac{3}{8}$in. diameter end-miller, and the pivot block, cut from $\frac{3}{8}$in. brass rod, was soldered into place. This was, of course, done after the stainless-steel pin had been fitted through the mount and the lever itself, and, after soldering, the pin was trapped in place. Brazing could have been used instead of soldering, but there would have been a risk of slight warping of the valve body, leading to air leaks.

If the valve had been one of the current aluminium types the recess cut into the body of the valve would have been a tapped hole so that the pivot mounting could have been screwed in.

The valve operating push-rod was taken out from the channel in the base of the valve and given a thick zinc coating to make it corrosion resistant. Also the rubber seating of the valve which is used to close the air intake jet was removed and replaced by a nylon insert. The nylon was cut with a very sharp cork borer of $\frac{1}{4}$in. diameter from a sheet of nylon 1/8in. thick. Synthetic resin-bonded fibre or p.t.f.e. would have done equally well, as would fine-grain bone.

The screw adaptor shown in Figs. 5 and 6 was used to connect the high-pressure air supply to the valve during testing. It was made from a piece of hexagon brass rod turned down at both ends and threaded $\frac{1}{4}$in. B.S.P. at one end and $\frac{1}{2}$in. B.S.P. (left-hand thread) at the other. $\frac{1}{2}$in. B.S.P. has an outer diameter of 0.825in. and 14 t.p.i. This connection proved quite air-tight although the valve connector was working at several times its rated pressure. In actual use on the aqualung the hexagon adaptor was turned down at one end to take the place of the air pipe and jet leading the air into the base of the valve.

In addition to these modifications the central brass stud in the diaphragm had to be shortened to bring the free end of the short lever as close to the diaphragm as possible. The central part of the stud was therefore cut away, and the two ends left brazed together again, saving about $\frac{1}{4}$in. of space.

Lastly the incoming air jet had to be closed down to 1/8th of its existing size. A piece of brass rod, 1/8in. diameter and $\frac{1}{4}$in. long, was drilled with a number 57 drill. The end to form the jet was then bevelled off to nearly a knife-edge, and the tube so formed was soldered into the original jet, so that the end of the new jet stood a little proud. When the screw-in adaptor was replaced by the direct $\frac{1}{4}$in. B.S.P. connector, this jet adaptor was transferred to the new fitting.

An innovation was the replacing of the diaphragm restoring spring by a rubber band, doubled and redoubled. The copper-clad steel spring used in the original model of the aqualung had rusted eventually, and it was decided to change over to rubber bands, in the absence of a suitable phosphor-bronze spring. This, however, is now obtainable from Pryce Engineers, 157 Malden Road, Cheam, Surrey, price 1/3.

Fig. 6 shows the lever assembly complete and fitted into the body of the valve, although the short lever will not in practice be allowed to rise to the position shown. The two levers should be fitted as closely parallel as possible, to bring their two arcs of movement as nearly coincident as they can be. If there is any restriction on their movement because the arcs do not coincide, it may be necessary to slot the pivot hole in the short lever where the two levers are connected together. The final positioning of the short lever is carried out by the screw adjustment in the base of the pivoting block which was part of the original valve assembly. The adjusting screw is reached through the outlet hole in the base of the valve, on the opposite side to the inlet.

This outlet hole has to be enlarged as described in the previous article.

# An Electric Mixer for the Kitchen

(*Concluded from page* 448)

### The Motor

No electric motor has been specified as so many people have odd electric motors lying in their spares box. The motor I used, as I wanted a liquid mixer, is as shown in Fig. 3. The shaft had to be bushed to fit the gearbox worm drive. If, however, a heavy mix is needed, a larger motor will be required, and in that case either of the ex-W.D. motors type 2377/320 or 2377/329 will answer the purpose, as they are specially fitted for connecting straight to the above gearbox. All that is required is the worm drive pinned to the motor shaft and then the motor is bolted to the gearbox top by means of the bolts, as shown in Fig. 1.

These fractional horsepower motors (approximately $\frac{1}{8}$ h.p.) run from 200 to 250 volt A.C. mains and are obtained from the same source as the gearbox. The firm will, in fact, send the gearbox and/or motor on seven days' approval against remittance.

If the motor you use is not one of the above, then the only point to watch is the correct alignment of the motor and gearbox, otherwise undue noise and strain on the motor will occur.

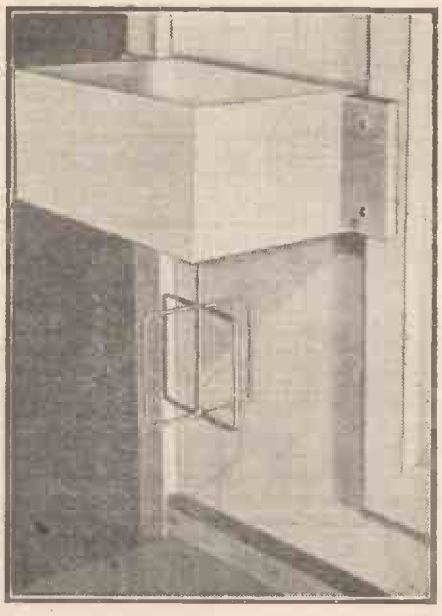


*Fig.* 5 (*Right*).—*The finished mixer.*

### The Case

The case can be either of wood or metal and may be attached to a wall. The breadth of the case is about 6in ; this gives a clearance of 4in. between the wall and the paddle shaft. The other dimensions, length and height, depend on the size of the electric motor. The switch in the motor circuit can be of any type and can be located either in the front or the top of the case, or, as in this instance, a switchplug can be used.

For holding the mixing bowl in place I use a sponge rubber-surfaced wooden block. The rubber allows just the right amount of " give" and saves bothering with any elaborate holding apparatus.

# MODEL MULBERRY

A Commercial Model of this Famous Artificial Harbour on Show at the Arromanches Museum

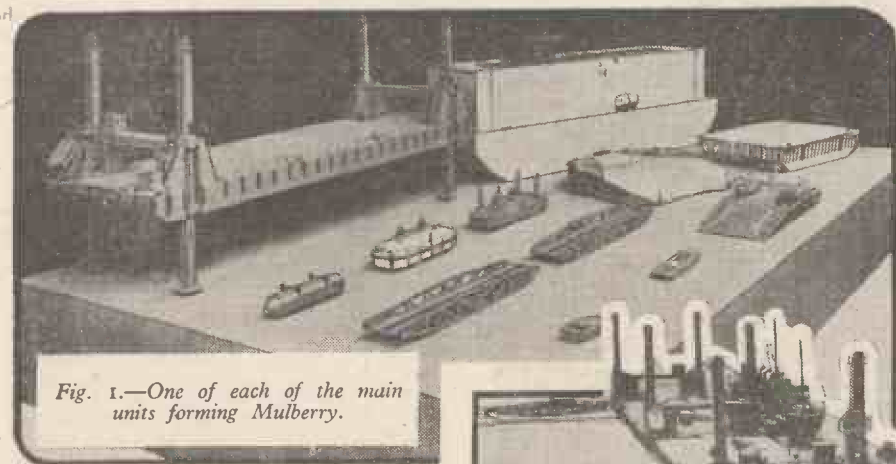


*Fig. 1.—One of each of the main units forming Mulberry.*

ON June 6th, 1944, the beaches of Normandy experienced the impact of the greatest combined naval, military and air operation the world has ever known. The little town of Arromanches was selected as the landing point for the British forces' invasion of the Continent. It has been perpetuated by the erection of a memorial on the sea front above the landing beaches, which takes the form of a permanent museum.

This museum is essentially dedicated to that great feat of British engineering, the artificial harbour called "Mulberry," and a series of scale models of Mulberry forms the major exhibit. Messrs Bassett-Lowke, Ltd., have had a number of skilled craftsmen working on these models for three and a half years, and

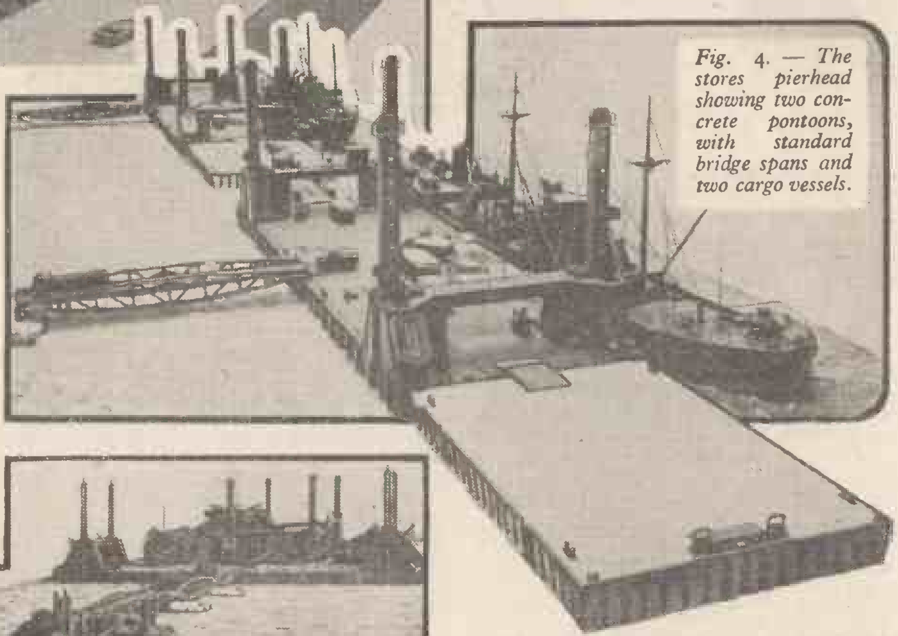


*Fig. 4. — The stores pierhead showing two concrete pontoons, with standard bridge spans and two cargo vessels.*

*Fig. 2.—View of pontoon pierhead model from the shore, showing shore ramp secured to the beach.*

the final exhibit was installed in May, 1956.

The display consists of five units which demonstrate the functions of the principal features of the project.

The first section is introductory and, as will be seen from Fig. 1, shows one of each of the main units, i.e., a concrete cassion, a spud pontoon, a concrete pontoon, one of each type of bridge span and various types of floats with erection equipment.

Groups of units were assembled at British ports and towed across the Channel in such order that they would be quickly erected on site. Part of one of these groups is shown in Fig. 3.

The second section shows five units or spans of the bridge as they were assembled for towing. The equipment for warping into position and mooring was carried on the spans. The "towing link" is complete with tugboat, the whole mounted on a simulated sea effect.

The third model shows a complete pierhead arranged for the disembarkation and transport of tanks and heavy vehicles, see Fig. 2. A spud pontoon is shown with two vessels discharging tanks through bow doors on to the buffer pontoons. On this the vehicles park before proceeding along the bridge to the shore. Light vehicles are also shown proceeding from the deck to the L.S.T. over a "Y" bridge constructed on the spud pontoon.

The bridge spans of Mulberry were made flexible to withstand the continual roll of off-shore waves and the model is animated to demonstrate this feature.

The Mulberry spud pontoon was anchored by four large columns or spuds, the feet of which were embedded in the seabed. In this way the pontoon could move up and down the spuds with the ride and fall of the tide. To demonstrate this feature the whole sea effect in the model slowly rises and falls, the depth of the water being indicated against a series of marks on the spuds. A section of this sea surface is formed in a transparent material to enable a clear view of the functions with the spud foot in the seabed. The animation is effected by mechanical contrivances fitted below the sea.

The fourth model shows in operation a "Stores Pierhead" (Fig. 4). This unit was formed with spud pontoons and concrete pontoons linked together end to end making a quay alongside which cargo vessels discharged stores and equipment. The model consists of two pierhead pontoons; ships are discharging cargo which is being loaded on to trucks. Two bridge roadways lead from the pontoons.

The fifth model shows the breakwater or harbour wall constructed of concrete cassions known as "Phoenix." These various huge concrete tanks were towed across the Channel as units and sunk in a long line end to end to form a breakwater inside which Mulberry was constructed.

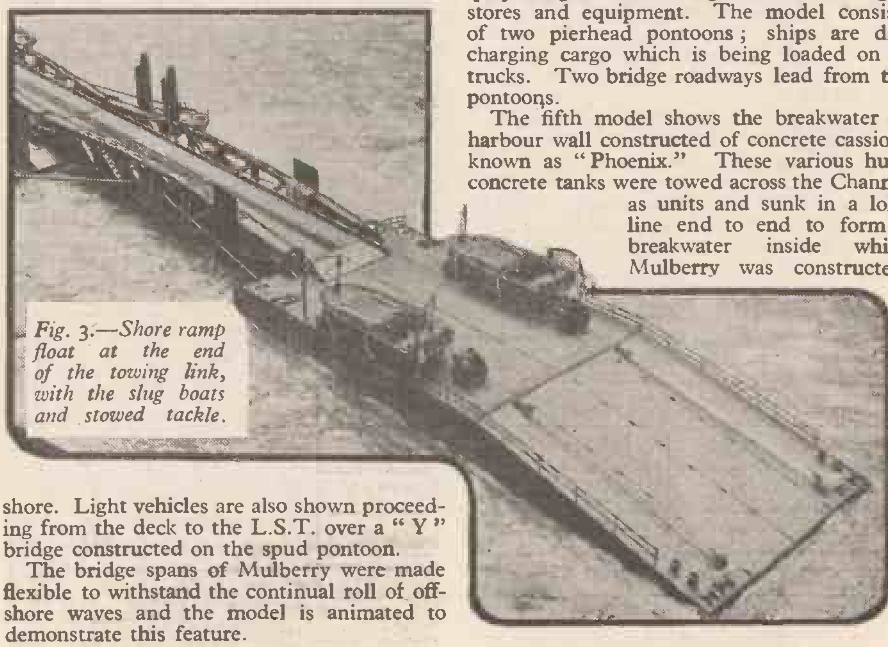


*Fig. 3.—Shore ramp float at the end of the towing link, with the slug boats and stowed tackle.*

# Building an 8 FT. Saili

An All-wood Family Craft Which Can Be Carried On The Ca

THE design of this small boat was conceived bearing in mind the following general requirements.

1. It should be of size small enough to be carried on the roof rack fitted to the family man's car, and should therefore be of a reasonable weight so that it can be lifted up on to the roof rack by the family team.

2. As a family boat it should be both as roomy and stable as possible, and should be able to take four persons as a maximum load. It should be robust enough to be used by the younger members of the family as a playboat.

3. It should be possible to propel the craft by oars, outboard motor or a simple sail.

4. The method of construction should be as simple as possible, so that a sound job could be made of it without having had any previous boatbuilding experience. The usual tool kit of the practical mechanic should be adequate.

Consideration of these various points indicated a craft not exceeding 8ft. in length and 4ft. in beam.

For strength, lightness and simplicity of design and construction it was decided to have a hard chine design with the frames covered with plywood. Resin-bonded plywood is obtainable in standard sized sheets, 8ft. x 4ft., so that to use these sheets economically, without having to make joins to give the right length, an overall length of 7ft. 9in. was finally adopted.

The pram type of design was used as it offered more room in the bow than other designs and was, perhaps, a little more simple in construction.

Four-millimetre thickness ply was used, and it serves its purpose well, being waterproof, strong and light. If a hole is pierced in the hull, should one accidentally strike a submerged stump, repairs can easily be made to the hull without having to remove a plank as in some other types of construction.

When buying the plywood for the hull or other parts of the boat be sure to insist that it is made to the B.S. Specification 1088 Phenolic glued to AX.100 test. Such plywood is unaffected by damp. This type of ply is often known in the local timber yard as "exterior grade" plywood, signifying that it may be used for outdoor constructional purposes without deteriorating due to dampness.

For the reader who might wish to try his hand at sailing the dinghy, the Una rig or Bermudian rig without a foresail is ideal for this small boat. It is a rig simple to fit and easy to use and safe, especially as the revolving type of boom is used which will give easy and rapid reefing for any wind conditions. In this design adequate

**Table of Offsets (in inches)**

| Station | Half breadth | | Height from sheer | |
|---|---|---|---|---|
| | To sheer | To chine | To chine | To keel |
| 0 (bow) ... | 11¾ | 10¾ | 12¼ | 14½ |
| 1 ... ... | 19⅞ | 16 | 13⅜ | 15⅝ |
| 2 ... ... | 24 | 20¼ | 15¾ | 18¼ |
| 3 ... ... | 22⅞ | 19 | 14½ | 17½ |
| 4 (transom) | 19¼ | 15¾ | 11¾ | 15¼ |

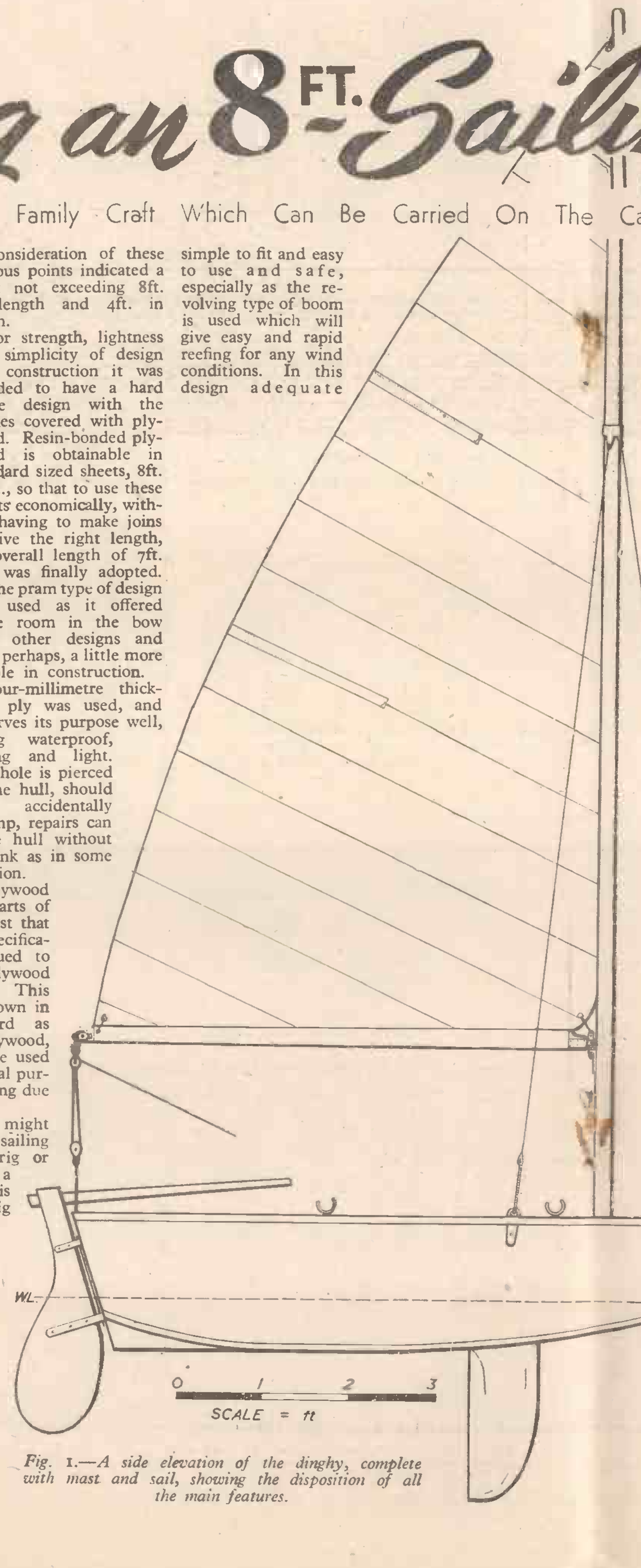



*Fig. 1.—A side elevation of the dinghy, complete with mast and sail, showing the disposition of all the main features.*

# ...ng Dinghy

...ar Top By FRANCIS HOOK

head-room is allowed for when the boom swings across, about 30in. clearance between the centre seat and the boom is provided.

The height of the mast—15ft.—presents a problem for the constructor who wishes to travel from place to place with the dinghy on the car roof. For such cases a suggestion is given for a two-piece mast. Such a design brings its own difficulties, but for such a small boat they are not without solution and this matter will be discussed at a later stage.

### The Design of the Hull

Boat designs are usually set out in tabular form from which figures the builder can set out full-sized lines of the vessel on the loft floor.

The table of offsets determines the body plans of the boat, and from them the shape and size of each may be determined. (See table at foot of first column.)

It is usual to give these dimensions to the outside of the planking so that when constructing the frames allowance must be made for the thickness of the planking. This procedure is *not* used in this design, the dimensions are all to the outside of each frame.

In addition to the table of offsets, three sketches are provided. The profile sketch shows the basic lines of the boat when viewed from the side—a side elevation, in fact.

A half-breadth plan shows half the basic lines of the boat as viewed from above, i.e., a plan view. The body plan shows the shapes of the various frames from bow to stern. These three sketches are incorporated in Fig. 4.

Sometimes the table of offsets is dispensed with and all the information is embodied in a visual table of offsets, see Fig. 3. This is, in effect, a dimensioned sketch showing how the erection board or form has to be set out before the building of the boat can be started.

For those interested in the final appearance of the dinghy, the heading photograph shows the author's boat under sail and two further diagrams, Figs. 1 and 2, show the disposition of the main features, such as sails, spars, dagger board, rudder, seats and rowlocks.


### Construction of the Frames

The first job to be tackled in the building of the boat is the construction of the frames. As has already been stated, the details of these frames may be set out full size from the table of offsets but, in order to make the construction as easy as possible, dimensioned diagrams are given here from which the shape of each frame may be set out accurately to full scale.

Large sheets of thin card are useful for setting out the frame plans, but in order to get a big enough sheet it may be necessary to glue two sheets together.

A better alternative is to use the plywood which will eventually be used to cover the sides of the dinghy. The frame plans need only be drawn in lightly in soft pencil, which will not disfigure them for their eventual use when the boat is painted.

Each of the frames Nos. 1, 2 and 3 is made up of five pieces of timber, see Fig. 7.

In frame No. 2, Nos. 1 and 5 are the side futtocks, 2 and 4 are the bottom futtocks, and 3 the plate joining the bottom two futtocks. A sixth piece ($1\frac{1}{2}$in. $\times$ $\frac{5}{8}$in.) is used temporarily to hold the tops of the side futtocks from being unduly strained during the erection of the boat. These are screwed to the futtock tops and not glued as are the joints of the futtocks at chine and keel.

The side futtocks are not cut exactly to length at the sheer end but are left $2\frac{1}{2}$in. longer to provide a fixing for these temporary struts. It is advisable to retain the use of these struts right up until the time when the seats have been fixed. During the building of the boat these struts pass through the slots X, Y and Z of the building form, as shown in Fig. 6.

Proceed then to prepare the various parts of each frame according to the full-sized plans, lay them on top of the drawings and ensure an exact fit.

The procedure in assembling the parts of each frame is to glue and screw parts 1 and 2, then 4 and 5, then join these two assemblies together with part 3. Remember to have part 3 on the same side of 2 and 4 as the side futtocks 1 and 5. Screwing procedure is important to avoid splitting. The shank of the screw should pass easily through the top piece of wood by a hole drilled to suit the gauge of screw used. For these joints

*Fig. 10.—Testing the fairing of the frames. This operation will be described next month.*

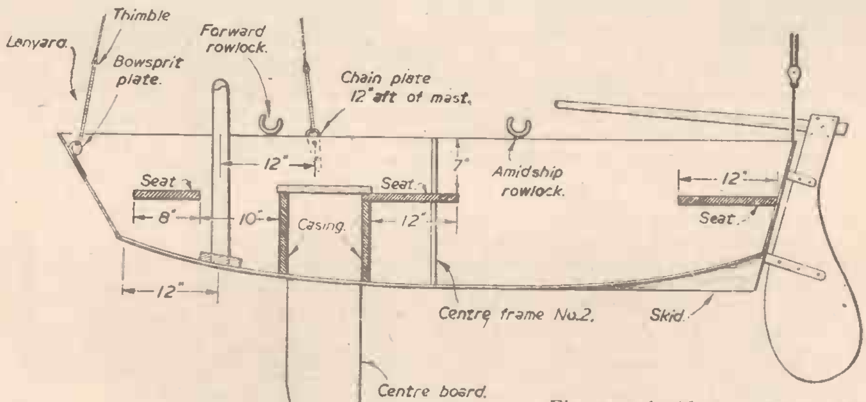



*Fig. 2.—A side elevation of the hull giving positions of all the main features.*

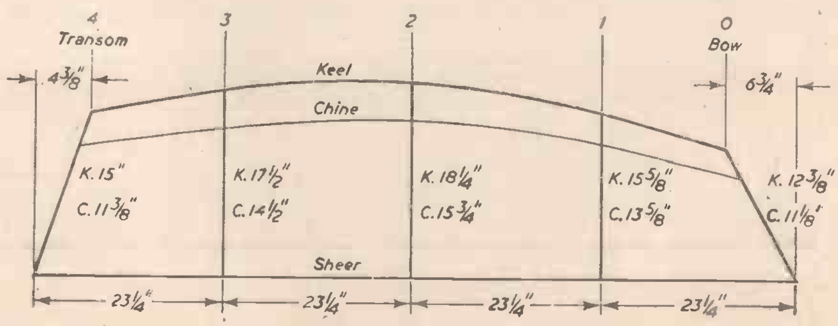



*Fig. 3.—The visual table of offsets.*

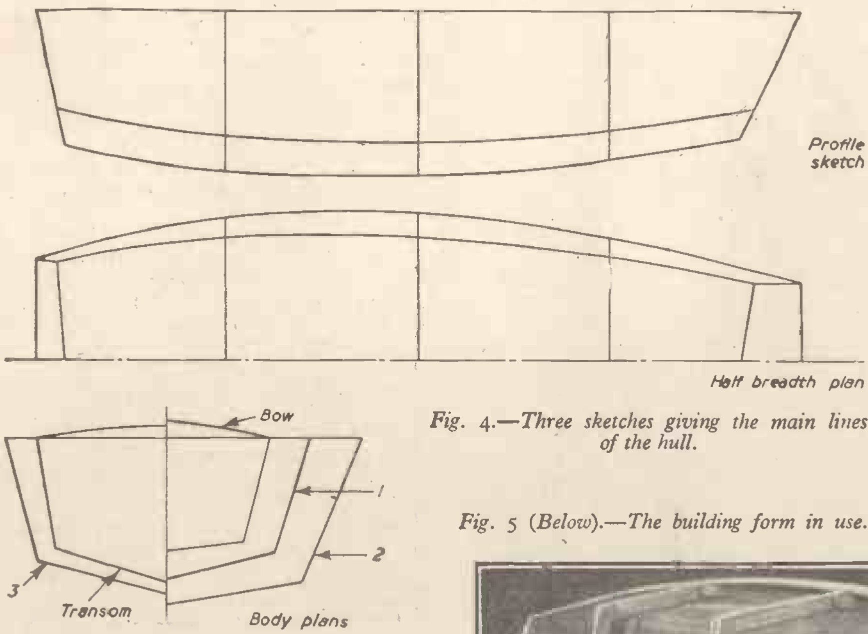
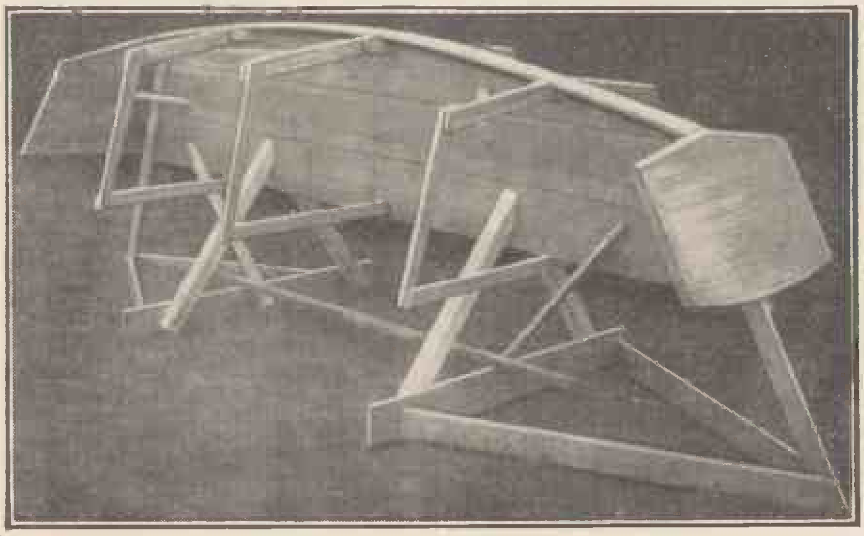



*Fig. 4.—Three sketches giving the main lines of the hull.*

*Fig. 5 (Below).—The building form in use.*



are used 1in. No. 6 brass countersunk head screws, and a suitable drill is $^{9}/_{64}$in. diameter. A slight countersink only is necessary in the wood, as it is the aim to have the heads of the screws flush with the surface of the wood.

The glue recommended for use is Aerolite 300 or 306. Full instructions are issued with every glue pack sent out by the makers. In the case of the No. 300 pack, glue ready for use and a hardener are supplied. No. 306 supplies a powder (ready for mixing with cold water to a syrup-like consistency) and the hardener. The advantage of the latter type is that it is sometimes more convenient to be able to make up a small quantity of the glue as required. The powder if stored properly has a very long shelf life, whereas the glue in the 300 pack does gradually deteriorate. There is also the odd chance that one might inadvertently dip the hardener brush into the jar of glue and thus ruin the whole jar!

Apply the glue to one frame member and the hardener to the other, and place in position on the full-sized drawings. Make a lead with a fine bradawl in the underneath member for the screw. Screw home the screws, driving them only as far as will leave the head of the screw flush with the surface of the wood.

When the three frames are assembled, screw across the top ends of the side futtocks the temporary struts already referred to. Set the frames aside to dry.

### The Transom and Bow

The transom and bow boards are made from ¾in. finished thickness mahogany. If weight is a serious consideration a lighter method would be to use plywood for these parts glued and screwed to frames, but it is assumed here that the solid method of construction is to be followed.

It is unlikely that boards of the correct width will be available, so that two or more pieces will have to be jointed up to make the correct width. For these joints use the Aerolite glue and lightly cramp them together with sash cramps so as not to squeeze out all the glue. It will be noted that this procedure is rather different to the old days of the rubbed joint using Scotch glue, when the object was to rub out as much glue as possible.

Mark out the shapes of the transom and bow. Note that in the table of offsets no alllowance is made for the curved tops of boards. This curve is shown in the working drawings of the frames. The curve is 1½in. for the bow and 2in. for the transom above the sheer line, and is struck with a thin batten sprung between the 1½in. mark on the centre and the two points on the sheer. Saw out to shape.

If this dinghy is eventually to be stowed upside down on the deck of a larger boat it

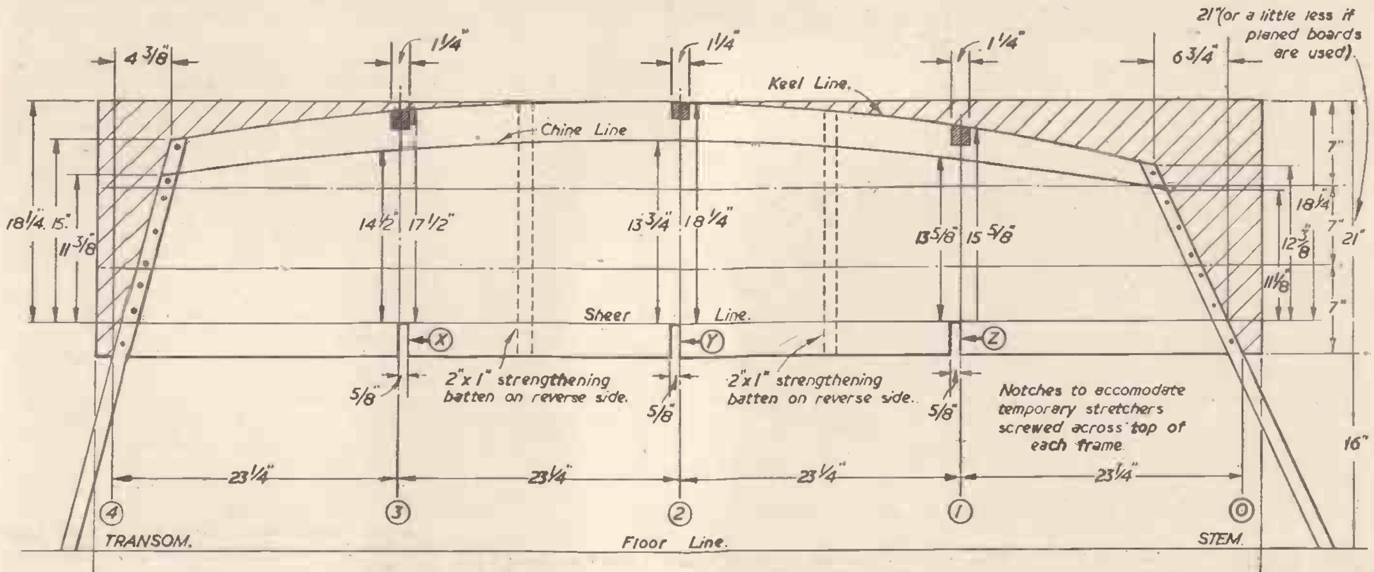



*Fig. 6.—How the hull is set out on the building form.*

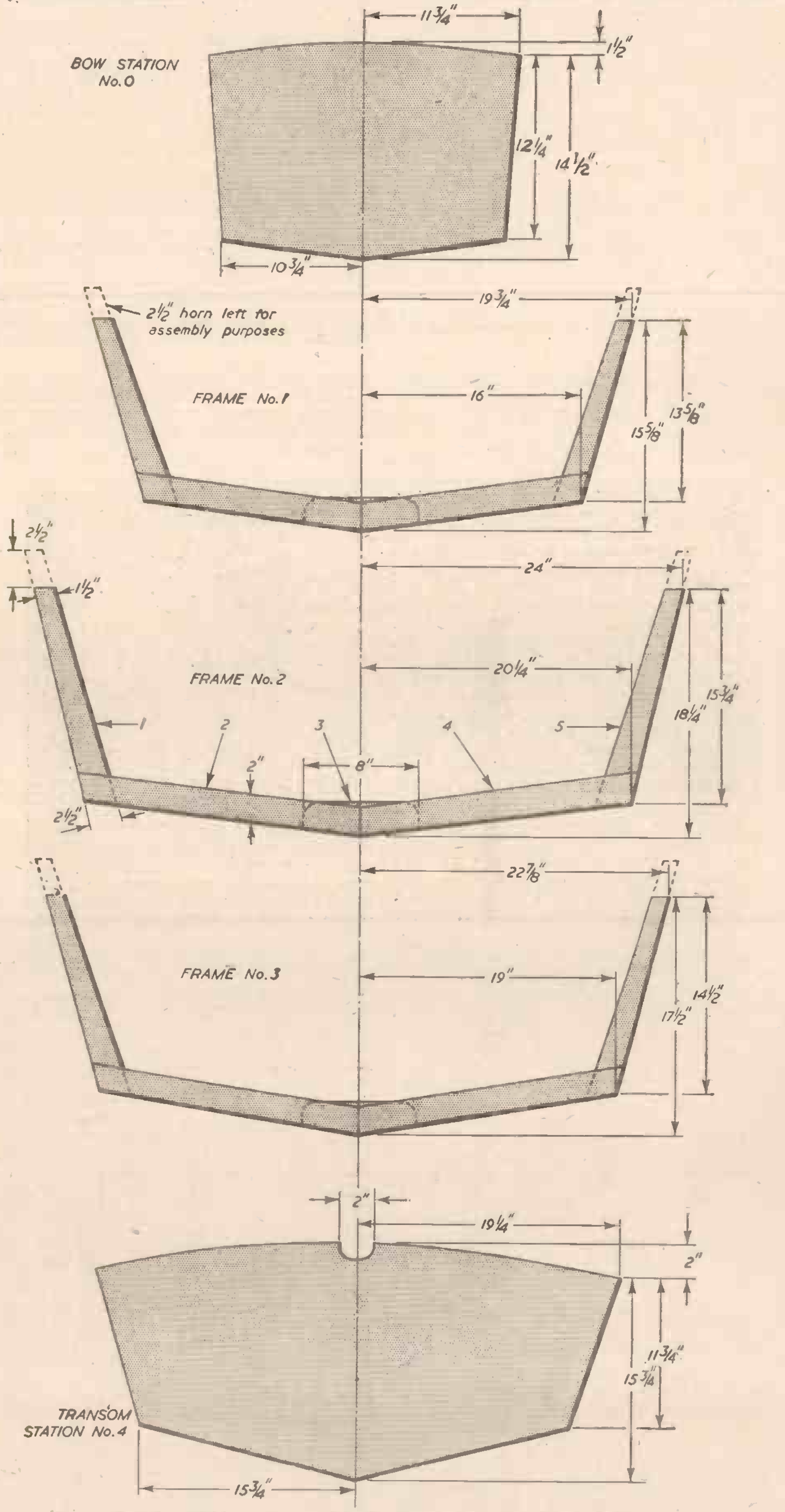



*Fig. 7.—Details of the bow and transom and frames 1, 2 and 3.*

would be an advantage to have these top edges straight or a reverse curve.

**Construction of the Building Form**

The building form is the framework around which the boat is built. Fundamentally it consists of three 1in. x 7in. planks on which are set out at either end the slopes of the transom and bow, the curvature of the keel, and the positions of frames 1, 2 and 3. The full details are set out in Fig. 6. Whilst the use of this form is only temporary the timber used in it may be used later on for other small details of the boat and the seats.

Cramp the three boards together and secure with two 2in. x 1in. battens, screwed on as indicated. Two further battens are screwed along the slopes of the bow and transom and are continued through to floor level as shown in Figs. 5 and 6.

**Tools Needed in the Construction of the Dinghy**

Hand saw, tenon saw, and bow saw.
Iron smoothing plane.
Spokeshave.
Chisels.
Mallet and hammer.
Screwdrivers and bradawls.
Hand drill and/or electric hand drill.
Two 3ft. sash cramps.
Three 9in. G cramps and one or two smaller G cramps.

**Materials Required for the Various Parts of the Boat**

Keel—oak.
Hog—pine.
Bow and transom—mahogany.
Frames—pine.
Knees—oak or elm.
Centre-board casing—mahogany.
Chine and sheer strips—pine.
Seat risers—mahogany.
Seats—mahogany or plywood.
Rudder—mahogany or plywood.
Tiller—oak.
Mast and boom—Sitka spruce.
Burden boards—pine.

**Suppliers of Materials**

*Timber.*—J. Williams and Son, Ltd., 45, Christchurch Road, Colliers Wood, London, S.W.19.

Cousland and Brown, Ltd., Manor Farm Road, Alperton, Middlesex.

*Sails.*—Jeckell and Son, Ltd., Wroxham, Norfolk.

Bowker and Budd, Ltd., Bosham, Sussex.

*Fittings.*—Arthur Beale, Ltd., 194, Shaftesbury Avenue, London, W.C.2.

The Bosun's Locker, 12, Poultry, London, E.C.2.

**Materials Required for the Dinghy**

*For the building form.*—Three pieces 8ft. x 1in. x 7in. deal planed all round; 50ft. run 2in. x 1in. deal planed all round.

*For the frames.*—9ft. run 2½in. x ½in. pine; 12ft. run 2in. x ½in. pine; 3ft. run 3in. x ½in. pine.

*For the skin.*—Two pieces of resin-bonded plywood 8ft. x 4ft. x 4mm.

*Hog.*—One piece 8ft. x 4in. x ⅝in. pihe.

*Keel.*—One piece 8ft. x 1¼in. x ⅝in. oak.

*Skid.*—One piece 3ft. x 1¼in. x 4in. oak.

*Chine and sheer strips.*—Four pieces 8ft. x 1¼in. x ⅝in. pine.

*Bow.*—One piece 24in. x 16in. x ¾in. mahogany.

*Transom.*—One piece 40in. x 16in. x ¾in. mahogany.

*Seats.*—Two pieces 4ft. x 12in. x ⅝in. resin-bonded plywood; one piece 4ft. x 8in. x ⅝in. resin-bonded plywood.

*Seat risers.*—Two pieces 8ft. x 1½in. x ⅝in. mahogany.

*Burden boards.*—Nine pieces 4ft. x 3in. x ½in. pine; eight pieces 4ft. x 2½in. x ½in. pine.

*Centre-board casing.*—One piece 3ft. x 12in. x ⅝in. mahogany.

*Centre-board.*—One piece 3ft. x 12in. x ⅝in. resin-bonded plywood.

*Brass countersunk headscrews.*—Two gross ⅝in. No. 6; one gross 1½in. No. 8; two dozen 2in. No. 10.

All timber dimensions, except those of the building form, show finished planed sizes.

*(To be continued.)*

# Soldering Simplified

## Hints and Tips for the Handyman and Motorist on Soldering Cables and Flat Surfaces : Recommended Tools : Soldering Brass, Copper and Aluminium

By W. K. REEVES

THE two main types of flux used in soldering are the well-known liquids and the paste, or resin-tallow, substances. The fluid flux is usually more "rapid" in action, hence its popularity, but, owing to the acids used in its composition, it is corrosive to most metals. Paste flux is said to be slower working than its liquid counterpart, but it is only by seconds.

Fig. 4 shows one of the best methods of fixing a nipple. A small cut is made with a hacksaw blade across and each side of the hole. The wire is passed through the hole and equally divided and laid down in the grooves. Gentle heat is applied : the nipple and about ¼in. of the cable are immersed in the flux ; then, after heating again until the flux boils, solder is applied. Should the solder not run freely, dip the cable into the paste again when the solder should, on the next heating, flow easily to the desired places. The method is the same for the spoke-type nipple except that no cut is made. The wire is passed through the nipple, splayed and turned over in the cup provided and finally soldered. This type of nipple is usually at the gearbox end of a clutch cable and it is good policy to file it smooth when cool and cleaned.

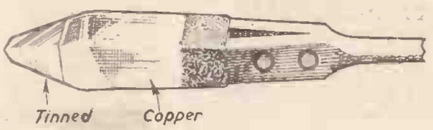



*Fig. 1.—The bit of a soldering iron showing how it should be cleaned and tinned to ensure the best results.*

### Soaking a Cable

In no circumstances should a nipple be brazed or welded to a Bowden cable. The inner wire is of steel and, if once it has been overheated, it is no longer steel and worse than useless, for no common method can be employed to retemper it. Should it be necessary to fit a new cable, the job may be quite easily carried out but the important point to remember is to thoroughly tin the wire for, say, ¾in. on each side of the intended cutting spot.


*Fig. 2.—Cutting a Bowden cable so that there is no danger of the strands unravelling. The nipple should be slid over the cable before it is cut.*

Perhaps "soak" the cable would be more expressive. The method of soaking is straightforward. Non-corrosive paste is put upon the length to be tinned, heat is applied until the flux boils and it will then be found that the solder is ready to run round, along and through the cable until each and every strand is securely fixed to its neighbours. A flick will remove any surplus solder and when cool the wire may be cut in perfect safety, as shown in Fig. 2. If it is possible to do so, slide on the nipple first, past the cutting point, as the action of cutting the wire will cause it to flatten. If the hole through the nipple is on the small side it may be necessary to enlarge it and, in the absence of a suitable sized broach or reamer, the expanded cable outside the nipple, by reason of its greater diameter than the hole, provides the strength.

### Vertical Soldering

It may happen that the inner cable is very oily, but this is one occasion where the soldering rule of "scrupulous cleanliness" may be forgotten. The method is to ensure that, as long as heat is being applied, the end of the wire being treated remains upright. It will probably be necessary to apply flux several times but its downward flow when melted will remove the film of grease.

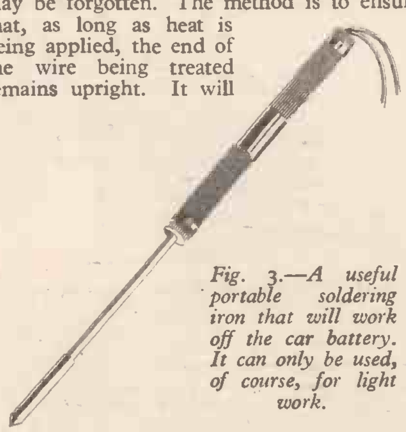


*Fig. 3.—A useful portable soldering iron that will work off the car battery. It can only be used, of course, for light work.*

It is not inopportune to remark, at this stage, on the method employed to solder an object in the vertical plane. One such job could be a cluster of pin holes in a fuel tank where it is not possible to remove the tank. A dirty soldering iron is used and, when heated, only one face is cleaned and tinned, leaving, for preference, the point dirty. After cleaning the area to be soldered, judicious application of the iron and the solder, in a series of small "dabs" should be made. It is a fairly easy matter to effect a repair resembling a welded joint with its characteristic ripples or herring-bone pattern. Fig. 1 shows the way to prepare the soldering iron.

### Powder Solder

There are, on the market, some admirable fluxes which have the solder, in powder form, already mixed. All that is necessary is, after cleaning, to apply the flux, heat it up and, after cooling, clean it off. As efficient as these fluxes are, they are not, in the main, suitable for nipple and cable work, as some have an acid base flux. A small tin filled with such a substance and carried in the tool kit is, however, a valuable asset. For replacing a petrol pipe union on the road it may be considered as an ideal product. Always, after a pipe repair, flush it through before refitting.

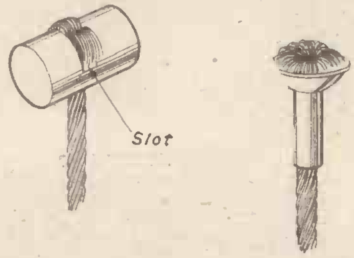



*Fig. 4.—Arranging the strands of a Bowden cable when soldering a new nipple into place.*

Tank repairs are easy enough to carry out but it must always be borne in mind that an empty petrol tank can be dangerous. To "air" a tank, the taps and filler-cap are removed and the tank supported upside down for at least 24 hours. This still does not guarantee a safe tank but as a soldering iron should never be used red hot and providing that all dry dust is removed from the vicinity of the repair and no soot sparks are on the iron, soldering may be carried out. For such a repair, rapidly acting flux is required but difficulty might arise if the work is needed in a chromium plated area. Ordinary fluxes are not efficient on chrome or metals containing chromium. Stainless steel is in this group and the correct flux to use is phosphoric acid.

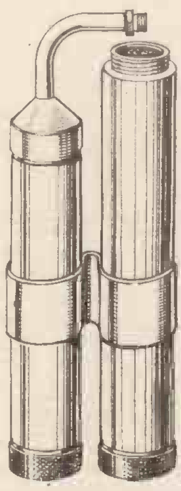


*Fig. 5.—A small methylated spirit blowlamp with many uses on the road and in the workshop.*

Soldering is carried out in a normal manner but on no account dip the iron into this flux. Likewise, if any other metal such as brass or copper is to be soldered to stainless steel or chromium plate, first tin the chrome with

(Continued on page 471)

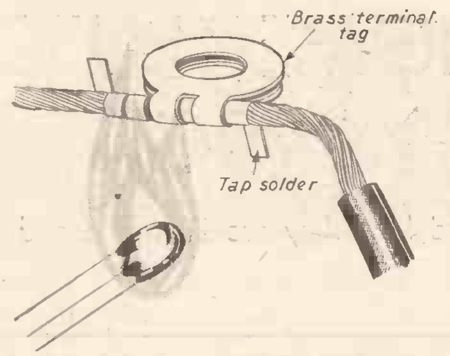



*Fig. 6.—Extremely useful for small emergency repairs is this solder tape which can be melted with a match flame.*

phosphoric acid and wash clean with water. Then, with ordinary flux, proceed to solder the dissimilar metal in a normal manner. As with all soldered surfaces, wash thoroughly with water and dry off after repairs are finished.

Tinplate and brass are, perhaps, the most easily soldered of the common metals and liquid flux is suitable for most jobs. Copper requires rather more heat and, in order to get the solder to run freely it is often found to be advantageous to back up the heat output of the soldering iron by the use of a blow-lamp. Again, liquid flux is the best unless the job is an electrical one. If rubber-covered wires are being soldered, the correct method is to use a resin-cored solder, as the resin-cored flux is absolutely neutral to rubber. Should a plaited or woven copper wire conductor need to be soldered or its ends tinned, the area must be well washed to prevent corrosion, unless resin is used as the flux. Equally important is that it must be thoroughly dried. Should it be necessary to couple copper pipes with a rubber connection, the ends of the pipes should always be well tinned first as rubber contains sulphur, the greatest enemy of copper. One good example of this is ordinary rubber-covered copper wire which is invariably tinned or coated.

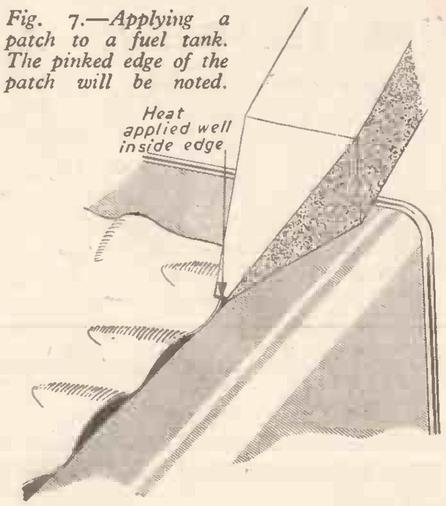
### Soldering Fuel Tanks

Many car fuel tanks are made of a coated sheet called "terne-plate." The coating in this case is lead, and a paste flux is the best choice for soldered repairs. Should it be necessary to fit a patch and terne-plate is not available, use tin-plate, but be sure to tin it thoroughly on both sides before fixing. A strong fixing may be effected if the patch, instead of being a plain circle or oval, has a scalloped or pinked edge. The reason is, that such a patch has a much longer perimeter for its area than a clean-edged patch. When soldering patches or lapped edges, the iron should go as far over the lap as it is required that the solder shall run under. It is not sufficient to solder the edges and the term "float a patch on" should be self-explanatory. Fig. 7, shows the scalloped patch and iron floating solder under to the required depth.

### Aluminium Soldering

Aluminium is often said to be impossible to solder but this is not correct, for aluminium

*Fig. 7.—Applying a patch to a fuel tank. The pinked edge of the patch will be noted.*




solder is on the market and has been for years. Neither a strong nor a lasting joint may be made, however, especially under damp conditions. The great difficulty is due to the rate at which this metal oxidises and one of the best ways of getting solder to take is to heat the job, melt some solder (either ordinary or aluminium) at the desired spot and briskly scrub with a wire-brush. As the bristles pass through the molten solder and scratch the aluminium clean, cover is automatically provided. Once the area is tinned it is wiped clean with a rag and solder may then be built up in a normal manner.

# Common Ailments in Tropical Fish

## Causes, Symptoms and Cures

By I. W. BRASSINGTON

THERE are a large number of fish diseases and because of this we must be ready and know how to deal with them. A healthy tank is a good insurance against them, and a glance at some of the causes below will help you to steer clear of disease.

If you should run into trouble during your first year or two as an aquarist, it is most likely to be in the form of one of the following ailments.

### Air-bladder Trouble

The air-bladder is an organ near the stomach which maintains a pressure of air inside the fish equal to the pressure of water outside. As it swims down into deeper water, so the fish adjusts the amount of air in its air-bladder to compensate for the extra pressure of water, brought about by its descent. If this balance becomes upset there follows a loss of control and the fish swims about in a very drunken manner, sometimes settling on the bottom of the tank and heeling over on its side, or making desperate attempts to reach a different level, meanwhile rolling about in a most unnatural way.

The cause is due, in the majority of cases, to faulty feeding, resulting in constipation. This trouble often follows a period when food has not been sufficiently varied. It is not difficult to visualise that an upset in the digestive system may cause the stomach to distend and press against the air-bladder and so disrupt the functioning of that organ.

If the patient is placed in a shallow tray containing no more than 2in. or 3in. of water, which should be floated in the aquarium, this will minimise its distress. The temperature should be identical before the fish is transferred—in fact, by far the best plan is to fill the tray from the aquarium itself. The temperature should then be raised, by adjusting the thermostat, and kept as constant as possible around 80 degrees, for a few days. If the symptoms are recognised in the early stages, the fish will usually recover by merely feeding with "live" food.

### White Spot

An outbreak of white spot (the Ichthyophthirius parasite) can be attributed to the introduction of fresh stock into your tank and a quarantine period is advisable before putting in any fish newly purchased.

The symptoms are unmistakable, white spots on the affected fish, which quickly spread, if not treated. As a cure use quinine hydrochloride at the rate of not more than two grains per gallon of water, or alternatively, use a two per cent. solution of mercurochrome at the rate of four drops per gallon. Raise the tank temperature to about 80 degrees during treatment, which should take perhaps three or four days, and then get rid of the mercurochrome by changing the water in your aquarium a little at a time—say four or five gallons a day until all visible traces of the medicine have disappeared.

I must add a warning here, that there is some danger to the fish in the use of both these cures, and it is, therefore, important to be able to recognise this disease and treat quickly, when a weaker solution may be tried, or alternatively to be able to isolate a single victim and treat separately, before the whole tank has to be subjected to the treatment.

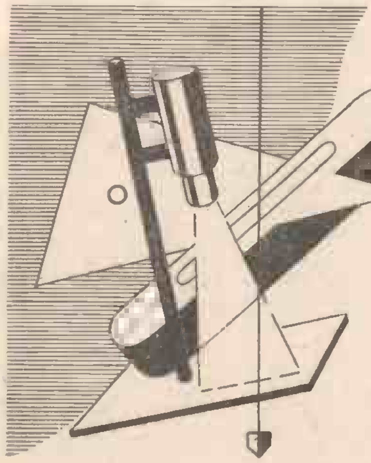
### Fungus

Fish sometimes develop a fungoid growth which resembles cotton wool and is often caused by damage to scales through the fish receiving a knock of some kind, or may be grazing against a sharp edge of rock. Whatever the cause, the fish must be isolated in a solution of rock-salt—strength, two level teaspoons per gallon of water, with the water at tank temperature. Over a period of 24 hours, this should be increased to four teaspoonsful and, if necessary, even more, providing the fish can stand the concentration. As soon as the treatment appears effective, freshwater must be added gradually, to reduce the salt content, before the patient is returned to the tank.

### Shimmies

You may occasionally find your fish doing an unusual amount of shaking with head and tail, as though attempting a new and complicated dance. This is the sign of a chill and an immediate check-up should be made on the heating equipment. See that the heater is in order and that the thermostat adjustment has not been accidentally altered. Check the thermometer against another one—these do sometimes go wrong, and remember when topping-up, that the water being introduced, should be at the correct temperature. A stream of cold water entering the aquarium, is at once fascinating and dangerous to fish.

If you suspect this ailment, raise the temperature to about 80 degrees, keep it as constant as possible for a few days, and things should put themselves right.



# Checking HOME BUILT ENLARGERS

## The Effects of Inaccuracies and how they are Detected and Eliminated

By C. MONDAY

THE following notes are based upon observations made during the construction of the 35mm. enlarger described in the February issue. The usual type of enlarger shown in Fig. 1 comprises three main components. (A) Baseboard and column. (B) Head, containing lamphouse, condenser and negative carrier. (C) Lens panel. The head is capable of vertical movement on the column while the lens panel has some form of focusing movement independent of the head travel.

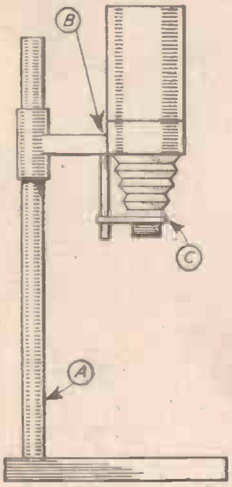



*Fig. 1.—The components of a typical enlarger.*

To achieve minimum constructional accuracy there are four basic requirements. (1) The centres of the lamp, condenser, aperture in the negative carrier, and the lens are on the same straight line. (2) This line produced is at right angles to the baseboard in both the longitudinal and transverse planes. (3) Operation of the focusing movement throughout its range maintains the lens on the centre line. (4) Operation of the head movement maintains the centre line normal to the base.

These requirements appear to be more formidable than they really are. It must be admitted at once that the home-built enlarger cannot attain the same accuracy as a factory-made unit by a reputable manufacturer who will have an inspection department equipped with instruments completely beyond the scope of any amateur. The accuracy obtainable by careful home construction will, however, be quite satisfactory.

It will be assumed that the enlarger is completed but can be dismantled for detailed checking, and to enable corrections to be made a form of construction that allows for adjustment of the various parts is very desirable.

### Condenser Alignment

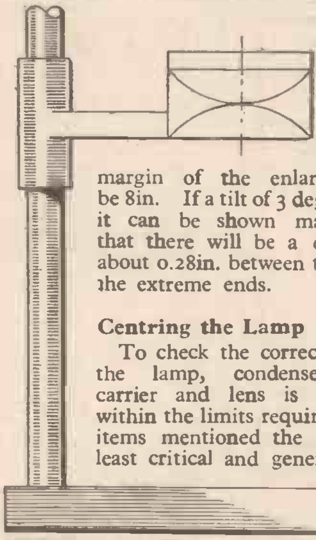
When the baseboard, column and condenser housing are assembled the appearance will be something like Fig. 2, the condenser being about half-way up the column. The only instrument required for the first check is a small pocket level about 2in. to 3in. long. Set the baseboard level by packing under the corners and taking readings at right angles to one another as shown. Readings should be made at several points, the most important being directly below the condenser. The level readings may indicate that the baseboard itself is not flat, but if machine planed wood or thick plywood has been used the error is not likely to be very great.

Repeat these checks on the condenser. A double condenser will have a flat top surface upon which they can be made, but if a single one is used clamp a flat plate to the underside, projecting all round, and obtain readings from that.

It should be possible to obtain an accuracy of ±½ deg. or even ±¼ deg. in the condenser level without difficulty. Any inaccuracy in the front to back level should be in such a direction that the front of the condenser is higher than the back. The additional weight of the lamphouse and lens panel when fitted will then reduce the error instead of increasing it as it would do if the readings were reversed.

If the tilt is limited to ±½ deg. there will be no noticeable distortion and any errors of focusing at the margins, even at the accepted minimum resolution of eight lines per millimetre, will be undetectable.

A deliberate tilt is sometimes introduced to correct converging verticals in architectural photographs. If a negative of 1½in. × 1in. is used with a magnification of eight, then the width between parallel lines at the margin of the enlargement will be 8in. If a tilt of 3 deg. is assumed it can be shown mathematically that there will be a difference of about 0.28in. between the widths at the extreme ends.



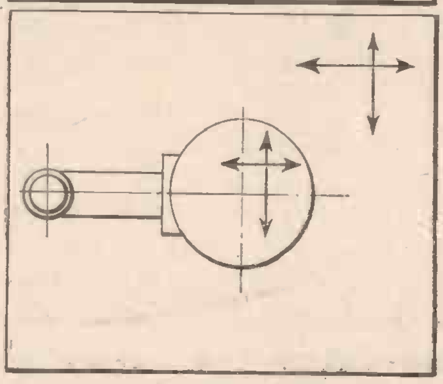


*Fig. 2 (Top)—Baseboard, column and condenser assembly. (Below)—Readings are taken at right angles to one another.*

### Centring the Lamp

To check the correct centring of the lamp, condenser, negative carrier and lens is not difficult within the limits required. Of the items mentioned the lamp is the least critical and generally can be set by eye or by measurement with a rule.

If the mounting is eccentric the negative may be unevenly illuminated, but unless the error is considerable the effect will not be detectable in the finished enlargement, particularly if the diameter of the lamp is large in proportion to the size of the negative. It is quite easy to arrange for an adjustable lampholder when the lamphouse is made.

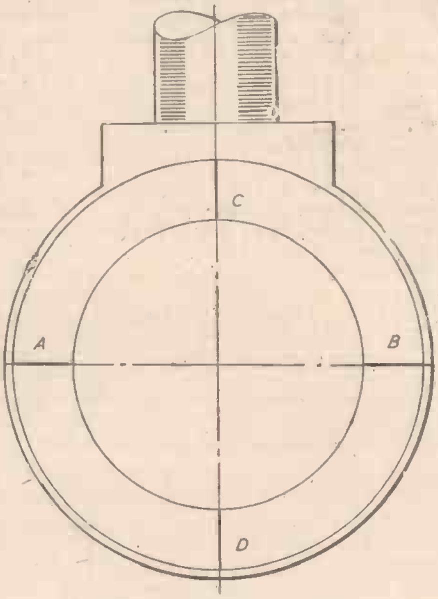



*Fig. 3.—Centring the condenser.*

The method adopted to check the remainder of the system depends to a certain extent upon the type of construction, but the following suggestions will be applicable to most enlargers.

### Centring the Condenser

With the condenser and its housing only in place on the column a view looking down upon it will be similar to Fig. 3. A disc is cut from cartridge paper the same diameter as the condenser, and two lines at right angles to each other are drawn right across it through its centre. The centre part is then cut away leaving a rim about ½in. wide, and the outer portion is pasted or clipped to the underside of the condenser so that the lines are uppermost and visible from the top. The line AB should be parallel to the direction of sliding movement of the negative carrier.

A point is now required on the baseboard directly below the intersection of AB and CD. There are two simple methods of obtaining this position, both shown in Fig. 4. For the first a straight edge is used against the side of the condenser housing and its point of intersection with the baseboard marked on a sheet of paper pinned to the latter. This is done at a number of places round the condenser, and the points are joined to form a circle, the centre of which can be found by simple geometry.

As an alternative a plumb line made with a small symmetrical weight on a piece of cotton may be used. It is dropped from the centre of the condenser which can be found by using a piece of plywood with cross lines on it

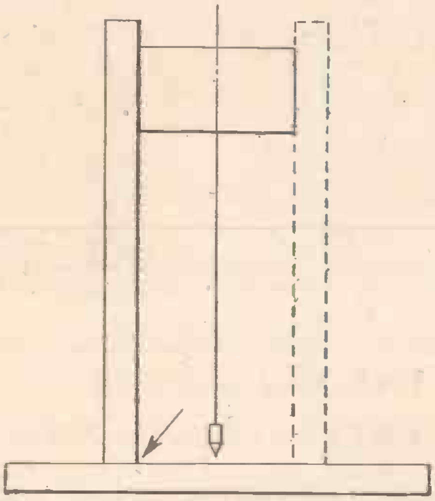


*Fig. 4.—Two methods of centring the condenser.*

lined up to AB and CD. If the second method is adopted, make sure that the baseboard is still set level before the plumb line is used. Once the centre point is marked upon the paper, the enlarger head must not be moved until after final checking.

The paper on the baseboard is marked out in bold lines with a central cross in accordance with Fig. 5. A graticule for projecting, made by drawing lines in Indian ink on tracing paper or cloth, is shown in Fig. 6, the outside diameter being slightly less than that of the condenser, while the outer rectangle is equivalent to the negative size. The inner rectangle may be of any convenient and slightly smaller size.

**Aligning the Negative Carrier**

Mount the graticule on top of the negative carrier so that the larger rectangle occupies the aperture for the negative. The carrier is then set in place and the cross lines should coincide with AB and CD on the condenser. Adjustment is made to the carrier or to its positioning stops until this alignment can be obtained. As an alternative the graticule can be used to mark the correct position for the hole on a blank carrier.

**Aligning the Lens**

The lens panel and bellows are assembled next and the lamphouse fitted, after which the lamp is switched on. Focus the lens until a clear image of the graticule is projected on to the baseboard target. If the lens is mounted correctly on centre, the centre of the graticule will coincide with that on the target, while the image of the inner rectangle will also appear. Should the centres fail to coincide, adjust the lens panel until they do. Mark the lines EF and GH on the baseboard paper in line with the projected cross lines. These may be used afterwards to position the paper carrier on the baseboard.

The focusing mechanism for the lens may form part of the lens mount for short focal lengths, or else the lens panel will slide on guides. Operate this mechanism to its limits in both directions, checking at several positions whether the graticule centre is still in alignment with the target centre. If not, mark the positions of the former on the target and number each one for identification. The projected lines will become increasingly out of focus during this operation, but their positions will still be discernible.

If the graticule centre has coincided with the target centre throughout the movement, then the optical system is accurate. A regular displacement in one direction indicates that the lens panel is being moved sideways or being tilted during the movement. An

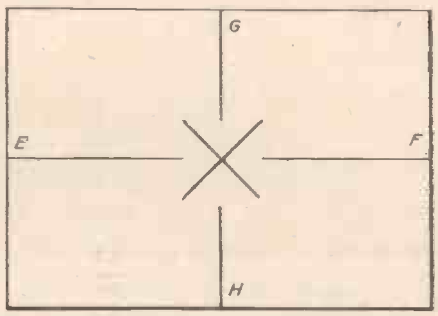



*Fig. 5.—How the paper on the baseboard is marked out.*

irregular displacement may indicate slackness of moving parts, bent guides, or insufficient rigidity. To investigate mathematically the results of such an error would be difficult, but from experience it appears that a total displacement of ⅛in. from the centre would have no noticeable effect upon the finished enlargement.

The reason why the lens focusing alone has been used is that it is the most important movement, and alteration of the head position to give sharp focus during the check would introduce any errors that may be present in the latter action and thereby give incorrect results.

**Checking the Head Movement**

Remove the lamphouse and use the level on the condenser as previously described while the head is raised and lowered throughout its range. If the readings are within ±½ deg. the action may be considered to be satisfactory. Variable readings indicate a column that is bent or lacking in rigidity. There is no cure for these defects other than to replace it with a straighter or stiffer column.

It is worth noting that if the lamphouse is replaced and the graticule projected and refocused, its centre need no longer coincide with the target centre. Inaccuracies in mounting the head and column may cause a displacement in any direction, but provided that the condenser remains level it is not a serious fault. The device for locating and holding the bromide paper to the baseboard may have to be repositioned for each degree of enlargement, but the accuracy of the projected imagine will not be affected.

It is, of course, desirable for convenience that the two points coincide throughout the head range, and if they do so then the constructor can congratulate himself upon a good piece of workmanship.

If displacement errors are present in the focusing mechanism it may be possible to determine whether they are due to sideways movement of the lens panel or angular tilt of the lens by observation of the projected image. Move the head to its top limiting position and focus the graticule on to the baseboard so that the maximum size of enlargement is produced. Operate the focusing mechanism slowly while observing the image. If one outer line of the rectangle becomes out of focus before the one on the opposite side, then the centre line of the lens is at an angle to the true centre of the system. When both lines come into and lose focus simultaneously, then any error is due to sideways displacement. Unless the angular error is fairly large, the difference in focus is not easily discernible, but in that case the effect upon the enlargement will be slight.

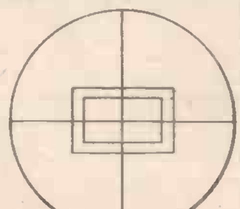


*Fig. 6.—The graticule for projecting.*


**Railways to Adopt 25,000 volts, 50 cycle A.C. System**

RAILWAY electrification in Britain will be carried out more cheaply, more simply and probably more quickly, as a result of the decision, subject to the approval of the Minister of Transport, to adopt as standard a system embodying the latest technical progress, which takes current direct from the national grid.

This system employs 25,000 volts, 50-cycles alternating current, with overhead wire conduction. The 50-cycle system has already proved successful on sections of the French Railways, and on a British Railways experimental installation introduced in 1952 between Lancaster, Morecambe and Heysham.

**New Material**

A U.S. firm, the Poughkeepsie Finishing Co., Paterson, New Jersey, has developed a method of making rayon fabrics longer-wearing by coating both sides with a thin layer of latex. Colour is not affected and the main use will be for heavy furnishing and car upholstery.

**New Film Technique**

THE Dynamic Frame has been designed to overcome the major drawback of modern wide screen systems: that of composing every shot, irrespective of its subject matter, within a vast but rigid format. In this new process the setting, action and mood of each scene determine its space requirements, and the appropriate horizontal or vertical format can be varied imperceptibly or suddenly, as required. The picture expands or contracts to hide, reveal or emphasise a particular moment, and finally, the position of the image on the screen shifts occasionally to follow an action.

**Wall to Protect Shipping**

AN open-work wall, 123 yd. long and 22 yd. high has just been built in the port of Marseilles to protect shipping from the Mistral wind that comes down the Rhone Valley and blows off the land.

The open-work wall, which it is claimed is a better protection than a full wall, is made of steel plates set horizontally, separated by a space of just over 4 in. This wall can reduce the speed of a wind blowing at 75 miles an hour to 17 miles an hour.

**Rubber Water Tanks**

THESE giant rubber tanks were made to fill an urgent need by the army authorities in Cyprus for a water container that would stand on sloping ground; they hold 5,000 gallons each but will fold up into a small parcel.

# A MODEL AIRSHIP

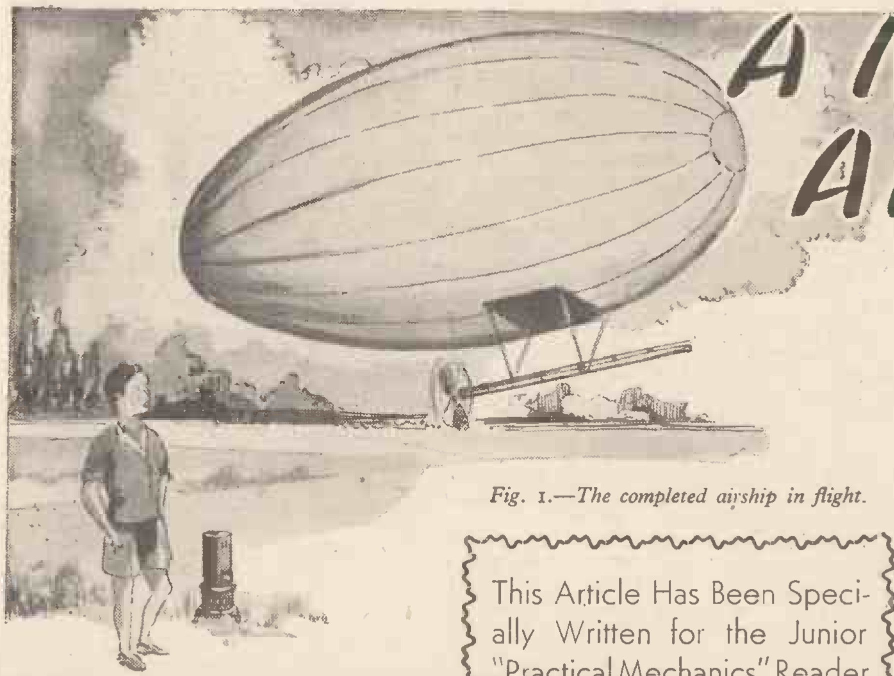


*Fig. 1.—The completed airship in flight.*

This Article Has Been Specially Written for the Junior "Practical Mechanics" Reader

THIS airship is made of tissue paper and is inflated by hot air from an ordinary oil stove. The fuselage and propeller are hooked on to the balloon when inflation is completed (see Fig. 1). When inflated, the airship will make flights of about one minute or more in duration, usually longer than the propeller runs for. The duration of flight can be greatly prolonged by using a small pad of cotton wool soaked with methylated spirits and ignited to keep the air hot inside the envelope, but as there is some risk of setting fire to the envelope it is not advisable to do this. Out of doors the airship will rise to a great height and will probably blow away beyond recovery if provided with a methylated spirits flame. The danger, of course, is that it may start a fire when it lands.

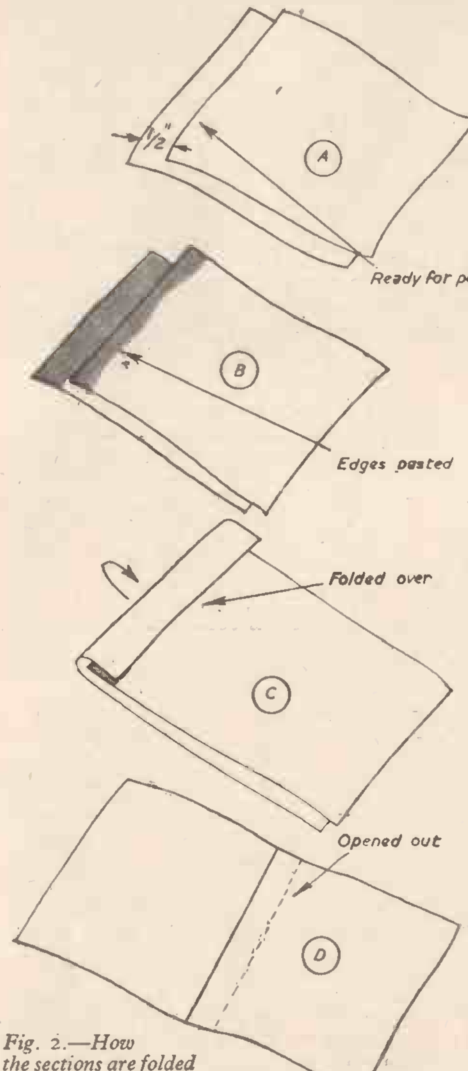



*Fig. 2.—How the sections are folded and joined together.*

### The Envelope

To make the envelope, nearly a quire of tissue paper is required. The usual size for sheets of this paper appears to be 20in. by 30in. It should be as tough and strong as possible, but as the weight is very important, it should not weigh more than 5oz. for the quire (i.e., 24 sheets). Do not use the very soft fluffy sort of tissue paper, as this has very little strength; the right paper should make a crisp noise when crumpled up in the hand, and should be as free from porosity as possible, though probably such thin paper is bound to be porous to some extent.

Take 18 sheets of the paper and cut them in half lengthways, making 36 pieces each 30in. by 10in. Paste these together in threes so as to make 12 pieces, each 90in. by 10in., and allow the paste to dry before proceeding.

### Joining the Sections of the Envelope

Ordinary flour paste of rather thin consistency, brought to the boil and allowed to get cold before use, is quite suitable for the purpose. The two pieces to be joined should be laid on top of each other, the lower one protruding ½in., as shown at A in Fig. 2. Smear a little paste along the edges of both pieces (B) and fold the underneath one back over the top one, as shown at C. Press down lightly with a pad of rag and open out flat before hanging up to dry.

When the 12 long pieces are dry (they will surely tear if not dry), crease one along its length to mark the centre line, then mark out the shape as shown in Fig. 3. The final shape of the airship depends upon the shape of these pieces, so draw the curves in exactly. Sighting along the end of the paper with one eye closed will foreshorten the curve and so help to show up irregularities. When you have the shape drawn to your satisfaction, lay the sheet on top of the other 11, keep them all together by laying weights on them and cut out all the 12 at once.

Now paste these together in twos along the edges, as shown in Fig. 2, and hang each pair up to dry. These pairs require to be hung up very carefully, for they will no longer lie flat when opened out. They will dry very well if hung concave side down over two chair backs about 2ft. apart. When the paste is dry, fold the double strips flat again as they were before being pasted, bring two of the double strips together, and join them as already shown, and open out to dry. You will now have three sections of the envelope, each consisting of four strips, which, when opened out, have a shape something similar to the shell of a boat.

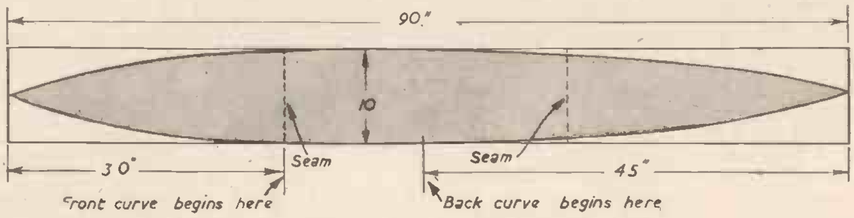



*Fig. 3.—How each section is shaped to form the envelope.*

When these three sections are dry, fold them up flat again, and join the first to the second and the second to the third, just as before, and allow these two seams to dry. The envelope is then practically complete except for the last seam, but do not attempt to open it out just yet.

### The Disc for the Nose

For the last seam, draw the edges together, keeping them flat on the table, and paste and fold over as before. Start from the tail end and leave about 2ft. of seam unjoined near the nose end, but join about 6in. of the seam right up to the nose. When this last seam is dry enough, open out the envelope as far as possible and paste a disc of tissue paper over the front end. This disc will probably require to be about 8in. in diameter to close the opening.

The best way of fixing the disc is to hold a dinner plate bottom upwards, inside the envelope (through the 2ft. of open seam), and get an assistant to apply the disc and press it down smoothly against the plate.

The tail does not require a disc, the pointed ends of the strips are simply gathered together and bound with sewing cotton.

Adhere to the dimensions closely, for if you try to make the envelope more slender in shape you will probably upset the stability; or if you think it looks too big for convenience

*(Continued on page 479)*

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*(Continued on next page)*

do not attempt to make it smaller, or it may not have enough lifting power.

### The Wire Frame

Do not be discouraged if the envelope does not appear to be of a good shape, as it is impossible to judge the shape until it is inflated.

Cut a square hole just behind the front transverse seam and fix in the wire frame shown in Fig. 4. This is made of thin piano wire about No. 23 gauge. It is fixed by simply lapping the envelope over the wire and pasting down. The 2ft. of open seam can then be pasted up in the manner already described, and the envelope is finished. Its weight should at this stage be 3½oz.

The square opening is, of course, at the bottom of the envelope; on the top fix two single loops of darning wool by stitching the wool once in and out again through the double thickness of the transverse pasted seams, one loop at the front seam and one at the rear seam. These loops are for hanging the envelope up while it is being inflated.

### The Propelling Mechanism

The propeller and motor are illustrated in Fig. 5 and, as already mentioned, form a separate unit specially designed with a view to extreme lightness. The whole unit, including the suspension wires, will weigh about ¾oz. The fuselage is made from two strips of birch wood, ¼in. by 1/16in. by 2ft. long. These are spaced apart by small pieces of cork at intervals of about 3in., glued and bound with sewing thread; the corks are ⅛in. thick at each end, increasing in thickness towards the centre, where the two strips of wood should be about ½in. apart.

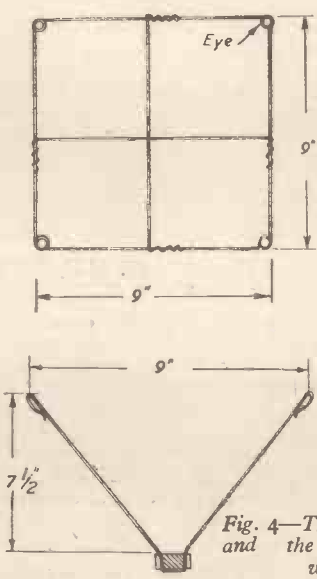



*Fig. 4—The wire frame and the supporting wires.*

The bearing for the propeller shaft is brass, about ½in. by 1/32in., the propeller shaft being a piece of No. 23 gauge piano wire; the hook for the front end of the elastic is also made of the same wire. The propeller is a composite affair with a small cork for the boss, a strip of wood 4in. by ¼in. by 1/16in. for the arms, and blades of thin cardboard, the whole being 10in. diameter. Two good feathers stuck into the cork boss and trimmed to shape would probably make a good light propeller. Two small glass beads form the thrust bearing. Two strands of 3/16in. strip elastic should be used; this will turn the propeller comparatively slowly, but will provide enough thrust to keep the airship in motion.

The supporting wires are made of the same wire as was used to frame the opening in the envelope; fix the wires between a cork and the wood. The hooks should be rather long, as shown, as they are easy to fix and do not jump out of their eyes as short, open hooks would do. The diagonal stays are of sewing cotton, the two rear wire stays having an eye near the top to prevent the cotton from sliding down the wire.

### Inflating the Airship

The best method of inflating the envelope is by means of an oil stove. The stove used by the author was a large size "Valor," the cylindrical body of this being 7¾in. diameter. Remove the top plate and cover up the ornamental holes in the top end of the cylindrical body by wrapping a piece of tinplate (or any thin sheet metal) into a cylindrical form and slipping it inside the body of the stove. Four "ears" about ½in. wide should be made by snipping the tinplate with shears and by bending these ears outwards over the edge of the stove body the tinplate will be held in position. The gaps left by the ears will then accommodate the cross-wires in the envelope opening and allow the tinplate to protrude a little into the envelope.

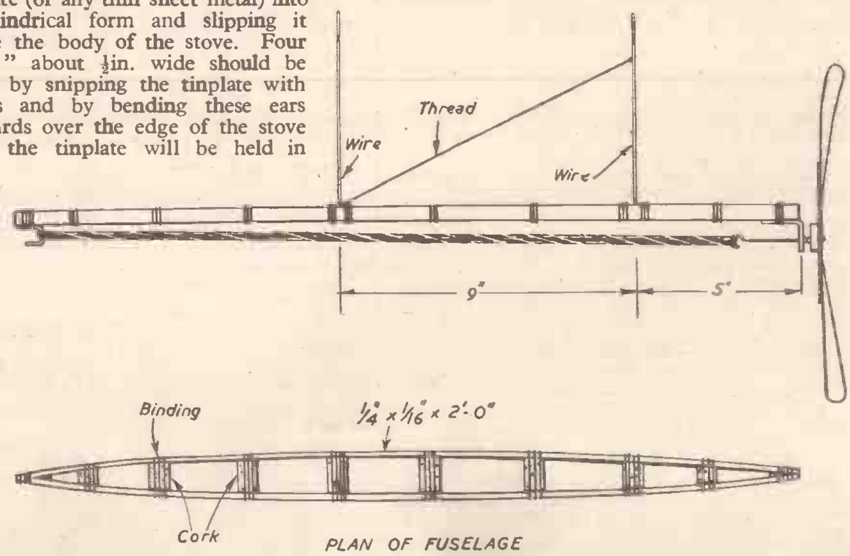



*Fig. 5.—Details of the fuselage and propelling mechanism.*

With the wick turned right up the envelope becomes fully inflated in less than one minute, but it is advisable to keep it going longer as the air inside then gets hotter and gives more lift and a longer duration of flight. When properly heated it will easily rise to 50ft. or more with the propeller and motor attached.

### How to Fly the Airship

The best place to fly the airship is a lofty hall, but not everybody is fortunate enough to obtain access to such a place. If released in an ordinary large room it rises to the ceiling and stays there, because the propeller has not enough thrust to overcome the friction and by the time the air has cooled enough to let the airship fall again the propeller has probably come to a standstill; but by inflating it just enough to support its own weight it is possible to get it to fly the length of the room.

Out-of-doors flights may be made when the air is quite still. The best time of the day to fly a model airship is usually just before sunrise—the air is frequently very still then, but directly the sun shows itself little puffs of wind spring up, which will probably cause some exciting moments.

### Captive Flights

Captive flights may be made with the airship on the end of a thread, but this is not usually very successful for directly any pull comes on the thread the whole thing tilts, spills out the hot air and falls quickly. If you try it, fix about 1ft. of the thin piano wire on to the fuselage, projecting vertically downwards, and tie the thread to the wire, this prevents the thread and the elastic from becoming inextricably mixed.

## What Is Instinct?

It has been found by experimenters that it is impossible to train insects. They have wonderful habits, they can milk others as we do cows, they can provide their eggs with food by paralysing other beetles so that these poor things live just long enough to be fresh when eaten, but all this, we hear, is instinct. The argument is that the wasp or fly, shall we say, cannot be taught new habits, but I think that that is not fair. How do we know how long a period of education is required? Human beings took millions of years to arrange the habit of breathing, and I do not think that an impressed habit is a very fair method of judging the sense of anything which lives.

The experiment has often been made of teaching fish to read or even to answer the telephone. The Chinese used to train carp to ring a bell when they needed food, and if little bags of fish food, marked A and B, are hung in a tank it is found that if A contains the food the fish still go to A at first, *after* the food has been put in B.

Fishermen know how sensitive is their prey. Fish can see round corners by using the refractive index of water and, although they do not have any ordinary hearing apparatus, they sense vibration on their skins very readily.

There is another famous experiment in which dogs were trained always to answer a bell, which they soon learned meant food was ready. When one day their kennels were dangerously flooded and an alarm bell rang to call the staff, it was weeks before the dogs would respond to the food bell; they interpreted the ringing as indicative of drowning.

Monkeys have been taught to press a button for food, and if two bells of different tone are provided it only takes the monkey about a week to find which note means food.

These performing horses which apparently add and subtract, giving the answer by tapping with their hoof upon the ground, are nearly always taught to watch some movements by the human exhibitor.

If you have patience, you can make use of the fact that many animals hear notes far above our own frequency range. If you conceal a piece of quill pen, sharpened to a point, in your hand and scratch the tip with your finger an exceedingly high squeak is produced. It is so high that it is quite inaudible to you as a note and inaudible as a sound a few feet away; but a dog can hear it. If you teach him that two squeaks mean "bark," one squeak "sit down," and a series of squeaks "sit up and beg" you can do some baffling tricks. A.M.L.

# A Wheatstone Bridge

## Constructional Details of an Instrument for Finding the Resistance of a Piece of Wire or a Circuit

THIS instrument is, to the electrician, as important as the balance to the chemist, and, therefore, very useful to have.

It consists of a 12in. × 8in. board of very dry oak or of ebonite, with nine brass terminals mounted upon it in the positions shown in Fig. 1. At the points marked 20, 40, 60 and 80 brass pins are driven into the base 1.2 in. apart. At a distance of 7in. from this row of pins is a row of five more (points marked 10, 30, 50, 70 and 90) the same distance apart and arranged alternately with the top row as shown.

The zigzag line is a length of bare Eureka resistance wire of 22 gauge. Fasten one end under terminal R, and stretch it lightly in a zigzag manner round the brass pins as shown, finishing off under terminal $X^1$.

Rule eleven horizontal lines across the board, as shown, 0.7in. apart, and number the intersections of these lines with the resistance wire.

### Board Connections

The dotted lines represent connections made at the back of the board with thick copper wire. Be careful to join up the correct terminals R to B; $B^1$ to $X^1$; $R^1$ to X; $G^1$ to Z; G to the middle of the $R^1X$ wire. Solder all connections if possible, but remember that a good screwed-up connection is better than a badly soldered one. A battery is joined up between B and $B^1$, and the galvanometer between G and $G^1$.

The instrument is used commonly to find the resistance of a wire or a given circuit.

Suppose we want to find the resistance of a certain piece of wire. Connect it up between X and $X^1$, and between R and $R^1$ connect up a standard resistance coil, say 5 ohms.

To the terminal Z is connected a length of flexible wire, with a short tag of stiff copper wire soldered to the end of it. When everything is connected up, touch the zigzag wire with this flexible lead. The galvanometer needle should move violently. Try different spots on the zigzag wire until eventually one is found where the galvanometer needle is unaffected.

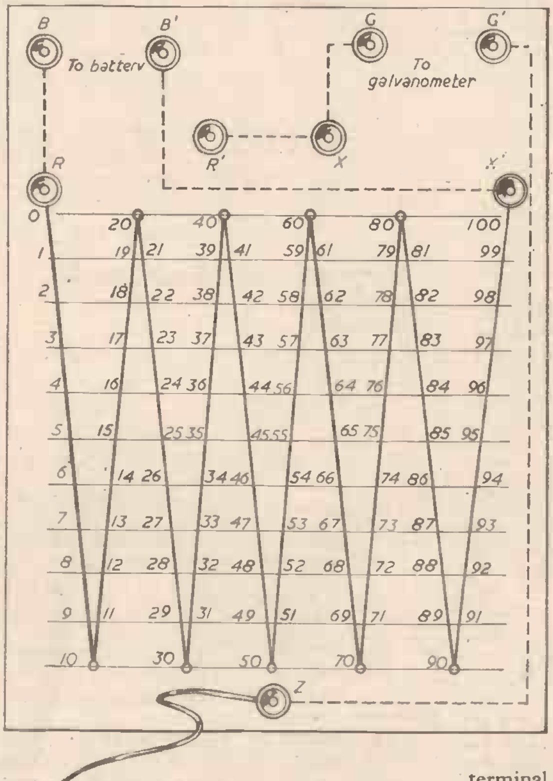



*Fig. 1.—The lay-out of the Wheatstone bridge.*

### The Formula

Note the number of this spot by means of the parallel lines and figures. Suppose the spot is 25. By using the following formula you can find the resistance of the wire.

$$\frac{100-N}{N} \times R = x$$

Where N = the number on the board,

R = the standard resistance,

x = the unknown resistance,

then $\frac{100-25}{25} \times 5 = x$

$\frac{75}{25} \times 5 = x$

$x = 15$

thus the resistance of the wire is 15 ohms. If the unknown quantity is suspected of being high resistance, a high standard resistance should be used. It is simple to make a standard resistance, remembering that Eureka 22 gauge is 1 ohm per 33in. For 5 ohms cut off 165in. plus 1in. for connections. Coil this round a small cardboard cylinder leaving 2in. free at either end for connections. When placed in the bridge, ½in. of the wire should go under each terminal leaving the full 165in. of resistance wire to give the correct resistance between the terminals.

# A Miniature Road Crane

## A Simple Toy Made from Odds and Ends

THIS toy can easily be made with odd pieces of wood, a cotton reel, and pieces of wooden knitting needles. For the platform (A, Fig. 1) saw a piece of ⅜in. wood 8in. long by 3½in. wide. Plane it on both sides and around the edges. Cut out four pieces of ⅜in. wood to the sizes given at B, Fig. 2, for the wheel bearings. These are screwed to the platform, as shown in Fig. 1, at a distance of ⅜in. from each end. Now saw two side pieces (C C) to the dimensions given in Fig. 2, and carefully smooth the edges with a chisel. On the centre line of each piece make two holes.

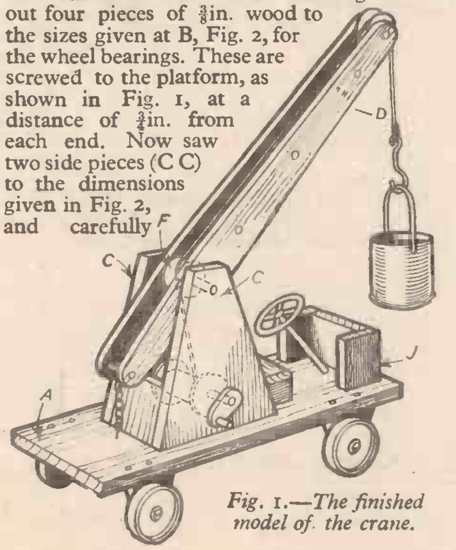



*Fig. 1.—The finished model of the crane.*

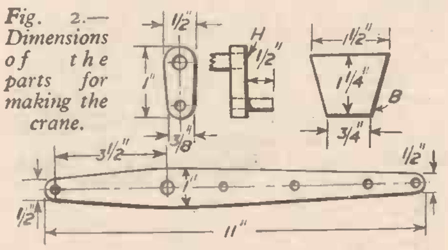
### Making the Jib

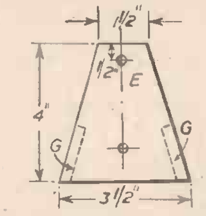
To make the jib (D), cut two pieces of ¼in. wood to the shape shown in Fig. 2, and make the holes in each a tight fit for pieces of knitting needle. Cut five pieces 1in. long, and one piece 2½in. long. Glue the ends of the short pieces in the holes in the sides of the jib after slipping a boxwood pulley between the top ends. The long piece passes through the hole E in each side piece, also through another pulley F, the rod projecting ⅜in. on each side. There should be a space of ½in. between the jib sides for the full length.

### The Winding Drum

This consists of a deep-flanged cotton reel just long enough to fit nicely between the side pieces C C, which are 1⅞in. apart when fixed to the platform. Now get a wooden rod or stout knitting needle to fit the hole in the cotton reel, and cut off a piece 3in. long. Screw one side piece to the platform from underneath, place the jib and winding drum in position, and then screw down the other side piece. To strengthen the sides, screw two pieces of wood (G G) between them at the front and back, and also to the platform. Make the little winding handle (H) out of wood 3/16in. thick, and fix one end on to the winding drum shaft with a small screw, and glue a short piece of round wood in the hole in the other end. The rear end of the jib can be held down by a short piece of chain and a small screw-hook.

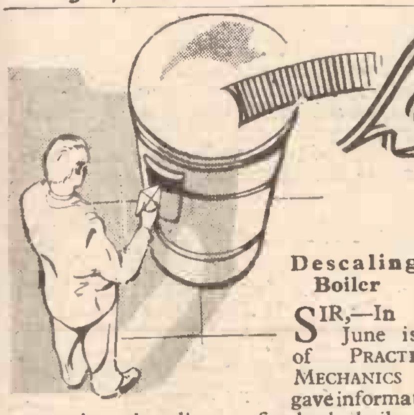
*Fig. 2.—Dimensions of the parts for making the crane.*



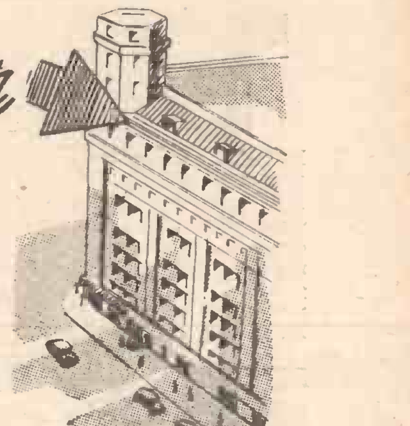




The front part (J) and the driver's seat can be made from pieces of ¼in. wood, and are nailed or screwed in place. The steering wheel is simply an iron toy wheel, about 1¼in. diameter, screwed on to the end of a piece of dowel rod glued into a hole in the platform. The running wheels are wooden ones, 1½in. in diameter, and are fixed to the bearing bracket with round-headed screws and washers.

To complete the crane you will require 5 or 6 yards of thin twine, one end of which must be attached to the winding drum and wound up. The other end is passed over the two pulleys and tied to a wire hook.



# Letters to the Editor



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

### Descaling a Boiler

SIR,—In the June issue of PRACTICAL MECHANICS you gave information concerning descaling a fire-back boiler. I would recommend the following procedure :

Close the main stop valve and put out the fire. Run off the hot water from the taps, remove the top draw-off pipe (or immersion heater, if fitted) and siphon off the remaining hot water from the tank. (The w.c. pedestal is a useful sump.) Disconnect the boiler pipe near the hot water cylinder, connect a piece of hose to the top (return) pipe and another piece of hose to the bottom (flow) pipe leading to the sump. By means of a tyre pump blow out the water from the boiler.

Connect a large funnel to the bottom pipe and a hose to the sump to the top pipe. Use *inhibited* muriatic acid (one part acid—two parts water) and pour the first acid cautiously down the funnel. The attack on the scale releases large volumes of gas, which will tend to blow back the acid up the pipe. Add the remaining acid and leave until no froth issues from the hose on the top pipe. The level of the funnel should be slightly above the level of the hose outlet.

Finally, run water into the funnel until the liquid leaving the hose on the top pipe does *not* turn blue litmus paper red. Reconnect, check all joints (including the inspection hole on the boiler) for leakage, and the system is ready for use.

By this procedure the scale will be removed without damage to the system.

To avoid scale completely a water softener is necessary, but it can be reduced by not "forcing" the boiler, as most scaling takes place when the water is actually or almost boiling in the boiler.—P. P. JENNINGS (Leeds, 7).

SIR,—Your statement to H. Smaller, Grimsby, in "Your Queries Answered" for June that "you must then flush out the system very thoroughly with running water until there is discoloration of blue litmus paper to red" is wrong. Blue litmus turning to red would show acid was still present, probably in a quantity to be still dangerous to health. I would suggest Universal indicator papers, which give a colour range from pH1 to 10, and continue flushing out till the pH was the same as untreated water from the same main supply. The pH value is easily recognised by the series printed inside the covers of the book. These papers are made by Johnsons of Hendon.—G. EDKINS (Surrey).

### Checking Rifle Sights

SIR,—In a recent issue of PRACTICAL MECHANICS a reader wrote asking for information on "sighting" his B.S.A. Cadet Major air rifle ; the answer, as I see it, is this :

As a target use a big black mark or an inverted "T." From a prone position, or padded rest, shoot the usual five shot grouping. If it is shooting low put the rear sight up a notch ; if the group is to the right or left of target move rear sight in the direction you wish the shots to go. As to the front sight, move it exactly opposite.

An article on such guns would be interesting. Also on English watches.—R. T. DAWSON (Washington, U.S.A.).

### Flying Saucers

SIR,—Re your June issue editorial, which deals mainly with landings of flying saucers, many of the flying saucer believers agree with you in your opinion that landings have not been made, but you had not mentioned the reports from sources that are of the greatest value. I refer to the reports from those people who are in charge of and responsible for the defence of their country ; radar experts, who daily are responsible for thousands of sites, and many aircraft, and pilots of great experience, both military and civil. These men are experienced in matters relating to the identity of aerial objects. Civil pilots have great responsibility, and such pilots, many with 14-15 years' flying experience, can instantly recognise any aerial object. From such sources come the best and most genuine reports. An excellent report came from Captain Howerd of his sighting over Canada, which was witnessed by the entire crew and many of the passengers. Another good report came from the War Office and Air Ministry on November 7th, 1954, when radar tracked a U.F.O. over this country. Two excellent books on U.F.O.s give information from the American Air Force Intelligence. The first was by Major Donald Keyhoe, "Flying Saucers From Outer Space," which is full of sightings by the American Air Force, and the second book is by Captain Edward J. Ruppelt, formerly head of the American Air Force organisation set up to investigate the U.F.O.s. This book is an official American Air Force Intelligence report, confirming the existence of the U.F.O.s. From 1947 to 1953 26.94 per cent. of their reports remain unexplained.

He states that in a nation-wide poll only 6 per cent. of U.S.A. citizens did not believe in U.F.O.s. Another statement in the book is that the U.S.A. does not have a secret weapon being reported as a U.F.O. He also states that the Royal Air Force is a firm believer in the U.F.O., and are in close contact with the U.S.A. Air Force, and that the people of the Aeronautical Division of General Mills, Inc., who launch and track the big skyhide balloons, believe in U.F.O.s. He said these scientists and engineers all have seen U.F.O.s and they are not their own balloons. Captain Ruppelt and his men worked 14 hours a day on the investigation. —RONALD W. J. ANSTEE (Bristol, 2).

SIR,—I have read your various comments on Flying Saucers, and must say that I agree with every word. Many of those who believe in them *want* to believe in them. They are mostly youths seeking publicity. They sometimes get it in local papers. For example, I read an interview with one of these "Saucerites" in a provincial rag, from which I learnt that the speaker *knew* the answer to the flying saucer problem, but apparently forgot to tell the reporter, or the reporter forgot to ask, because we are still in the dark in spite of the interview, and in spite of a lecture given by the one interviewed which, the report stated, went on for over two hours! I have just been looking through a copy of a journal which deals with flying saucers. It is a 20-page duplicated journal in which the question is asked : "What has been done in this country in an attempt to reach a satisfactory solution to the F. S. Mystery ? It is a sad tale to have to tell, for whether we like it or not we must admit that very little has been done. There has been no shortage of interesting news ; some of it has been spectacular. But no practical use has been made of it."

I should like to ask the editor of this precious magazine what practical use can be made of myth, hallucinations, auto-suggestions, hoaxes and, in some cases, science fiction and pure humbug ? In any case, as the editor of this journal apparently has the answer, or thinks he has, all he need do is to tell us ! I gather that he interviewed the Air Ministry on the subject with somewhat negative results. Personally, I would prefer to rely upon the statements of the Astronomer Royal, than upon the beliefs, conjectures and vainglorious boasting of enthusiastic youths. Like you, I preserve an open mind on the subject of flying saucers, but nothing I have seen or read convinces me that any strange object seen in the sky has come from another planet. Science fiction writers, of course, have not been slow to cash in on the new craze. Some, indeed, like to read their books as though they were expressions of fact. Lord Dowding believes in fairies. I do not. If you believe in fairies you will, of course, believe in flying saucers from another planet. From that point you will say that their mission is peaceful, though what that peaceful mission is no one has yet stated, nor has anyone explained how they propose to get over the language difficulty.

It is a pity that these "Saucerites" are all such poor photographers, for all of the pictures I have seen have been out of focus, and most of them showing only an incomplete image. The photograph in Adamski's book, for example, can hardly be considered as convincing.—E. N. (Sheffield).

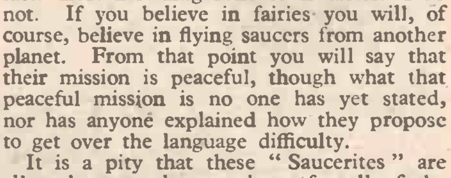
[*We have received a large amount of correspondence on the subject of our flying saucer comments. A high percentage of our correspondence agree with us. We have not, however, amongst the dissenters received one from any scientist or person of standing whose views would be acceptable. Our challenge to Lord Dowding and to Adamski still stands.*—ED.]

### Photoflood Control Unit

SIR,—*Re* PRACTICAL MECHANICS, May, 1956, the article on "Photoflood Control Unit."

As wired up it is possible for either unit to be switched "off" and thus to lose the advantage of the dimming principle.

The alternative circuit shown below gives




*Mr. W. R. Rodgers' alternative circuit.*

dimming protection to *three* circuits with double-pole on-off switch, and at no time is there any open circuit.—W. R. RODGERS (London, S.W.17).

# Trade Notes

### Rota-Trig Chart

FROM the firm of Rota-Trig, 31, The Broadway, Tolworth, Surbiton, Surrey, we have received an ingenious and useful cardboard calculator which shows at a glance the correct trigonometrical formula to use in given circumstances. This should be very useful to the workman who uses trigonometry only occasionally and who no longer remembers the correct formulæ. For any further details write to the above address.

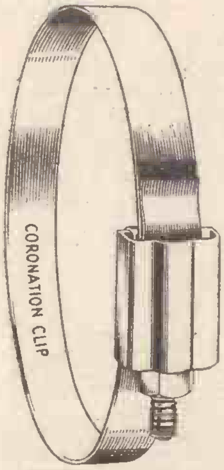
The Rota-Trig calculator.

### Electronic Timer Kit

PRIMARILY designed to give controlled exposure of a photographic enlarger or contact printer from 1 to 60 secs., this electronic timer illuminates the enlarger lamp when switched on and then switches it off again at a pre-determined time, set by the dial pointer. A separate on-off switch is also fitted. All the materials and components required are included in the kit together with full instructions for building. The instrument operates from A.C. mains 200-250 volts, 40-60 cycles, but is also adaptable for use on D.C. mains. A component replacement service is in operation. The complete kit, including constructional details, costs £3, packing and postage 2s. 6d., from G. R. Products, 22, Runnymead Avenue, Bristol, 4.

### New Hose Clip

THE Coronation universal hose clip, shown in the sketch, is made by F. H. Bourner and Co. (Engineers) Ltd., Manor Royal, Crawley, Sussex, and consists basically of a length of strip and a housing incorporating a unique tightening mechanism. A clip of any required diameter may be obtained and fitted in a few seconds. All inquiries should be sent to the above address.




*Coronation universal hose clip.*

### Bassett-Lowke Catalogue

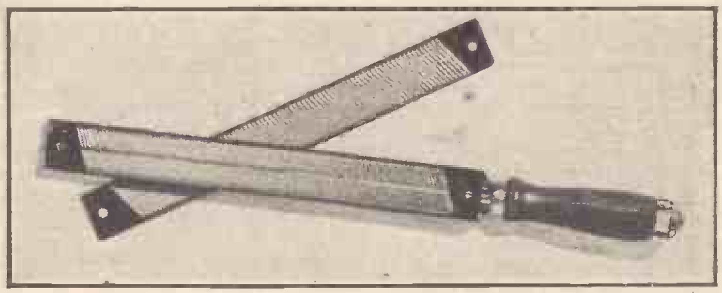
THE latest edition of the "Model Shipping and Engineering Catalogue" is now on sale and costs 2s. 6d. Many new items have been added to the standard range of boiler fittings and castings for locomotives, marine and stationary engines, ship fittings, ship's machinery and model building accessories. The address of Bassett-Lowke, Ltd., is 18-25, Kingswell Street, Northampton.

### Hand-operated Rotary Tube Pump

MANUFACTURED by Patay Bros., 137, Chapmanslade, Westbury, Wilts, this pump is available with 1in. to 1½in. inlet and outlet bore diameters. It employs a new type of impeller with no blades and a self-priming device working on a new principle. Its capacity is up to 3,600 galls. per hour, suction lift up to 30ft. and total head up to 36ft. The total weight is 27lb. and it incorporates all the advantages of a centrifugal pump. Details are available from the makers at the above address.

### The Tresa File

ORIGINALLY a Swiss invention, this new tool incorporates interchangeable blades. The makers claim that it is not so subject to breakage by dropping and that it is the only file which can be used satisfactorily on wood, plastics, cork, rubber, brake-linings and similar soft materials as well as on iron and steel. It is marketed in three models, i.e., Standard and Narrow, which retail complete with one double-sided blade at 12s. 6d. each (spare blades of either grade at 4s.) and Long, complete with one blade at 15s. (spare blades of either grade at 5s. each). Main distributors are Messrs. Thomas Chatwin & Co., Victoria Works, Great Tindal Street, Birmingham, 16, and Messrs. Mawhood Bros., Ltd., Prometheus Works, Corporation Street, Sheffield, 3.



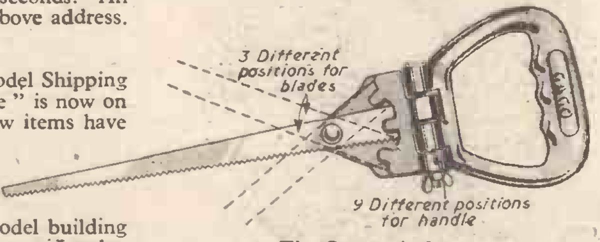
*The Tresa file and spare blade.*

### New Dormer Price Lists

WE have received from the Sheffield Twist Drill and Steel Company Limited, copies of their latest Home Trade price lists for Dormer drills, reamers and milling cutters. These lists relate to Catalogue No. 11 and cancel all previous issues. The comprehensive index gives both price list and catalogue page numbers. Send inquiries to the above firm at Summerfield Street, Sheffield, 11.

### The Cago Swivelsaw

A UNIVERSAL saw for cutting metal, wood, asbestos and fibre boards, utilising interchangeable blades and specially designed for use in awkward places, is being marketed under the trade name "Cago." The blade may be fixed in any of nine angles to the handle in the horizontal plane and in three positions in the vertical plane, giving a total of 27 different positions. Price of the saw, with one wood-cutting blade, is 17s. 9d. and spare blades cost 2s. 9d. each. There are four types of blade available.




*The Cago swivelsaw.*

### The "Rack-a-Tier" Truck

(Patents Pending)

THE "Rack-a-Tier" was originally designed by Messrs. Wicksteeds, Meridian Works, Barkway Road, Royston, Herts, for use in their own works to assist machine operators on repetition work.

It will be seen from the illustration that this piece of equipment has a vast range of applications, particularly where it is desirable for the trays to remain in the horizontal position. The balance being adjustable so that the attendant takes none of the weight make it eminently suitable for use by women. By this "balanced weight" principle, loads well in excess of two cwt. are easily manageable.

It has been found that machine operators greatly appreciate the "Rack-a-Tier" and in the assembly shop, too, these trucks are useful.

Mechanics engaged on such jobs as motor and aircraft maintenance will find the "Rack-a-Tier" of invaluable assistance, and banks of them are ideal as convenient and compact storage. When in the vertical position, they will fit tight up to a wall, the trays being removable from either side. The wheels are quickly detachable, avoiding the necessity of having wheels for every frame. For transport and easy storage, the whole truck may be folded up flat.

*The Rack-a-Tier truck.*

# Your Queries Answered

### 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.

## *Casting Mixtures*

**I AM interested in casting plaster ornaments, etc., and I wish to obtain a mixture that will be : Stronger than plaster of paris ; will set in approx. $\frac{1}{2}$-1 hr. ; that is resistant to heat ; and inexpensive.**

**I understand that cement depends for its strength mainly on the sand with which it is mixed. Would it be possible, in order to achieve a smoother finish, to replace the sand with prepared chalk, hydrated lime or builders' finishing plaster ?—G. E. Cowell (Isle of Man).**

WE are afraid that you will not find a casting mixture which will fulfil all your requirements. Plasters of any kind are not resistant to heat. Cement itself is not really heat-resistant. Hence, you will, we think, have to modify this requirement. Furthermore, the best cements and plasters are not quick-setting. Usually, with these ordinary plasters, if the plaster is quick-setting it is quick-breaking.

Again, cement does not depend for its strength on its sand content. The strength of cement is, first of all, in the actual cement material used, and, secondly, in the compacted interlocking of the inert particles which are coated with cement and which form the "aggregate" of the mass.

In a cement mix the sand can be replaced with chalk or whiting (giving a very smooth mixture), but not with lime or builders' plaster or with anything containing a strong alkali.

You can make plaster of paris stronger by slaking it with glue water, although this will much delay its setting. For your purpose, we would suggest a mixture of equal parts of Portland cement and whiting. This can be slaked with plain water or with water containing 5 per cent. of glue or gelatine. It will set (slowly) to a hard, dense mass. The material is cheap, but it is *not* heat-resisting.

If heat-resisting properties are essential, you will require a magnesite mixture. This is made by mixing 2 parts of calcined magnesite and 1 part of fine sand, China clay or similar filler. This is slaked with a solution made by dissolving 40 parts of magnesium chloride in 60 parts of water. The mixture sets slowly, but since it expands very slightly on setting, it is productive of very sharp casts. It is the most heat-resisting of all these cement and plaster mixtures. It is white in colour and very dense in texture, although fairly light in weight.

## *White Undercoat Paint*

**PLEASE give me a formula for a white non-poisonous or leadless white undercoating paint.—A. Wilson (Plymouth).**

THE following non-poisonous, non-yellowing white paint formula will suit your purpose excellently. On a rough surface it will dry "flat," but on a smooth surface it will dry with a very slight sheen. The sheen can be almost completely eliminated by diluting the paint a little with more white spirit. The paint is of good quality, and it can be used both as an undercoat and as a surface finish paint.

| | |
|---|---|
| Linseed oil (raw) | 320 grams. |
| White Spirit ... ... | 60 ,, |
| Drier ... ... | 15 ,, approx. |
| Titanium oxide ... | 500 ,, |

If the paint is required purely as an undercoating, the white titanium oxide can be diluted by one-third of its bulk of a cheaper white pigment, such as blanche fixe (barium sulphate).

Two grades of titanium oxide are available, viz., the "Anatase" type and the "Rutile" type. The latter is very slightly cream in hue, but it is well-suited for out-of-doors use. The "Anatase" type is rather whiter, but it is better suited for indoor use only, since outside it tends to chalk badly. Both these pigments have excellent covering powers. They are absolutely non-poisonous and they do not yellow with age.

Titanium oxide is manufactured by British Titan Products Co., Ltd., Billingham, Co. Durham.

If you want to make your own drying compound, gently melt together 10 parts of lead naphthenate and 90 parts of cobalt naphthenate (both parts by weight). Then dissolve 10 parts of the resulting mixture in 90 parts of warm white spirit or paraffin. The resulting "mixed driers" made in this way can be used very satisfactorily in the above formula.

A drier of one sort or another *must* be mixed with an oil paint (but not with a cellulose paint) for, without it, the paint would never dry satisfactorily.



## *Dyeing a Dartboard*

**PLEASE inform me of a good dye for dartboards, both of the paper coil and the wooden variety. I find that the dyes I obtain from local chemists rub off when mixed strong enough to give a good colour. Black, red, green and yellow are the main colours I wish to use.—F. Willott (Burton-on-Trent).**

TO get good and satisfactory results the materials of a dartboard must be dyed properly, previous to being made up in the form of the dartboard. It is quite useless to paint the dye solutions over the finished board, because if you make any such attempt the dyes will run badly.

The wood, card or paper of the dartboard should first of all be soaked overnight in a cold solution of five parts of tannic acid in 95 parts of water. They should next be allowed to drain, and then dyed in a solution made by dissolving six pints of the dye in 94 parts of water. The materials must be entered into the cold-dye bath, which later is then raised slowly to near boiling point, retained at that temperature for about 15 minutes, after which the materials can be removed, rinsed in water and then allowed to dry.

Generally speaking, dyes of the "basic" class are the most suitable for this use—dyes such as brilliant green, magenta, methyl violet, naphthol black, nigrosine (water soluble), fast acid scarlet, brilliant yellow, orange II, etc.—and these are usually only obtainable from laboratory supplying firms, such as Messrs. Philip Harris and Co., Ltd., Birmingham, or Messrs. Griffen and Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2. Some of the "home" dyes obtainable locally may be of use for this purpose, but most of them will be found to be unsatisfactory.

The above type of dyeing is not easy. One thing is certain, you cannot possibly "dye" a dartboard in different colours merely by brushing the dye solution over it as, apparently, you have been trying to do.

## *Staining Ivory*

**IS there any method by which ivory can be stained red or green which does not involve boiling the ivory in the dye ?—H. Villiers (Brighton.)**

GENERALLY speaking, ivory dyes well. Make up a solution containing 10 parts of a water-soluble dye, six parts of Glauber's salt, 84 parts of water. Place the ivory in the cold solution, then gradually warm the solution to about 60 deg. C. (140 deg. F.). Retain it at that temperature for about 15 minutes. Allow it to cool, then withdraw the ivory and rinse it well in cold water. This process will not harm the ivory.

If you wish to dye it entirely in the cold, use a spirit-soluble dye, dissolving in methylated spirit—about 10 parts of dye in 90 parts of spirit. Usually, the water dye is more satisfactory than the spirit dye.

### Chinese Concentric Balls

**BY what technique are those Chinese concentric balls of ivory carved ?—R. J. Barron (Coventry).**

GENUINE examples of Chinese concentric balls are actually carved out of a solid ivory block. Various curved cutting tools are used for the purpose. At first the aim is to cut out from within the block the largest of the balls. This having been effected, the next sphere is cut off and detached from within that sphere, and so the process goes on slowly until the smallest (inner) sphere has been cut out. The process is an exceedingly slow one, taking years of spare-time work, but methods of softening the ivory (by treatment, for instance, with phosphoric acid) have been worked out, thus, presumably, speeding up the task. In some of the commercial articles of this type, examination may show that the concentric balls have been formed separately and then assembled together through the ivory sides being softened and then cut away, previous to being carefully replaced, but the "real thing" is carved laboriously out of one block of material.

### Aging Gold Plating

**I HAVE had some antique ormolu articles gold plated. How can I reduce the excessively bright gilt effect of the plating so as to give it a duller, slightly tarnished appearance ?—A. Gilston (Leeds).**

METALLIC gold is unattacked by most substances; this, of course, constituting one of its most valuable properties. It is, however, acted on in some degree by, among other things, alkaline sulphides. We suggest, therefore, that you obtain from a photographic chemist ½oz. of sodium sulphide. Dissolve half of this in an eggcupful of water, and paint it cautiously on to the gold surface. It will dull the gold in consequence of the formation of gold sulphide.

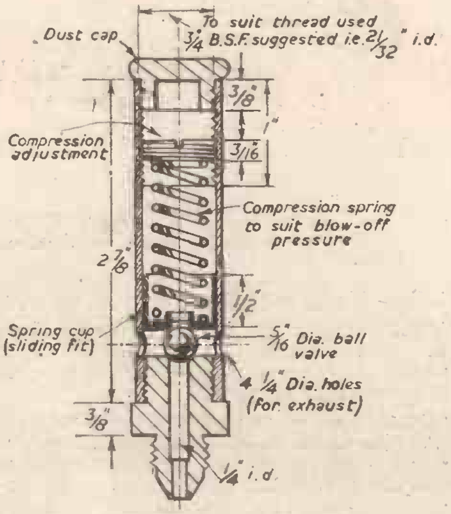
We advise a very cautious application of the sodium sulphide, because if you apply too much the gold may turn black. A weak solution is suggested, followed by solutions of greater strength if necessary.

An alternative method is to mix equal quantities of flowers of sulphur and slaked lime, to boil these with water in a pan for about 15 minutes, and then to filter off the resulting yellow solution. This being an alkaline, polysulphide might, we think, be effective in dulling the gold plate. If these methods do not succeed, your safest alternative will be to go over the gold with one of the many tinted spirit varnishes which are now available, although it seems rather a pity to cover up the surface of real gold with an inferior product.

### Air Compressor Safety Valve

**I HAVE constructed an air compressor unit from an ex-Lightfoot twin cylinder V.T.2, and would like some dimensions for a safety valve to open at, say, 40-60 P.S.I. Also for an air filter to eliminate any oil that may be present when spraying.—A. Tasner (Romford).**

YOU can construct the safety valve you require from the sketch above. These




*Details of an air compressor safety valve.*

valves are, however, quite inexpensive to purchase, and as such, it is recommended that you adopt this course of action. Firms to contact are: Aeraspray Manufacturing Co., Ltd., 179-213, Thimble Mill Lane, Birmingham, 7; The Aerograph Co., Ltd., Lower Sydenham, London, S.E.26; Aerostyle, Ltd., 170-176, St. John's Street, Clerkenwell, E.C.1; Benton and Stone, Ltd., Astonbrook Road, Birmingham, 6.

The fitting of a home-constructed air filter to eliminate moisture and impurities from an air supply for paint spraying is not recommended. We suggest you purchase a properly designed and constructed unit from either one of the aforementioned concerns, or from C. A. Norgren, Ltd., Shipston-on-Stour, Warwickshire.

### Matt Black Finish on Steel

**I HAVE a large quantity of small pressed steel parts on which I wish to obtain a matt jet black finish by means of chemicals. Can you help me? —L. Carter (Romford).**

THE best method of effecting your task would be to copperplate the steel parts lightly in a copper sulphate bath, then to immerse them for a minute or two in a bath made by dissolving one part sodium sulphide in 10 parts water. This would give a lasting black on the parts due to the formation of black copper sulphide. If the parts are large in number, they would require "barrel plating," which is a system of plating the parts in a rotating drum, so that all areas of the parts are equally plated. This would have to be done by an outside firm of platers, but it should not be an expensive job.

Direct processes of blackening steel are not easy and are apt to be unreliable. We quote two of them below:

(a)—Heat one part of sulphur with 10 parts of turpentine for about half an hour or more. Spread the resulting oil lightly with a brush over the parts, then spread the parts on a clean shovel and heat them over a coke or other glowing fire until the black patina develops. This gives a fairly good black, which deepens in intensity after the parts have been rubbed up with an oily cloth.

(b)—Use the following formula:

| | |
|---|---|
| Nitric acid ... | 15 parts (by weight) |
| Copper sulphate ... | 8 ,, |
| Methylated spirit ... | 20 ,, |
| Water ... ... | 100 ,, |

Dissolve the copper sulphate in the water first, then add the nitric acid, and, finally, the methylated spirit. Immerse the degreased parts in this solution and then allow them to dry. The method is not reliable, but works well with certain types of low-carbon steel.

# Information Sought

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

### Emptying a Washing Machine by Mains Pressure

PLEASE tell me how to construct a valve fitting for attaching by hose to an ordinary kitchen sink water tap by which means a bucket or washing machine may be emptied or filled by mains pressure.—E. G. PRESSMAN (Paignton).

### A Spinning Indian Kite

WITH reference to the article on kites in June, 1956, I have made several Indian kites as the article suggests, but although nicely balanced, they spin in the wind.

A partial remedy is to place the stabilising tail at right angles to the plane of the kite and a set of "tailings" keeps it headed into the wind nicely. I should like to make one without "tailings"; can you suggest anything ?—V. S. REED (Wirral).

### Materials for Clay Pigeons

CAN you please tell me what are the ingredients used in the manufacture of clay targets or clay pigeons, used in shooting competitions ?—PATRICK O'CONNOR (Tipperary).

### Cleaning and Preserving Sponges

PLEASE enlighten me on the technique for cleaning and preserving sea sponges. —C. FEATHERSTON (Dhekelia).

### Keeping Deep Frozen Food

I HAVE recently constructed a deep freeze cabinet, and wish to know what procedure is necessary with the fruit and vegetables to prepare them for deep freezing, in order to keep them for an indefinite period. I understand that something has to be added to the liquid before it is frozen.—S. W. POXON (Burton-on-Trent).

### Housing Meteorological Instruments

I HAVE been given some meteorological instruments, thermometers, etc., and am anxious to put them to good use. I understand some sort of a screen called, I believe, a "Stevenson" screen or maybe a "Bilham" screen is usually used for housing these instruments. Could you give some idea of what these screens consist—material, dimensions, etc. ?—J. E. CATT (Herts).

### Garden Cascade

I WISH to install a small rock garden cascade as cheaply as possible, probably with centrifugal pump. A lift of, say, 3ft. from reservoir to uppermost pool should be sufficient, with a quite moderate fall of water.

Please advise me on the use of an old vacuum cleaner motor and lamp bulb for resistance, design and manufacture of impeller, etc.—H. H. SAUNDERS (Hants).

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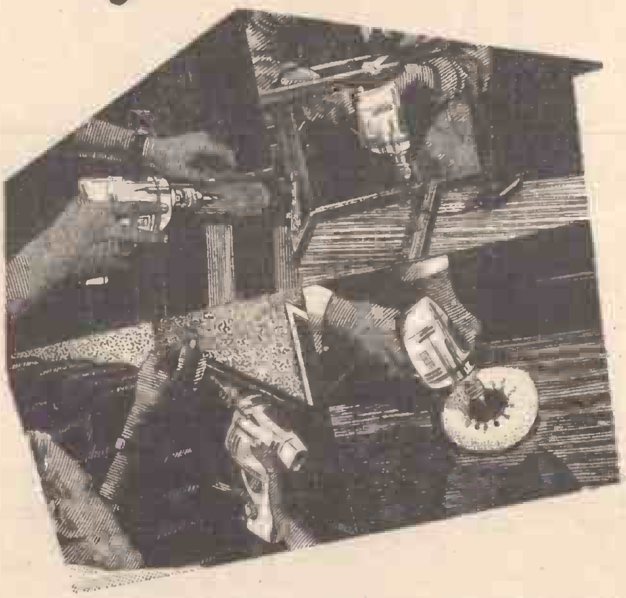

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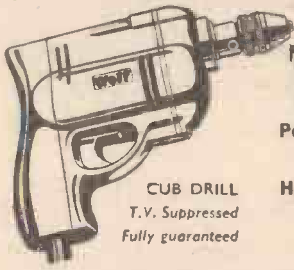


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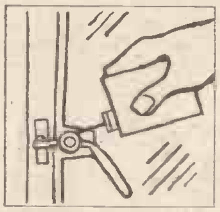

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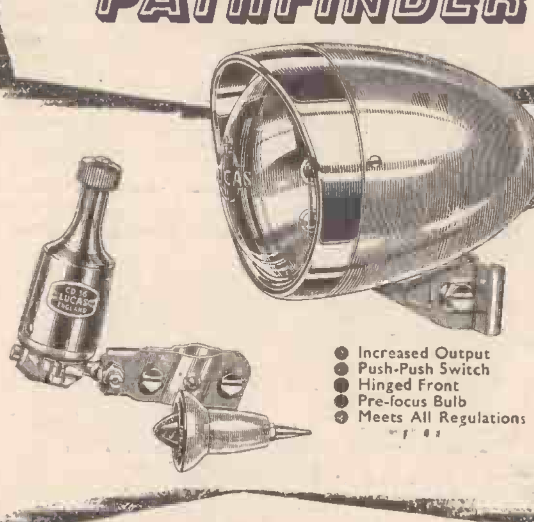

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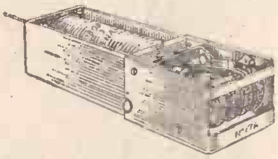

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THE Cyclist
Editor : F. J. CAMM
VOL. XXIV AUGUST, 1956 No. 409

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## WHAT I THINK

By F. J. C.

### The Cycle Show to be Biennial

THE Council of the Bicycle Manufacturers Association has taken the decision to run the Cycle and Motor Cycle Show after the 1956 Exhibition, now in course of preparation, every two years. The next exhibition will, therefore, be held in 1958. It has been apparent since the war that developments in the bicycle trade have been insufficient to warrant an annual exhibition. In fact, it can be said that bicycle design has become almost static and standardised, and what changes are made are made for the sake of changing design and cannot be considered as improvements. As far as the motor cycle side of the industry is concerned, trade has been quite healthy for the past three or four years, but the minor competition of motorised bicycles and lightweight motor cycles has somewhat eaten into the demand for the motor cycle proper. Additionally, the adverse publicity given to the sport of motor-cycling has caused sales to drop.

It cannot be denied that a motorised bicycle has affected the sale of bicycles, and a movement which was sneered at with leering contempt when it was introduced has now taken root and is flourishing. Those bicycle manufacturers who have entered this field were wise in their generation, wise to ignore the insincere opposition of the C.T.C.

That stupid school which for years has been vapouring both in print and out of it against motorised bicycles has received something of a quietus. According to their oft-expressed view, you are not a " real " cyclist unless you ride an ultra-lightweight machine, painted in circus colours, festooned with gadgets, and pelt along the highway as fast as you can every day in the year, irrespective of the weather. They write glibly of the joys of riding in ice and snow, in fog and in rain, when every cyclist avoids being on the road under such weather conditions. It is, of course, easy to write in this strain from the comfort of an armchair, and I have always strongly suspected that some writers have never undertaken the tours they claimed. A few guide books, some photographs donated by kindly friends, and it is easy! One well-known artist prepared his touring sketches from photographs that gave the impression that he lived on his bicycle with his sketchbook under his arm.

It must be admitted that the Cycle Show has ceased to be the attraction that it was. It has become more of a trade event than an exhibition which attracts public attention.

Even in the days of the Stanley Show there were rifts and dissensions. The late J. Dring, the Stanley Show secretary, when asked in 1891 whether he thought the show was going to be a success, replied in the affirmative, stating that the cycling club " is now so large that the majority of people interested in the wheel know scarcely anything of the dissensions that have arisen in the cycle trade. Pneumatic tyres, in any case, will be sufficient attraction to save the show." The dissension to-day, however, is largely amongst the sporting element, and concerns the fight for control. Anyway, the trade will now have a space of two years in which to think up some new designs which can claim to be real improvements, as distinct from changes in colour finish and frame angles. There is plenty of room for improvement, too. The built-in gear is still a pipe dream, and so is the shaft drive to eliminate the chain. There is no valid reason why these obvious improvements should not be produced forthwith, and we predict that any manufacturer who has the enterprise to market a shaft-driven bicycle with a two- or three-speed gear built into the bottom bracket would be assured of an unprecedented demand.

If it is insisted that the bicycle that we know to-day is incapable of much further improvement, then the need for an exhibition at all vanishes.

### Frank Urry Passes On

IT is with the greatest regret that I have to record the death of my old friend and colleague, Frank Urry, M.B.E. He was undoubtedly the greatest exponent of the pastime of cycling as distinct from the sport since the death of his father, the late John Urry. Frank Urry rode a bicycle for the love of it, and he kept it up day after day, year in and year out until the last year or so of his life. Of a philosophical turn of mind, he recorded his wheeling thoughts in prose and verse, and words of eulogy of the pastime simply poured from him. He was an excellent after-dinner speaker, and much sought after in this respect. He was one of the few cycling journalists who practised what he preached. His touring articles were written from the saddle and not the fireside, and he relied upon his own experience of the roads, lanes and villages rather than on pocket guide-book data. He was a keen advocate of the cause of cycling, but he was tolerant and understanding of the other point of view, and because of this he often clashed with the militant firebrands who have, by their attitude, done so much to damage the cause of cycling.

For many years he carried on the oldest cycling journal in the world—*Bicycling News*—of which his father was the editor, and on which Alfred Harmsworth, later to become Lord Northcliffe, served his apprenticeship to journalism. When the proprietors of *The Cyclist* acquired the proprietorship of *Bicycling News*, I became the editor of it, but it became one of the early casualties during the war, and was merged with a cycling trade paper. He continued to work for me as a contributor until a short time before his death when, as he wrote to me, he had decided to lay down his pen because he had given up cycling and, as he could no longer write from personal experience, he preferred not to write about his memories.

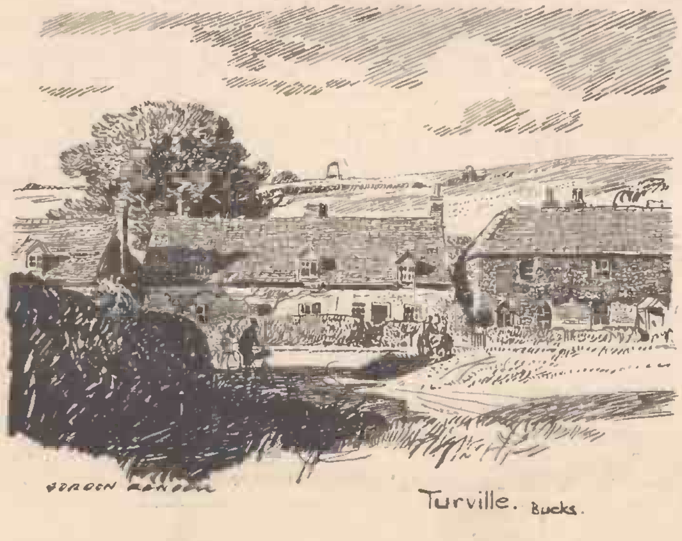
He was for many years a keen worker and a member of the council of the C.T.C. and, indeed, printed their house journal (he was the proprietor of The Colmore Press, Birmingham) until an internecine conflict caused him to sever a lifelong association with the C.T.C., to hand back the trophy which had been awarded to him for his services and to depart from cycling politics generally.

He once told me that cycling politics, like a great deal of cycling sport, had always been unclean, and he was very much in favour of purging the Augean stables of the deadwood and the old fogies who had come to regard themselves as the proprietors of the sport. Indeed, it was his impression that Yorkshire owned and controlled the C.T.C. and ruled it by a sort of divine right.

He founded the Centenary Club in 1939 in recognition of the centenary of the invention of the first rear-driven bicycle by Kirkpatrick Macmillan. This fact ought to be stressed, because the late B. W. Best, through the columns of the *Daily Herald*, claimed the credit for this. All of the details for the formation of the Centenary Road Club were jointly discussed between Urry and myself, and Best was unaware of it until the club was *de facto*. Frank was the first president of the club, and was president when he died.

As far as clubs were concerned his chief interest was in the Midland C. and A.C., which he joined at the age of 15, becoming secretary after five years. He remained secretary for a large number of years and was editor of the club journal, *The Roll Call*, for 21 years. He was president of the club for 1927-28 ; he became at one time president of the C.T.C. The whole of cycledom will mourn his passing, for apart from a few opponents in the C.T.C., it is true to say that he had not an enemy. The pastime can ill-afford to lose men of the character and fine spirit of Frank Urry, and I shall miss him more than most.

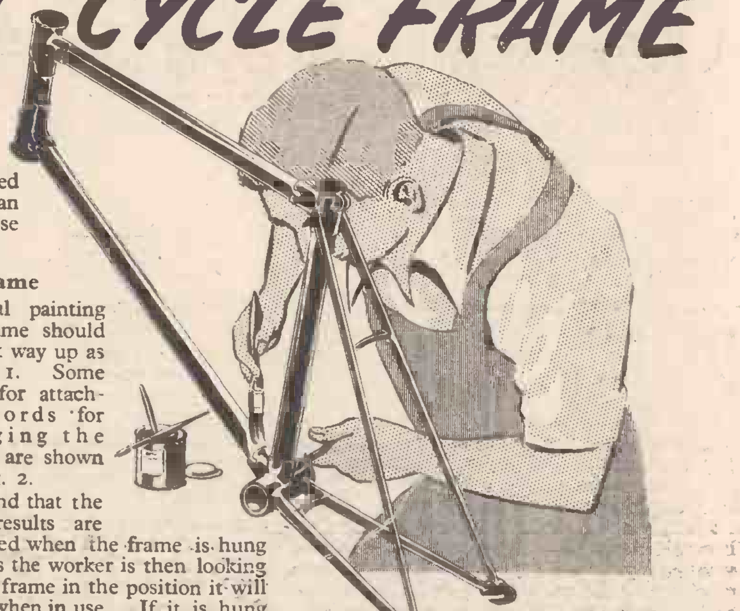
I hope that efforts are made by the cycle trade to perpetuate his memory, for he was the industry's best ambassador, and many thousands were attracted to the pastime as the result of the sincere advocacy of his writing.—F. J. C.



Turville. Bucks.

# ENAMELLING A CYCLE FRAME

## How to Apply a Lasting and Attractive Finish at Home



TO re-enamel a cycle frame it is essential that it first be stripped down completely; not only must all the components be removed, but also the bottom bracket and the head bearing assembly. It may be found difficult to remove the right-hand fixed bottom bracket cup, and if this is the case it can be left in place and covered with adhesive tape to protect it from the enamel. A similar technique may be employed to protect the frame parts of the head races if these are difficult to remove.

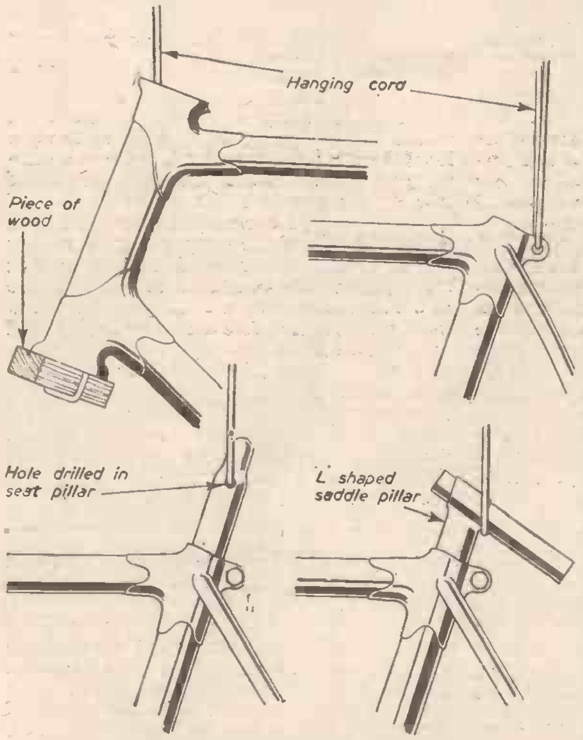



*Fig. 2.—Methods of hanging the frame.*

Before painting is commenced, all the old enamel should be stripped. The easiest way to do this is to use one of the numerous proprietary paint softeners now available, followed by vigorous scraping with an old knife. It is possible to enamel over the old finish after smoothing it with emery cloth, but better results are possible by enamelling straight on to the bare steel. An old knife with a pointed blade is useful for extracting paint from the intricacies of filed lugwork and when the frame is completely clean it should be emery-papered smooth. It is inadvisable to use a blowlamp on a cycle frame as the brazed joints could be weakened by too fierce a heat.

### Paints and Brushes

The best material to use is one of the numerous proprietary brands of brushing cellulose or a high-quality hard gloss enamel, and painting technique will depend upon the particular type of enamel purchased. Such information as whether undercoat should be used or whether one or two coats should be applied is usually supplied with the paint. Whatever cellulose or enamel is used it is certain that for the best results a soft, good-quality brush should be employed and most workers will find that a 1in. brush is the most convenient size. A far superior job results when a spray gun is used and if one of the small units designed for the handyman is available its use is recommended.

### Hanging the Frame

For the actual painting operation the frame should be hung the right way up as shown in Fig. 1. Some ideas for attaching cords for hanging the frame are shown in Fig. 2.

I find that the best results are obtained when the frame is hung low, as the worker is then looking at the frame in the position it will be in when in use. If it is hung above the head, one is inclined to miss streaks on the top of the tubes, which is the most noticeable place. An ideal arrangement is to hang the frame on pulleys and haul it up and down as required, but care must be taken that fluff and bits do not fly off the hanging cords and stick on the wet enamel.

Paint one tube at a time and inspect each one to see that it is covered all round. Always finish painting with long brush strokes down the length of the tube, as this results in a smoother finish. Care must be taken to keep paint from the threads inside the bottom bracket. If they do get paint on them, it should be removed before it dries.

The actual site where the painting is carried out should be a dust-free room, garage or workshop, and the frame should be left completely undisturbed throughout the drying period.

### Colour Schemes

Although there can be no doubt that the smartest and most serviceable colour for a cycle frame is black, it can be painted any colour at all, or, for that matter, any two colours.

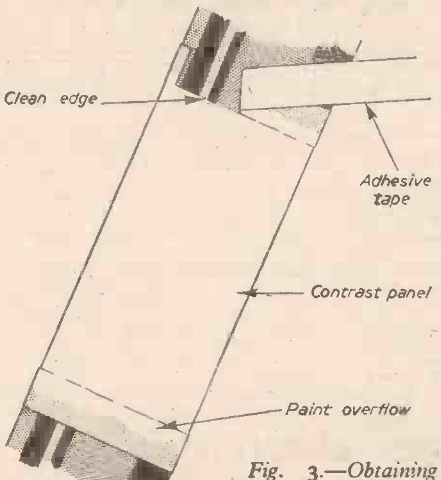



*Fig. 3.—Obtaining a neat seat-tube panel.*

*Fig. 1.—Method of working.*

Contrasting colours are usually chosen and some favourite colour schemes are red and green, maroon and pale blue, red and grey, green and yellow, dark blue and light blue or any of these main colours with white.

A good scheme is to use one colour for the frame and another contrasting colour for the forks and a panel on the seat tube. Similarly, the head tube between the top and bottom head lugs may be finished in a contrasting colour.

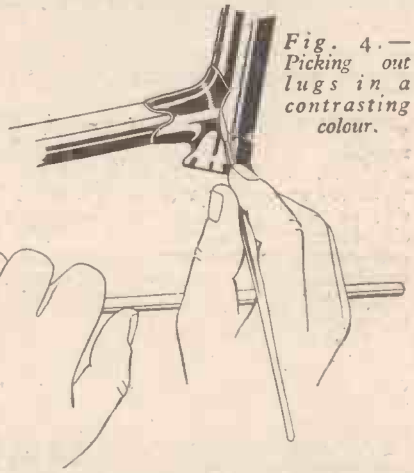


*Fig. 4.—Picking out lugs in a contrasting colour.*

It is not difficult for the amateur to achieve this two-coloured effect. The head tube panel can be painted in carefully with a small artist's brush—after the main colour is dry, of course! The panel on the seat tube may be painted in, using adhesive tape to prevent the contrasting coloured paint from overflowing its appointed area. The method of using this will be apparent from Fig. 3.

A cycle frame may be further enhanced by having the lugwork picked out in a contrasting colour, particularly if the lugs are attractively shaped and well filed. Fig. 4 shows the effect that can be obtained, the type of brush to use and method of steadying the hand.

### Transfers and Badges

The final operation is to apply transfers. Most cycle frame makers will supply transfers for their own frames provided that the applicant quotes the frame number. If the maker's transfers are not available, individual letters could be used to make up the name.

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