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EDITOR : F.J.CAMM

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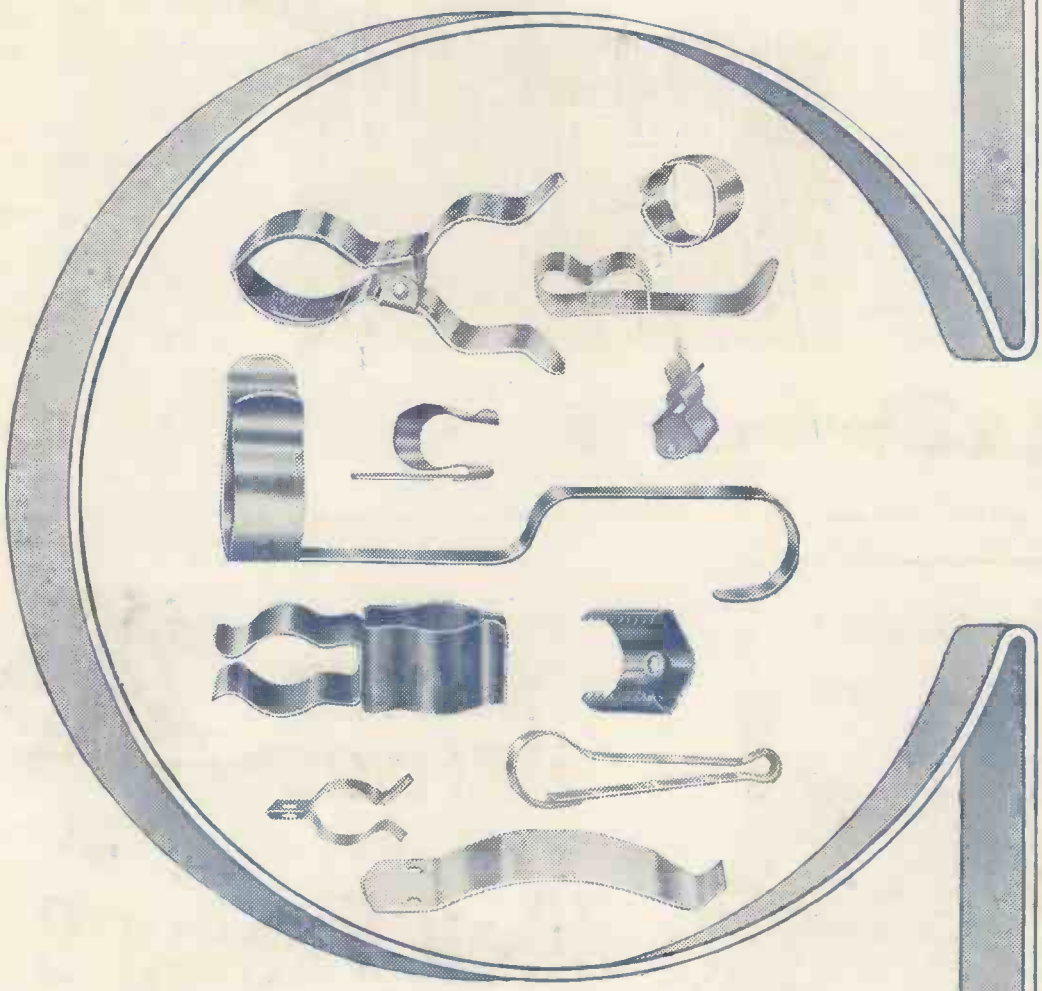

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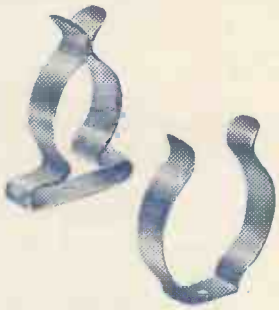

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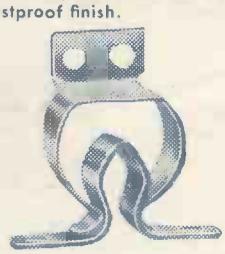

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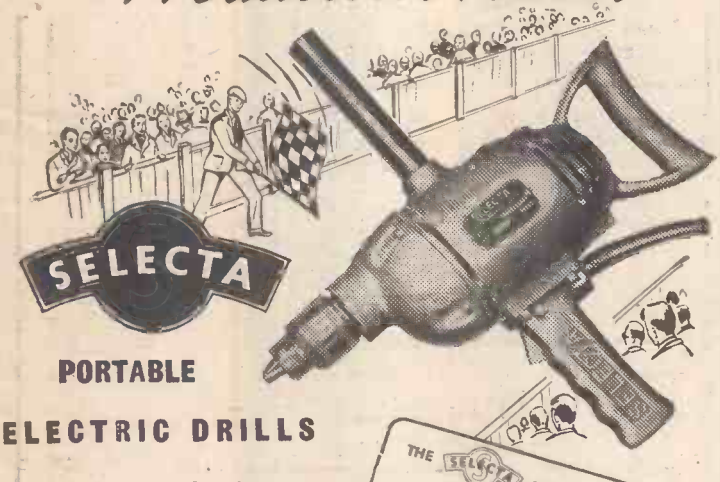

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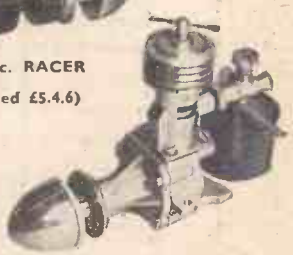

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JULY, 1954
VOL. XXI
No. 247

PRACTICAL MECHANICS

EDITOR
F. J. CAMM

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

FAIR COMMENT By The Editor

Radio Control Licences

HITHERTO, operators of radio-controlled models and equipment have not needed a licence but as from the 1st of June, 1954, a licence to operate such equipment became necessary, and operators should make application to the Radio Department, HQ Building, G.P.O., St. Martin's le Grand, London, E.C.1, for an application form and a statement of the conditions applying to the use of the equipment. The fee is £1, covering a period of five years. It is stressed that the regulations applying to maximum radiated power, frequency, stability, etc., must be observed in order that operation outside the band or any other misuse may not result in future difficulties for radio-control enthusiasts. The great danger is no doubt interference with TV reception over a wide area, due to harmonics from a transmitter not within the permitted lower band.

The construction of radio-controlled models as a hobby has expanded enormously during the past five years. Originally the movement was too small to warrant any statutory regulations, but it has now achieved such proportions and complaints are so general that a more rigorous control of operators is likely, unless the conditions laid down are complied with.

The Mellon Institute

I HAVE frequently drawn attention to the plight of British inventors in this country, who often are left to plough their lonely furrow and are not aided by the State in any way whatsoever. Indeed, the very reverse is the case, for they are discouraged by high patent fees on a rising scale. Moreover, the grant of a patent is not evidence of its validity. It can be set aside in the law courts, and the owner is unable to reclaim the fees paid. Another disadvantage is the long time which elapses between the application for a patent and its final issue. Thousands of patents are applied for and abandoned because of this.

I have, on other occasions, suggested that we require in this country a Ministry of Inventions to sort the numerous ideas submitted by inventors and to help those whose ideas are accepted to develop them. Many inventions are, of course, a sheer waste of time and money, but the Patent Office has no discretionary powers in the matter. It may not write to the inventor and tell him that his idea will not work, that it is impracticable, unwanted and unlikely to be a commercial success. The Patent Office is cluttered up with thousands of unwanted inventions and this operates to the detriment of really worth-while ideas, which must take their place in the queue before they are examined for originality and for possible anticipation. In America, they do things differently. There is the powerful Mellon Institute, which was founded in the year 1900, occupying enormous premises, housing valuable equipment. It is an Institute for scientific research in connection with industry. It was founded by Andrew W. Mellon and Richard B. Mellon, who realised that, to raise the general level of material and intellectual existence, able scientists must be provided with adequate facilities for research and that an independent scientific institution, with the sole aim of searching for those things which are essential to industrial progress and human welfare, would be the highest type of useful gift to the Nation. The Institute has three major functions. It conducts research in pure and applied science, it trains research workers, affording them unique opportunities for specialised development and it provides technical information adaptable to public advantage. Under the system adopted, various research problems are proposed by firms or associations. If a given proposal is of such scope as to be acceptable to the Institution, the investigation is set forth under a contract with the donor for a period of at least one year. A scientific worker with training and experience that fits him for that particular research is found and engaged by the Institute. He is accorded use of the laboratory and facilities, guidance and advice by the Executive Staff, and co-operative aid of Fellows of the Institute. Such a body, if formed in this country, but with an additional function of aiding poor inventors and those without scientific knowledge, would prove of inestimable value and it would be an organisation ancillary to the Patent Office. It could save the inventor much money and the Patent Office much time in fruitless search as to originality. Or can it be that the Patent Office finds it too profitable under the present system to discourage cranks from parting with their money?

The Pests' Bill recently introduced into Parliament and which will shortly become law has as one of its objects to find more effective and more humane means of ridding the countryside of the plague of wild rabbits. One clause forbids the sale or use in England and Wales of spring traps. The Secretary of State for Scotland already has this power.

Had we an English counterpart of the Mellon Institute, such a problem could have been submitted to it. One wonders in any case why the Department of Scientific and Industrial Research were not approached to find such a solution, which when found could have been made the subject of the Bill. The present Bill puts the cart before the horse.

The Institute of Patentees has performed much useful work in endeavouring to persuade the Government to become invention conscious, but so far their efforts have been unavailing. It is a pity that the vast inventive force in this country has not been harnessed to its needs, nor effort co-ordinated to that end.

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Making an EPIDIASCOPE

2.—Detailed Instructions for Making the Lifting Table and Accessories

By FREDERICK GILLSON

(Continued from June issue.)

THE platform on which I have placed my epidiascope (described last month) is made of wood. But you may prefer to make one of metal, together with all the accessories. Obviously it will take much longer to do so, and both the cost and the weight will be considerably increased.

Under the platform are the movable arms, manipulated by a handle, which raise the circular turntable. On this, books and other opaque objects may be placed for viewing on the screen. Fig. 1 shows the whole assembly and should be compared with the various sectional drawings (Figs. 2-7), which have corresponding numbers for easy reference.

The Baseboard

For this use five-ply wood, 19½in. × 10in., as shown in Fig. 2. Then from a ¾in. diameter broomstick cut four 7in. lengths. Place each of these in a 2in. galvanised foot, which must be screwed to the base where indicated by the four circles (see "A" Fig. 2). This will raise the height of the sticks a little, but they must be cut down to measure only 7in. from the baseboard.

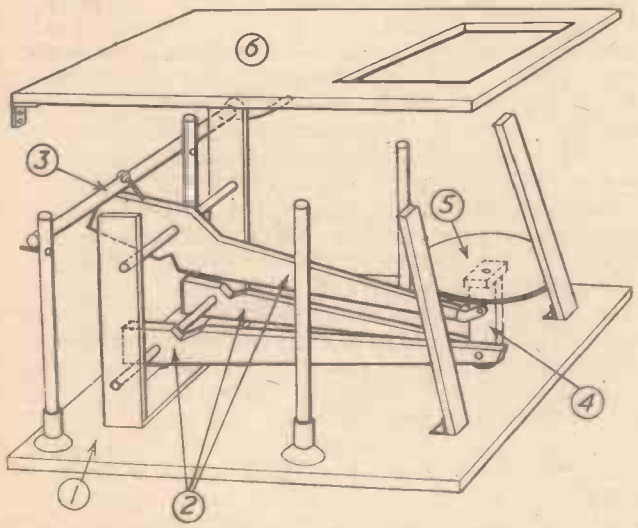


Fig. 1.—View of the lifting-table apparatus with the top section removed. The number of each component part is given for easy reference, and relates to the numbered drawings.

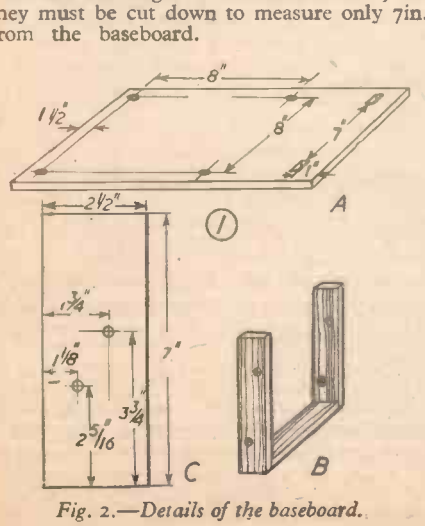


Fig. 2.—Details of the baseboard.

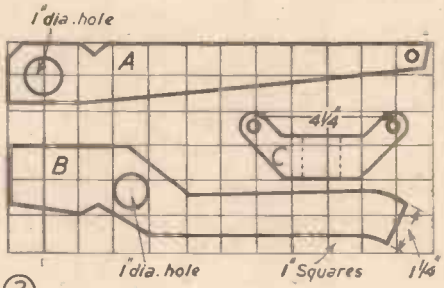


Fig. 3.—How the arms are cut to shape.

Then two 7in. strips of wood, 1½in. × ⅜in. are to be hinged and screwed in the position denoted by the oblongs. They will be found useful for taking the weight of the lantern-house and will help to ease the strain on the wooden top.

Next make the U-shaped stand (Fig. 2 "B") in which the three arms operate. Use ⅜in. wood, of which three pieces will be needed. The two for the sides are 7in. × 2½in., and in each of these make two 1in. diameter holes in the positions shown ("C").

The bottom piece is 7½in. × 2½in. Nail the two sides to this and so form the U-stand. Then screw this to the baseboard 3in. from the end. Before fixing, make sure the upper holes are nearest to the end where the turntable will be placed.

The Arms

Each of the two lower arms is cut from a 12in. length of 2in. × ⅜in. wood. Shape according to the 1in. squared drawing ("A" Fig. 3).

Now push a piece of ¾in. diameter broomstick, 8½in. long, through the hole of each of these arms, the ends of which should rest in the lower holes of the U-stand. To ensure smooth working keep the arms 2½in. apart by screwing them to the stick.

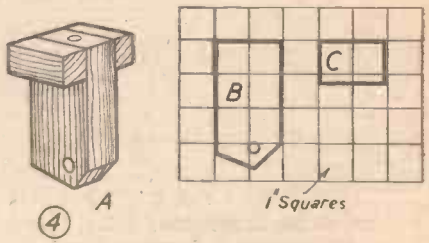


Fig. 5.—The pedestal construction.

For the central upper arm use a 12in. length of 3in. × ⅜in. wood, shaped according to the squared pattern ("B"). After making the 1in. diameter hole, obtain another 8½in. length of the broomstick, push it through the hole and let the ends rest in the upper holes of the U-stand.

Then from metal, 5in. × 2in., cut out a piece shaped like "C." Bend it along the dotted lines and drill two small holes for screwing to the end of the central arm. Keep these two holes uppermost.

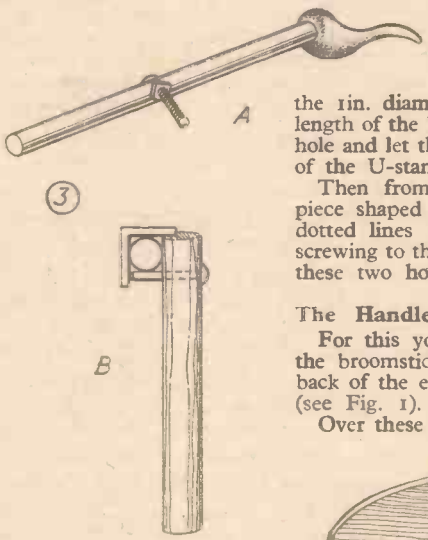


Fig. 4.—The handlebar.

The Handlebar

For this you will need a 11in. length of the broomstick. It has to be placed at the back of the end upright sticks, near the top (see Fig. 1).

Over these two sticks a 2in. angle-plate is to be fixed temporarily. Underneath, a 2in. bolt will hold the handlebar in position—providing the bolt fits tightly in the hole (see "B" Fig. 4). Take particular care to see that the roller turns freely by adjusting the bolt accordingly.

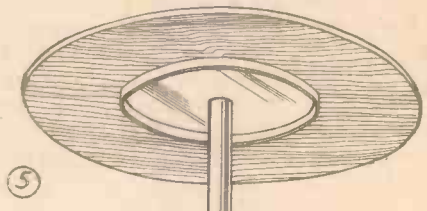


Fig. 6.—Pedestal details.

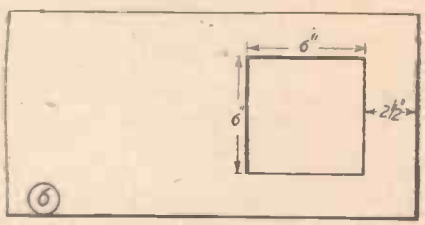
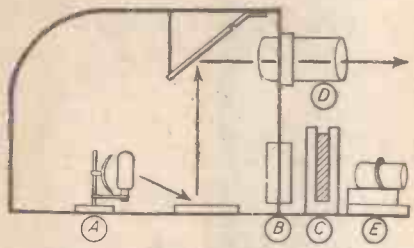
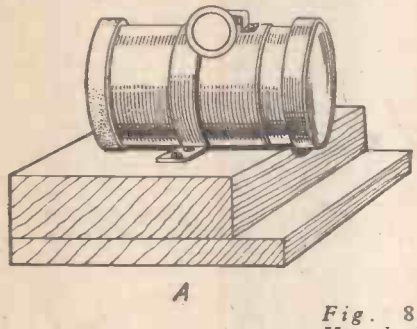


Fig. 7.—The top.

In the centre of the roller insert a 3½in. bolt and secure with a nut ("A" Fig. 4). The head of the bolt is to press upon the central arm, and the action will cause the turntable to rise. To prevent the wood being



The complete schematic layout of the epidiascope and attachments, showing position of lamp (A), condenser (B), slide grip (C), slide carrier (D), and lens unit (E). The arrows indicate the way the picture-postcard or object is reflected by the mirror through the lens.



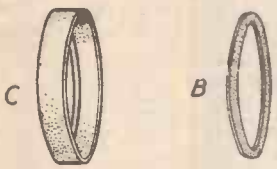


Fig. 8.—How the lens is mounted on two wooden blocks, and details of the extra lens mounting.

scraped, nail a strip of tinplate to the part where the bolt presses.

At the far end of the handlebar a curved cabinet handle is to be screwed on. To do this cut in half the metal bar (supplied with the handle), and make a hole in the wood just sufficient to grip the bar tightly. Leave 1½in. of the bar protruding and then screw on the handle.

The Pedestal

To support the turntable a wooden pedestal is needed. For this use a piece of wood, ⅝in. × 4in. × 2in., and shape according to "B" Fig. 5. At the top, on each of the broad sides, place a 1¼in. square block, length 2in. ("C"). Sandpaper the top so that the table will turn easily.

Fix the pedestal to the central arm by screwing each side of the metal brace to the pedestal (Fig. 1). Then through the bottom hole of the pedestal push a 2in. bolt and secure the lower arms with a nut.

The Turntable

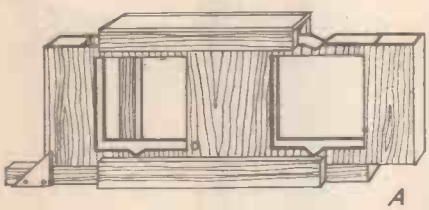
Cut this from a piece of 3-ply, 7in. diameter. A tin lid underneath will strengthen it. Through a hole in the centre, place a 1½in. bolt, ¼in. diameter. Drill a slightly larger hole to receive it in the centre of the top of the pedestal. (N.B.—Make certain the table turns freely.) A piece of grey velvet glued to the top of the table makes an effective finish.

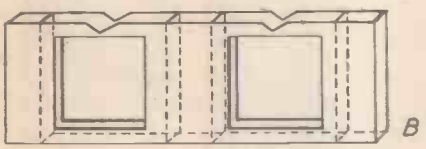
The handle should now be pressed down to see if the correct tension has been secured. If it has not, then unscrew the bottom of the U-stand and move the stand slightly backwards and forwards until the handle works easily. Then again screw the stand to the baseboard. After this has been done adjust the screws in the lower arms, so that the table will be level when raised.

The Top

Next make the top on which the lantern-house is to stand. Like the baseboard it is made of 5-ply and measures the same—19½in. × 10in. Cut out the square through which pictures are to be shown. At the other end screw the two angle-plates, which were fixed temporarily to the sticks (refer to "B" Fig. 4 and to Fig. 1). Then screw the top to the four sticks and to the two uprights of the U-stand (Fig. 1).

Give the entire platform and all it contains underneath one or two coats of glossy, heat-resisting black enamel. Then cut an oblong metal sheet, 31in. × 8in., and paint one side. When dry, turn it inwards and nail it to the top and base around the end that encloses the arms. The exterior of the metal sheet should then be painted.





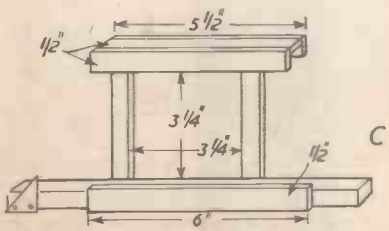
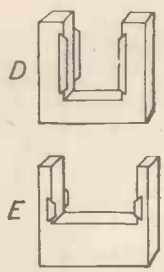


Fig. 10.—Details of the glass-slide carrier.

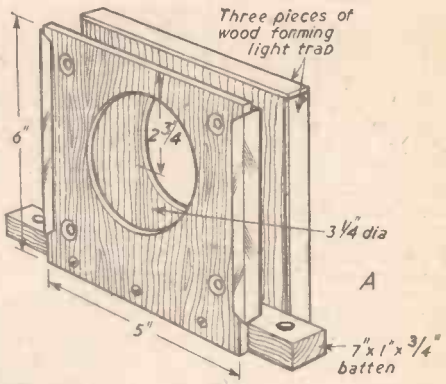


The lantern-house should be securely bolted on each side, with two angle-brackets to the platform. Place these brackets at the lens end of the lantern-house.

Several accessories are necessary to enable slides and film-strips to be shown.

The Lens Unit

Mount the 6in. lens with a metal strip, 7in. × ⅝in., on two wooden blocks, which are to be nailed together. The upper block measures 4½in. × 3in. × 1⅝in. and the lower



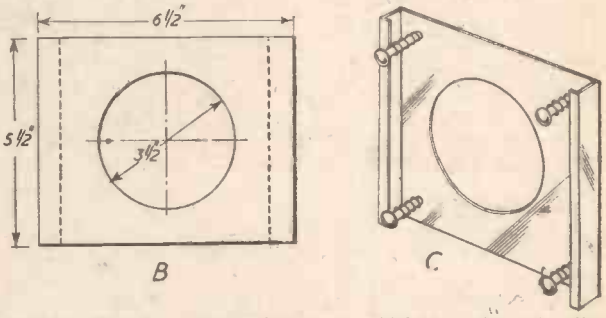
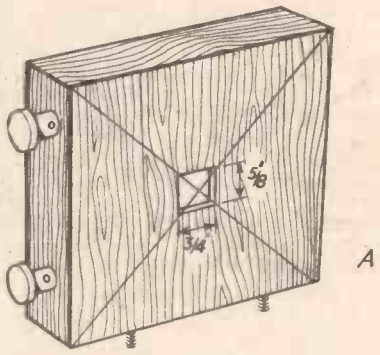


Fig. 9.—Details of the various parts which go to form the slide grip.



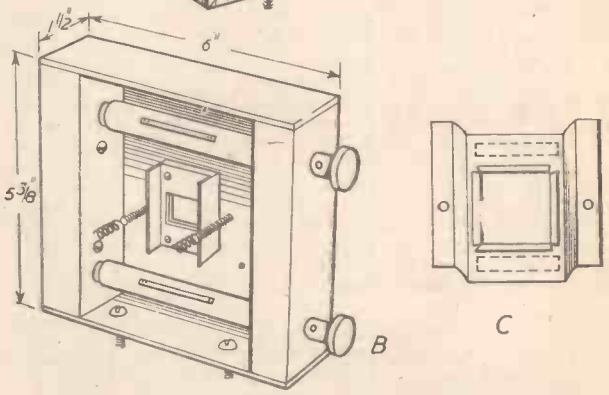


Fig. 11.—Constructional details of the film strip winder.

4½in. × 4in. × ⅝in. (see "A" Fig. 8). Screw down the strip tightly to avoid vibration. Bolt the block to the platform with two small angle-plates on each side.

It is most essential for another lens to be added to the lens tube. Fortunately it can easily be obtained for 2s. 6d. at a well-known multiple store. It is sold as a "reading-glass." The cheaper plastic kind is useless.

Remove the metal rim of the reading-glass and place the lens in two circular pieces of thin cardboard, which must be glued to the edges of both sides of the lens ("B"). Make a cardboard rim to receive this ("C") and fit it on the end of the lens tube ("A"). Make a cap from a round tin lid.

The Slide Grip

This is the apparatus that grips the slide-carrier and holds it securely when glass slides are being shown, see Fig. 9. Made of three-ply, the front and back sections measure 6in. × 5in. In each piece remove the circular portion 3¼in. diameter. Then between the two sections nail a ¾in. strip 7in. × 1in. (see "A").

Next take a piece of metal, 6½in. × 5½in. Remove the centre circle, 3¼in. diameter, and bend the two sides ½in. forward at right angles. The edges should then be bent slightly over the wooden front.

Through holes in this front section push four 1in. bolts and place a small spring around each bolt. Secure the bolts to the metal with solder.

On the back wooden section nail three strips of ¼in. wood, 5in. long. These strips will cover the end of the condenser and will form a light trap.

The completed slide grip ("A") is fixed to the platform with two 2in. bolts and nuts.

Glass-slide Carrier

Make the interior portion first, as shown in Fig. 10, "B." On three ¼in. wooden uprights, 3⅜in. × 1⅛in., nail two pieces of one-ply, 11in. × 3⅜in. But before doing so cut out the openings, 3in. × 3in., and the four notches. Then at the bottom of the two openings glue in strips measuring 3⅜in. × ¼in. square ("B").

Next make the frame ("C"). The wood to be used throughout is 1-ply, with the exception of the long bottom strip. For this the wood is ⅜in. thick and measures 11in. × ½in. Glue the pieces together. A small screw on the sliding section and a triangular piece of brass at the end of the base will prevent the carrier being pushed too far (see "A").

This carrier will take standard size slides (3¼in. × 3¼in.). It can also be used for 2in. × 2in. slides (viz., 35 mm. mounted), if a cardboard mask is placed in the carrier. This should measure 3¼in. × 3¼in., the size of the opening being 3in. × 2⅜in. Four strips of tinplate, 2in. × ¼in., placed at the sides will keep the slide steady (see "D").

A similar attachment can be made for microscope slides, but for these the opening in the mask is 3¼in. × 2½in. (see "E"). To obtain best results when using microscopic slides, in place of the 6in. lens use the objective lens of a microscope mounted on a wooden base.

Film-strip Winder

The frame is made with two upright supports, 5⅜in. × 1½in. × 1in., above and below which are nailed pieces of three-ply, 6in. × 1½in. Over the front of this nail three-ply measuring 6in. × 5⅜in. The opening is ¾in. × ⅜in.

The rollers are 3½in. sections of the broom-stick, with washers at the ends. Make two holes in each upright and drive four 2in. round nails in the end of each roller. Remove the heads of two nails and screw on the knobs, which can be bought from a radio dealer for about 6d. Then nail a strip of tinplate, 2in. × ¼in., on the rollers to receive the ends of the film-strip.

A gate will keep the film in position. It should be cut from brass, 2in. × 2in., and bent at the sides (see Fig. 11 "B"). The window should be a little larger than the one in the wooden front. Screw in position, after mounting on a ¼in. wooden base, and be careful to countersink the screws or the film may get scratched.

Then place a piece of tinplate, cut and bent as "C," in the brass groove over the film. This tin shield is held in position with two small bolts and nuts. Two springs should be put over the bolts. To protect the film further, glue a small strip of velvet on the underside of this shield. The winder is fixed to the platform with bolts and nuts.

For films requiring the downward movement, use the winder standing as shown in "A." If, however, the sideward movement is desired, simply turn the winder on to the thick wooden end.

The positioning of the various accessories may be seen by referring to the schematic layout at the top of page 425. When using a 35 mm. film on the film-strip winder, for a picture on a home screen, 20in. x 30in., the distance between the lens "E" and the film-strip winder (or slide grip "C"), will be about 1⅞in. For a very much larger picture, the lens has to be brought nearer the film and this may be accomplished by turning the adjusting screw on top of the lens tube. If no such screw is fitted, the lens must be moved bodily nearer the film or glass slide until the screen picture size is as large as desired. When the slide grip is in use, it is placed near the condenser so that the protruding rim of the condenser mount is covered by the three strips of wood fitted on the back of the slide grip to act as a light trap. The film strip winder is so constructed that an additional light trap is unnecessary, as the light has to come through a very narrow opening—⅜in. x ⅛in. This is quite sufficient for showing a 35 mm. film.

It will be seen that no attempt has been made to make elaborate light traps and a cooling fan has not been included. It is, however, easy to deal with the part of the lantern from which the bulk of the escaping light comes. This is the movable top of the lantern-house and the escaping light is thrown downwards on to the table. All that has to be done is to remove the 1in. of brass tube which holds up the flap, allowing it to fall flush with the top of the lantern-house. The flap is raised for ventilation purposes as the holes in the chassis are not sufficient.

A final hint. If you desire to reduce the amount of light that comes from under the top ventilation flap of the lantern-house, solder a 2in. strip of tinplate to the underside of the flap. It should be 19in. long, and bent to form an oblong, 5in. x 4in., which will easily slide into the opening. Paint the underside of the flap with dead black paint.

Items of Interest

An "Electric Blanket"

DEVELOPMENT of an "electric blanket" to prevent icing on aircraft is announced by the Society of British Aircraft Constructors.

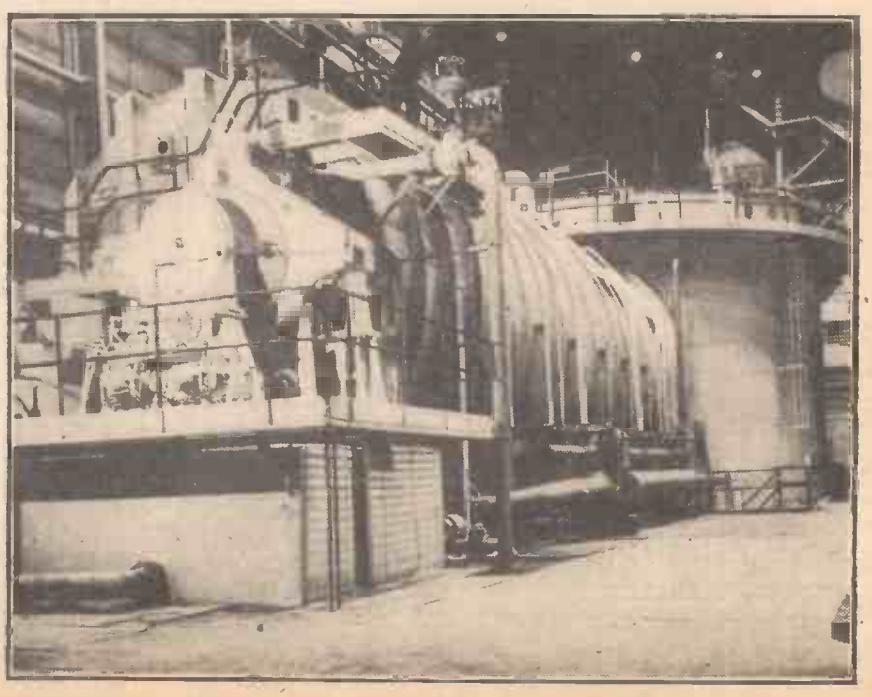
The device, designed by Dunlops, consists of electrical heating circuits sandwiched between layers of synthetic rubber. These are tailored to fit round such parts of the aircraft as jet engine intakes, wing leading edges, cabin heater intakes, radio aerials, etc., where it is important that there should be no ice.

A New Fire-resisting Glass

FRENCH journalists during a visit to the glass works at Saint Gobain were shown a new fire-resisting glass known as Sedlex. Its composition is the same as Pyrex (boro-silicate double of aluminium and sodium), but it undergoes a special treatment to make it capable of resisting sudden changes of temperature. A plate of the new material may be taken off the fire with a damp cloth and laid on an ice-cold surface and cold water poured on it. Another advantage is that the new composition is perfectly limpid and does not tend to take a greenish coloration with use.

Indoor Submarine Contains First Atomic Engine

INSIDE the hull of this "indoor submarine" located in the middle of the Idaho desert is the first atomic engine ever to produce substantial quantities of power. Designed and built by Westinghouse Electric Corporation and the U.S. Atomic Energy Commission, this nuclear power plant (Mark 1) was built for long-range testing and operation and is an experimental model of the actual engine (Mark II) which is to drive the atomic submarine U.S.S. *Nautilus*. The photograph, looking through the largest door of the main assembly building, shows the aft end of the hull and the large "sea tank" which surrounds the reactor compartment.



PLASTIC HANDICRAFTS

Notes on the Various Types of Plastics, Tools, and Methods of Working

By W. GORDON HOWL

ALTHOUGH plastics have adapted themselves to a moulding process, the number of articles which are fabricated from stock sections and sheets is favourably comparative and these materials are readily available at craft and hobby shops in small quantities. There is a selection of colours and textures from which to choose,

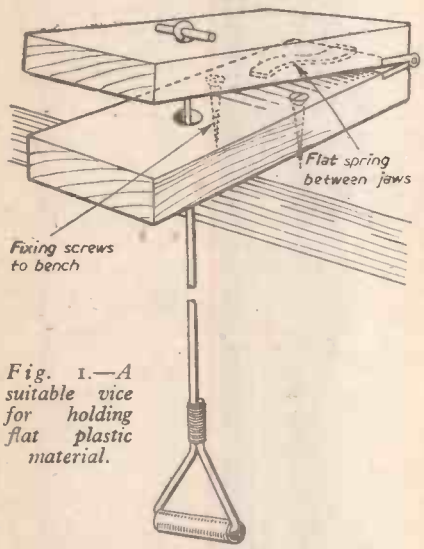


Fig. 1.—A suitable vice for holding flat plastic material.

unobtainable in the other craft materials of wood and metal. They range in colour, through most shades, from transparent to black, and may be obtained in a texture as pliable as rubber to a material as hard as lignum-vitæ.

Materials

In keeping with the other main craft materials, wood and metal, plastics are divided into two main groups which classify their properties.

As woods are specified hard and soft, metals as ferrous and non-ferrous, plastics are grouped into thermosetting plastics and thermoplastic materials. Thermosetting plastics are those materials which undergo a chemical change when the necessary heat and pressure are applied, resulting in an infusible and insoluble substance. It is advisable to note this heat-, acid- and alkali-resisting property in the choice of materials for table tops, etc. Thermoplastics, on the other hand, are readily re-formed after the original moulding process by the application of further heat and force, although care must be taken not to overdo this heating and re-forming, to ensure that the molecular chain structure is not broken and thus cause a flaw to appear at the bend which will not only result in a weak section but will mar the finish of the article.

Cast Phenolics

The only thermosetting plastics which will concern the craftsman are the phenolics.

The cast phenolics are an outstanding craft material, which is most suitable for turning by reason of its hard texture and close bond, which enables intricate shapes to be turned in it. Also, by reason of its bond, it will take a high polish and is adaptable to carving and other cutting operations.

Transparent and translucent castings are obtainable in a wide variety of colours in sheet form, in tubes and round and square rods. The typical sizes of sheets are 12in. × 24in. × ⅛in., the thickness increasing in stages of 1/16in. to 1in. Tubes can be obtained 2½in. and 1in. outside diameter, with a bore of 2in. and ½in. diameter respectively. Round rods ⅜in., 1in., 3in. and 6in. diameter, and square rods ½in., 2in. and 4in. are available.

In all probability these cast phenolics will be sold under the trade names of "Bakelite," "Catalin," "Marblette," "Lactoid," etc.

Laminas

The laminas, that is, those materials which are made by bonding paper or fabric with phenol-formalde hyde, are extremely adaptable for use as shelves, table tops, panelling, etc. They will resist alkalis, acids and heat and are very hard and durable. Although the laminas are prevalent in the shades of black and brown, they may be obtained in a variety of attractive colours. Sheets ⅛in. and ⅜in. thick are obtained in sizes 42in. × 30in., while thicknesses ¾in., ⅝in., 1in., 1¼in., 1½in., 1¾in. and 2in. are sold up to 30in. square. Still thicker blocks up to 4½in. may also be acquired.

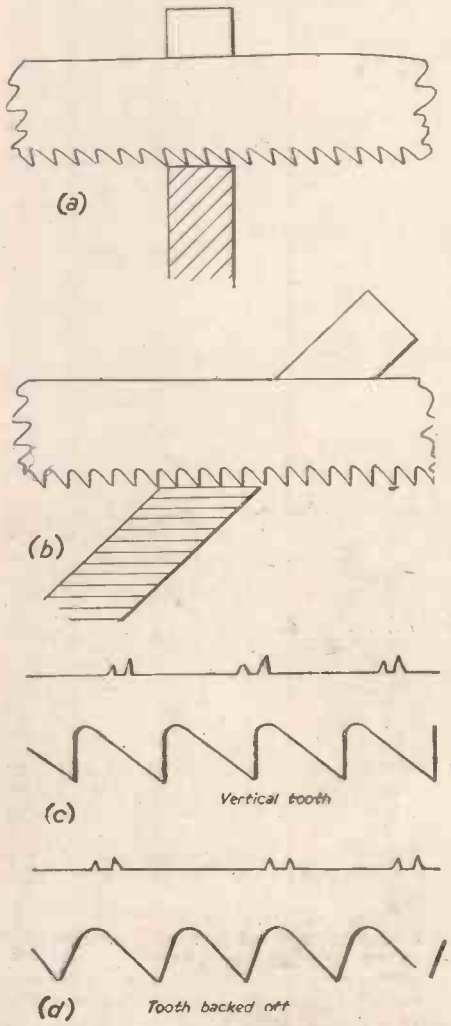


Fig. 2.—To prevent chipping of plastic when hand-sawing, use a combination of long-edge cutting with neutral or negative rake saws. (a) Short edge sawing will chip plastic. (b) More teeth cutting to prevent edge chipping. (c) Neutral rake saw. (d) Negative rake saw.

The Acrylics

This is the most popular group which carries the trade names of "Perspex," "Plexiglass," "Lucite," which are almost household words. The methylmethacrylate plastic is a widely applicable craft material with very few limitations. It can be softened by heating and moulded into many forms and shapes. It can be carved and engraved by cutting tools or hotpoint. The crystal clear and coloured acrylic plastics will take a high polish and give a very smooth finish. The sheets of Perspex are obtained in sizes of 54in. × 48in. and in the thicknesses of 1/16in., 3/32in., ⅛in., 5/32in., 3/16in., 7/32in., ¼in., 5/16in. and ⅜in. thick; also it may be obtained in metric thicknesses—1, 2, 2.5, 3, 3.5, 4, 5, 6, 7 mm. in sheets 120 cm. × 90 cm.

Cellulose Plastics

This group is then subdivided into a number of other groups, Cellulose, Nitrate, "Cellulose Acetate," "Cellulose Acetate Butyrate" and "Ethyl Cellulose." As will be seen from the titles, the difference between the texture of the plastics occurs through the mixture of one of these materials with Cellulose. The Nitrate and the Acetate are so akin that no difference can be ascertained between them by just looking at them. If they are exposed to a naked flame, the difference is soon apparent. The Cellulose acetate will merely soften, but the Nitrate will burst into a violent yellow flame.

Cellulose acetate butyrate is obtainable in extruded tubes, and thin glossy sheets which are very adaptable for wall board trimming and table edging. It is easy to work and cement.

The cellulose acetate is the most adaptable of this group to the craftsman. It is available in rods, tubes and in thin flexible sheets from ⅛in. thick to thin enough for lampshades. The backing base for the emulsion of roll film is made from material and can be bought in large coloured sheets under the names of Kodapak and Kodatrace. The substance is easy to cut, shape, carve and form under heat, but not direct heat or the molecular structure of the material will be fractured. It can easily be dyed, painted or lacquered.

Cellulose acetate can be purchased under the trade names of "Celluloid," "Chemace," "Nixonite," "Lumarith," "Tenite I."

Vinyl

The last plastic group of use to the craftsman is the Vinyl group. This material differs

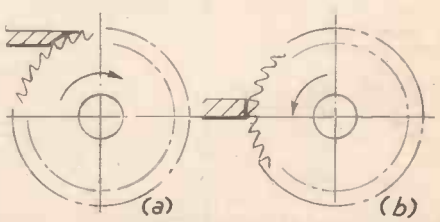


Fig. 3.—Shows the correct and incorrect way to present plastic sheet to the circular saw. (a) Present plastic to top of a saw with a neutral or negative rake with a deep tooth for chip clearance to prevent chipping. (b) If the plastic is presented in this usual way it will be chipped badly.

from the plastics previously presented in its flexibility. It was developed during the war to replace rubber during the grave shortage. This type of material needs little explanation, for it can be seen every day in its use as curtains, aprons, belts, bath bags, etc., and is tasteless, odourless and non-toxic. This Vinyl acetate may be adapted to a number of uses and should be worked as fabrics. When sewing Vinyl with cotton by machine it is an asset to powder the working surface under the needle with French chalk.

Vinyl butyrate can be obtained in small flexible tubing, commonly called spaghetti. This is excellent for binding, such as may be seen on the sides of trays and on car steering wheels, for thonging in leather craft, etc.

Vinyl butyrate is obtainable in a variety of colours, with which many attractive designs can be contrived. It is advisable to forsake the hobby shop when buying products of the Vinyl group, as a far wider variety of patterns and textures will be found at the drapers or multiple stores.

Marking Out

In this and the following instructions the Vinyl group of plastics is not dealt with, and all references are made to the more solid variety, particularly the acrylic groups.

The tools required for marking out are identical with those used for marking out wood and metal. Primarily necessary is a good sharp pointed scriber; do not use a knife edge scriber, for it will tend to dig into the plastic. A straight edge is necessary, together with a set square, or, better still, a combination square, and a pair of engineer's dividers.

Where the plastic is found to be preserved with tissue, it is desirable to retain the latter in position until it is imperative to remove it, such as before heating or cementing.

A good working knowledge of geometry is expedient. Do not guess when laying out; it is an expensive and idle pastime. If the shape you need is irregular, make a paper template first and try it in all positions on the stock to save waste of material. A little care and forethought in marking out will save a great deal of trouble later.

Sawing and Filing

The plastic must be held firm when sawing, in soft jaws, such as wood or pieces of green baize on the face of your vice jaws; a suitable vice is shown in Fig. 1. A fretworker's anvil is equally suitable if it is adapted to grip the stock. Intricate shapes will be found to cut best if clamped between two pieces of scrap wood. When cutting square edges and mitre corners use a mitre block and cut as for cutting wood, using the appropriate saw.

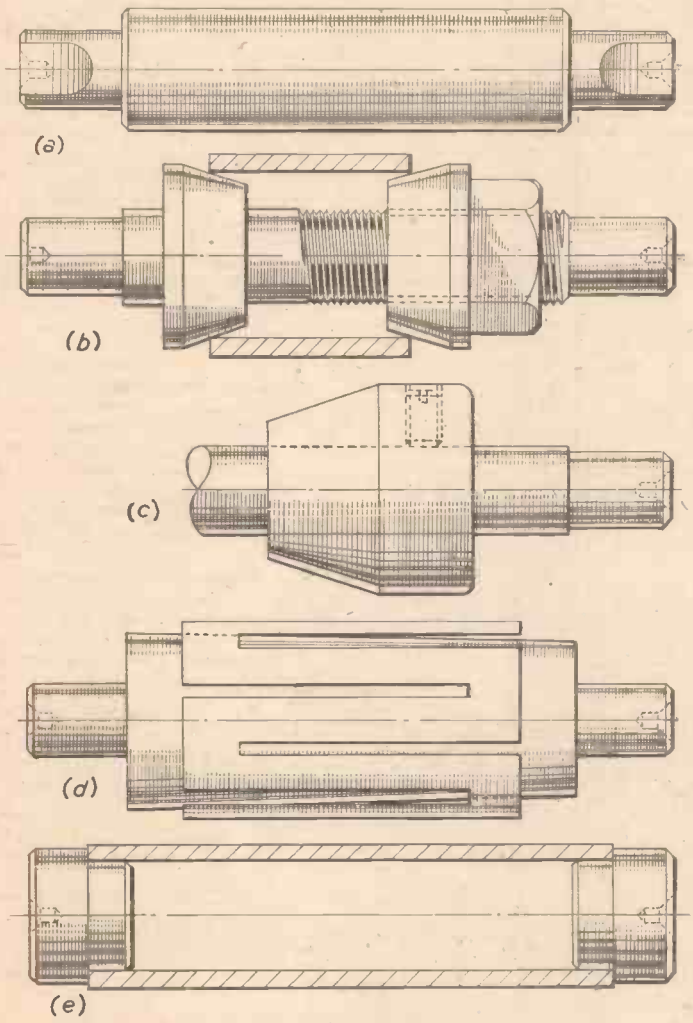


Fig. 4 (Left).—Mandrels for turning plastic tubing. (a) Solid mandrel (taper .006in. per ft.). (b) Doublecone mandrel (care must be taken not to crack or distort the tube when tightening the clamp nut). (c) An alternative end for use with a double cone mandrel. (d) An expanding mandrel. (e) If no mandrel is available, the ends of the tube can be plugged with scrap plastic.

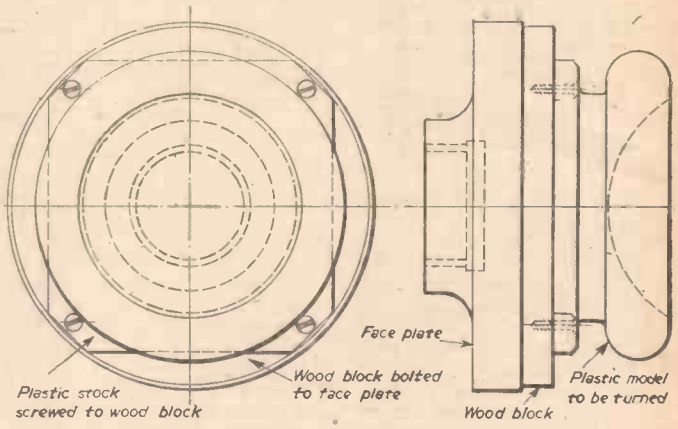


Fig. 5 (Above).—Face-plate turning in plastics.

Always cut plastic on its widest face; never, if it can be avoided, present an edge to the saw, Fig. 2 (a and b), as this will cause bad chipping.

Another cause of chipping results from the use of the wrong saws. Under no circumstances should a wood saw be used, whether tenon or otherwise.

The best type of saw to use is a fret, jewellers' or coping saw, of 12 to 14 T.P.I. for general work. When cutting heavy stock a thicker blade will be more suitable and a hack saw will be found most adequate. It will be noticed that all the saws recommended are frame saws. These saws only use blades to do the cutting and thus give a good clearance and avoid friction. Unavoidably the teeth of all these blades are all intended for cutting metal and have a positive rake. Although the blades can be used for sawing plastic a slightly chipped edge results and it will be found that a neutral or negative rake tooth is far better. See Fig. 2 (c and d).

The teeth can be modified by filing the rake angle only in a vice; try to make the angles of every tooth identical, it will be well worth while, although a little tedious.

A number of home mechanics are fortunate enough to possess a power saw, either circular or band. The notes on hand sawing apply in general, but on power differ in the particular, see Fig. 3 (a and b).

Throughout, in sawing plastics by machine, keep in mind the maxim "Fast speed, slow feed."

The cutting speed with a 7in. to 9in. diameter circular saw is found to be suitable for plastics at 1,800 to 2,000 r.p.m. with 14 to 15 T.P.I. P.C.D. With a band saw, convert R.P.M. to F.P.M. by the formula

$$\text{R.P.M.} = \frac{12\text{F.P.M.}}{\pi D}$$

With power cutting it is more necessary to modify the teeth to neutral or negative rake than with hand sawing. While this conversion is being undertaken, the root of the tooth may be deepened to allow a greater chip clearance, necessitated by the speed of the saw.

If the reader has a motorised spindle head to which a carborundum slitting wheel can be fixed he will find it ideal for cutting plastics.

Filing

Generally the filing of plastics to shape does not differ from other materials. Two points to bear in mind, are, do not file across a short edge and clear all scratch marks to finish.

Turning

The material mostly used for turning will be the cast phenolic group and it may be turned either on a woodworker's or machine lathe. If the material is handled in a way similar to soft brass, it will be of assistance in getting acquainted with this material.

Setting up stock in the machine lathe may be between centres and driven by a dog as for metal. Owing to the low coefficient of friction of the casin a live centre should never be used, always use a well-greased dead centre. Make the centres with a drill or awl, not with a centre-punch. The material will not stand heavy blows. The tubes may be set up on machine arbors, of which a selection is shown in Fig. 4, remembering not to drive too hard on the tapered type of arbor. If no arbors are available, the ends of the tube may be plugged with scrap material and turned as a solid rod. Bowls and other objects where it is necessary to turn the inside or bore should be chucked or mounted on a faceplate, Fig. 5, and attached with woodscrews into the scrap material.

(*To be continued.*)

SMALL INDUCTION COILS

Constructional Details of Simple Shocking Coils and Coils for Experiment

By F. G. RAYER

ELECTRICAL induction coils provide a simple means of increasing or reducing voltage and offer a quite wide field for experiment. Tesla coils, shocking coils and spark coils employ step-up windings, and it is these which are of most interest. The actual constructional work in such coils is very straightforward, and successful results are readily achieved when the correct methods of operating are known. Such coils may be operated from dry batteries or an accumulator, and it is possible to obtain an output of several thousand volts with even moderately sized dry cell batteries.

The smaller coils, especially those operated

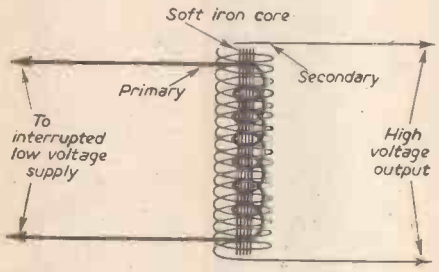


Fig. 1.—Induction coil.

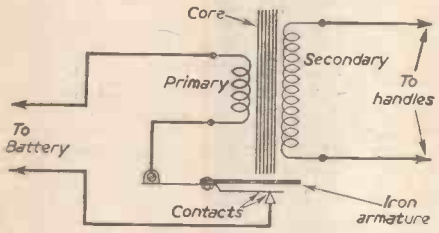


Fig. 2.—Typical shocking coil circuit.

from dry cells, are quite safe, but the larger coils are capable of giving dangerous shocks and should be treated with proper respect. Coils operated from accumulators can have an extremely high output voltage. Even with the smallest type of shocking coil, shocks should in no circumstance be administered to anyone unless they are prepared. To begin with, a single 1½ volt dry cell is an amply powerful source of current for such coils, a stronger battery subsequently being used as desired.

The form an induction coil takes is shown in Fig. 1. The primary consists of relatively few turns of thick wire, and the secondary of a large number of turns of thin wire. A central core of soft iron or similar material completes the coil. With such a coil, the primary current will be large, but of low voltage, while the second current is small, but of high voltage. The step-up ratio depends upon the relative number of turns on the windings. For example, with a 100 turn primary and 10,000 turn secondary, the step-up ratio would be 100:1. In practice, the secondary voltage is much higher than this figure alone suggests, due to eddy currents inducing high voltages in the primary when the primary circuit is opened. As a result, an output of 1,000 volts or more may readily be obtained from a 100:1 coil operated from a 2 volt battery.

A voltage only arises in the secondary when the current in the primary is rising or falling—that is, when the circuit is made or broken. The output of the secondary will depend upon several factors :—the ampere-turns of the primary, the efficiency of the core, the degree of coupling, and the turns ratio. If these terms are understood, the output may readily be adjusted to any desired level within the limits of the current available.

Briefly, the greater the number of turns on the primary, and the heavier the primary current, the greater will be the secondary output obtainable. Primaries are therefore wound with stout wire so that a large current can flow. The primary current (and thus the output) may be increased by increasing the battery voltage, or by using a primary of heavier gauge.

The efficiency of the core need not receive much attention, except that if really high outputs are required a laminated core is desirable. Such a core may be made up from iron wires or strips tightly bound together. With a solid core especially of large diameter, heavy eddy currents can flow, thereby wasting some of the potential output of the coil. Solid cores are perfectly satisfactory for the smaller coils, however. The degree of coupling between primary and secondary will usually be fixed, the secondary being wound over the primary. But with experimental coils the secondary may be removable, or coupling may be modified by sliding a brass or copper tube into a slot provided between primary and secondary.

The question of turns ratio has already been mentioned. No particular ratio need be

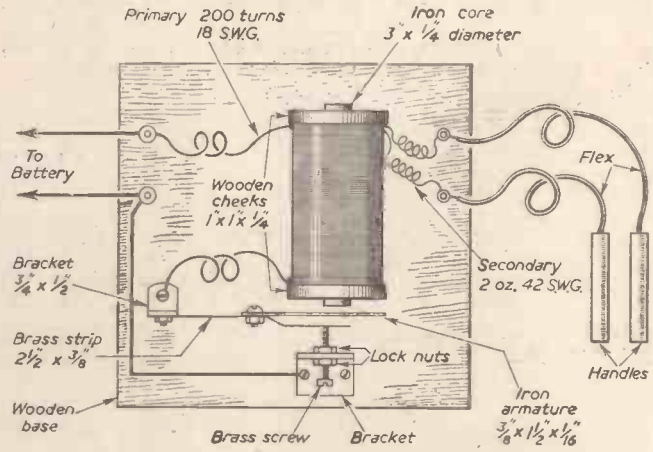


Fig. 3.—Practical layout of coil in Fig. 2.

obtained in any coil, and it is usual to indicate a secondary by the gauge and weight of wire wound on, and not to attempt the laborious counting of turns on this winding. To speed and simplify construction, some form of mechanical winder is best made up to deal with the secondaries.

Circuit Interruption

Fig. 2 shows the usual method of interrupting the primary current, this resembling that in a bell or buzzer. This is generally found in shocking coils, which, in consequence, give a continuous A.C. output of high voltage. The output can to some extent be controlled by adjusting the armature and contact screw, output being at maximum when the speed of interruption is rapid, as shown by a high-pitched buzz from the armature.

The practical construction of such a coil will become apparent from Fig. 3, and presents little difficulty. The core may consist of a length sawn off a large bolt, the cheeks being a tight push fit. To avoid short circuits, a layer of tape is placed over the core, before winding. The finished primary should similarly be covered, to prevent secondary turns slipping down, and possible breakage. For the primary, cotton covered wire is best, but enamelled wire is suitable if care is taken to keep the insulation intact. For small secondaries, silk-covered wire is best, but enamelled wire will be required for large secondaries, both to save space and reduce cost. A secondary may be tapped to provide alternative outputs.

This coil should first be tried with a 1½ volt battery only. With larger batteries the output is too high for the purpose in view.

A second method of circuit interruption is shown in Fig. 4. With this, the primary circuit is normally open. When the switch is depressed, a secondary voltage momentarily appears. Similarly, when the circuit is opened a second output or spark is obtained, of reversed polarity. This is convenient for large coils, or when single sparks are to be produced at will. With a low-resistance primary and accumulator, the primary circuit should be completed momentarily only, to avoid overheating.

Experimental Coils

With the simpler type of winding, it is necessary to remove the secondary before changing the primary, but unwinding can be avoided by using either of the bobbins shown in Fig. 5. That at "A" has a removable core, with small cheeks, for the primary. The secondary may thus be left intact. This type of coil also enables the degree of coupling to be adjusted at will by sliding the core, complete with primary, partly out of the secondary.

The method shown in Fig. 5 at "B" employs sectionalised windings, four cheeks being fixed securely to the core. Here, the primary may again be modified without the secondary being unwound. The secondary will be in two sections, and full output will only be obtained when these are

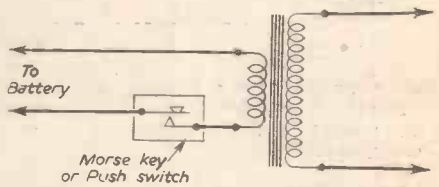


Fig. 4.—Circuit for hand interruption of primary current.

connected in series in such a way that all turns are in the same direction. A lower output can be had by using one section of the secondary only.

Details for a small coil have been given. For larger coils, much stouter wire may be used for the primary—12, 14 or 16 s.w.g. To provide high momentary currents, a 2-, 6- or 12-volt accumulator is best, though an accumu-

lator is by no means essential with even powerful coils.

For larger coils than that in Fig. 3, 4 or 8oz. of wire can be used in the secondary. The gauge is not critical. Very fine wires permit of more turns with a given bobbin, but are difficult to handle. The inner end of such windings should be soldered to thin flex, the joint being covered with insulating material and contained within the bobbin. This prevents the winding being rendered useless by the thin wire breaking away.

For large coils, 1 to 2lb. of 42 to 48 s.w.g. wire can be used. As the output can be extremely high, every care should be taken when experimenting with this type.

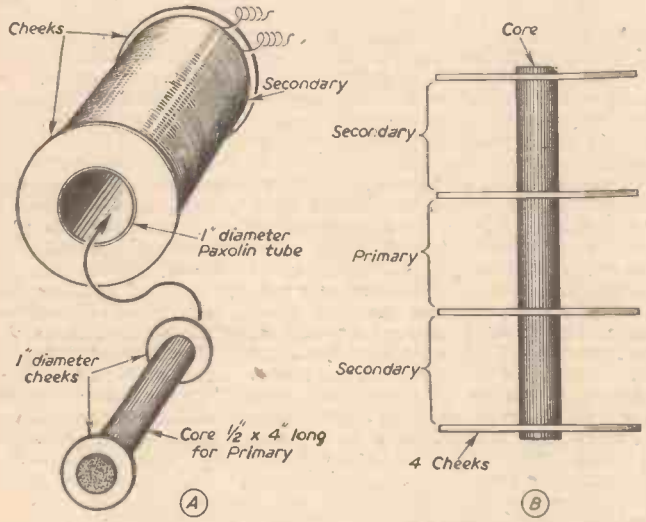


Fig. 5.—Accessible primaries for experimental coils.

Spark Gaps

A simple form of spark gap enables the relative output of coils to be compared, or allows the result of modifications to be found, if the gap is measured. Such a gap is shown in Fig. 6, and may readily be made up from oddments.

The voltage at which a specified gap will spark is not exact or constant, depending upon the sparking surfaces and other factors. However, for the purpose in view a sufficiently accurate indication can be obtained by this means, especially for comparing the result of modifications.

With a spark gap of ½ millimeter, sparking will arise with a voltage of about 3,000 to 4,000, increasing to about 5,000 to 6,000 volts with a 1 mm. gap. Larger gaps, such as 2½ mm., spark at a potential of about 10,000 volts, while gaps up to about 6 mm. require a potential of about 20,000 volts. The larger coils—e.g., ¼in. and ½in. types—should obviously be used with great care.

Sparks of 10,000 volts approach the limit possible from dry batteries of reasonable capacity. For the exact measurement of voltage by spark gap methods, the gap needs to be accurately arranged, and this is scarcely within the needs of experiments where a comparative measurement of fair accuracy is all that is required. In addition, the duration and frequency of the voltage surges need to be controlled within known limits.

Other Voltage Measuring Methods

Since the output of an induction coil is of high voltage but very low current, methods which impose a load on the secondary do not give a true indication of the voltage which may arise when no current is drawn. However, some such methods do permit of an easy and accurate measurement of output under known conditions.

The simplest method is to use a high-resistance A.C. voltmeter, but this can be used only with coils giving a continuous output. (E.g., with interruption similar to that in Fig. 3.) The meter should, for preference, not require a current greater than .1 mA. for full-scale deflection. With such a meter, a reading of 1,000 volts can be anticipated from the coil in Fig. 3. Higher voltages may be read by adding further resistors in circuit so as to obtain meter ranges of 5, 10, 15 and 20 kV.

Another method is to use a neon which strikes at known voltage, and a potential divider, illustrated in Fig. 7. Small ex-Service neons of this kind strike at about 125 to 175 volts. The exact voltage can be found by wiring neon and meter to a potential divider connected to A.C. mains, and adjusting the potential divider until the neon strikes. In this case, the meter need not be of low-consumption type, provided the potentiometer resistor circuit can pass the current required.

When the striking voltage of the neon is found, an indication of the coil output voltage can be obtained by adopting the circuit shown. For example, assuming five 2 megohm resistors are used and that the neon strikes when wired in parallel with the lower resistor only, then the total voltage will be five times that at which the neon strikes, e.g., 1,000 volts upwards, with a 200 volts neon. By adding further resistors, or wiring the neon across a 1 megohm resistor only, higher voltages may be found. In all cases the total resistance across the coil should be as high as possible.

The surge accompanying interruption of the primary circuit gives the highest output, and the neon may glow when this is done, but not when the circuit is completed. The voltage produced at the latter instant is less high, as can also be demonstrated with an adjustable spark gap.

Good insulation should be maintained in the secondary windings and connections. The type of cable used for sparking-plug leads in vehicles is suitable for the secondary circuit, and will guard against shocks or loss of power due to leakage. The output can also be increased to some extent by wiring a condenser of .5 to 2 mfd. in parallel with the contacts interrupting the primary circuit.

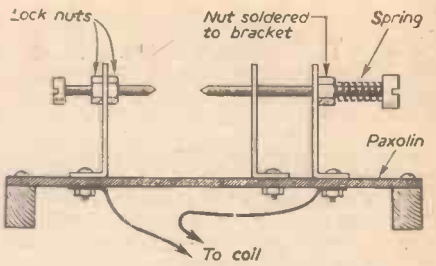


Fig. 6.—An adjustable spark gap.

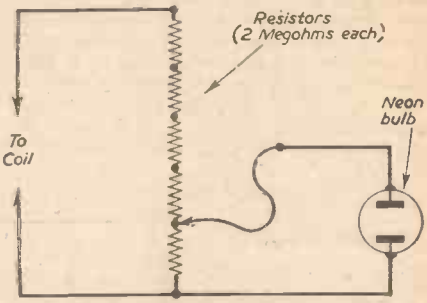


Fig. 7.—Using a neon to find voltage.

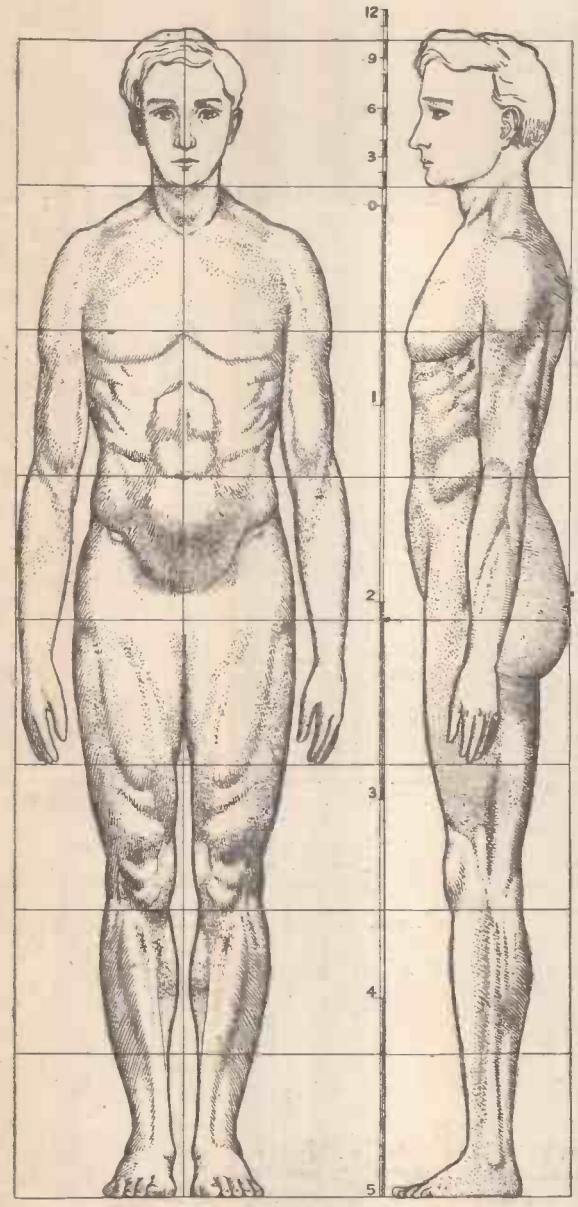
NEW B.R. TENDER ENGINE

BRITISH RAILWAYS have planned some 12 types of standard locomotive which will eventually be capable of replacing the 400 different types in service in 1948. Many of these new types are now in service.

The building of the first of the new standard Class 3 2-6-0 tender engines has now been completed at the Swindon works of the Western Region. Of the 20 locomotives to be built, 10 are to be allocated to the North Eastern Region and 10 to the Scottish Region. They were designed under the direction of Mr. R. A. Riddles at the parent office at Swindon, but certain details were undertaken at Brighton, Derby and Doncaster. These locomotives have almost universal availability over main and secondary lines throughout Britain, and are to replace various tender engines of similar power classification, now becoming obsolete.

The leading dimensions are as follows:

Cylinders (2) dia. and stroke	17½in. by 26in.
Wheels, coupled, dia. ...	5ft. 3in.
Wheels, Pony Truck, dia.	3ft.
Wheelbase, coupled ...	15ft. 4in.
Wheelbase, total engine	24ft. 1in.
Wheelbase, engine and tender	46ft. 11½in.
Heating Surface:	
Tubes	932.9 sq. ft.
Firebox	118.4 sq. ft.
Total Evaporative ...	1051.3 sq. ft.
Superheater	190 sq. ft.
Grate Area	20.35 sq. ft.
Boiler Pressure	200lb. per sq. in.
Tractive Effort ...	21.490lb.
Adhesion Factor ...	5.08
Weight of Engine ...	57 tons 9 cwt.
Weight of Engine and Tender	99 tons 12 cwt.



MAKING LAY FIGURES

Constructional Details of the Jointing Arrangements in these Useful Artists' Devices

By E. W. TWINING

JUST why figures with movable joints for the use of artists are known as "Lay" figures I do not know, and no one has ever been able to explain to me the reason for the term. They are, of course, the reverse of animate figures, yet they can be made to assume, within reasonable limits, any attitude which can be taken up by the living human body, which they are supposed to represent.

Lay figures can be of any size, from miniatures, as small as it is mechanically possible to make the movable joints, up to the full size of the natural living model. Below a certain fraction of full size they have little use, unless there are a number of them which can be arranged in a group, and then they are invaluable for studying the relative attitudes and positions of all the figures for the purpose of arranging the composition of a picture or a group of statuary. For such a purpose the figures would not need to be draped.

Draping the Figures

The chief use of lay figures by artists and in art schools lies in the placing upon them of drapery and costumes and then they ought, in the writer's opinion, to be full life-size. Whilst it is true that it is possible to make miniature costumes of any historical period and of any material, if they and the figures are not full size the costumes do not hang correctly. The folds do not come out to scale and, although they may appear passable and attractive to the eye, they would look too stiff and too thick if they were photographed. This is because whilst the lineal size of everything is reduced, the thickness of the material remains the same. Of course, different materials have different degrees of stiffness. Velvet, for instance, could not possibly be used to drape a figure much smaller than natural size, and even fine linen and cambric will not hang naturally on figures less than half full-size. Silks, too, although one could not imagine any woven material much thinner, are out of the question for small figures.

On a half-size figure, if any garment were made of velvet it would be as well to remember that it would, as regards the folds and consequent lights and shadows, represent a velvet of twice the natural thickness, which would be almost equivalent to draping a full-size figure in an Axminster carpet. This matter of scale of figure and thickness of material in draping cannot be too strongly stressed.

This article is written primarily to show the muscular form of the human body, where the joints come to enable it to fold and assume its many attitudes and how, in a model, these joints may be made. It may be pointed out that no dimensions are given in any of the accompanying drawings with the exception of scales of full-size measurements against the full-length figures (Figs. 1 and 2). From these scales the reader can construct lay figures to any size that he deems fit. The height of the figure, see Fig. 1, is 5ft. 10in., and if the lay figure is required for draping it should be not less than half full-size and for the draping the thinnest and softest cotton should be used—old, well-washed and well-worn Nainsook or Dorcas being best.

Fig. 1.—(Left) The outline and muscular contours of a male figure.

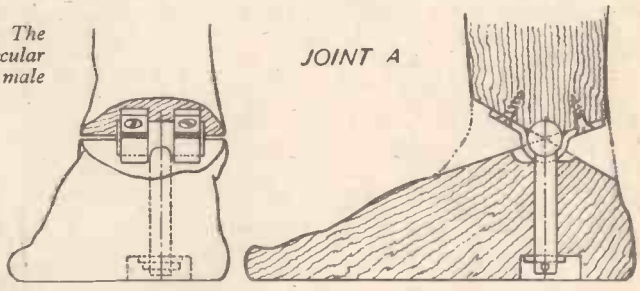


Fig. 3.—The ankle joint.

Constructional Details

Fig. 1 shows the outline and muscular contours of a standing male figure and it is these contours which should be modelled in carving from suitable woods the trunk, the head and the limbs. Everyone knows that the contours change slightly with every change in attitude: some muscles come up into greater prominence whilst others sink and move in various directions, but these changes are comparatively slight and whatever muscles come into play or into greater stress they are there all the while. There never has been a lay figure yet made which will yield exactly the same appearance as the real human body in action. So, too, with the moving joints it is quite impossible to reproduce a folded limb without cutting away some muscular portion to allow for the fold.

The main point is that in our lay figure, as may be seen from

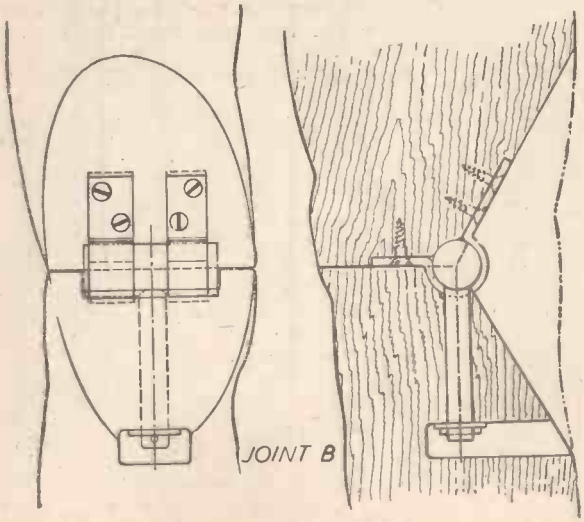


Fig. 4.—The knee joints.

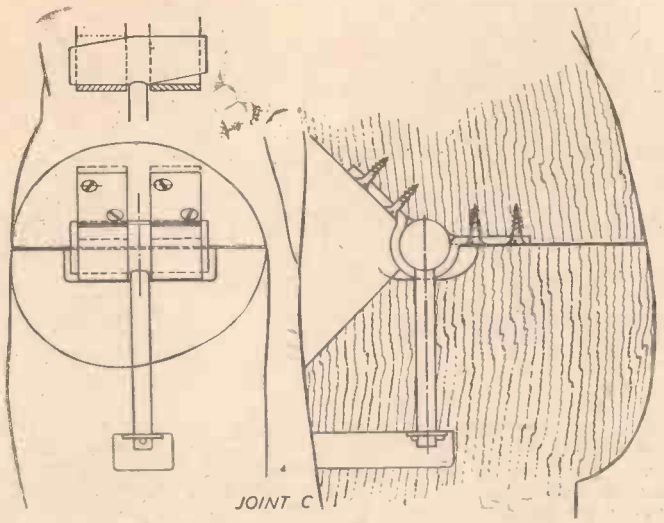


Fig. 5.—The hip joints.

Fig. 2, all the articulated joints are placed where they should be, just as if we were doing away with the tissues and modelling the bare skeleton, a drawing of which Fig. 2 actually is. In this drawing circles and rectangles indicate the directions in which the joints move. All of them have been given a letter and the remaining enlarged detail drawings, showing the joints individually, bear corresponding letters.

In every one of the joints except the neck articulation the actual movements are made round about T-shaped pivots which enable us to get radial movements in two planes at right-angles one to the other. The result of this is that the joints have all the universality of the natural joint, though not quite. The wrist joint in nature permits of twisting through a semi-circle and a radial movement each of nearly 180 deg. and a very small side-to-side movement as well. This last is not permissible by the tee-piece in the lay figure, but as the other two movements have greater range and are more common, the third has been sacrificed in joint A, Fig. 3.

The Hip Joint

The same applies to the hip joint C, Fig. 5, where in the living model a completely universal movement is possible, i.e., swinging the leg both forward and backward, bending it to a right-angle forward for assuming a sitting position and moving it a small amount outward (the right leg out to the right or the left leg to the left); the last has been omitted because it is unusual and is very unlikely to be wanted in the lay figure. Should it be wanted then it would be obtainable by tapering the head of the tee-piece a little on each side of the centre, as shown in the additional sketch at the top of joint C, Fig. 5, though it is not recommended because it reduces the bearing surfaces and consequently the possible tightness of the joint.

The Shoulder

The shoulder joint D, Fig. 6, gives in two planes all the movements which are natural, but it will be seen that to give space in which the tee-joint can move a circular recess must be cut in the body. This, however, will not matter; what *is* a pity is that the rounded shoulder of the deltoid muscle has to be cut away, though it is no worse than other parts which have to be cut, notably the thigh and part of the groin in Fig. 5.

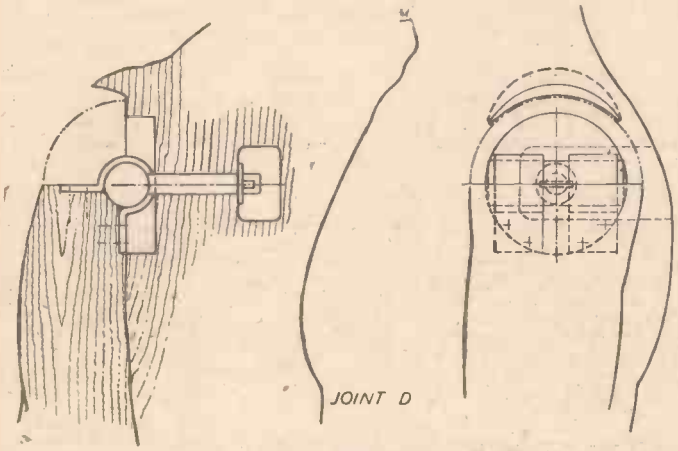


Fig. 6.—The shoulder arm joints.

The Knee Joint

The cutting away at the back of the knee joint, Fig. 4, is fortunately at the back of the leg and will not show nor interfere with the hang of draperies, but there are some joints which will interfere with draperies when the figure is in certain poses. For instance, the knee joint; if the figure is standing the draperies will probably hang satisfactorily on it, but if the pose is a seated one the kneecap will be replaced by a deep recess of 90 deg. or more in angle, and it is evident that the drapery will have no nicely rounded knee to support it. It is recommended that two carved detachable pieces be made to place upon the flat part of the upstanding lower leg and so reproduce a knee, or knees, over which the draping material can take a life-like support. When the arms are straight down at the sides the gaps at the shoulders may need something of the same kind.

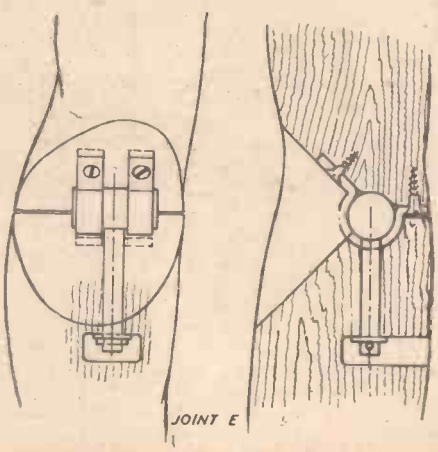


Fig. 7.—The elbow joint.

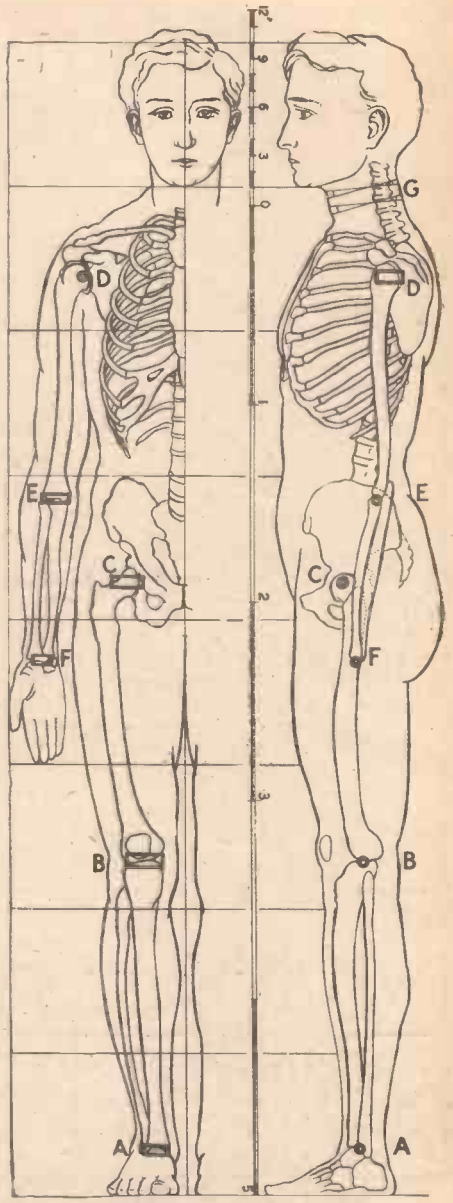


Fig. 2.—The human skeleton and positions of all the joints.

The Hands

The hands (Fig. 8) do not show much action. They are a problem and are never of use in lay figures. Except in full-size figures it is almost hopeless to articulate the fingers, and if they are ever likely to be required to hold anything, such as, for instance, a part of the dress or the draperies, it is suggested that the best plan is not to carve them or any portion of them below the wrist but to provide a pivoted socket using the same pivot as shown in Fig. 8, and in this socket (both sockets, of course) model a pair of hands in some plastic material, modelling clay, modelling wax or similar material. The same material can be used over and over again. By so modelling (and they only need to be roughly modelled) it will be possible to place them in any required position and make them actually doing something. They need not reproduce every joint in the fingers and thumb; in fact in most cases there is no need to model separate fingers.

The Joints

The tee-pieces of all the joints should have fairly large diameters, the horizontal top bar of the tee being much larger than the vertical bar. They may vary somewhat in

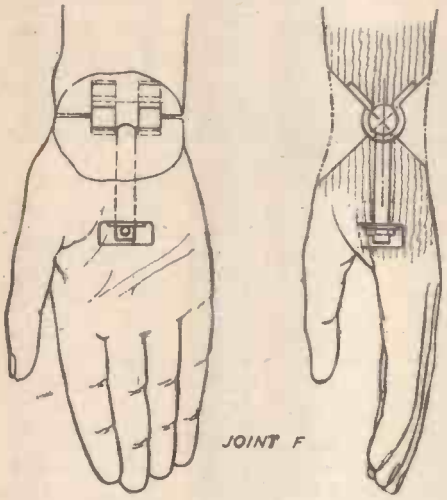


Fig. 8.—The wrist joint.

size, for the shoulder, hip and knee joints have to take greater frictional strains in order to support the limbs. For a life-size figure these top bars should be quite 1in. in diameter. They are clipped by and work in a clamping band which must put considerable pressure upon them, and they must, therefore, be quite a tight fit in these. To make the tee-pieces the large, horizontal pivots are drilled at their centres and the longer leg of smaller diameter (the vertical bar of the tee) should be slightly shouldered down to fit the drilled hole, knocked into the hole and sweated with solder. At the other end (the tail end) the vertical bar of the tee is fitted with a washer, is drilled and a taper pin pushed in. This pin should not only be a tight fit in itself but must make the long leg of the tee work tightly in the wood.

The Neck

The neck joints are shown at G, Fig. 9. These form what is a perfectly universal movement for the head. There are really two joints as shown; the head and middle portion of the neck are pivoted on a strong cord which is anchored at the bottom in a hole by gluing and a hardwood peg driven down the hole. At the top of the head the cord is locked by a couple of screws holding down washers over the cord. The head is capable of being turned to right or left and inclined to right or left. By loosening the top joint it can be made to look upward or downward and by means of the bottom joint it can be thrown backward and upward or forward and downward. Whatever may be the attitude of the head, little wedges, preferably of cork, will be required to hold in it place. For the cord a good blind cord is recommended.

With regard to the nature of the wood for carving: this had better be light in weight, and it is suggested that nothing could be better than yellow pine or Siberian pine or any kind of light wood which does not possess hard and soft grain alternately. Some dry deals are beautiful for carving.

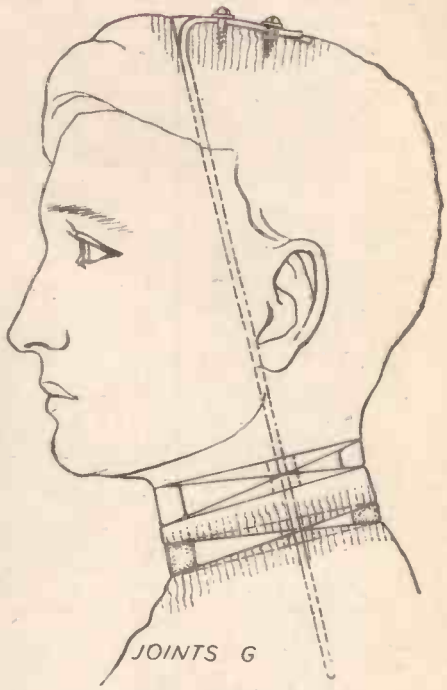


Fig. 9.—The neck joints.

A Simple Electrical Game

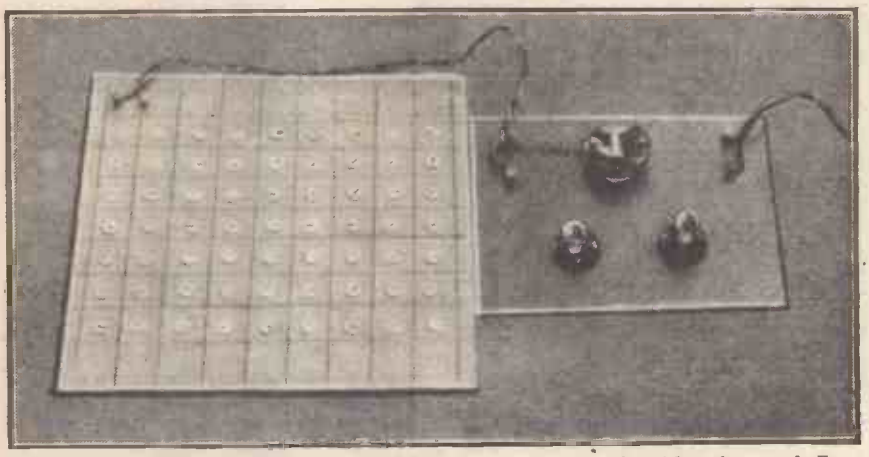
An Amusing Game of Chance for the Party

THE game illustrated is suitable for amusement purposes at a party, etc., and is extremely simple to construct, yet effective in action. When connected up and switched on, a green bulb lights and remains illuminated until the circuit to the relay is completed, when the green bulb goes out and the red bulb lights. The relay circuit is completed when a coin falls across two of the drawing pin heads which are connected to different sides of the circuit. The competitor's aim is thus to toss or roll as many coins as possible upon the board before causing the red bulb to come on.

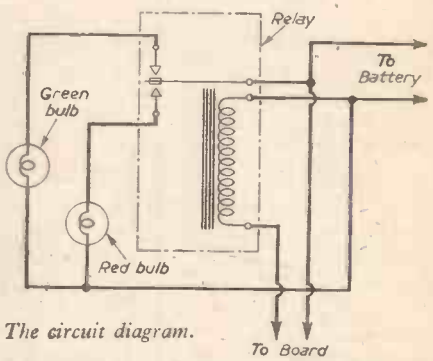
The board itself is of strong cardboard, ruled in one inch squares. A drawing pin is pushed through the centre of each square, as shown. The whole is then turned over, and approximately half the pins are connected together by twisting thin tinned copper wire from point to point, the wire terminating at a small terminal. The pin points to which the wire is taken are then turned down with pliers. A sheet of stout paper large enough to cover all the pin points is then pressed down upon the underside of the board so that the remaining drawing pins pierce it. The projecting points are connected together, and to a second terminal, by means of a further length of thin wire. Crossing wires are prevented from contact by the stout paper.

The circuit diagram shows all connections, and the relay can be of any simple type which will operate from any convenient 3 or 4½v. dry battery. When the winding is not energised, the armature completes the circuit to the green bulb; when energised, the circuit is transferred to the red bulb. The relay, two bulb-holders, and terminals for battery and board connections, are mounted upon a second piece of any insulating material, connections being underneath. Two 3.5v. flashlamp bulbs are suitable.

A simple channel down which coins may be rolled from a fixed distance can be made from thin metal or wood. To avoid disconnecting the battery, an on/off switch of any type may be added in one battery lead. If coloured bulbs are not to hand, transparent coloured paper may be tied over clear bulbs.



A photograph of the completed game showing the relay and the red and green bulbs.



The circuit diagram.

Making a ROWING MACHINE

A Keep-fit Device to Make and Use in the Home

A perspective sketch of the rowing machine in use.

THIS apparatus is quite easy and inexpensive to make, is equally suitable for the home or club, and is not only useful to those who are keen athletes, but will also help the ordinary individual to keep fit.

The heading illustration shows the machine in use, from which it will be gathered that it is made with a bottom frame, which is fitted at one end with a sliding seat and at the other with a foot-rest. Outriggers are fixed at each side of the frame and on these the oars or rowing handles are pivoted. The "pull" is obtained by running a length of strong cord from the ends of the oars through pulleys at the back of the frame to a short bar connected to a number of springs fitted across the frame under the seat.

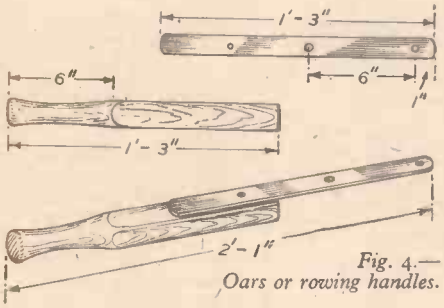


Fig. 4.—Oars or rowing handles.

The Materials Required

Good quality deal is suitable for making the machine, although, if it is used to a great extent, hardwood such as ash or birch will give better service. The frame should be made first, the dimensions and method of construction being shown in Figs. 1, 2 and 3.

The sides are 4ft. 3in. long by 3½in. wide by 1in. thick, and they are prepared by cutting grooves 1in. wide by ¼in. deep right across, 1in. from the end for the reception of the front bar. Another groove of the same size is cut 2½in. up from the bottom edge, exactly in the centre, for the reception of the centre bar, and a recess 1ft. 6in. long by ¼in. deep is cut in the bottom edge at the back for the reception of the bottom boards.

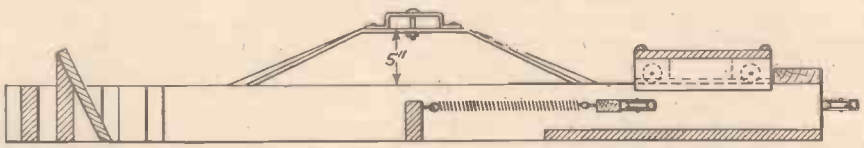


Fig. 1.—A sectional elevation.

Three other grooves ¾in. wide by ⅜in. deep are cut near the front to receive the foot-rest, the front groove being spaced 1in. in from the front bar and the others 1½in. apart. The sides are joined by a front bar 1ft. 0½in. long by 3½in. wide by 1in. thick, a centre bar 1ft. 0½in. long by 2½in. wide by 1in. thick, a back bar 1ft. 2in. long by 3in. wide by 1in. thick and a bottom 1ft. 2in. long by 1ft. 6in. wide by ¼in. thick, made up in two or three widths as may be convenient. The front and centre bars are fitted into the grooves provided, and are nailed through the sides, the joints being glued. The back bar is simply screwed at the top edges of the sides, while the bottom is fitted in the recesses in the bottom edges of the sides and screwed in place.

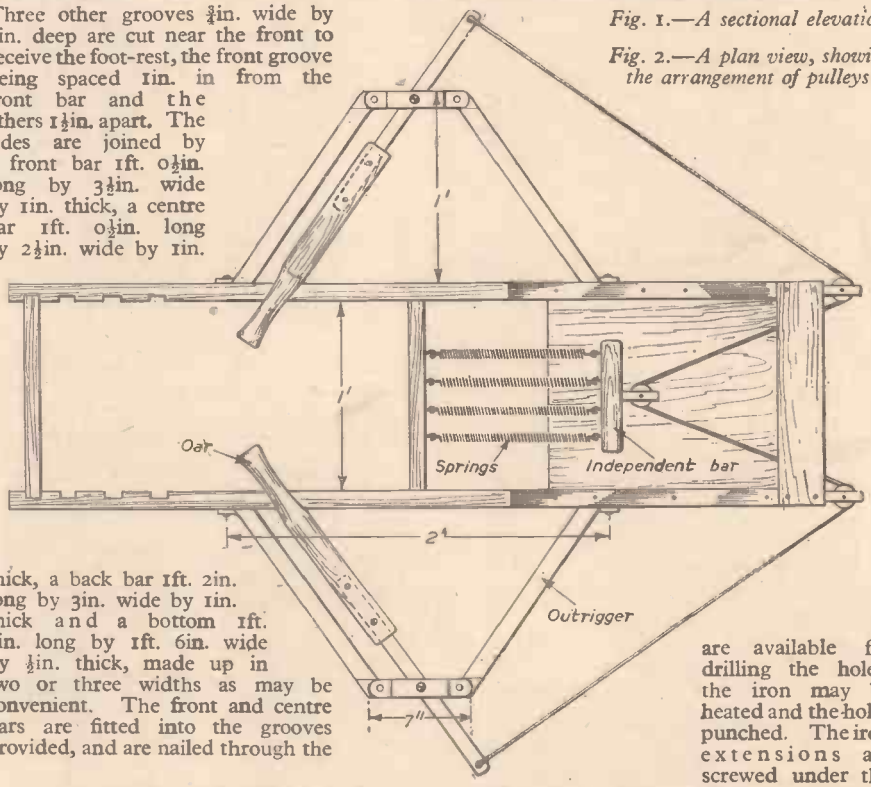


Fig. 2.—A plan view, showing the arrangement of pulleys.

The Oars or Rowing Handles

These are made partly of wood and partly of iron, as shown in Fig. 4. The wooden portions are 1ft. 3in. long by 1½in. square, worked up to the section shown, and suitably shaped for the hands for a length of about 6in. The extension pieces are 1ft. 3in. long, the iron being about 1in. by ¼in. section. Two screw holes are provided at one end, a larger one for fitting to the outrigger and another for attaching the pulling cord. If no means are available for drilling the holes, the iron may be heated and the holes punched. The iron extensions are screwed under the wood handles as shown in Figs. 2 and 4. The outriggers may be made in either of the ways shown in Fig. 5. Iron 1in. wide by at least ¼in. thick should be used, and they are turned up to the shape and dimensions shown at Figs. 1, 2 and 5. The feet at the ends should be about 3½in. long and provided with two holes for fixing to the sides of the frame with wood screws or bolts. A spill could be riveted into the centre of the straight portion of each outrigger for attaching the oar, the end being screwed and fitted with a nut to prevent the oar working off. A more satisfactory method, however, is to fit a long staple above the straight portion of the outrigger, riveting it in place, and fitting a bolt through the staple and outrigger by means of

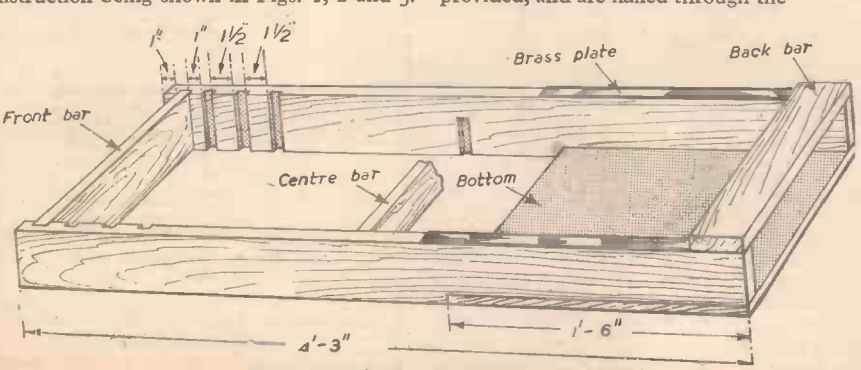


Fig. 3.—Details of the bottom frame.

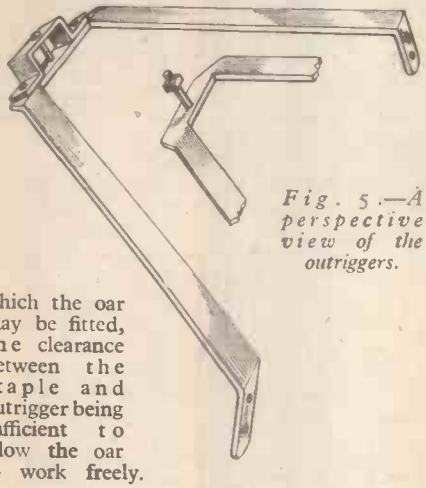


Fig. 5.—A perspective view of the outriggers.

which the oar may be fitted, the clearance between the staple and outrigger being sufficient to allow the oar to work freely.

The Oar Springs

The plan of the machine given in Fig. 2 shows the way in which the oars are connected to the springs and the method of arranging the cord. The springs should be about 10in. long and of the kind used in gymnasium equipment; they are attached by means of screw hooks to the centre bar of the frame and to another independent bar at the other end, which should be from 6in. to 8in. long by 2in. wide by 1in. thick. Pulleys are fixed to the ends of the frame and to the independent bar, and the cord is run from the end of one oar over the pulley at the side of the frame to the pulley on the independent bar, then through the pulley at the other side of the frame to the end of the other oar. The number of springs and the length of cord may be adjusted to suit individual requirements, but it will be generally found that four springs, as shown in Fig. 2, will be sufficient. Stout elastic may be used in place of the springs, but it will be less satisfactory and will weaken quickly if the machine is used to any great extent. The foot-rest shown in Fig. 6 has a back 1ft. 0¾in. long by 6in. wide by ¾in. thick, made to fit into the grooves in the sides of the frame. Triangular-shaped pieces of wood 4in. high by 1½in. wide by ¾in. thick are nailed ⅜in. from the ends, the top edge of the back is planed level with the

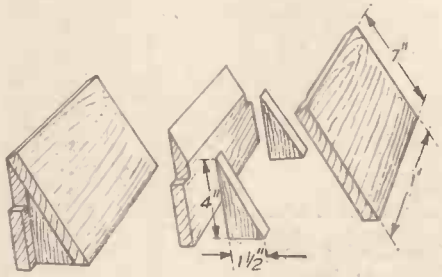


Fig. 6.—The foot-rest.

triangular pieces, and a front 1ft. long by 7in. wide by ⅜in. thick is nailed on to complete the foot-rest. Small portions of the ends of the back are cleaned off level with the triangular pieces and front. It will be found that the machine will be worked easier if the feet are strapped to the foot-rest.

The Seat

This is made as shown in Fig. 7. The seat board is 1ft. 2in. long by 11in. wide by 1in. thick. Guide pieces 11in. long by 3in. wide by 1in. thick are glued and screwed under the board 1in. in from the ends. A spacing block 5in. long by 2in. wide by ¾in. thick is fixed outside each guide piece, and outside this again a covering piece 11in. long by 2in. wide by ½in. thick is fixed, the latter being screwed to the spacing block and through the seat. Small brass or iron wheels 2in. diameter by ¾in. thick are arranged to revolve between the guide and covering pieces, two wheels being placed at each side. Thin washers should be inserted on each side of the wheels, and screws are run through the covering pieces into the guide pieces to fix them. Small half-round battens could be nailed across the front and back eges of the seat to

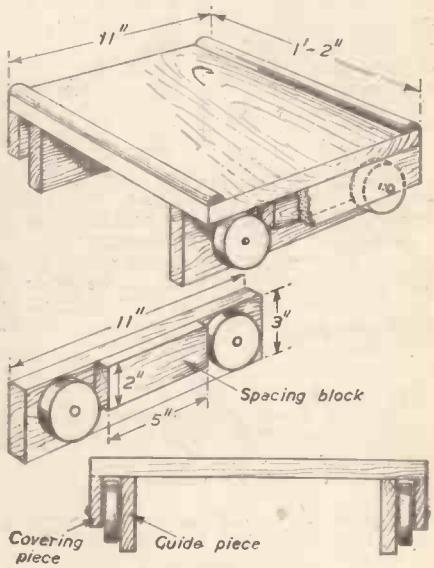


Fig. 7.—The seat.

prevent slipping when the machine is in use. It is also a good plan to arrange small brass plates on the top edges of the frame to take the wear of the wheels.

BLACK NICKEL PLATING

How to Obtain a Fine Metallic Black Finish to Models, Ornaments, etc.

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

The Solution

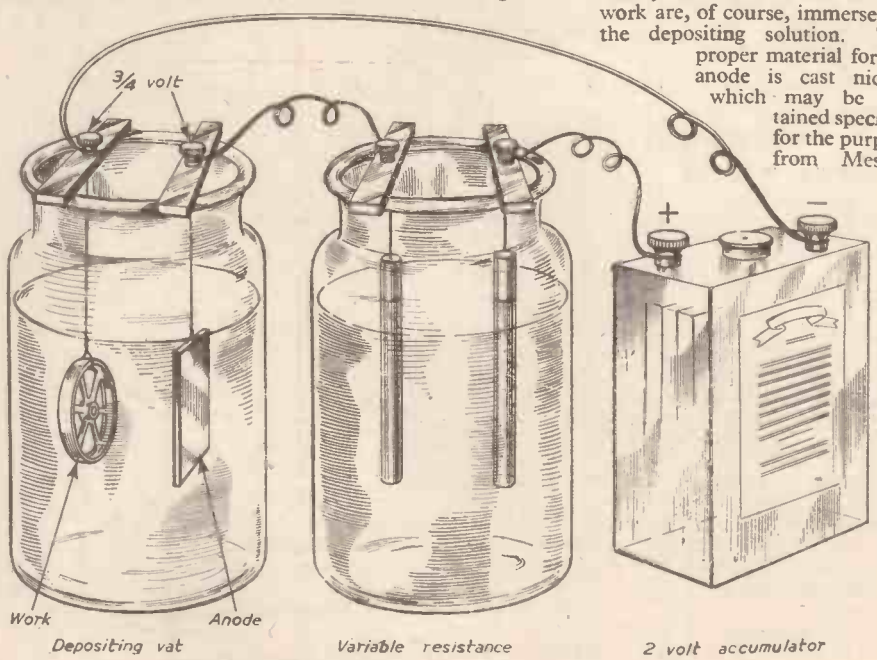
Small parts may be done at home using a jar of suitable size for a vat and a two-volt accumulator for the electrical supply. This voltage is too high for our purpose, so a resistance will also be necessary, but this will be referred to again later.

The solution for the depositing vat is made up as follows:—

Nickel-ammonium sulphate	...	2 oz.
Ammonium sulphocyanide	...	½ oz.
Zinc sulphate	...	¼ oz.
Warm water	...	1 qt.

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

An anode of some kind must be provided, the anode being connected to the positive terminal of the accumulator, and the work which is to be plated connected to the negative terminal; both the anode and the work are, of course, immersed in the depositing solution. The proper material for the anode is cast nickel, which may be obtained specially for the purpose from Messrs.



The arrangement of apparatus for black nickel plating.

Canning and Co., Ltd., Great Hampton Street, Birmingham, but if you intend to plate only one or two small articles a carbon rod (obtainable from an old dry battery of the electric bell type) may be used. With a proper anode the nickel dissolves away, thus maintaining the strength of the solution, but with a carbon anode the solution becomes impoverished and must be strengthened up by the addition of chemicals from time to time. The work should be kept well clear of the anode, say, from 4in. to 6in. away, and should be turned during the process of depositing, otherwise the side away from the anode will have less deposit than the near side. If two anodes are used, one on each side of the work, turning is not necessary.

The Resistance

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

The Preliminary Cleaning

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

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

A Home-made Pick-up

An Inexpensive Instrument for the Gramophone Enthusiast

By H. CANALE

THE pick-up described in this article can be constructed quite simply for the outlay of one shilling—the cost of an "Eclipse" button magnet, plus a few oddments usually found in the home workshop.

Fig. 1 shows the constructional details of the magnetic cartridge assembly: magnet (1), pole pieces (2), and coil (3). The pole pieces are made by drilling and sawing to shape the keeper supplied with the magnet, while the

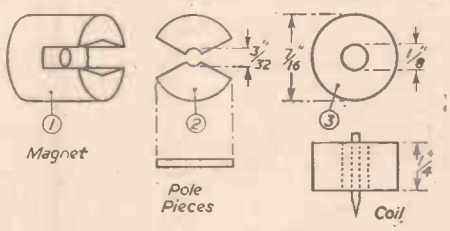


Fig. 1.—Magnetic cartridge assembly.

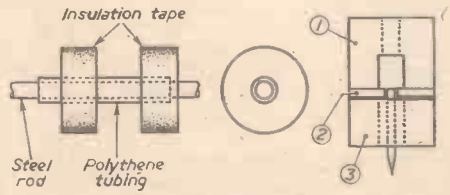


Fig. 2.—The temporary coil former, and Fig. 3, the assembled cartridge.

coil is of the self-supporting type wound on the temporary former shown in Fig. 2.

Make the former by slipping a piece of polythene tube on to a steel rod and wrapping insulating tape round it to form temporary walls. Coat the inside of the former with cellulose cement and, using 40-gauge wire, commence winding, a layer of cement being applied after each layer of wire. When complete, remove the walls and withdraw the rod, the coil then slips easily off the polythene tube.

After the cement has hardened, insert a piece of soft rubber into the centre of the coil, then push a semi-permanent miniature needle

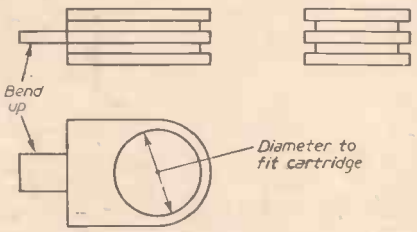


Fig. 4.—The pick-up head.

through the rubber as shown in (3) of Fig. 1. Cement pole pieces (2) to the coil, keeping the needle centrally in the aperture and assemble as in Fig. 3. This can now be inserted into a piece of thin-walled brass tube. Those with sisters will find that an old lipstick case will do admirably.

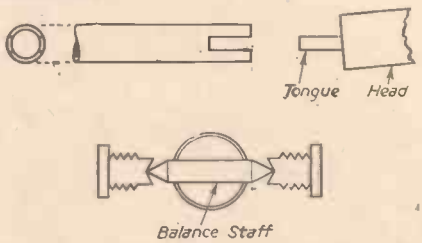


Fig. 6.—The vertical movement arrangement.

The design of the arm is purely an individual matter; a suggested design is shown in Fig. 7 and details of the head may be seen in Fig. 4.

Only a brief outline of the arm and head will be given, but mention must be made of the necessity for perfect freedom of movement in both the lateral and vertical planes, as any stickiness in the bearings will prevent perfect tracking.

For the vertical movement it will be found that the balance-staff and bearings from an old alarm clock are ideal, while a brass block drilled to a good fit for a silver steel pin and having a ballbearing at the foot is satisfactory for the lateral movement. Details will be found in Figs. 5 and 6 which are self-explanatory.

Three graduated pieces of brass tube form the arm. In my case, ¼in. tube was unobtainable, so a sawcut was made along a length of copper rod to take the leads from the cartridge. Some form of balance-weight is necessary to prevent too heavy needle pressure on the records; either pieces of lead inserted into the rear of the arm, or a steel block drilled to fit the outside, will do.

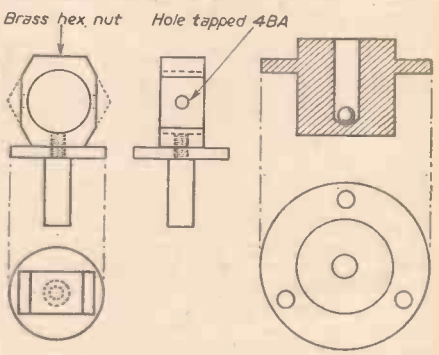


Fig. 5.—The arrangement to allow horizontal movement.

For appearance a cover can be made for the pivot, and the whole unit plated. Cadmium was used and was found to impart a more pleasing finish than the usual chrome.

Compared with more expensive pick-ups, the reproduction is quite amazing and is far superior to the "standard" commercial type.

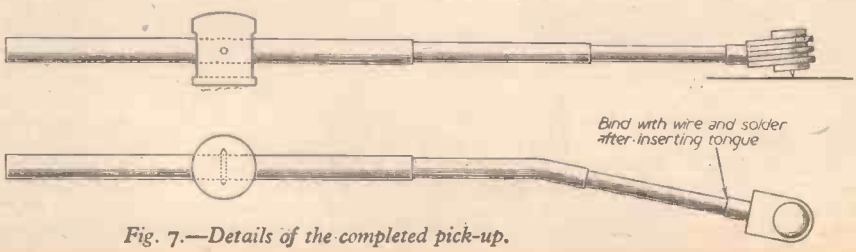


Fig. 7.—Details of the completed pick-up.

Small Wind Power Plants

3.—Constructional Details of a Serviceable Unit

(Continued from the June issue.)

This series of articles was first published in "Practical Mechanics" in 1944, and is now being reprinted in response to readers' requests.

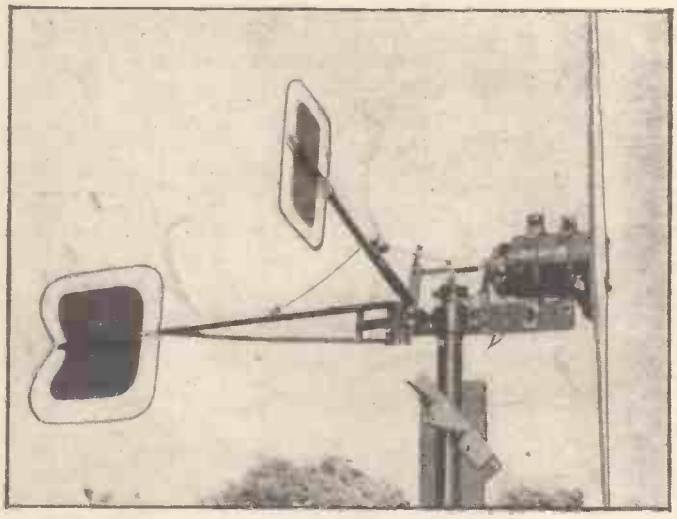
LAST month we described how to rewind a Lucas A900C dynamo to make it charge at low speeds for windcharger use. In this article, instructions are given for building a good windcharger with this particular dynamo.

Turntable and Slip Ring

The turntable is built on the lines suggested in the first article of the series. Two iron pipes (1) and (2), Fig. 1, about 2in. and 2½in. diameter and 3ft. long, fit closely together in one another. The cross-arm, which carries the dynamo and tail, is made from two flat iron bars (32) Figs. 2 and 3, bent at the local forge, and bolted around the inside pipe. In the photographic illustrations these bars are 3in. x ¼in., but something lighter would do quite well, although they should be wide enough to take four ¼in. bolts to secure them to the pipe. The bars lie flat against each other on the side that holds the dynamo, but a space of ¼in. is allowed on the short side for tightening purposes. The bottom of the outside pipe is closed by a wooden block (4), Fig. 1, 3in. or 4in. long, driven tightly into the pipe. A length of copper or brass tube (3) fits tightly in this block and passes up through the turntable to carry the control rope (35), Fig. 3, through the oil reservoir (7). This is filled through the opening (8) with heavy motor oil when the whole machine is finally mounted on its pole.

The filler (8) is made by tapping a wander-plug socket into a ⅜in. slanting hole. The oil is poured through a piece of rubber tube joining the filler to a funnel laced to the side of the windcharger on a calm day. The copper pipe also carries the positive connection from the slip-ring (6) to the cable (9), Fig. 2. This slip-ring is made of brass. The case from an old headphone earpiece, with the bottom cut off, will generally do for the purpose. It is driven on to the wooden block (5), which also serves as a support to centre the top of the copper pipe. If it is available a short piece of pipe (not shown), which fits closely outside the copper pipe, is hammered into the hole in block (5) to act as a "bearing" for the copper pipe, and to prevent enlargement of the hole in the block. If necessary, slip-ring and wooden blocks are all secured by countersunk woodscrews, but they should all fit so that considerable force is necessary to drive them home. A piece of brass acts as a soldering tag for the slip-ring.

The brush ring (15), Fig. 2, is taken from a Ford self-starter, and contains four heavy copper brushes. The two insulated ones are removed, leaving the two diametrically opposite earthed brushes. It is attached by any convenient method to the copper pipe. In the illustration it is soldered by four small brass brackets to a clip, made from sheet brass, which bolts around the copper pipe. Alternatively, the slip-ring may be attached to the copper pipe, and the brushes bolted to the two pieces of angle-iron which hold the rope pulley-drum. They must, in this case, be insulated from the angle-iron and connected together by rubber covered cable. Two connecting clips (10) and (11), made from ½in.-wide copper strip, are bolted in position before the pipes receive their first coat of enamel. The dynamo is fixed on the turntable by two iron rings (21) (22). Here, again, the assistance of the nearest blacksmith is needed.



(Above)—General view of the windcharger described in the text.

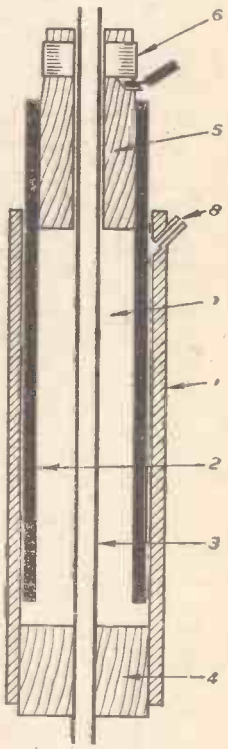


Fig. 1 (Right)—Section through turntable and supporting tube.

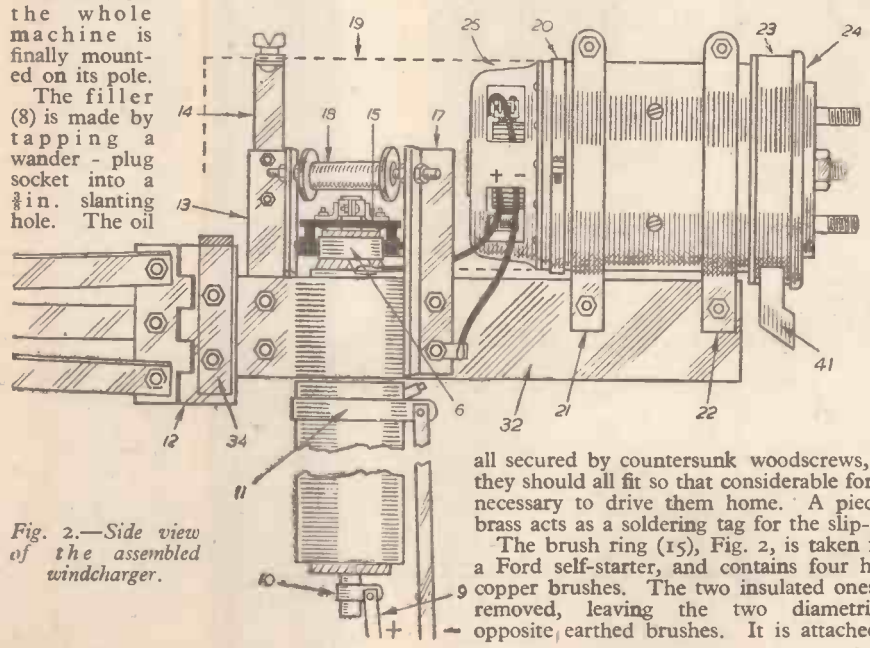


Fig. 2.—Side view of the assembled windcharger.

Braking System

In building a home-made windcharger, the braking system presents the greatest problem in the whole design. Commercial units follow three systems: (I) an internal expanding friction brake working on a drum at the front of the dynamo. (II) A dynamo mounting which tilts up to a vertical position. (III) A swinging tail-vane shut off. The first type is very efficient and simple, but does not lend itself to home construction. An internal brake drum on this dynamo would be awkwardly large, whereas an external brake element usually burns out in the first storm. Besides, the problem of governing would not be helped in any way by this system.

Type II is very simple in theory, but drastically weakens a vital point in the construction of the unit. A dynamo held to the turn-

table by a single bearing will sooner or later vibrate itself off. The only hope of survival in a home-made plant lies in exceptionally strong construction.

Type III is really the only brake that can be used easily on a home-made plant, and it also solves the question of governing. The main tail is held by a hinge (12), bolted to the cross-arm. The writer was doubtful about the strength of such an arrangement, but it has proved quite efficient. A good hinge, with at least four " bearings," is needed.

The tail is held in position by a rubber band (30) Fig. 3, cut from a strong motor tube, and stretched between two large cotton spools. A rubber band is easier to mount, and works more efficiently than a steel spring. The arm (29), which carries one cotton spool, also acts as a stop to limit the position of the tail, which is variable by changing the spacing nuts (27) (28).

To shut off the windcharger, the tail is pulled to one side by the rope, turning the dynamo and propeller out of the wind. A great advantage of this type of brake is that the machine may be shut off to any extent required, so that it acts as a " trickle-charger " to maintain the batteries in a full condition. During winter months it is well

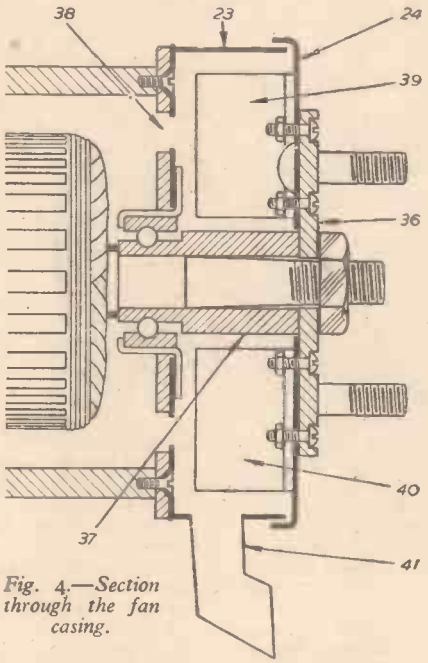


Fig. 4.—Section through the fan casing.

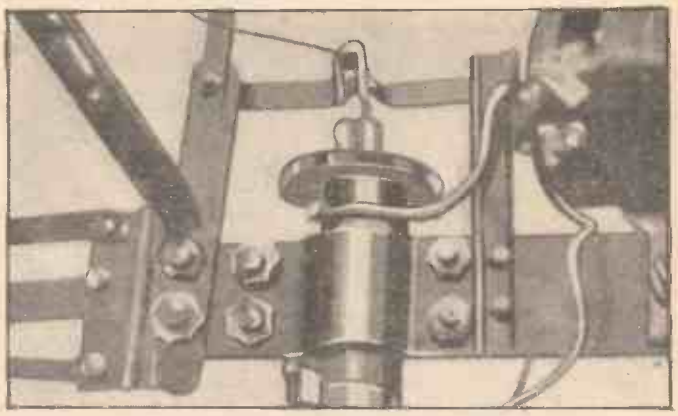
to make a habit of half-shutting off the windcharger last thing at night in case of storms.

The pulley (18) is made from an empty wire spool, mounted on the axle of a bicycle wheel between two pieces of angle-iron. These 1¼in. or 1½in. angle-irons (13) (17) are slightly opened and closed in a vice to give the slope necessary for the pulley-drum, and are mounted on opposite sides of the turntable to bring the drum into position above the copper tube. This necessitates cutting away a piece of the upright (13) as shown in Fig. 2. A more efficient and durable pulley is obtained by mounting a complete bicycle rear hub instead of the wooden spool. The upright (13) also carries the bracket (14) which holds the rain cover in position.

The second pulley (26) is bolted to a right-angle bracket (34) held by the bolts which secure the hinge, see Fig. 3. Two pieces of aluminium are bent round this pulley to form guards for keeping the rope in the pulley-groove. The pulley should be at least 12in. from the turntable. Remember that wire cannot be used instead of rope, since it would short-circuit the dynamo.

Action of Governor

The bracket that holds the second pulley-wheel also has attached to it a length of light 1in. angle iron or circular tube with the governing vane on its end. The operation of this governor is extremely simple. When the wind pressure on the side vane becomes sufficiently great to stretch the rubber, the side vane closes up with the main tail, turning the dynamo and propeller to one side. When the wind falls, the rubber pulls the dynamo into the normal position again. The main tail is so large that it acts as an " anchor " in space, against which the side-tail and the rubber exert opposing forces. The length and area of the side tail is best found by trial while " running in " the finished wind-charger on a small experimental pole, erected temporarily in a windy spot. Three feet is a suitable length to try, with a vane about 12in. square.



Enlarged detail of the turntable and fittings.

There is a very important point to be observed in the construction of this governor. The line drawings and photographs were made on an anti-clockwise windcharger, so that for a clockwise dynamo the side-tail would have to be on the other side from that illustrated. The reason for this distinction would take too much space to explain but will be obvious to many readers. If built on the wrong side, the side-tail will refuse to work. The side-tail needs to be strengthened by a length of wire stretched from its end to the clamping ring (22). The vane must also be reinforced by several light bars bolted along its rear side. The tension in the rubber band is made adjustable by attaching the second spool to a long bolt whose head has been removed, passing the bolt through a hole in a small bracket, and screwing the nut to any position required. The main-tail is displaced a few degrees by reducing the spacing nuts (28) to balance the permanent pressure against the side-tail.

If a side governor is used, the tail vane should be not less than 20in. square. Never use a flat iron bar to hold a windcharger tail. It can vibrate in one direction, and soon breaks off at the " node " of this vibration. Angle iron, or tubing, is rigid in all directions. The rain cover (19) is made from tinplate, soldered at the edges, and with a " porch " at one side for the rope. It is held by the band (20) and the bracket (14), and adds greatly to the appearance of the finished unit.

Cooling Fan

Those who wish may add a forced draught cooling fan to the front of this dynamo. As well as increasing the permissible charging current, it completely protects the front bearing from rain. Even if no fan blades are fitted, it is worth while to add the casing for this latter purpose alone. A small cake tin (23), with a diameter the same as that of the front plate of the dynamo, is held in position by the screws that hold the front plate. The screwheads will force the tin to the shape of the countersunk holes. Six ⅜in. holes (38) are drilled through the tin and front plate. Two intake " scoops " (41), Figs. 2 and 4, are shaped and soldered to the bottom of the cake tin, where they will pick up the least rain. One of these can be seen in the general view in the photograph.

The plate which holds the propeller to the axle (36) is spaced as far as possible from the dynamo by the piece of pipe (37) which presses against the inside race of the dynamo bearing. To the back of this plate is attached a lid (24) of a second cake tin, so that it overlaps the first by ½in. A loop of wire is soldered to act as a rim for the first tin, where it has been cut short, so that no water will make its way between the two tins when the machine is shut off on a rainy day.

Six aluminium fan blades are bolted symmetrically around the plate by six B.A. bolts, countersunk on the front plate. These blades are bent to an angle of 45 deg. The top one (39) is bent upwards over the head of the propeller bolt, which it then holds in position, and the bottom one is bent downwards, also over the head of the other propeller bolt. The air draught emerges through the brush inspection holes and the gap (25) Fig. 2. A strong plate, 6in. by 4½in., is used as a " washer " between the front of the propeller blade and the two nuts that hold it, since large local strains in the timber cause it to split at high speeds. A single 1 mfd. condenser is connected across the brushes, to prevent radio interference.

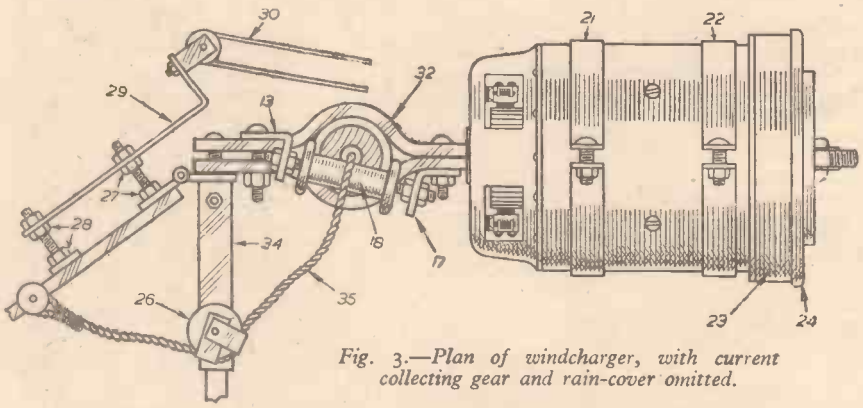


Fig. 3.—Plan of windcharger, with current collecting gear and rain-cover omitted.

(To be continued)

The Aqualung

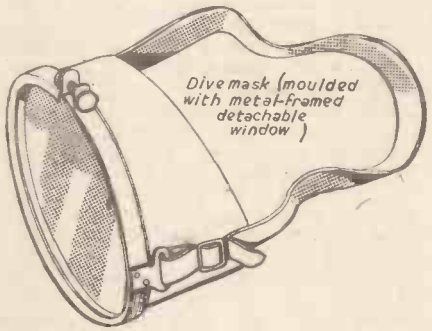
A Light, Compact Diving Apparatus Which May be Used With Equal Facility for Pleasure or Utilitarian Purposes

THE sport of underwater swimming, fishing and exploration is becoming increasingly popular in many different parts of the globe, but mainly in America. It is best suited, of course, to those places with tropical or semi-tropical water conditions, but in England, during the summer months, the temperature is suitable for this kind of aquatic sport.

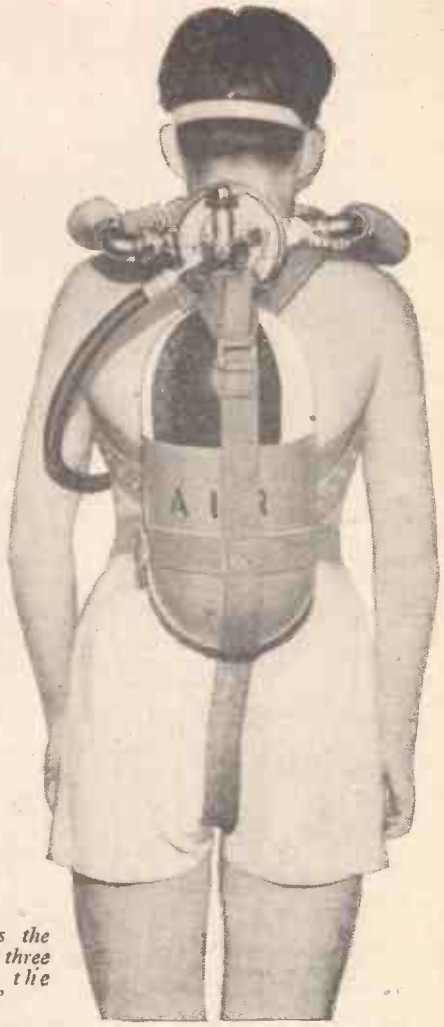
The Aqualung was popularised by Captain Cousteau, the famous French underwater explorer, and is made in this country under licence by Siebe Gorman and Co., Ltd., Davis Road, Tolworth, Surrey, who are experts in all matters connected with diving and, during the war, were responsible for producing the frogman suits, human torpedo suits, etc.

Types of Aqualung

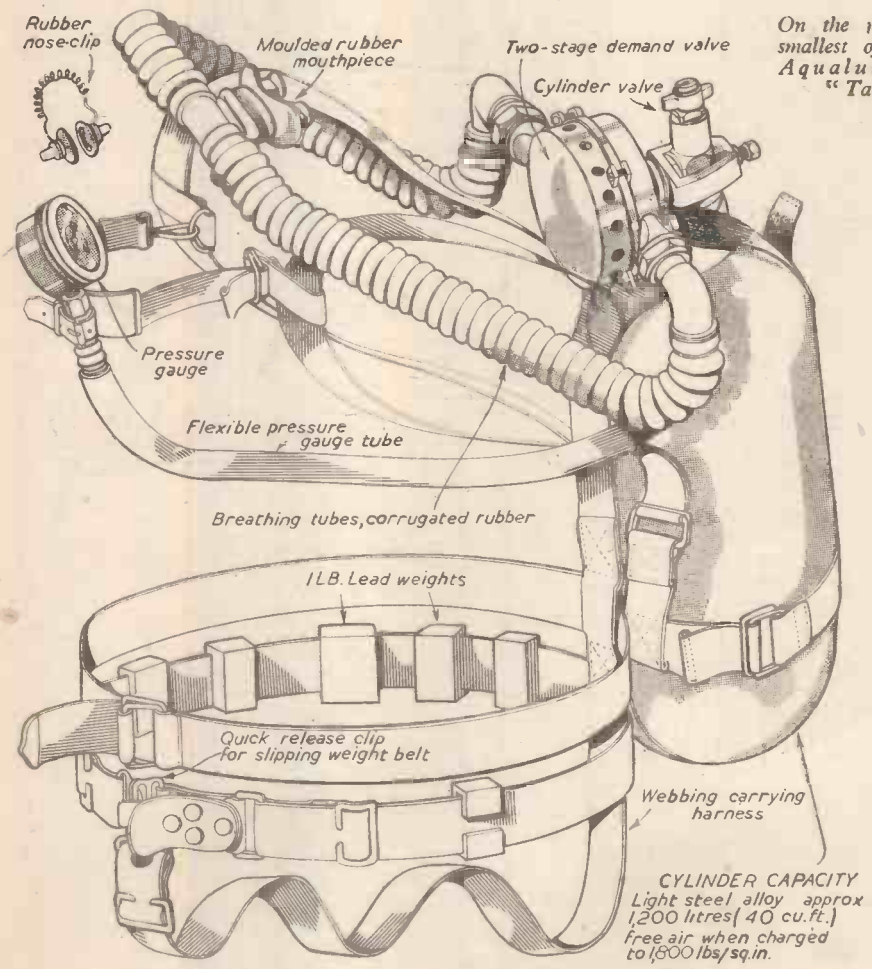
This apparatus is in three sizes: the Standard "Essjee" Aqualung with one compressed air cylinder, the Twin "Essjee" Aqualung with two compressed air cylinders, and the Junior "Tadpole" Aqualung with one small compressed air cylinder. They consist of one or two cylinders of compressed air strapped to the swimmer's back in a webbing harness, including a belt with lead weights suspended on it (see diagram). Each of the cylinders is capable of holding 40 cu. ft. of air when fully charged to 1,800lb./sq. in., and the air flowing to the lungs is regulated and reduced to the pressure of the surrounding water by a two-stage demand valve. The air travels by means of a corrugated pipe to a mouthpiece and the exhaled carbon dioxide passes into the surrounding water via another corrugated pipe and an outlet valve. A pressure-gauge registers the amount of air in the cylinders. The units weigh 20, 25 and 50lb. respectively in air, but, of course, under water weigh practically nothing.



The dive mask used in conjunction with the Aqualung.



On the right is the smallest of the three Aqualungs, the "Tadpole."



The general layout of the "Essjee" Standard Aqualung.

The operating depths and times, assuming light exertion, are as follow:

Depth	Standard	Twin	Tadpole
10-12ft.	35 mins.	1 hr. 10 mins.	24 mins.
33ft.	22 mins.	44 mins.	12 mins.
60ft.	15 mins.	30 mins.	—
100ft.	10mins.	20 mins.	—

Used in conjunction with the equipment is a diving mask which covers the eyes and nose, and large rubber flippers are fitted to the feet. Cylinders may be recharged by the British Oxygen Co., Ltd., at any of their depots. Also supplied by Siebe Gorman is a special sponge rubber suit for protracted diving in very cold water. The use of the Aqualung in conjunction with this suit suggests many other more utilitarian purposes, such as inspecting dock walls, oyster-bed cultivation, pearl and sponge diving, inspection of underwater cables, and many others.

Building a

Full Constructional D

THE catamaran, with its twin hulls, is one of the earliest forms of water craft, and is still used by some of the more primitive peoples of the world. It doubtless owes some of its popularity to the fact that a hollowed-out tree trunk forms a simple but effective method of float construction. The catamaran is very much simpler to build than the more conventional, larger, single-hull craft; it draws very little water and can be safely navigated in weedy rivers and lakes; it is practically impossible to capsize and very difficult for it to sink, and, finally, with the floats unbolted, it could be stowed on the roof of a 10 h.p. car. Thus, simplicity of construction, safety in use, easy portability and shallow draft make this type of craft ideal for the amateur handyman and his family.

General Description

It is unnecessary to give a great number of details under this heading, as the cover plate gives a good general idea of the finished catamaran. The chief dimensions, however, are: floats, 11ft. 3in. overall; beam, 6ft. 8in.; cockpit, 7ft. 2in. x 3ft. 10in. (ample room for two); mast, 14ft.; boom, 8ft. A battened Bermudan mainsail is used. The catamaran is fitted with a centre board, and steering is by two rudders (one in each pontoon) which are linked by an additional bar connecting the two tiller bars. The craft has a safe loading of 500lb.

Materials

There are many woods which may be used in boat construction, both hard and soft types. For the catamaran, apart from making certain that the material is straight grained and free from knots, almost any wood can be used, with the exception of the gunwale, chine and keel, which must be made of a bendable wood, such as spruce.

The floats are covered with $\frac{3}{16}$in. resin bonded plywood B.S.1088, obtainable from J. Williams and Sons, Christchurch Road, Colliers Wood, London, S.W. Hardboard could be employed but this requires a great deal of looking after in use.

All the fixings must be of brass or copper as the use of steel nails and screws would result, ultimately, in nothing but a sheer waste of time and materials.

All the joints must be glued and for this purpose a waterproof glue is used. One specially recommended is "Aero 300," and this is used in conjunction with an acid hardener, further details of which can be obtained from the manufacturers, Messrs. Aero Research, Duxford, Cambridge.

Construction

The frames (1, 2, 3, 4 and the transom) are the first to be made. The details from Fig. 5 (A and B) should first of all be drawn out on any suitable paper to full size and used as templates for the final gluing and screwing up. The bow knee (Fig. 6) and the apron (Fig. 5C) should be cut out next, leaving the latter slightly over-large in its width dimensions, to allow for adjustment when the chine and gunwale strakes are fitted. Screw the bow knee and apron temporarily together (as in Fig. 6), and then prepare for the next stage, which is the setting out.

You will require for this stage a clear floor area 11ft. 6in. long or a long plank, well supported on trestles. A centre-line, the length of the float, should be drawn and the various station distances (bow, 1, 2, 3, 4, and transom) marked along it (see Fig. 1). Transom and frames should then be screwed keel uppermost on blocks 1½in. high and firmly fixed vertically in their respective positions. The apron and knee should now be permanently fixed.

Next the keel strip is bent into position and, after making certain of the fit, glued and screwed. Following this, the gunwale strips are fixed and then the chine. The joints at

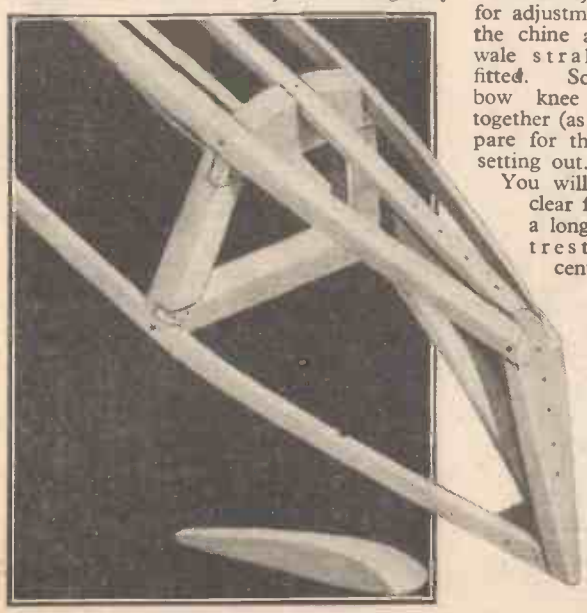
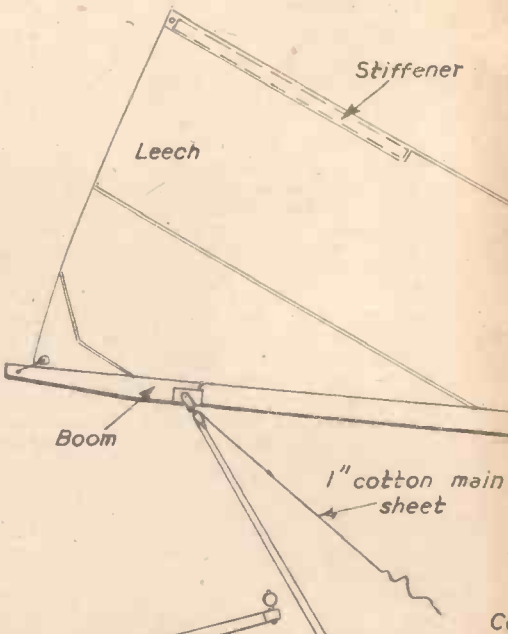


Fig. 2.—A bottom view of the bow construction.



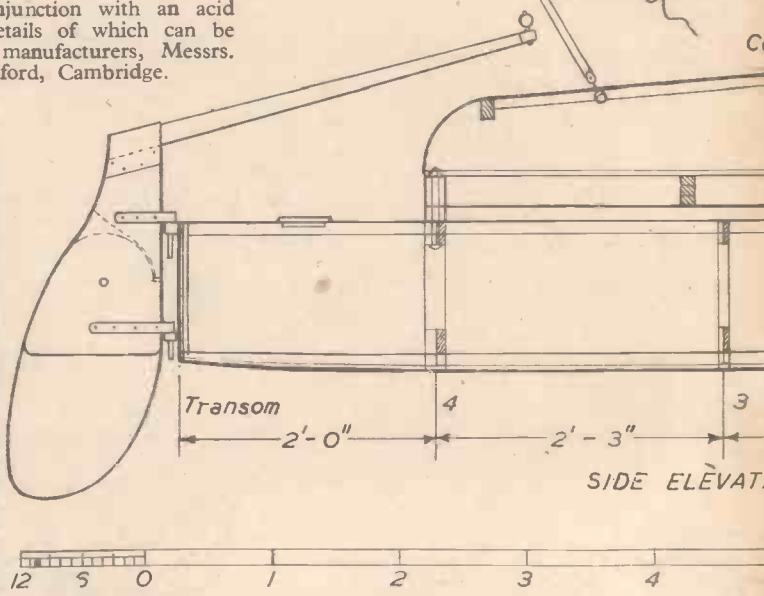
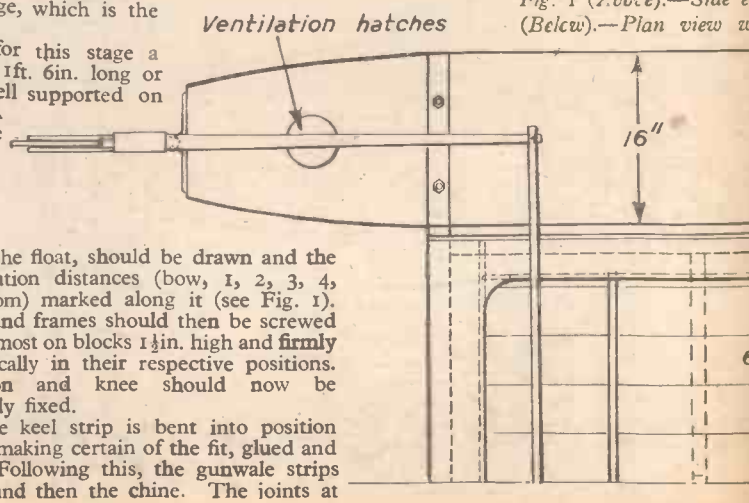
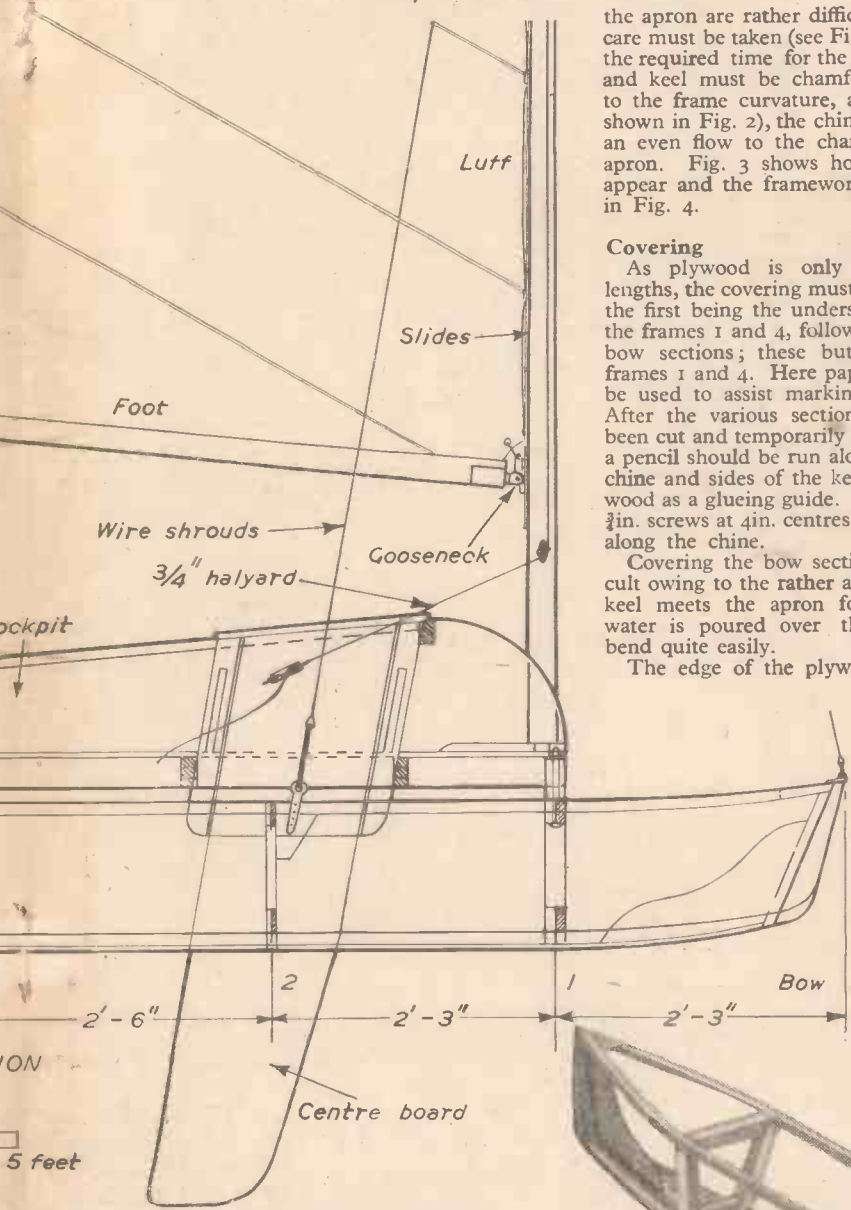


Fig. 1 (Above).—Side e
(Below).—Plan view w

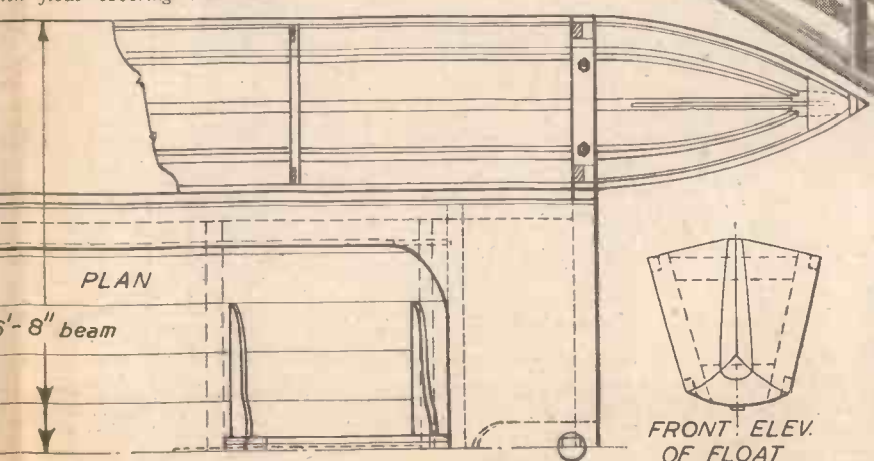


CATAMARAN

Details of an Unusual but Handy Craft



levation, giving main dimensions and general details.
ith float covering removed.



the apron are rather difficult to cut and great care must be taken (see Fig. 2). After allowing the required time for the glue to set, the chine and keel must be chamfered off to conform to the frame curvature, and, at the bow (as shown in Fig. 2), the chine strip must provide an even flow to the chamfered sides of the apron. Fig. 3 shows how the transom will appear and the framework should now be as in Fig. 4.

Covering

As plywood is only obtainable in 8ft. lengths, the covering must be done in sections, the first being the underside length, between the frames 1 and 4, followed by the stern and bow sections; these butt at the centres of frames 1 and 4. Here paper templates should be used to assist marking out the plywood. After the various sections of plywood have been cut and temporarily tacked into position, a pencil should be run along the inside of the chine and sides of the keel, marking the plywood as a glueing guide. Fixing should be by ¾in. screws at 4in. centres on the keel and 3in. along the chine.

Covering the bow section may prove difficult owing to the rather acute curve where the keel meets the apron foot, but, if boiling water is poured over the plywood, it will bend quite easily.

The edge of the plywood should now be planed off to the angle of the frame-sides, as the side covering overlaps. Between frame 1 and the bow the overlap gradually changes to a butt joint. When the side covering has been completed and all the chamfering along the chine done, the float can be unscrewed from its building position and turned topside up. Now add the small reinforcing pieces ($\frac{3}{16}$in. ply) just forward of frame 2. These are to give additional thickness to the skin, where the shroud plates screw on.

After well varnishing the interior and placing in position the galvanised bolts in frames 1 and 4, the deck can be added. This is followed by the fixing of the stem, half round moulding along the gunwales and a ¾in. x ¼in. rubbing strip along the keel.

The whole of the foregoing procedure must, of course, be repeated for the second float.

Fig. 3.—Constructional details of the transom.

The Cockpit

This superstructure is quite simply made and can be modified in many ways, providing the final result is a robust job. A suggested design is given in Fig. 7.

The two main cross bearers should be good sound timber as they will have to take a considerable strain. They should measure 4in. x 2in. x 6ft. 8in. long, and are drilled at each end with two holes for attachment to the floats. They are positioned at the distance between frames 1 and 4 and are joined together by two longitudinal runners 3in. x 1½in. These runners are themselves connected by three deck bearers also 3in. x 1½in. All joints on the above should be mortise and tenon, glued, wedged and screwed as well.

This framework should now be covered fore and aft by ½in. planking to form a platform. The planking should be, if possible, tongued and grooved, and nailed on. The cockpit sides come next and are made from ½in. plywood. They must be glued and screwed to the side runners. Now add the horizontal strips which form the forward and stern cockpit edges.

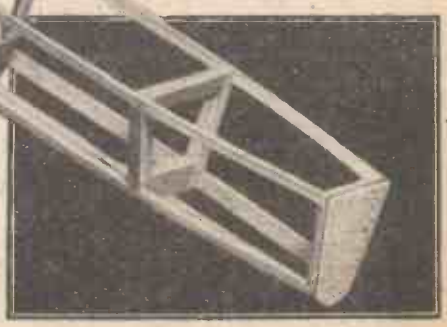


Fig. 4.—The completed framework.

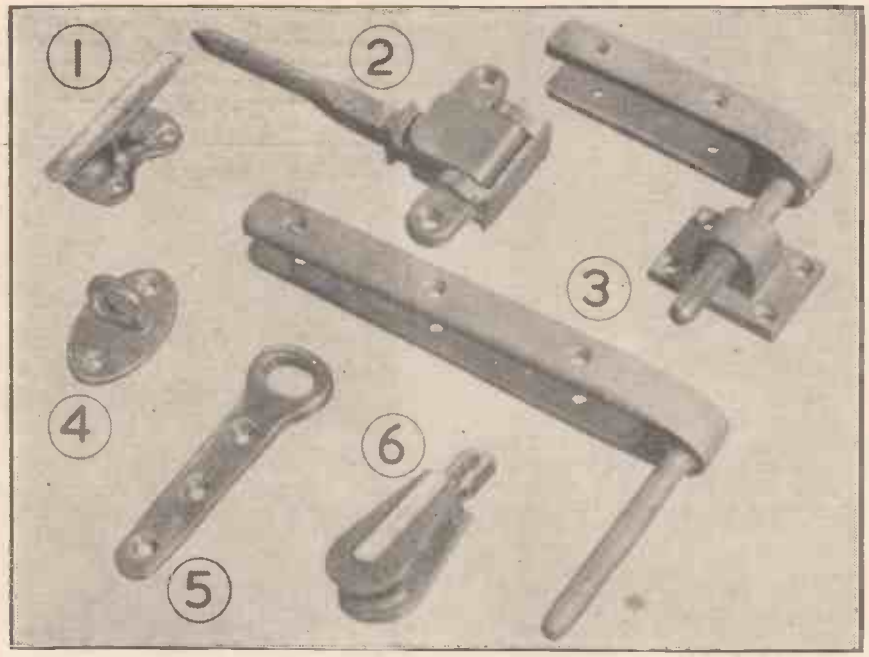


Fig. 8.—(1) Halyard Cleat; (2) Gooseneck; (3) Typical Pintles, and Gudgeon Plate; (4) Ring Plate; (5) Chain Plate; (6) Pulley Block.

Next comes the covering and this can be done in one piece or in separate sections, the joints in the latter case coming along the cockpit edge beams.

The Centre Board Trunking

First cut the slot to take the trunk, which is made up as detailed in Fig. 5D. The boards forming the sides should be true, as any warping will affect the easy sliding action of the centre board, dimensions of which are given in Fig. 5D. Attach the top edge of the trunk to the cockpit cross member; the screwing can be done through the hole for the mast in the for'd coaming. As the centre-board has to take a lot of strain, four knees are now added to the trunking sides; these can be screwed up through the floor planking from the underside, but diagonal screwing will be necessary to attach them to the trunking. Finally, add the mast step plate, which is nailed to the floor boards and drill ½in. holes in the main bearers to suit the bolts in the floats.

The Rudders

For the blades, use is made again of ¼in. resin bonded plywood. This is pivoted between two cheeks and securely glued and

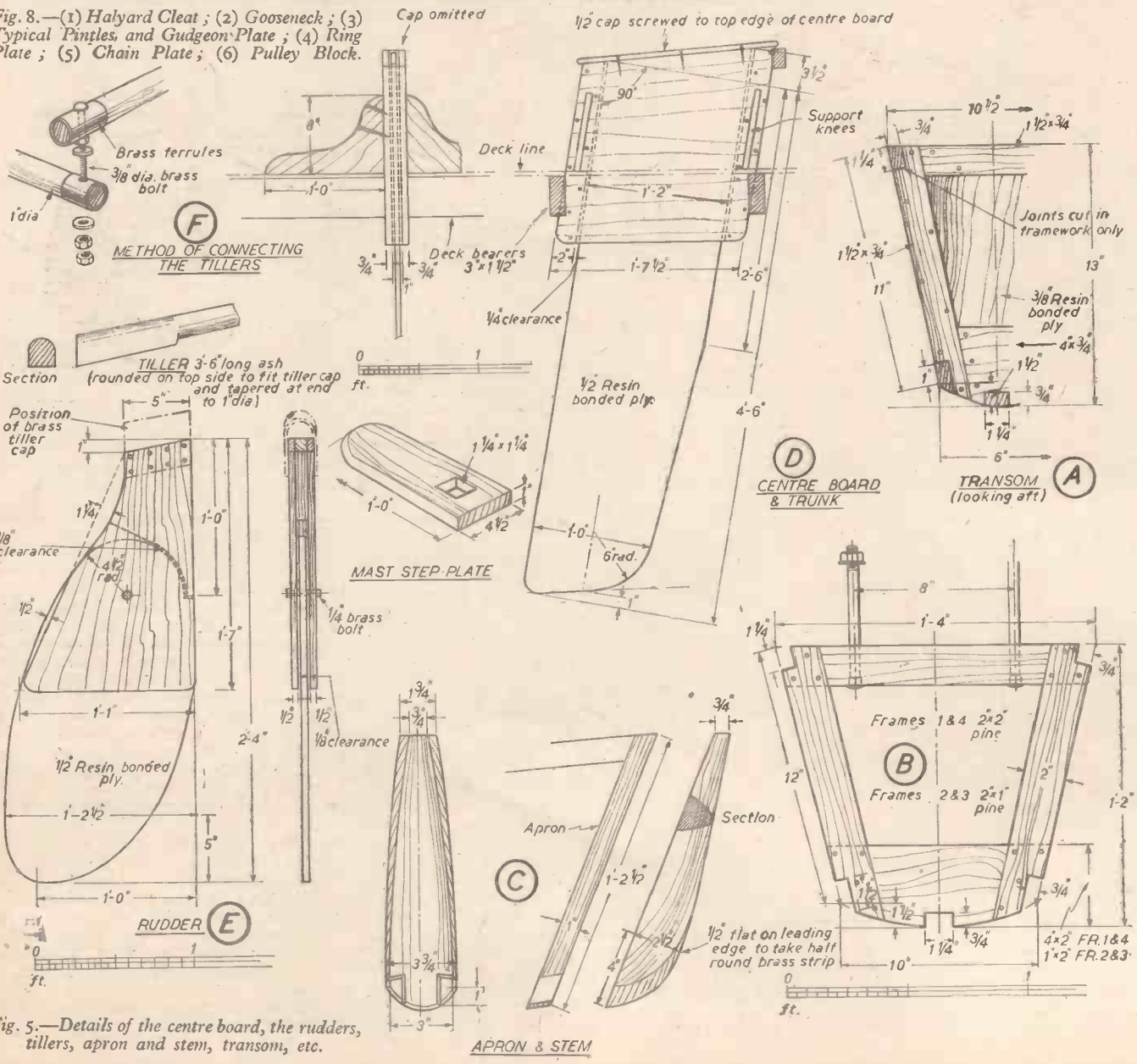


Fig. 5.—Details of the centre board, the rudders, tillers, apron and stem, transom, etc.

nailed to a distance piece, the resultant three thicknesses forming the rudder stock, to which is added a wrapped over brass cap to form the tiller bar socket, (see Fig. 5E.) The tiller bars are best made up from oak or ash and are ferruled at the tapered ends, to provide the bearing hole for the connecting bar (see Fig. 5F). This is made up from stout dowelling, also ferruled at the ends. The length of this between the bearing points should be the same as the distance between the starboard and port rudder pintles, typical examples of which are shown in Fig. 8.

The Mast

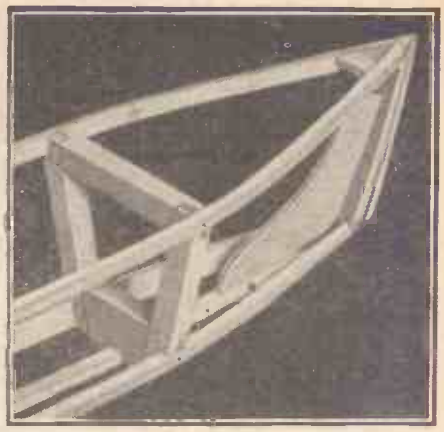
This should be made from spruce or pine and should be 2½in. diameter at the base, tapering to 1½in. at the top and 14ft. high. It can be made from two strips glued back to back, this simple lamination making for greater strength. At a distance 3in. down from the top, a slot ⅜in. wide should be cut for a small pulley to take the halyard. This pulley should be inserted after the mast is varnished and this also applies to the track, which should run from immediately below the pulley slot to within 1ft. 6in. of the foot. The top of the track should be closed to prevent the sliders being pulled out.

The Boom

This is 8ft. long and made from spruce or pine. A section is shown in Fig. 6. It is of the slotted type, the rope edging on the sail foot, sliding into the hole and the sail along the slot, thus securing it. At the mast end and below the slot, a hole should be drilled to take the gooseneck spigot (see Fig. 6). It is also usual to reinforce this end with a brass capping, 1ft. 6in. from the boom tip, provision should be made for fitting the pulley, an example of which is shown in Fig. 8. Another should be attached to a brass ring to allow it to slide along the traverse bar in the cockpit.

The Rigging

This comprises four ⅛in. galvanised wire shrouds, one from each bow, where they are attached to eye plates. The other two run from the sides of the port and starboard floats, just forward of frame 2, and are attached to chain plates screwed into the reinforced positions in the plywood skin. All four are then brought up to within 2ft. of the mast head and attached to a pronged brass collar. Each must be fitted with wire strainers. The main halyard is ⅛in. hemp and after passing through the pulley at the top of the mast, it passes through another at the foot and so to a belaying cleat in the side of the centreboard trunk.



A general view of the bow construction.

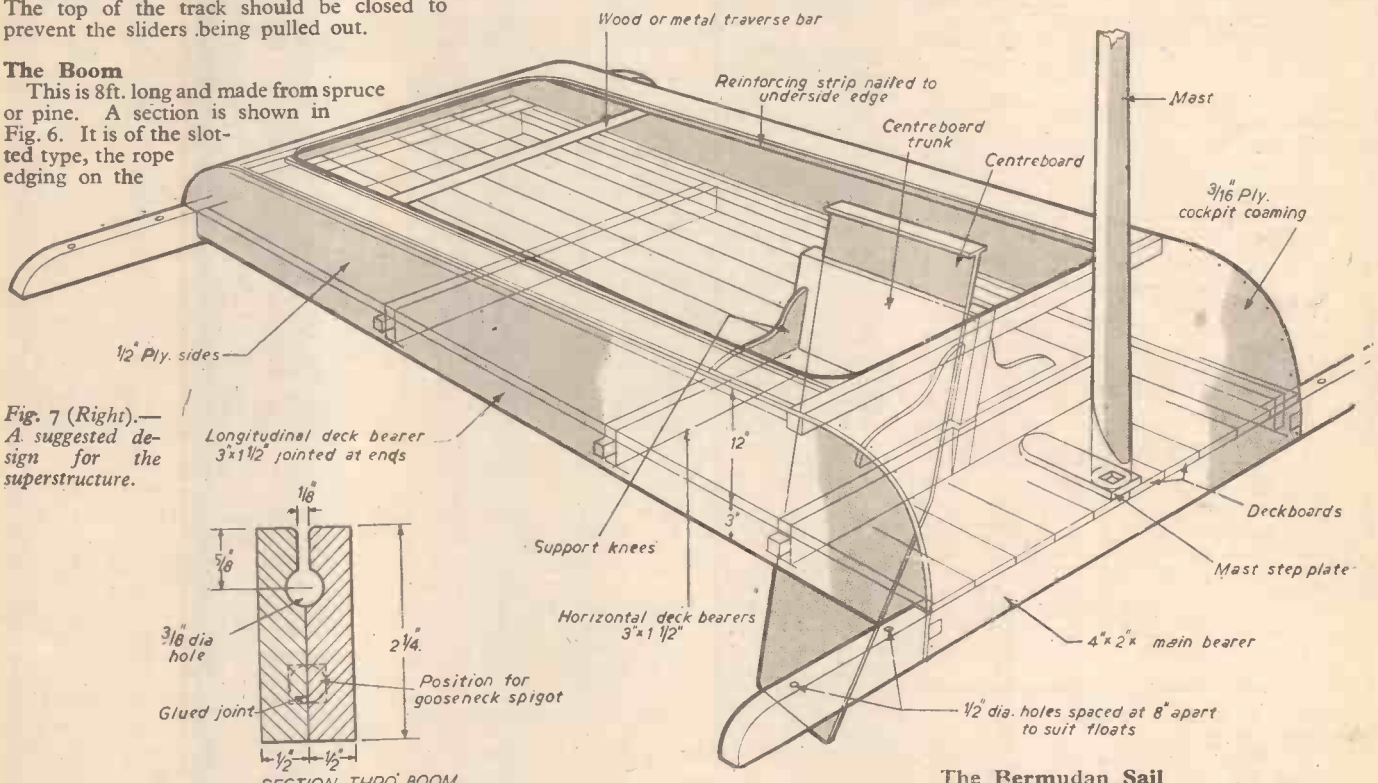
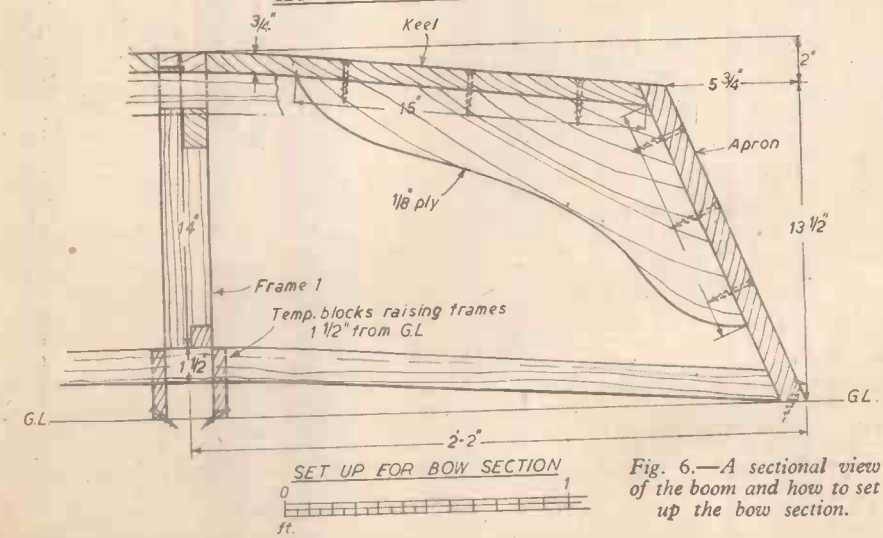


Fig. 7 (Right).—A suggested design for the superstructure.

SECTION THRO' BOOM



SET UP FOR BOW SECTION

Fig. 6.—A sectional view of the boom and how to set up the bow section.

The Bermudan Sail

Sailmaking is a very difficult task, and few amateurs care to tackle it. Messrs. Jeckels & Sons, Ltd., of Wroxham, Norfolk, and Messrs. A. Beale, of Shaftesbury Avenue, London, W.C.2, make sails to order and will gladly give quotations, but whatever the reader's decision, the main dimensions are as follow: 11ft. 6in. luff; 7ft. 6in. along the foot; 13ft. 6in. leech, in which are three battens. The sail is made in 1ft. wide panels from lightweight sail cloth and should be roped along the foot and up the luff, to which brass slides are sewn.

Finishing

All the woodwork should be sandpapered and if a varnish finish is desired, the floats and superstructure can be stained to enhance the natural grain in the wood and at least three coats of a marine varnish applied. Alternatively, if you have used hardboard for the skin, painting is the best treatment, but once again marine paints should be used. The mast and spars are always varnished and to preserve the shine on the brass fittings, these should be varnished also.

Man-made Elements

The Discovery of New Elements Other than the Natural Ones

By "PHYSICIST"

IN the last decade or so, the age-old quest for a means of transmuting the elements has been realised in a surprisingly rapid manner. Not only have existing elements been transmuted into other known elements, but hitherto unknown elements have been made.

Unfortunately, many of the newer discoveries in this field have passed unnoticed by most of us, being completely overshadowed by the development of nuclear fissionable materials which are capable of the spontaneous evolution of large quantities of energy. That this is so is inevitable, for the strategic and economic importance of atomic power cannot be overlooked and, whilst everyone is aware of the man-made element, plutonium, because it is used in atomic weapons, few have heard of the other man-made elements, the discovery of the last of which was announced recently.

This most recently produced element, which has been tentatively called eka-holmium, is the ninety-ninth one and we may, no doubt, look forward to a future announcement of the discovery of the hundredth element—an event of no little importance. Out of this first century of elements, no less than eight will then have been made by man.

1. $_{92}U^{238} + {}_{0}n^{1} \longrightarrow {}_{92}U^{239}$
uranium 238 + neutron → uranium 239

2. $_{92}U^{239} \longrightarrow {}_{93}Np^{239} + {}_{-1}\beta^{0}$
uranium 239 → neptunium 239 + electron

3. $_{93}Np^{239} \longrightarrow {}_{94}Pu^{239} + {}_{-1}\beta^{0}$
neptunium 239 → plutonium 239 + electron

(a)

1. $_{92}U^{238} + {}_{1}D^{2} \longrightarrow {}_{93}Np^{238} + 2{}_{0}n^{1}$
uranium 238 + deutron → neptunium 238 + 2 neutrons

2. $_{93}Np^{238} \longrightarrow {}_{94}Pu^{238} + {}_{-1}\beta^{0}$
neptunium 238 → plutonium 238 + electron

(b)

1. $_{92}U^{238} + {}_{0}n^{1} \longrightarrow {}_{92}U^{237} + 2{}_{0}n^{1}$
uranium 238 + neutron → uranium 237 + 2 neutrons

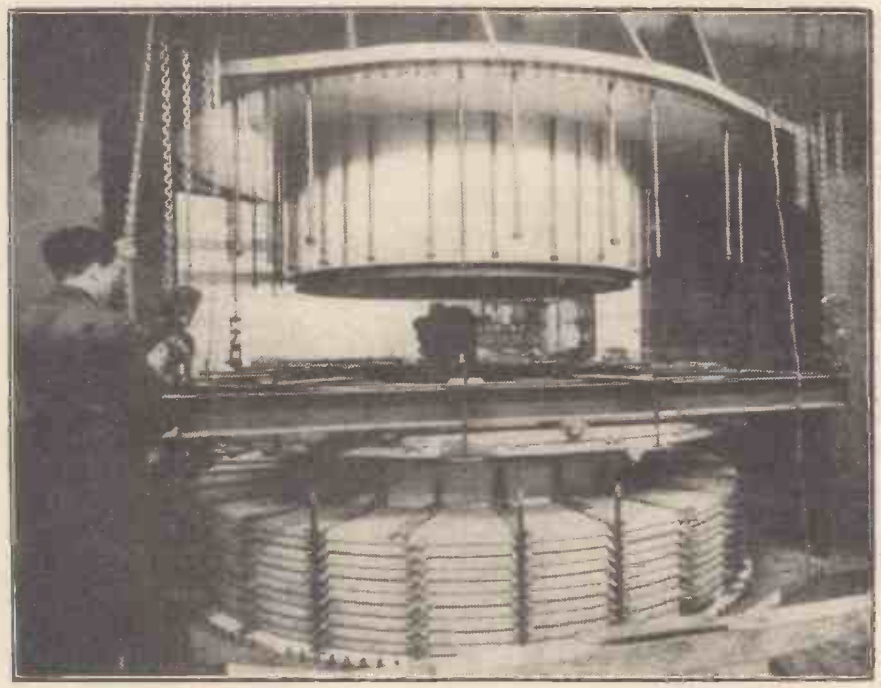
$_{92}U^{237} \longrightarrow {}_{93}Np^{237} + {}_{-1}\beta^{0}$
uranium 237 → neptunium + electron

(c)

Fig. 1.—Transmutation of uranium into the new elements neptunium and plutonium.
(a) Uranium 238 into neptunium 239 and plutonium 239 using slow moving neutrons;
(b) Uranium 238 into neptunium 238 and plutonium 238 using deutrons from cyclotron;
(c) Uranium 238 into long-lived neptunium 237 using high velocity neutrons derived from particles accelerated in cyclotron.
[Note that in these transformations, β-rays, i.e., high velocity electrons are emitted from the nucleus. These are thought to be produced by a neutron changing into a proton.]

It has long been known that there are 92 naturally occurring elements and it was commonly believed that these were all the elements capable of an independent existence. This appeared to be borne out by the behaviour of the larger atoms which, frequently, displayed the phenomenon of radioactivity, i.e., the omission of particles of matter from the nucleus which invariably led to a reduction in both atomic weight and atomic number.

Some investigators acknowledged the fact that heavier elements had probably existed in the past, but these, being radioactive and unstable, had by now completely disappeared. A few saw the possibility of remaking some of these by forcing particles into the nucleus; but the practical means of achieving this seemed impossible.



General view of the Harwell 110in. cyclotron magnet during erection. The magnet contains 700 tons of steel. Some of the copper windings have been installed on the lower pole. There are six pairs on each pole now that the magnet is completed, containing a total of 80 tons of copper. At maximum power a current of 600 amps at 500 volts is passed through the coils.

Although most of the new man-made elements do not survive very long, for they are radioactive and disintegrate by the emission of particles, their importance should not be underestimated. They represent the successful outcome of man's first attempts to synthesise atomic nuclei and as such, they may very well lead to the discovery of valuable new materials.

Among the existing man-made elements there is one material, plutonium 239, which though radioactive, is very stable until it is bombarded by neutrons, whereupon, it splits rapidly into two smaller atoms together with the evolution of a large quantity of energy. In point of fact it seems likely that most of the world's future power supplies will be obtained from the transmutation of uranium 238 into plutonium 239 in atomic reactors and thus we shall, in effect, obtain virtually free power as the stocks of this valuable and long-lasting element are built up.

Atomic Structure

All atoms are made up of a small solid core, or nucleus, in the space around which several smaller particles revolve. These smaller particles, known as electrons, carry a negative electrical charge and their total charge is counter-balanced by an equal and opposite charge on the nucleus.

It has been shown that, with one exception, the nucleus is not a single entity, but is made up of several discreet particles, some of which carry a positive electrical charge and are called protons, whilst others, having the same mass as the proton, are electrically neutral and are called neutrons. There is still much controversy as to the precise nature of the fundamental nuclear particle, but this need not concern us here.

By comparision with the nucleus, the

(Continued on page 447.)

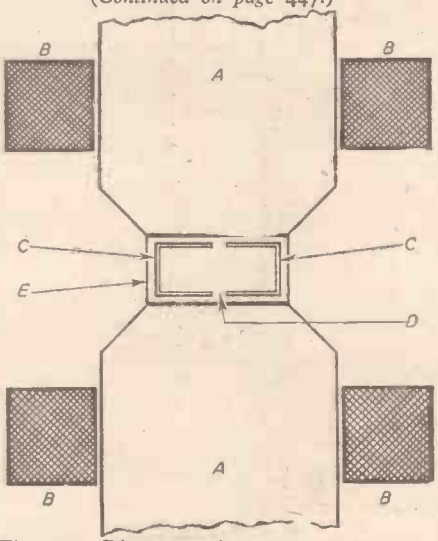


Fig. 2a.—Diagrammatic representation of a cyclotron. A—magnet pole pieces; B—energising coils for the magnet; C—"Dee" shaped accelerating electrodes, which are in an evacuated enclosure; D—particles to be accelerated enter the "Dees" here; E—evacuated enclosure in which the "Dees" are situated.

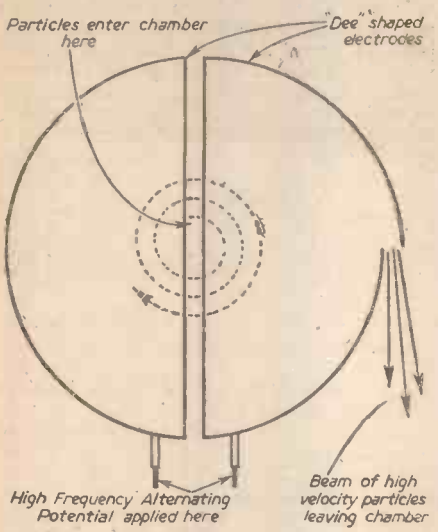


Fig. 2b.—Diagram of electrodes in which particles are accelerated. Path of particles undergoing acceleration is a spiral.

electron is virtually weightless, so that for all practical purposes it can be assumed that all the mass of the atom is in the nucleus.

It is customary to refer to the mass of the proton or neutron as unity, and in this way an atomic weight can be deduced for every atom which is numerically equal to the total number of protons and neutrons in nucleus. Thus, for hydrogen, whose nucleus is a single proton, the atomic weight is 1 and a particular type of uranium whose atomic weight is 235 has a nucleus made up of 92 protons and 143 neutrons.

Hydrogen, which is the simplest atom of all, has one electron rotating around the single proton and all other elements have atoms of increasing size and complexity, up to uranium 238 which is the largest naturally occurring atom (excluding plutonium 239, which was originally thought not to exist naturally, but has subsequently been found in very small quantities).

The chemical properties of atoms are determined exclusively by the number and configuration of the electrons which rotate around the nucleus and, as long as the number of electrons remains the same, the chemical properties of the atom will remain unchanged, even though the number of particles in the nucleus, i.e., the mass of the atom, varies. Of course, in all these variants, the charge on the nucleus must remain the same or the electron configuration will be disturbed and electrons will either be lost or gained to maintain the electrical neutrality of the atom and the chemical properties will alter. Thus, an atom of one element will be changed into that of another.

It is usual to consider the charge on a proton or electron to be unity and to express the total charge on the nucleus in these units. This is often referred to as the atomic number of the element and these run consecutively from hydrogen with an atomic number of 1 to the various types of uranium atoms of atomic number 92.

The atomic number therefore defines an element and, as we have seen, as long as this remains unchanged, the atomic weight may vary and yet all the variants will have identical chemical properties.

Almost every element is now known to exist in several such forms, which are called isotopes. They may be looked upon as atoms in which the nuclei are enriched or deficient in neutrons; the number of protons and, hence, the electric charge remaining the same.

The simplest atom of all, hydrogen, has an isotope—heavy hydrogen or deuterium, whose nucleus is twice as heavy as that of ordinary hydrogen. This, when combined with oxygen, gives heavy water, which is growing in importance because of its use as a moderator in atomic reactors.

Because isotopes of one element have identical chemical characteristics, they are extremely difficult to separate and methods of separation which rely upon differences in their physical characteristics have been evolved, notably diffusion, centrifuging, or the mass spectograph. These methods become less successful as the size of the nucleus increases, for the weight difference between the isotopes is invariably small and its significance thus decreases with increasing nuclear size.

The Isotopes of Uranium

Naturally occurring uranium contains three isotopes, viz., uranium 234, uranium 235 and uranium 238 (the numbers refer to the atomic weight of each isotope). There is only one uranium 235 atom to every 140

1. $_{94}Pu^{239} + {}_{0}n^{1} \longrightarrow {}_{94}Pu^{240}$
plutonium 239 + neutron → plutonium 240

2. $_{94}Pu^{240} + {}_{0}n^{1} \longrightarrow {}_{94}Pu^{241}$
plutonium 240 + neutron → plutonium 241

3. $_{94}Pu^{241} \longrightarrow {}_{95}Am^{241} + {}_{-1}\beta^{0}$
plutonium 241 → americium 241 + electron

4. $_{95}Am^{241} + {}_{0}n^{1} \longrightarrow {}_{96}Cm^{242} + {}_{-1}\beta^{0}$
americium 241 + neutron → curium 242 + electron

(a)

1. $_{94}Pu^{239} + {}_{2}He^{4} \longrightarrow {}_{96}Cm^{242} + {}_{0}n^{1}$
plutonium 239 + helium → curium 242 + neutron

(b)

Fig. 3.—Transmutation of plutonium into americium and curium.
(a) both elements formed from plutonium 239 by bombardment with neutrons in atomic piles;
(b) formation of curium 242 by bombarding plutonium 239 with high velocity helium nuclei.

atoms of uranium 238 and uranium 234 is even much less abundant. Unfortunately, it was found that only uranium 235 was able to split under neutron bombardment and initiate a chain reaction in which a large quantity of energy was evolved. It was this material which first attracted the attention of physicists and led to the development of the atom bomb.

Up to this point, no new elements had been discovered and it was thought that fissionable material would have to be extracted at enormous expense from naturally occurring uranium (less than 0.7 per cent. of this being fissionable). But in 1940, scientists at Berkeley in California found that the heavy isotope, uranium 238, could capture slow moving neutrons, to give a new man-made isotope—uranium 239, which was not stable and rapidly emitted an electron from its nucleus, thereby becoming an isotope of a new element (since the charge on the nucleus has thus been altered), which is called neptunium 239. This isotope of element 93 was radioactive and emitted another electron, giving an isotope of element 94, viz., plutonium 239 (Fig. 1a). Unlike neptunium 239, plutonium 239 is only feebly radioactive and is fairly stable, so much so that it would take 20,000 years for it to decay, by particle emission, to half its original weight. This interval of time is often referred to as the half life period of the isotope.

It is obvious, since plutonium 239 is used in atomic weapons, that it undergoes fission when bombarded by neutrons, but if this does not occur, it slowly emits helium nuclei of atomic weight 4 and becomes uranium 235.

The attention which has been given to the devastating potentialities of this new element has obscured the epoch-making significance of its discovery. Although this isotope of plutonium is so important, it was not the first man-made isotope of this element, for the same investigators, some little time previously, had bombarded uranium 239 by heavy hydrogen nuclei (deuterons) moving at high velocity and had thus obtained an isotope of the element neptunium, viz., neptunium 238, which quickly changed by electron emission into plutonium 238. This is an isotope of plutonium with a half life period of 50 years (Fig. 1b).

In all, some seven isotopes of neptunium, all of them man-made, are now known and there are eight isotopes of plutonium. Some time after it was first made, plutonium 239 was found to occur naturally in small amounts.

High Energy Particles for Atomic Transmutation

The development of apparatus in which nuclear particles can be accelerated to high velocities is largely due to Lawrence and his co-workers in California, who devised the cyclotron which overcame the limitations of the linear accelerators that had previously been used for that purpose.

They succeeded in doing what had formerly been held to be impossible, by making the particles travel in approximately circular paths repeatedly through the same electric

Atomic Number	Name	Isotope	Half Life Period
92	Uranium	U^{227}	—
		U^{228}	9.3 mins.
		U^{229}	58 mins.
		U^{230}	20.8 days
		U^{231}	4.2 days
		U^{232}	70 years
		U^{233}	1.62×10^{5} years
		*U^{234}	2.35×10^{5} years
		*U^{235}	8.91×10^{8} years
		U^{237}	6.7 days
		*U^{238}	4.51×10^{9} years
		U^{239}	23.5 mins.
		U^{240}	—
93	Neptunium	Np^{231}	53 mins.
		Np^{232}	—
		Np^{233}	—
		Np^{234}	4.4 days
		Np^{235}	420 days
		Np^{236}	22 hrs.
		Np^{237}	2.6×10^{6} years
		Np^{238}	2.0 days
		Np^{239}	2.3 days
		Np^{240}	—
		Np^{241}	—
94	Plutonium	Pu^{232}	22 mins.
		Pu^{234}	8 hrs.
		Pu^{236}	2.7 years
		Pu^{237}	40 days
		Pu^{238}	90 years
		*Pu^{239}	2.4×10^{4} years
		Pu^{240}	6,000 years
		Pu^{241}	10 years
95	Americium	Am^{238}	1.5 hrs.
		Am^{239}	12 hrs.
		Am^{240}	50 hrs.
		Am^{241}	475 years
		Am^{242}	400 years
		Am^{243}	—
		Am^{244}	—
96	Curium	Cm^{238}	2.5 hrs.
		Cm^{240}	27 days
		Cm^{241}	55 days
		Cm^{242}	162.5 days
		Cm^{243}	—
		Cm^{244}	—
97	Berkelium	Bk^{243}	4.6 hrs.
		Bk^{244}	—
		Bk^{245}	—
98	Californium	Cf^{244}	45 mins.
		Cf^{246}	35.7 hrs.
99	Eka-holmium	Symbol not designated. At weight = 247	Not stated but very short lived.

Fig. 4.—Table of isotopes of elements 92 to 99. Isotopes marked with an asterisk occur naturally.

and magnetic fields. Suitably shaped electrodes were fed with an alternating potential and arranged in such a manner that the particles continued to accelerate and travel in paths of ever-increasing radius (Fig. 2b). The speed with which the particles travel is in the main limited only by the frequency of alternation of the accelerating potential and the strength of the magnetic field.

The earlier investigations on the new elements were carried out with a cyclotron having a 60in. diameter accelerating chamber, but later work was performed on a 184in. diameter cyclotron. Last year, a new machine, called the cosmotron, was developed and, for the first time, enabled particles to be accelerated to the same speeds as cosmic rays. A larger machine still, the bevatron, has just been completed and this can accelerate particles to twice the speed attainable in the cosmotron.

Other methods of particle acceleration have been devised, some in which very high potentials are produced and applied to the electrodes, but the cyclotron and its recent modifications is the instrument which has proved most successful.

One of the reasons for accelerating nuclear particles to such high velocities was to use them as projectiles which could penetrate the nuclei of atoms and it is from this type of experiment that most of the new elements have been made.

The New Elements

During 1944 and 1945 two new elements, curium and americium, were discovered, first in the products of atomic fission and, later, by the bombardment of other atoms with high speed nuclear particles. Thus, plutonium 239 was transformed by neutron capture into plutonium 240 and, by the same process, into plutonium 241. This isotope of plutonium decays by the emission of an electron from the nucleus and becomes americium 241 (Fig. 3a). Americium 241 is fairly stable, having a half life period of 475 years. Seven isotopes of this element are now known.

Curium, the 96th element, was first detected in atomic fission products, being formed by neutron capture by americium 241, followed by the emission of an electron from the nucleus, which gives the isotope, curium 242 (Fig. 3(a)). It has also been made by bombarding plutonium 239 with helium nuclei which have been accelerated to high velocities (Fig. 3(b)). Six isotopes have been discovered, none of which are very stable.

Further work carried out in 1950, in which the above two elements were bombarded with helium nuclei travelling at high speed, produced elements 97 and 98 respectively. Americium 241 thus bombarded gave element 97, which was called berkelium 243: a very unstable isotope, whose half life period is 4.8 hours. Two more isotopes have subsequently been discovered.

Element 98, which was formed when a few millionths of a gram of curium 242 were bombarded with helium nuclei, has been given the name californium 244. This isotope is very unstable, its half life period being a mere 45 minutes. A longer lived isotope, californium 246, whose half life period is 35.7 hours, has since been discovered.

It was thought that no further elements would be made, because heavier bombarding particles would be needed and, or, higher velocities achieved and these could not be reached in the then existing cyclotrons. The recent announcement that element 99 has been produced in one of the newer cyclotrons at Berkeley, suggests that these difficulties have been overcome. In common with all the other man-made elements, except plutonium 239, only a minute quantity of this element has been made. It has been tentatively called eka-holmium 247 and it is characterised by a very short life before it disintegrates by particle emission.

Unfortunately, none of the man-made elements except plutonium 239 are suitable for use in atomic weapons and therefore it is unlikely that they will ever be made in quantity, but the importance of these discoveries lies in the fact that there now seems no limit to the number of new elements that can be made. Perhaps, some may prove even more valuable than either uranium 235 or plutonium 239, in so far as they may disintegrate with the evolution of considerably more energy.

That they require specialised and expensive equipment and have as yet been made only in minute quantities is not in itself a deterrent to their ultimate exploitation. We have seen in the large scale development of atomic energy the successful outcome of an equally difficult and expensive task. Virtually nothing is impossible once its value is realised and we can, undoubtedly, look forward to a future in which these unknown elements will play a very important part!

The Inventor and the Manufacturer

2.—Striking a Bargain

By W. J. WESTON

THE inventor has sent to the Patent Office his preliminary description, his "provisional specification," and has applied for a patent. Perhaps he already has the official "acceptance" of his application and he is possessor of the dignified document whereby Queen Elizabeth II declares, "Whereas We, being willing to encourage all inventions which may be for the public good, are graciously pleased to condescend to his request, and We grant to him the sole use and exercise and the full benefit of the said invention." That is an achievement. But, if the inventor is to prosper from his success in embodying a novel idea in material form, another task, maybe a harder one, is before him. To exploit his patent he must find capital; and normally that involves his finding a manufacturer able and willing, upon mutually agreeable terms, to co-operate. The quest is not hopeless, but it is not easy. Each day about 300 applications reach the Patent Office; and many inventors will, disappointment seeming to attend their efforts, sadly say *Hoc opus, hic labor est*—"Therein is the toil, therein the task."

We will assume that the search, maybe by way of television, and its Inventors' Club, has ended in success, but what about the bargain? The one struck is likely to be less favourable to the inventor than that imagined in his more sanguine moods; perhaps this is inevitable. For the inventor knows well what a boon to people his invention would be, if only they could be induced to use it; he forgets that much persuasion—skilful Salesmanship, if you like—is necessary to overcome ingrained habit, and he under-rates the cost of installing equipment to produce on a large scale. However, consider some of the points he has, or should have, in mind.

Should he stipulate a down payment for "all rights," which will leave him carefree about whether few or many of the patented articles are sold? Should he, on the other hand, stipulate that he should receive a part of the price, or part of the net profits (royalties), sharing with the manufacturer the ups and downs of the market? The usual and perhaps the most desirable course is to stipulate a combination of the two: a sum down and a share in the profits.

In Mr. Bagley's very useful and most entertaining book, "Everyman Inventor," these instances are given: for a "table cigarette lighter," £25 down and a minimum royalty of £50 a year; for a "petrol lock," £200 down and 25 per cent. of profits; for a "conveyor," £4,000 down and minimum royalty of £1,000 a year.

The nature of his invention has much to do with the decision to be taken. Some inventions strike the world with glad surprise. Obviously these are what people have been longing for and sales are certain to be large. Other inventions, boon and blessing though they are, come tardily into general knowledge and use. After many years, sales may be great, but long before that time the patentee's monopoly has gone. Clearly, the inventor should incline towards royalties when his invention may reasonably be placed in the first category, towards a lump sum when it cannot. The inventor need feel no compunction in leaving the manufacturer to greet the coming market alone; the manufacturer is well able to take care of himself.

An inventor might be inclined towards the lump-sum payment for another reason: he does not have to bother about how the figure of "net profit" is reached. It is not everyone that can make a rational estimate of the amount of "overheads" to be set against gross profits; the income tax inspector himself may express doubt. The inventor can, and usually does, bargain for a right to inspect books; but if, as may be assumed of manufacturers in this country, the buying firm is an enemy of shady practices, this right is not needed. If the buying firm is intent on trickery, the inspection would probably disclose nothing reprehensible. In short, the inventor had better reconcile himself to the fact that he is in the manufacturer's hands for a fair deal.

One further point is to be noted. The patented invention must be "worked" within three years of the date of grant: the patentee himself must have used it on a commercial scale or have arranged with his licensee to work it. If not, any person may ask the Comptroller either for a "compulsory licence" or for the patent to be endorsed with the direction, "licences of right." To the inventor that sells for a lump sum this matters hardly at all; it matters very much to him whose reward is wholly or mainly in royalties. He will, being wise, stipulate that one clause in his agreement should be such that it will bind the manufacturer to work the patent.

Clear statements about liability for renewal fees and about the bringing of actions for infringements should have place in the contract. These are, however, minor matters.

The inventor is protected from the time when he files his application, and the Patent Office does not publish his invention until some two years later, when the examiners have accepted the application. During the interval the inventor may negotiate and decide how far he will disclose his discovery.

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WELL known in the field of competitive and pleasure cycling is the firm of Rotrax, Ltd., manufacturers of high quality, hand-built bicycle frames. Although comparatively small, employing only a dozen or so young men on actual production, the company is actively engaged at the present time in turning out both cycle and speedway motor-cycle frames. A Rotrax frame was chosen by the organisers of the 1951 Festival of Britain as representative of the best in British cycle frames.

The racing cyclist, like all keen sportsmen, is a particular individual who insists on his machine being tailor-made to his own specification. A tall man will order a high frame to accommodate the length of his legs and a short man a smaller frame; one man will demand a cycle with a long wheelbase and another, with his own ideas on these matters, will require a short wheelbase machine. Rotrax, Ltd., cater for enthusiasts such as these.

Undoubtedly the most widely used and valuable tool to the frame builder is the welding blowpipe. Every man engaged on production is a skilled operator and before being allowed to work on the actual production models must first be able to make a sound braze on a sleeve or socket inserted for a depth of 6in.

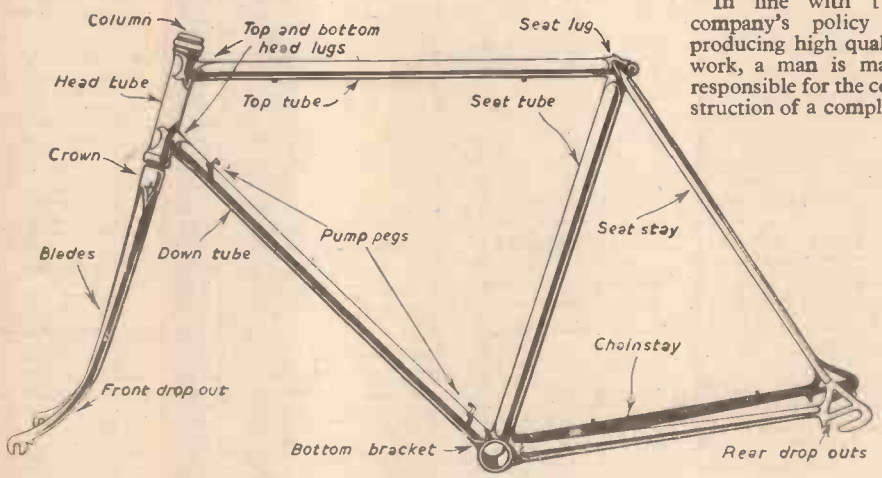
This, it will be appreciated, is no mean feat and testifies to the high standard the company requires in its products.

Brazing is the standard method of producing the frame although welded frames are made up if specifically required by a customer. After a great deal of experimental work Rotrax has found that the B.O.C. Brazotectic silicon bronze rod used in conjunction with Alda copper silver alloy flux produces the strongest and easiest to work joint. It is, in fact, their proud boast that not one of the joints made with this rod has ever failed on a crashed machine. The operators find that approximately three lengths of 1/16in. Brazotectic silicon bronze rod go into the production of each frame. The most noticeable features in the production shop are the numerous jigs to which the frame is clamped during the brazing and which facilitate full movement in all directions, thereby enabling access to the joints at all angles. Ease of access is particularly essential when brazing the more difficult joints such as the seat and bottom bracket lugs which carry four tubes brazed into one bracket. Great care has to be taken during this operation to avoid disturbing the joints that have already been completed.

In line with the company's policy of producing high quality work, a man is made responsible for the construction of a complete frame from start to finish, and does his own filing, cutting, brazing, etc. A cycle frame is made up of a series of tubes and all Rotrax models are made of Reynolds double-butted 531 tubing which comes in 20, 21, 23 and 24 gauge. The correct gauge tubing is selected and mitred up, the decorative lugs are filed out and the diamond, as it is termed, is set up and the lugs are tacked into position. After tacking, the diamond, consisting of the top tube, seat tube and down tube is brazed together. Great care is taken with the brazing to ensure that full penetration is effected, as a cycle frame can only be as strong as its brazed joints. The next stage in the production involves cutting out the head with a facing tool and trimming the seat lug slot and bolt. Following upon this operation the chain stays and rear drop joints which carry the rear axle are prepared and, after alignment, brazed together. The blades, as the front forks are called, are selected for the rake and cut to the length called for in the customer's specification. The diameter of the wheel must also be taken into consideration when deciding the length and extent of rake. The two front drop-outs are brazed to the bottom of the stays and the crown holding the blades together at their top end is brazed on, together with the column, completing the front fork assembly.

The diamond and the front forks are brought together and the ball races inserted in the head. The chain and seat stays which, with the seat tube, form a triangle have not as yet been fitted. They are now tacked into position on the bottom bracket of the diamond and the complete assembly is fitted to a jig or service plate. The top tube is then carefully lined and trued with a spirit level. The seat stays are next cut to size, clamped to the jig and then tacked into position on the frame. A final alignment check is made before lifting the frame from the jig and brazing in the seat stays. Apart from minor details such as fitting and brazing the top and bottom bridges which carry the rear mudguard and drilling of various holes to accommodate the brake cables, etc., the major part of the fabrication is completed. The frame is sent away for shot blasting and enamelling and returned for final finishing before delivery.

Reprinted from "Torch" a new quarterly technical bulletin, by courtesy of The British Oxygen Co., Ltd.



The cycle frame assembly.

Club Reports

International Radio-controlled Models Society

THE above society is running its Fifth International Radio-controlled Models Contests at Birmingham on July 10th and 11th. A welcome is extended to all radio-control enthusiasts to attend. The aircraft contests are included in the F.A.I. Calendar and run in accordance with the Code Sportif of the F.A.I. The contest for model boats will be held on July 10th at the Valley Pool, Bourneville, and the contest for model aircraft on July 11th at R.A.F. Station, Moreton-in-the-Marsh, Glos. The Hon. Competition Secretary is A. R. Greenfield, 5, Glemdower Road, Perry Bar, Birmingham.

Craftsmanship Exhibition

THE second Trades and Craftsmanship Exhibition organised by the Alton and District Chamber of Commerce was held recently in Alton.

In the non-competitive classes the apprentices of the Royal Aeronautical Establishment at Farnborough showed examples of sheet metal work, instrument making and foundry work, and the variety of goods displayed on the trade stands ranged from precision gauges and surgical appliances to clocks, watches and pottery.

A jet plane model capable of 120 m.p.h. was among the models shown by the Alton and District Aero Club. A plane of only 14½in. wingspan capable of flying at over 100 m.p.h. and a model aeroplane diesel engine, little larger than a half-crown, were also exhibited. It is planned to make the exhibition an annual event.

LETTERS TO THE EDITOR

The Editor does not necessarily agree with the views of his correspondents.

Flying Saucers

SIR,—It seems that V. A. Milburn (May issue) has some very clear ideas concerning the propulsion of "Flying Saucers," but cannot separate them from some fundamental fallacies. Perhaps if we can chase out the fallacies, we may be able to get at something important.

First, then, Mr. Milburn says, " . . . the pressure under high speed . . . produces a corresponding rise in temperature since it is frictional . . . " What, please, is "frictional pressure"? The heating is caused by friction, and pressure has nothing to do with it. Anyway, it can be overcome by suitable refrigeration. Mr. Milburn's statement that the human body is immobilised by "pressure caused by high speed," seems reminiscent of the attitude of doctors, about the time of the invention of railways, who predicted that the high speeds planned for the trains would be impossible, "because the human body would simply disintegrate at so high a speed as 30 m.p.h. ! " In other words, speed, as such, has no effect on the human body. Acceleration will produce the effects described, but Mr. Milburn clearly denies that his remarks refer to acceleration.

The centrifugal and centripetal forces are one of the best illustrations of Newton's Third Law of Motion, that action and reaction are equal and opposite. To unbalance them, as described by Mr. Milburn, would be to break one of the fundamental laws of the universe. Even if it could be done, however, it would not be of any use for propulsion, as, the centrifugal and centripetal forces being evenly distributed around the "Saucer," the unbalanced force would be similarly distributed, and would only tend to compress or burst the structure. To introduce a directional component into the force would be to break the Second Law of Thermodynamics; in other words, to increase the "order" of a part of the universe without a corresponding decrease of "order" somewhere else; to cause a decrease in entropy.

Finally, the concept of motion "in all directions to its line of flight," is meaningless —or has Mr. Milburn never met the "parallelogram of velocities"?—B. L. KERSHAW (Leeds, 6).

SIR,—In reference to A. E. Hunt, of Middlesex (April PRACTICAL MECHANICS) and many others who claim lack of genuineness of the Flying Saucer photographs, might I draw their attention to an incident which happened near where I live.

Late last year or early this, two boys were out bird-watching together on or near Coniston Old Man, the mountain at the head of Coniston Water, in the Lake District. The two boys were cousins, of 13 and 11 years. The elder one had a camera.

Suddenly, one of them noticed something coming round the side of the Old Man. It hovered, came closer and finally sped away at a phenomenally high speed. While it was hovering, however, the boy with the camera photographed it, but in his excitement forgot to focus his camera properly. He took the film to a chemist in Coniston village to be developed and printed. While this was being done, he drew the flying saucer, for such at it appeared to be.

The photograph, drawings and his description matched up superbly with the photograph and description given by George Adamski, which he had never heard of and definitely never seen. It corresponded, not only in size, movements and manoeuvrability, but, most important of all, in shape. If a close-up photograph, in good focus could have been taken from the same angle, the two would have corresponded almost exactly.

"Faking" is out of the question as no one with access to the original negative had the facilities to do it. (Incidentally, I have seen and handled a print and enlargement from the original negative.)

I know the boy by sight and he and his family and the chemist are very well known to some lifelong friends of my family.

If anyone is interested, full details of photograph, drawings and the story are in: the *Lancashire Evening Post*, dated February 18th and 26th, 1954; the *Daily Sketch*, dated March 24th, 1954 and the *Daily Mail*, date unknown, and possibly others.

Some people, mostly "Semi-Scientifics" as I call them, say "It could have been a cloud," or "Conditions were exactly right for a 'Second Sun Mirage'"—but has anyone ever heard of either of them conforming to the conditions stated above?—A. C. LARMAN (Nr. Ulverston).

Pepper's Ghost

SIR,—Fig. 1, page 347, May issue, is incorrect. If the mirror were in the position and the actor shielded from the glass as shown, it is the reflection of the actor in the mirror that would be reflected in the glass. The image or ghost would, therefore, appear somewhere near the "May, 1954" of page 346, not in the position illustrated.—R. A. FAIRTHORNE (Hants).

[*Author's reply: "Your correspondent is right in his comments. Fig. 1, however, is not intended to be optically correct. It is freely adapted from Pepper's own sketch of the arrangement (see "Cyclopaedic Science Simplified," by J. H. Pepper).*]

Interplanetary Space Travel

SIR,—Commenting on Mr. Milburn's letter and on Mr. Selwood's, it may save much confusion if the following proposition is considered.

"You cannot achieve any results in physics or engineering by getting hold of technical words and shuffling them about into new arrangements," e.g., "pressure," as defined and measured, cannot possibly be "frictional." "Centrifugal forces" and "centripetal forces" are not forces at all, but rather unfortunate historical *names* for a single thing. This thing happens to be an acceleration due to rotation, not a force. Looked at from one point of view it could be taken as "centrifugal," from another as "centripetal" (a term rarely used these days because of the muddle it causes), but it is still the same thing; the radial acceleration due to rotation. Just as a "debit," from the supplier's point of view, is a "credit" from the customer's point of view. Both, however, are names of the same transaction. If Mr. Milburn can make the "centripetal" differ from the "centrifugal" acceleration, he can certainly make a difference between his "credits" and his banker's "debits" and his financial problems are, therefore, solved !

Seriously, Mr. Milburn would save himself much heartbreak and disillusion if only he would learn the difference between ways of talking about things and things themselves. The only way to learn is by experimenting. He should start by lifting himself by his bootstraps.

As for Mr. Selwood's defence of Adamski's photographs on the grounds that they were "processed by a reputable chemist," I would point out that such films as "The Lost World," "King Kong," "Topper," "Things to Come," "When Worlds Collide," etc., to say nothing of Mickey Mouse, Tom and Jerry, "Snow White and the Seven Dwarfs" and the like, were all processed by reputable chemists. Moroever, they were processed in automatic machines under conditions that preclude any faking ! There is nothing, except common honesty and the common sense of the audience, to prevent anyone pointing a camera at anything and calling the resulting photograph something else.

Mr. Adamski is far from being "the world's best faker." He is an exceedingly clumsy one. The dingiest motion picture studio could do better.

What is interesting is the curious optical phenomenon by which Mr. Adamski's friends who, by their sworn affidavit, were too far to see—even with glasses—much more detail of the "visitor" than whether it were clothed, should nevertheless be able to sketch and describe in detail ("independently of Mr. Adamski," they say) its slant eyes, and other minute facial characteristics.

Even more interesting is the fact that, though some people connected with the book swore affidavits, Mr. Adamski himself did not. He was wise !—R. A. FAIRTHORNE (Hants).

SIR,—In his letter in the May issue, Mr. J. C. D. Marsh makes two criticisms of a previous letter; one valid, the other not. He states that a comparison between the passage of heat, and the passage of electrons, through space is "futile." Since the work of de Broglie and Schrödinger on wave mechanics in 1925, it has been known that there is no fundamental difference between a stream of electrons and a ray of heat, or any other electromagnetic ray; they can both be considered either as streams of particles or as rays, whichever is the more convenient at the time. The wavelength of an electron stream is extremely short, and the mass of the "particles" of a heat or light wave train extremely small, but both really exist. The electron microscope is a practical application of the wave nature of the electron.—G. MACDONELL, B.Sc. (Pinner).

Spirit Duplication

SIR,—In reference to your article on Spirit Duplication in May, it will be found that improved results will be obtained if about 10 per cent. of glycerine and about 10 per cent. water is added to the methylated spirit.

The proportions of glycerine and water are best ascertained by the trial and error method as the humidity of the atmosphere and the texture of the paper make a considerable difference to the percentages.—F. H. TOOVEY (Middx.).

READERS' SALES AND WANTS

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

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MISCELLANEOUS

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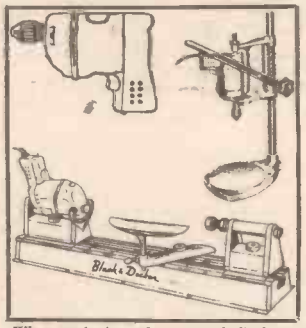

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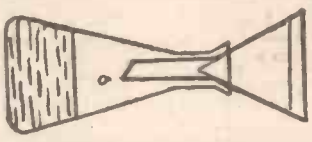

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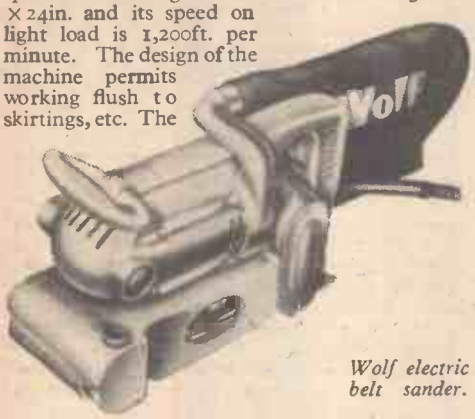
Trade Notes

Wolf Electric Belt Sander

THE latest addition to the already extensive range of machines manufactured by Wolf Electric Tools, Ltd., is a heavy-duty portable belt sander, Type BS3. Well balanced and compact in design, this 3in. belt sander is recommended for heavy-duty work and is fast, accurate and easy to operate. Not only does it meet a long-felt need throughout the woodworking industry, but it also finds a ready application in the metal working and stone working trades for surfacing and polishing.

One point in which the BS3 sander differs fundamentally from other machines of this type is in its abundant power for continuous operation—a power developed by a motor of special Wolf design. The sander belt is 3in. × 24in. and its speed on light load is 1,200ft. per minute. The design of the machine permits working flush to skirtings, etc. The efficient built-in dust extractor system is operated by a double-sided fan on the motor. One set of blades forms the normal ventilation fan and the other provides a powerful suction which constantly removes dust from the rear end of the sanding belt, thus speeding up performance and prolonging belt life. The dust bag, conveniently mounted on the outlet nozzle, is easily removed for emptying.



Wolf electric belt sander.

As with all Wolf machines, the armature is dynamically balanced to highest precision limits and insulation is flash tested to 1,250 volts. The belt pulleys of the BS3 are mounted upon porous bronze oil-impregnated bearings, whilst the armature and gears are mounted on heavy-duty ball-bearings inserted in steel liners for maximum strength.

The transmission from motor to sanding belt is by means of helical spiral bevel and spur gears cast in nickel-chrome alloy steel, high-frequency hardened.

The BS3 is priced at £38 15s., and can be bought separately or complete in a strong steel carrying case with 12 assorted belts at £43 15s.

"Polyflex" Plastic Flooring

THIS is a new floor surfacing material, the first Polyvinyl plastic flooring to reach the English market. It is available in a wide range of multi-coloured and marbled finishes. The marble effect is contained in the liquid and appears while the floor is being laid. It is claimed that this flooring will not dust, lift or crack, is resistant to grease, fat, oil and petrol and is completely fireproof and waterproof. Laid to a thickness of 1/32in. to 1/16in., it is a "warm," comfortable floor, easy on the feet and "quiet." It can be washed, scrubbed and polished and, in constant use, becomes glasslike.

It can be laid on any firm surface and the job does not require skilled labour. It can be laid on bricks, concrete, flagstones, quarry tiles, timber, old composite floors or any other firm base, without keying and is equally suitable for use by the building contractor and the home handyman. Its range of application is wide—from bedroom to office, from kitchen to factory. The material cost is 8s. per yard and it is available in any colour, in gallon cans, sufficient to cover 6 yards. The price is 48s., carriage paid to the nearest station. The makers are Surfex Flooring Company, Siding Works, Camberley, Surrey.

An example of "Polyflex" plastic flooring.

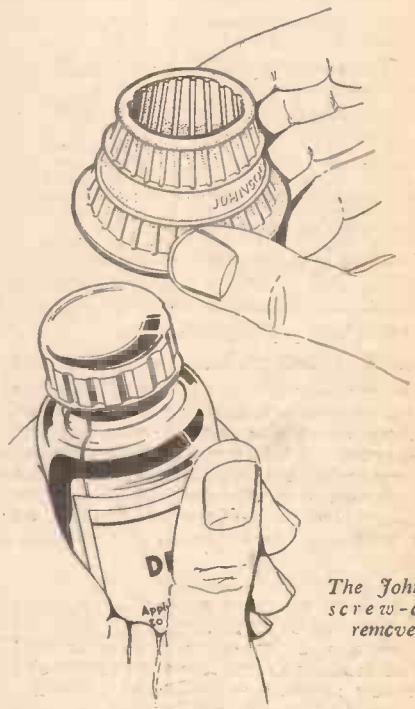
"Modern Solders" Booklet

MULTICORE SOLDERS, LTD., Multicore Works, Maylands Avenue, Hemel Hempstead, Herts, have recently issued a second and larger edition of "Modern Solders," directed mainly to manufacturers' sales and technical staffs which, in addition to containing more than 50 illustrations, graphs and tables, is a complete and up-to-date mine of information to all extensive users of solder. It contains precise information on melting points and characteristics of the various standard and non-standard alloys—tables of gauges, even down to 34 s.w.g., with lengths per pound and tensile strengths, specific gravities and electrical conductivity of the whole range of Multicore solders. Pages are devoted to full details of the many fluxes available including the new A.I.D. approved ultra high-speed Type 362 flux, of five-core solder, the new automatic soldering machine and many other special products. Photographs show Ersin Multicore solder being used all over the world in many vastly different assembly applications and techniques.

"Modern Solders" is available to all radio, television, electronic equipment and other allied manufacturers although Multicore Solders, Ltd., do not ask that the firm's letter-heading should be used when applying. Other interested users are invited to write for complimentary copies of "Hints on Soldering." and "Multicore Solders' Technical Summary."

Johnson Screw-cap Remover

THAT this handy little gadget fills a long-felt need will be agreed by anyone who has wrenched vainly at a recalcitrant bottle cap, which resolutely refuses to be unscrewed. As will be seen from the illustration drawn below, the cap remover is made of rubber, is cone-shaped, open both ends and is ribbed inside and out to provide a grip for the hands and on the bottle cap. The price is 6d. and the device is available from any photographic dealer.



The Johnson screw-cap remover.

BOOKS Received

Clarke's Tables and Memoranda: A Pocket Compendium of Technical Data for Plumbers, Builders, etc. 400 pages. 8s. 6d. net. Published by B. T. Batsford, Ltd., 4, Fitzhardinge Street, Portman Square, London, W.1.

THIS book has been completely revised and enlarged by a third to form the tenth edition. It is pocket-sized, measuring 4¼in. x 2¾in. x ¾in. thick and contains in concise form, for easy reference, all the salient memoranda for plumbers, builders, sanitary, heating, electrical and gas engineers, to which they may have to refer in the course of their work.

Model Jets and Rockets for Boys. By Raymond Yates. 115 pages. 8s. 6d. net. Published by T. Werner Laurie, Ltd., 1, Doughty Street, London, W.C.1.

IN this book for younger readers the author tells in simple language the history of rockets and explains the principle of the jet engine and its use in simple form for driving small scale models of various kinds. The text is illustrated by photographs and line drawings.

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.

Plaster Casts: Rendering Non-porous and Obtaining Celluloid Effect

I AM experimenting with small plaster cast models. Could you please advise me how to render the finished plaster non-porous ? What is the best method and material by which a transparent film (quick drying) can be deposited over finished and painted model, to give celluloid effect ?—K. Wright (E. Yorks).

TO render the plaster casts non-porous, dissolve 10 parts of cooking gelatine in 90 parts of hot water, and stir into the solution, also, a few drops of carbolic acid or lysol in order to preserve the gelatine and to prevent mould growths occuring therein. This liquid will set to a jelly when cold. It must, therefore, always be warmed before use in order to re-liquefy it. Merely dry the plaster cast in a warm oven, and brush the warm gelatine solution on to it liberally once or twice. The gelatine solution will enter the pores of the plaster and will seal them adequately, thus rendering the plaster non-porous.

In order to obtain a transparent film on the casts and to obtain the celluloid effect which you desire brush the sealed casts over with any clear transparent lacquer. Or, dissolve clear scrap celluloid in a mixture of approximately equal parts of acetone and amyl acetate until you have obtained a clear liquid of varnish consistency. This is then brushed over the casts until you obtain the required glazed surface. The lacquer so applied will dry quite hard within a few hours. Such a lacquer can be applied by spray if desired. If you add more acetone to the lacquer it will tend to dry flat and unglazed. The more amyl acetate in the lacquer, the more glazed it becomes, but the longer it takes to dry.

Another good type of clear lacquer may be made by dissolving 15 parts of polyvinyl acetate in 85 parts of warm methylated spirit. Polyvinyl acetate may be obtained from our advertisers of plastic materials. Acetone and amyl acetate are obtainable from Messrs. Reynolds and Branson, Ltd., Leeds, or from Messrs. Griffen and Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2. These liquids are inflammable, so that carriage costs on them are likely to be high.

Knocking in Water Pipes

SINCE having galvanised water pipes fitted throughout the house I have had trouble with knocking noises in the pipe when the cold water taps are turned off.

The water pipe is lowered in one place to get under the joist, so as to run straight up to the tank in the loft. This is the main flow for the house.

Would the lowering of this pipe be the cause of the trouble ?—F. Robinson (S.W.11).

KNOCKING noises, such as you describe, in domestic water pipes are nearly always caused by the sudden development of pressure-waves in the pipes, the pressure being transmitted through the water; thus it will be noted particularly that these knocking noises occur when a water tap is suddenly closed, or when sudden pressure arises from an overheating boiler. The pressure-waves may be set up in any area of the pipe where there is a restriction to the even flow of water. Usually, this restriction occurs at an abrupt bend in the pipe, the bend being either in the vertical or horizontal plane. We think you have diagnosed the trouble pretty accurately when you say that it is due to the lowering of the pipe in one area so that it goes under a joist. We assume here that the pipe makes a sort of abrupt U-bend. The trouble can be remedied by eliminating this abrupt bend and any more like it. The pipe should rise or descend as smoothly and as gradually as possible. This smoothing-off, as it were, of the pipe line will obviate any sudden pressure waves which may be formed and thus the knocking will cease.

Repairing Plastic Cycle Cape

I HAVE torn my plastic cycle cape and I wish to repair it myself. I am told that when stitching plastic material a certain glue is applied to the stitches to stop them being pulled out, but I am not sure if this is correct. A 3in. diameter patch would fit over the tear; alternatively, the patch could be stuck on. Please tell me the correct procedure and where to obtain the plastic sheet and the glue.—D. J. Harris (Essex).

THE cement used for applying to the stitching thread which you mention depends entirely on the nature of the plastic. On an average, quite good results can be obtained by stretching a thread out tightly and by rubbing on to it with the fingers a little transparent cellulose cement which can be obtained in tubes from most of the chain stores. This treatment will give the thread a grip, and will prevent it from being pulled out. Patches of material are usually cemented, not stitched. Here, again, the cement used must depend on the nature of the plastic. You can obtain a suitable cement for this purpose from Vinyl Products Ltd., Butter Hill, Carshalton, Surrey.

Readers are asked to note that we have discontinued our electrical query service. Replies that appear in these pages from time to time are old ones and are published as being of general interest. Will readers requiring information on other subjects please be as brief as possible with their enquiries.

Artificial Flower Making

WHAT is the material and treatment used for leaves of artificial flowers ? I have tried using fine linen, but require a permanent stiffening medium. Can you recommend a process and suggest method of colouring for leaves and petals ? Also suitable glue for attachment of stems ?—W. Boyd (Invernessshire).

ARTIFICIAL flowers are made of a fine cotton fabric which has been varnished on both surfaces with a quick-drying plastic resin varnish. Linen fabric or fine cotton material is quite suitable for this purpose and the fabric may be dyed before treatment. A good stiffening varnish is made by dissolving 20 parts of polyvinyl acetate resin in 80 parts of warm methylated spirit. The varnish, when cold, being applied by means of a brush or by spray. Polyvinyl acetate resin is obtainable, under the name of "Gelva Resin No. 7," from Shawiningan Ltd., Marlow House, Lloyd's Avenue, London, E.C.3, price about 6s. per lb. The varnish itself can be dyed by dissolving a small quantity of any spirit-soluble dye in the methylated spirit. Thus, it can readily be made up in several colours for use when painting in details of leaves, etc. When made slightly thicker than the above dilution the varnish will provide an excellent adhesive for your use.

Removing Lime Film from Glass

WHAT is the best and quickest way of removing lime shading put on last year as a fairly heavy mixture of

(*Continued on page 458*)

A.C./D.C. MOTORS 24 v. 2a., 6in. x 2½in. dia. spindle 1in. x ¼in. New 18/6.

Time Delay Relays supplied to your requirements.

Powerful small Blower Motors, 24 v. A.C./D.C., 14/6. As used for the Hedge Trimmer.

Type 6C Oscilloscope Unit. With VCR138 3½in. Tube, and conversion circuit for standard "Scope," 58/6.

Transformers, Input 200/240 v. Sec. tapped 3-4-5-6-8-9-10-12-15-18-20-24-30 volts at 2 amps., 21/6. 17-11-5 volts, at 5 amps., 22/6. 17-11-5 volts at 1½ amps., 16/6. 6.3 volts, 2½ amps., 8/6. 12 months' guarantee.

Selenium Rectifiers F.W. 12-6 volt, 1 A., 8/6. 3 A., 14/6. 4 A., 23/6. 6 A., 30/-. 24 v. 2 A., 30/-. 250 v. 100 mA. H.W., 9/-, 250 mA., 17/6.

D.P.D.T. Relays. Operates at 200/300 volts D.C., 8/6. D.P. Make and Break, 8/6. Any combination or voltage can be supplied at varying prices.

0-5 amp. 2½" Square M/c Ammeters, 11/-.

Veeder Counters. P.O. Type, 24/50 v. D.C. 0.9999, 15/6.

M/c Microphones with matched transformer, 15/6.

6 volt Vibrator Packs. Self contained in steel box. Output 150 v. 30 mA, 22/6.

Rheostats, 12 v. 1 A., 2/6. 12 v. 5 A., 10/6.

Latest Car Lights Relay Assembly "Flasher" Unit, 6 or 12 v., 17/6; or with 2 lamps and switch, 50/-. STATE BATTERY CONNECTION TO CHASSIS.

4 ft. Fishing Rod Aerials, Set 3, 7/6. Base, 3/6.

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4½in. dia. 0-100 Micro-amp. Meters. Made by Ernest Turners, £3/12/6.

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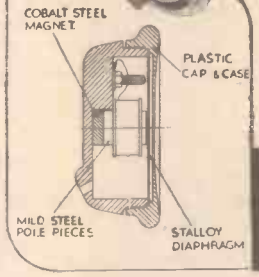

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6 v. or 12 v. 2 a.	31/9
6 v. or 12 v. 4 a.	49/9

Supplied assembled and tested, 6/9 ex.

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2/6 v. ½ a. H.W.	1/9
6/12 v. ½ a. H.W.	2/9
6/12 v. 1 a. F.W. (Bridge)	5/9
6/12 v. 2 a. F.W. (Bridge)	9/9
6/12 v. 4 a. F.W. (Bridge)	14/9
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150 v. 40 mA. H.W.	3/9
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VARIABLE RESISTORS.—5 amp. 2 ohms, 5/9; 5 amp. 7.5 ohms, 7/9; 25 amp. 0.4 ohms, 8/9; 150 ohm 1.5 amps., 11/9. Suitable for chargers, etc. Complete with knob.

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R.S.C. CHARGER TRANSFORMERS. Primaries 200-230-250 v. A.C. 50 c/cs. 0-9-15 v. 1.5 a., 12/9; 0-9-15 v. 6 a., 22/9; 0-9-15 v. 3 a., 16/9; 0-4-9-15-24 v. 3 a., 22/9. 0-11-22 v. 15 a., 45/-.

EX. GOV. ACCUMULATORS (NEW).—2 v. 16 A.H. with Non-spill Vents, 5/9.

EX. GOV. AUTO-TRANSFORMERS.—50 c/s. 15-10-5-0-215-235 v. 200 watts, 25/9. Double wound 10-0-10-210-230 v. to 5-0-115-125 v. or reverse 200 watts, 25/9. Double wound 10-0-200-220-240 v. to 10-0-270-290-310 v. or reverse 200 watts, 27/9. Many Auto Trans. in stock (up to 5 kVA) at very low prices.

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PRECISION GEAR UNITS.—Taken from gun predictors, containing approx. 40 4in. ballraces, 40/50 spur and bevel gears, differentials, etc., 85/-. Carr., 2/6. **ALSO** a much larger unit containing approx. 100 4in. ballraces, 85/90 gears, housings, shafts, worms, material, etc., too numerous to specify. £7/15/-. Carr., 7/6. These units provide a fascinating and extremely useful store of material for the experimenter.
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HAND GENERATORS, complete with handle and 72/1 gearbox. Output 28 volts and 300 volts. As described for WASHING MACHINE in P.M. August issue and WRINGER March issue. Each 25/-, post 1/9.

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ROTARY PUMPS. Vacuum or Air. Also suit non-corrosive light liquids (NOT salt water) and will lift from depth. Standard ⅜ gas inlet & outlet. ¼ h.p. to drive. Useful paint spray, &c. New & boxed, 30/-, post 1/9.
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Silent Synchronous Mains Motors. U.S.A. made. 220/250 volt A.C. mains, with gearbox and external train 4 r.p.m. and 24 r.p.m. New. Ex W.D. ... 18/6
Compressors, various sizes, air receivers from 12/6. Pulleys, Belts, etc.
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Saw Bench Tops with ball race spindle, pulley, etc. 45/-
May we send our list of 300 Interesting Items? 1½d. stamp, please.

carbonate of lime and water on cloche glasses ?—R. E. Girvin (Galway).

THE easiest method of removing the lime film from the glass is to mop the glass over with a rag saturated with strong spirits of salt (hydrochloric acid—technical grade) or to immerse the glass sheets in a bath of this acid. After this treatment, which will remove the lime film very rapidly, the glass must be very well rinsed in order to remove all traces of acid. Small splashes of the acid will not appreciably injure plant growths, but large splashes should be well washed away with water. The acid falling on the soil will not affect plant growth, because the acid will at once be neutralised by the lime and other ingredients of the soil. A strong caustic soda solution (1 in 5), used hot, will remove the lime film, but not as efficiently as the hydrochloric acid. Moreover, this will very positively damage plant life and almost anything else with which it comes into contact.

A very simple method of removing the lime film is to immerse the glasses for two or three days in water and then gradually to bring the water to near boiling point. The lime will be softened and will become capable of being scraped away with a blunt edge.

Paint Brush Cleaner

I HAVE several expensive paint brushes which unfortunately have been allowed to become hard because the paint was not washed out of them after use. Turpentine or soap and water now has no effect on them. Could you please give me a formula for making an efficient cleaner which will not harm the bristles or the bristle setting ? A paint softener seems to be called for.—S. Kremer (Manchester, 20).

AN excellent paint brush cleaner can be made according to the following formula :

A.

Petrol, paraffin or white spirit	2 parts (by vol.)
Oleic acid	1 part (by vol.)

B.

Ammonia	¼ part (by vol.)
Methylated spirit ...	¼ part (by vol.)

Stir *B* into *A* until a smooth cream results. For use stand the brushes in the above mixed solutions for about 24 hours. Then wash out with hot water and soap.

This cleaner will not harm the bristles or the bristle setting. You will be able to obtain oleic acid (pale olein) in your district from Messrs. J. W. Towers & Co., Ltd., 44, Chapel Street, Salford, 3.

Pearl Effect on Plastic

I WISH to cover some very small articles with a pearl coating such as is used on some imitation pearl beads.

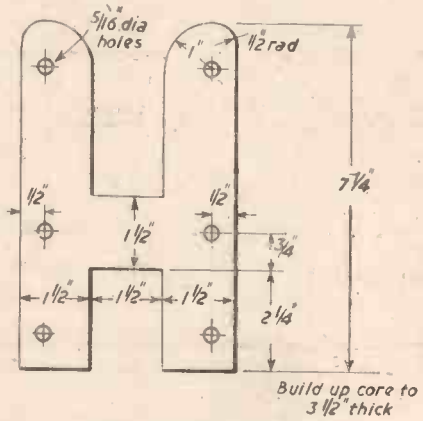
Can you please tell me if I can obtain the necessary pearl colour (powder ?), and where, in what medium it should be mixed and whether it should be sprayed, painted on or the articles dipped ?—J. C. E. Hutchinson (London, N.9).

YOU can obtain from Messrs. May & Baker Ltd., Dagenham, Essex, a material known as " Pearl Paste," which is a damp, white, silky looking paste having about a 30 per cent. water content. This is used largely for producing a pearl effect on or in plastic materials and it would, we think, meet with all your requirements, for the paste could be mixed with gum water or, better still, with any transparent lacquer and applied to the surface of the articles by brushing or spraying or by dipping. The best method of application would depend on the nature of the articles themselves, and since you do not give us any idea of this we cannot help you here. However, Messrs. May & Baker, Ltd., will, no doubt, be pleased to give you further particulars of their Pearl Paste, together with advice concerning its best method of application in your own particular instance.

Making a Growler

PLEASE give me constructional details of a growler for a voltage supply 230 volts A.C. 50 cycles. It will be mainly for 6 volt motor cycle dynamo armatures, the smallest size being 1¾in. clearance × 3½in., plus commutator 1in. diam. × ¾in. Would the growler be suitable for testing motor cycle magneto armatures also ?—H. H. Seymour (S.E.1).

WE suggest that you build the core of the growler of Stalloy stampings approx. 0.018in. thick to the dimensions given below. The stampings being clamped together by means of ¼in. diameter bolts which are insulated from the core by paper or tape bushings and washers. For use on a 230 volt 50 cycle supply the coil could have 400 turns of 15 s.w.g. D.C.C. copper wire. Do not switch on the coil until the armature has been placed on the poles of the growler. The growler could be used for testing motor cycle magneto armatures. A short circuited coil on such an armature will tend to heat up when placed on the energised poles of the growler.



Details of the growler core.

Instantaneous Plating

I HAVE seen demonstrated at street markets a liquid that imparts a high chrome finish to metal objects. The liquid, slightly red in colour, is brushed on to the object, which is then polished ; a high chrome is the result. I understand that the chrome soon wears off, but will last longer if given a coat of clear varnish.

Could you tell me where I might obtain some of this liquid or how I might make some up ? I have tried some of the advertised plating powders without success.—D. E. Challis (Enfield).

THE liquids which are sold at market fairs and which purport to be aids to metallic plating are frauds. They comprise a soluble salt of mercury, and the so-called " plating " which they give rise to is merely a superficial film of metallic mercury which sinks to a slight depth below the surface of the metal. When the metal object is heated, or even when it is left lying at ordinary temperatures, the mercury film volatilises from the metal surface, and thus the " plating " disappears apparently mysteriously. A layer of varnish on the film delays its volatilisation, but not permanently.

Plating powders are similar frauds. They consist mostly of chalk or whiting into which a little mercury has been ground, and they may have minor additions, also, of tin and antimony salts. Some of them, also, contain finely ground magnesium powder, which, in such a medium, aids the deposition of the mercury film.

If you want to make a liquid similar to the one you saw at the market fair you have merely to take an eggcupful of dilute nitric acid (say, 1 in 1) and to dissolve 1 globule of metallic mercury in it. You will thus get a solution of mercuric nitrate which, when rubbed with a soft rag on a brass, copper or steel article, will produce the mercury film or metallic " plating " which you desire. All such solutions, however, are intensely poisonous.

Information Sought

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

Mr. R. Hart, of Derbyshire, writes : " I am planning to build a cupboard for drying clothes in inclement weather. I have the hot water cylinder flow and return pipes running through this cupboard, but shall need more heat than they provide. Could you suggest some form of electrical heater for the job ? Are there any special precautions I should take with the ventilation of the cupboard ? "

Mr. H. H. Booth, of Liverpool, asks : " Would you please give me details on how to make an electrical vacuum chimney sweeper."

Mr. W. Bunce, of High Wycombe, writes : " I understand altimeters are ideal for conversion to barometers. I have two and would like to make two barometers. Could you please give the details ? "

Mr. C. Elson asks : " Could you assist me with details on how to make a duplicator ? "

Mr. J. Woods, of Liverpool, writes as follows : " Having tasted the thrills of surf riding at Newquay, I would like to make my own board. Have you any information to offer ? "

Mr. B. R. Silk writes : " I am a home chemist and wish to make a clamp and boss-head for a retort stand. I should be much obliged if you could give me details and materials required ? "

Donal O'Shea, an Irish reader, asks : Could you please give me details of electrical units used for clearing coarse fish out of small lakes—either by stunning them, or attracting them to a bag net by an electric current ? I understand that a 6-volt variable vibrator unit is used.

The following is a letter from Mr. V. D. Duggan, of Ireland : I propose to build a canoe this summer and would be grateful for advice on the following :

On either side of the canoe I intend to suspend a hollow, wooden float, like those used by South Sea natives, etc. What angle from the gunwale would the supports of the floats require to make with the canoe's side ? What size would the floats require to be in order to render suitable stability and non-capsizing ability to the craft ? What would the best position on the sides of the canoe be for fixing the floats and how far out from the sides should they be suspended ? The length of the canoe would be from 9-12ft.

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which interfere with the effective working power of the mind, and it develops such valuable qualities as:—

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THE "STROLLER"

EXCITING NEW BATTERY PORTABLE WHICH CONVERTS TO A PICNIC RECORD PLAYER

- ★ Sensitive 4-valve superhet.
- ★ Attractive 2-tone case and three colour scale.
- ★ 7 inch elliptical speaker.
- ★ Full A.V.C. and fixed tone correction
- ★ Space for Mains Unit.
- ★ Factory-built look.

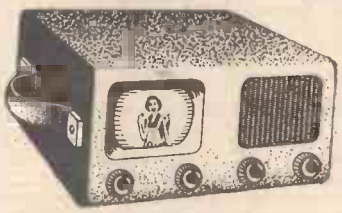
The Elpreq "Stroller" is an all-dry battery operated superhet, using frame aerial and 1.5 volt valves Types IR5, IT4, IS5 and 3S4. It is particularly selective and gives powerful results on long and medium waves. Battery consumption, however, is quite low. The cabinet is ultra-modern and finished crocodile and/or lizard skin in two shades. The control-board is similarly finished, and with the three-coloured dial, gives the whole a factory-built aspect.

Full constructional details of this superhet and of the Picnic Player unit which, by the undoing of four screws, slips into the cabinet in place of the radio, will be found in our booklet "The Stroller," price 2/6 (returnable if parts purchased).

Cost of portable cabinet and all parts for Stroller, including valves, speaker, but not batteries, is £8/17/6 (H.P. deposit £2/19/2), carriage 5/-. Cabinet available separately, price 37/6, plus 3/6 postage.

MINIATURE PORTABLE T.V.

YOU CAN PROBABLY THINK OF MANY OTHER REASONS WHEN YOU MAY NEED A MIDGET TELEVISOR, BUT IT WILL CERTAINLY BE USEFUL WHEN:—



(a) Someone is ill, or confined to another room.

(b) Your big T.V. fails.

(c) You want to alter or adjust your big T.V.

(d) The commercial programmes start.

(e) Servicing an aerial installation.

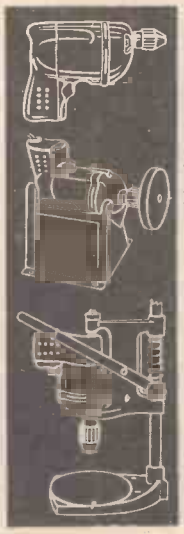
The Elpreq Miniature Televisor uses standard conventional circuitry employing a total of 13 valves and 2 crystal diodes. The cathode ray tube used is a 2½in. Service type V.C.R. 139A, which has a standard equivalent and will therefore always be obtainable.

The total cost comes to £16-£17. A carrying case, similar to the artist's illustration above, will be available shortly. Its size will be approximately 9½in. x 8in. x 6in. (internally).

Full construction data, layouts, diagrams, templates, etc., running into some 50 sheets, is available, price 5/- post free.

14 DAYS' FREE TRIAL

Send only deposit—refunded if tool not approved.



½in. DRILL
Robust tool with trigger switch and self-centring chuck. Drills, sands, polishes, grinds, sharpens. Also, with attachments, drives: lathe, saw bench, rise and fall, grinder, buffer, etc. Price £5.19.6 cash, or 40/- deposit. Carriage and Packing 2/6.

Horizontal Stand
17/6, post 1/6.

Vertical Bench Stand
£3.7.6. post 2/6.

Lathe Stand
£5.5.0. or 35/- deposit. Carriage and packing 5/-. The four items £15.9.6 or £5.3.2 deposit.

WELDING TRANSFORMER

Totally enclosed and fitted High, Low and Off Switch. Intermittent output 4 volts 1,000 amp. Ideal all welding or as power unit for spot welder. Price £4/10/-, carriage and packing 7/6.

FISHING ROD FROM DINGHY MAST
Tubular aluminium not separate sections, extends like telescope from 15ins. to 9ft. 6/6 each.

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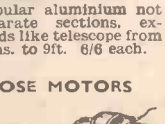

Works off A.C./D.C. mains or batteries—many speeds — many uses, including battery charging. Data given, 11/6, post and packing 2/-.

CRYSTAL SET

Two wave-band bakelite case, germanium crystal—gets "Home" and "Light" anywhere without batteries. 18/-. Headphones, 15/6 pair.

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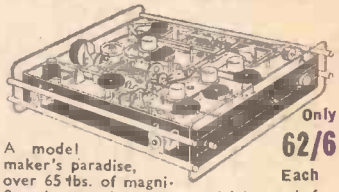

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THE Cyclist
Editor: F. J. CAMM

VOL. XXII JULY, 1954 No. 386

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

Phone: Temple Bar 4363
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COMMENTS OF THE MONTH By F. J. C.

The Parting of the Ways?

WHY NOT FOUND A NEW CONTROLLING BODY?

THE position of the three contending parties to the seemingly never-ending dispute over control of road sport has been aggravated by the stupid decision of the U.C.I. It would now seem that cycling sport exists to prop up controlling bodies which are more interested in developing their own egos than in developing the sport. The fact that they are in existence to do so seems to have been completely forgotten in the heat of controversy, where personalities override policies and logic goes by the board.

The U.C.I. by its reversal of policy has done great harm to road sport, and this, coupled with the harm done by the N.C.U., has placed British road sport in a most unenviable position. The problem does indeed seem to be insuperable under existing forms of control. The time has come, therefore, for all clubs to give serious consideration to the formation of an entirely new body to control all forms of road sport, and governed by men known to be non-partisan in the dispute, which means, of course, infusing fresh blood into control. The N.C.U. has patently proved itself to be incapable and unworthy of control. Perhaps someone who thinks on these lines will call a meeting of delegates from all clubs with the object of founding such a body.

It has been done before; when it was obvious that the old Road Racing Council only had power to make pious and sloppy resolutions which they had no power to enforce, clubs arose in wrath and formed what was then regarded as a dissident body, the R.T.T.C. When the N.C.U. stabbed road sport in the back in the 1890's, the Road Records Association was formed. The clock has been put back at least 50 years during recent months and the methods then adopted to rectify the matter might well be copied. It would mean, in the first place, a joint action on the part of a large number of the leading clubs, giving notice of withdrawal of their affiliation to the N.C.U. and the R.T.T.C. During the formative period of the club a caretaker body could be put in operation to control sport and hand over when the new body had been properly constituted. This would mean that the N.C.U. might go out of existence. Unless its finances improve, it is likely to do this anyway.

It would be important to the scheme we envisage to make quite sure that none of the firebrands and recalcitrants who live to do battle on the flimsiest pretexts, conceived in hate and bred in malice, have nothing whatever to do with the new body. There are too many committee men with plurality of office serving on many other committees, and importing to one the secrets of another. There are plenty of able men willing to fill the various offices. The self-appointed proprietors of the cycling sport should be sent back to the obscurity of the wilderness from which they should never have been allowed to emerge. Certain branches of the sport have become the perquisites of the few. Some are making a nice living out of the sport, merely paying lip service to it, not necessarily believing what they say. There is far too much underhand work going on in the cycling movement for anything to emerge by an amalgamation of existing bodies. Their hates and prejudices could not be effaced, nor is any one of the three bodies prepared to sink its identity by amalgamation. Their identities and their disruptive influences should be destroyed by obscuration.

Licences Reaction

WE print the following B.L.R.C. reply to the recent N.C.U. "whopper" regarding licences for the League riders going abroad, and readers will be able to judge from this whether there is a case for the formation of a new body.

"The offer does not comply with the requirements of the Joint Agreement and whether intentionally or otherwise will have the effect of destroying B.L.R.C. associations with Continental cycling. Furthermore this offer, if accepted, will have the effect of destroying the B.L.R.C. itself. As the body responsible for introducing and continuing road racing and bearing in mind that we control 75 per cent. of all road racing in this country, including *all* professional and independent road racing, we do not consider it just or advisable that the B.L.R.C. should cease to exist.

Whilst on the face of things the N.C.U. offer might not appear to be unreasonable, we would state that at the Joint Meeting on May 8, 1954, our delegates submitted proposals for a Joint International Licence on similar lines to the N.C.U./S.C.U. licence at present in use. Our proposals provided for a card bearing the badges of all three organisations, with space for insertion of name, address, club and category of the named rider, and authorising him to compete abroad in specified events.

This proposal was in conformity with the provisions of the Joint Agreement and, if accepted, could have been the answer to the major problem before the Joint Committee. The N.C.U./R.T.T.C rejected this proposal (which we consider reasonable) out of hand and tried to avoid any vote being taken thereon.

The N.C.U. put a counter proposal to the effect that the N.C.U. International Licence should be accepted in lieu of the combined form of International Licence. This suggestion is in direct contravention of the requirements of the Joint Agreement.

By their action in rejecting our proposal they have committed a breach of the Agreement.

Counsel's opinion re the Joint Licence is as follows:

'It is clear from Clause 8 of the Agreement that all parties to it are bound to use a combined form of international licence as from April 28, 1953. This clause is in the imperative and in the absence of any stipulation as to when it comes into operation it must be deemed to take effect at once and the second part of the clause envisages one form of licence which can be used by each party to the agreement.'

The British League of Racing Cyclists now requires the N.C.U./R.T.T.C. to agree to conform to the requirements of the Joint Agreement."

Members of cycling clubs should remember these facts and consider whether the time has not come to put a period to the activities of the N.C.U. which, in any case, has outlived its period of usefulness.

Perhaps the C.T.C. will take a lesson from this and confine its activities to cycle touring only, and suppress those of its officials who express opinions on cycling subjects outside that sphere, and of which they can know precious little. They are not cycling legislators, as they fancy themselves to be. Nor are they equipped to be so.

Polperro, Cornwall.
The lovely West Country fishing village and former haunt of smugglers.

Wayside Thoughts

By F. J. URRY, M.B.E.

The medieval cross at COLSTON BASSETT, Nottinghamshire.

The Vernal Season

WE all waited a long while for the first real burst of spring, and how beautiful it was after five weeks of east-edged atmosphere that left a blue tinge along your knuckles if you had the temerity to ride without gloves. At the end of the first week of May the glory of an English spring transformed the grey skies and keen winds into a fairyland as only God's alchemy can. The roads became crowded with the bright costumes of cyclists, the apple bloom unfurled itself and the dandelions, burnished gold in their verdant setting, tried to outshine the sun itself. Why do so many of us despise that common bloom ? Just because it is common I suppose, and possibly for the reason it is concerned with a fable of youth not mentionable in polite society. Anyhow, I like to see them sprinkled along the grass verges, flaunting the gold of spring as the cuckoo flaunts the call, both redolent of the jolliest time of the year.

I was very fortunate, for a week-end trip with nearly thirty companions just happened to drop into the right weather report and made a merry beginning to a season, which I hope will bring joy in its train. It is the hours one is out and about that count, rather than the miles travelled, the sights and the sounds and the scents, rather than the leagues you trail that make cycling the most delightful means of travel. I am aware that that approach to the pastime may be somewhat difficult for the young folk to absorb, for the personal adventure of speed is a large portion of their enjoyment, and it is not until later in life they come to realise that cycling is far more than a means of expending restless energy.

The Way It Is

I WAS one of a party of twenty-nine men who had agreed to make Tewkesbury their headquarters for a spring gathering. Seven of us gathered to ride from Birmingham to the confluence of the Severn and Avon rivers on the Friday, forty-three miles of fairly easy road, which were fanned by a bitter east wind that kept us a glove-wearing company all day. There were bits of brittle sunshine, but the cool draught made shelter needful to enjoy a rest and smoke which usually meant an indoor perch, and, fortunately for me, these little cafes are frequent on the way to Evesham. To-day I like to ride ten or a dozen miles, then have a rest and smoke, and by so doing can manage a fifty miles journey without any great discomfort ; but if, as I once did, I scorned anything less than thirty miles before a dismount, I am afraid cycling would be too vigorous an exercise for me to comfortably undertake.

We arrived at Tewkesbury in time for an early tea, and to welcome later our busy friends who had left town in the evening and hurried down on cars with bicycles hung on behind ; all of them complained of the chill temperature.

But in the morning, what a change ; there was great shedding of raiment even at nine o'clock, and the glorious spring day was reflected in every face as we trundled into the lanes to circumnavigate those comely villages strung along the base of Bredon Hill. Looked at from the main roads, Bredon is just a long, grey-green mound, rising like a whale's back over the Avon plain, but penetrate it in gentle mood and its borders harbour some of the most English of English scenes in the country. For it is real country, unspoiled in vision and speech, a little land tucked away on its own almost beyond the noise of the great highways running each side of it. There are no villages more floral and quiet, more picturesque and personal to the scene to be found anywhere, and the curious thing was that of the twenty-nine men who meandered round Bredon's base that day, only two had even been the way before, yet those folk would consider themselves travelled people. We lunched at Elmley Castle, and rolled back to Bredon village to complete the circle, and I've never heard a body of men so full of praise for the beauty and glory of a simple jaunt on a perfect spring day. Two of our company live on the Ridgeway outside Redditch and see Bredon's top most days of the year ; they slipped off after lunch and went over the hill—no easy climb—drifted down to Overbury to join us at tea, warm, a little foot-weary but very satisfied ; and one of them had turned over his sixty-fifth birthday. Such is the power of cycling—properly applied, and aided by the beauty of day and district.

The Ducklings

THE weather was as good as yesterday's promise when we strolled to Upton-on-Severn the next morning, keeping the lane ways over the low ridge 'twixt Avon and Severn, and the air was full of bird music fanning the gentle miles with melody. We rode only fifteen miles maybe, but it was enough to fill a lovely morning with quiet exercise and gracious visions, with a session in the middle of it reserved for the tea-pot. Early in the afternoon after a noon lunch we boarded a wagon—yes, a char-a-banc—to take us to Slimbridge and the Severn Wild Fowl Trust. The wagon was to keep everyone together, and since it is twenty-three miles from Tewkesbury to Slimbridge over a most uninteresting road, and at least three hours is needed to see the result of Peter Scott's hobby turned to National purposes, the question of cycling there and back to headquarters was not attractive.

The Trust enclosure is well worth a visit for anyone with a streak of wildness in his make-up. I had expected to see the birds in captivity, but most of them are as free to come and go as their wilder comrades of the estuary, and it was good to see duck and geese flight into the area and land like young seaplanes on the pools. Some of the rarer species are almost unbelievably decorated and beautifully feathered ; you can watch them for hours. Among them are the vain ones who will calmly pose for photography, apparently confident of their own loveliness and the good behaviour of the human performer.

Our visit was on the wrong day for the 26 acres were crowded with people, when a weekday would have give us almost a private view. If you go—and you should, for it is a world sight—then make it a weekday and a fine one, for Slimbridge is no place for cycling shoes when the rain descends or, indeed, following closely on a wet period.

Home Again

THE seven cyclists who rode south on the Friday rolled home again on Monday and their exposed skins had received the brown burnish of health. That road between Bredon and the Dumbletons, once so lonely and over which I have oftimes raced in the long ago, is now carrying the north bound traffic at an ever-increasing tempo. It is still beautiful between the hills that shelter it from the winter winds and make the Evesham valley so prolific of produce ; but it has lost its old-time remoteness, for the traffic is always with you. Our meandering brought us to Evesham and beyond, before comfortable thirsts needed attention, and then over the watershed to the Alne we rode, past the woody domain of Ragley into the old Roman outpost of Alcester, and lunch. As you grow older, that rest after lunch, which once puzzled me when the Guv'nor took me touring, becomes very comforting, and we took our ease by Coughton manor where the Throckmortons still hold sway, prior to the long rise through Studley and on to the summit of Gorcot Hill, thereby gaining the Midland plain. It was hot, and we were not used to temperatures running close to the eighties, and I think all of us were a little limp by four o'clock, when a cup of tea revived the chatter and the activity to wander gaily home. It was a gallant week-end just right for my reduced power of individual movement, proving that this old body can still manage a 40 to 50 miles journey and enjoy every league of it, notwithstanding a left leg that occasionally shirks its fair share of propulsion. So now a feeling of confidence is making me look forward to June and that proposed Welsh visit in the company of another ancient, when we have promised ourselves a gentle meander around the areas of the Principality that so attracted us 50 or 60 years ago.

Around the Wheelworld

By ICARUS

Stop-watch Timing

TWO runners within the past few months have beaten 4 min. for the mile, and I congratulate them. Without in any way wishing to belittle these great achievemens I take leave to question whether it is possible to time such events with an ordinary split-second watch, possessing a Craftsman's Certificate (issued by the N.P.L.), accurately to 1/5th second. I write with more than ordinary knowledge of watch mechanisms, and with long experience of adjusting them for the Key A Certificate, recently superseded by the Craftsman's Certificate. The stop and start mechanism of all stop watches depends upon a gear having very fine teeth being thrown into, or out of, mesh with a wheel attached to the second wheel arbor. When the button of the watch is pressed, the idling wheel which brings the chronograph hand into action may jump forward a 1/5th second, or it may lag a 1/5th second. In the first case, this would be against the runner or the cyclist, and in the second it would be in his favour. There is no means of eliminating this error, for the teeth of the gear, when it swings into mesh, may land on the top of the teeth of the wheel into which it meshes. Hence the lap or lead on the reading. In some watches where the teeth are somewhat coarse the hand may leap forward or lag as much as 2/5th second. In any case, in a record such as the mile event to which I have referred it is impossible to say with certitude that either runner was within the four minutes by 1/5th second for the reasons I have given. In my view, the same stop watch should have been used and operated by the same time-keeper so that the same plus or minus time error exists in both cases. Apart from this, there is the time lag between pressing the button and the actual engagement of the gears. Some time-keepers do not react so quickly at the sound of a starter's voice or pistol as others—an added reason why, where possible, the same time-keeper and the same watch should be used. Also, two different watches would be bound to have a different rate. I know this will be small for such short time events as the running mile, but if the watch has just been fully wound it is not unknown for it to gain 1/5th second in 4 minutes. I do not know any time-keeper who understand watches and fewer still the finer points of time-keeping.

Gordon Randall's Success

MY colleague, Gordon Randall, who does those delightful sketches which illustrate this supplement each month, has a water colour in the Royal Academy this year—it is of the Old London Apprentice at Isleworth.

In my view, his work is equal if not superior to that of the late Frank Paterson, whose economy of line relied upon large white patches for effect.

Amateur Circuit of Britain

BRITAIN'S first eight-day amateur cycle race starts on Saturday, August 14th, and finishes on Saturday, August 21st. Prizes to the value of £500 will be awarded and these will include primes at selected points on the route. The course is approximately 960 miles long. This race has taken place as a result of the efforts of the B.L.R.C. It will be remembered that at the A.G.M. it was announced that owing to its heavy costs the only existing amateurs' stage race would have to be discontinued unless a sponsor could be found. The secretary of the B.L.R.C. was instructed to find such a sponsor, so that amateurs could have a major event on a par with cycle circuits on the Continent. Such a sponsor has been found—for Quaker Oats Ltd. have offered to put up a trophy and prizes and to make a donation to the B.L.R.C. to cover the other costs of the race.

The major amateur event hitherto has been the stage race originally called the Brighton to Glasgow Marathon, which was run last year as the five-day Brighton to Newcastle race.

This year's Amateur Circuit of Britain will be in eight stages totalling nearly 960 miles.

It will start and finish at Southall, and the stage points will be at Derby, Scarborough, Morecambe, Rhyl, Aberystwyth, Gloucester, and Weston-super-Mare. The organiser is Mr. Vic Humphrey, of Southall, who organised last year's Brighton to Newcastle event, and the race will be run under the rules of the British League of Racing Cyclists.

Speed Tables

TEMPLE PRESS LTD. have just published a second edition of their "Speed Tables" at 3s. net. In stout paper covers, its 94 pages consist of tables of time and speed equivalents for speeds of 10 miles, 25 miles, 30 miles, 50 miles, 100 miles, and 12 hours, and roller racing speeds for 440yds., 600yds., 880yds. and 1 mile, with an additional conversion table of yards to decimals to the mile.

New Roadster Tyre

DUNLOP announce a new Roadster tyre in which the existing triple stud pattern has been developed by the addition of teeth which lessen still further the likelihood of skid.

The new tyre has also a stronger cord of high fatigue resistance with generous rubber insulation to enable the casing to stand up to concussion. The sidewall rubber has also been strengthened, not only to withstand the constant flexing of a high mileage tyre but, without reducing liveliness, to improve its resistance to cutting and accidental damage. There is no increase in price; the cost of the cover is still 11s. 6d.; of the tube, 5s. 4d.

English Road Cycling

I GIVE without comment, as the views coincide with mine, the following quotation from *L'Equipe*, dated May 11th, 1954. The article is written by Maurice Simon. "With the support of the U.C.I. the B.L.R.C./N.C.U. conflict crops up again, once more menacing British cycling. The U.C.I. decides to withdraw from the B.L.R.C. (the more active body) control of the Tour of Britain.

"The state of English Road Cycling, since Saturday, has taken an extremely gloomy turn. It seems that the N.C.U., taking advantage of its position as the sole British body recognised by the U.C.I., has decided to get rid of the B.L.R.C., ex-rebel body actually associated with the N.C.U. but still rivals and founder of the road racing movement in Britain.

"On Saturday a veto was sent to the L.V.B. by the N.C.U. to prevent a team of British riders (the best ever got together by the English), members of the B.L.R.C. taking part in the 'Week-End Ardennais.' The team was obliged to go back to England without having raced.

"As a final blow, yesterday morning the *Daily Express*, organisers of the 'Tour of Britain,' received a letter notifying them that the U.C.I. had decided that the event could no longer be run off under B.L.R.C. rules, although this had been the case since its foundation.

"One can, therefore, expect the situation to take a stormy turn. The B.L.R.C. claims to have been tricked. In March, 1953, it had been temporarily recognised by the U.C.I. In April an agreement was signed by the N.C.U. and the B.L.R.C. Soon after, the N.C.U. asked that the International recognition given to the B.L.R.C. should be withdrawn, under the pretext that it was not practical, internationally, to have two bodies in one country.

"Now, say the members of the B.L.R.C., they want to cut off their international relations, when we are those who started road racing in Britain.

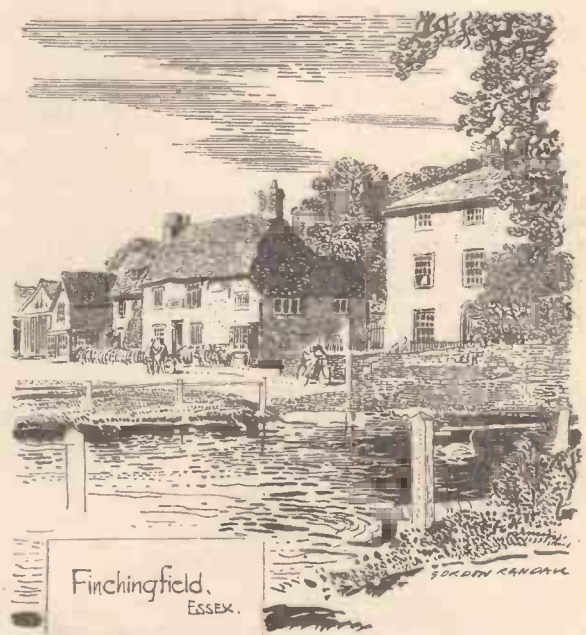
"The decision of the U.C.I. about the 'Tour of Britain' is considered by the B.L.R.C. as interference in a purely internal matter.

"By virtue of the N.C.U./B.L.R.C. agreement, it is still the B.L.R.C. which controls all road races for professionals and independents in Great Britain. This agreement still exists and it is difficult to understand the attitude of the U.C.I.

"When questioned, Mr. Asher, director of the organisation of the 'Tour of Britain' for the *Daily Express*, replied that the important thing is that the tour should take place.

"While waiting, tension amongst British cyclists increases."

For Editorial Views on this *impasse*, see previous page.



See "Gordon Randall's Success" on this page.

Weags Bridge spanning the lovely Manifold River. Staffs.

CYCLORAMA

By H. W. ELEY

The Cool and Silent Wood

ON a sultry July day, when the road glared white in the sun and I felt hot after several miles of steady climbing, I turned off the highway and entered Sorrel Wood —and immediately found coolness and shade beneath the bower of trees. Down the main path of the wood the tall trees made a delightful, shady canopy of green, and in the little glades I found a silent joy and refuge. There was no bird song in this woodland sanctuary; just an occasional squawk from a gaudy jay, but otherwise, silence, deep and satisfying. And what noble trees stood like sentinels in that sylvan retreat! Tall elms and giant oaks there were, and away to the left a little group of silver birch, with their trunks gleaming faintly in the sun which filtered through the branches. I leaned my machine against a tree, sat down on a log, lit my pipe, and gave myself up to half an hour's sweet content—far from the madding crowd, cool after my riding, and presently ready to take the road again, to ride up to the door of the "Three Horns" at Hanningley End, and there find refreshment in a tankard of good ale.

"The Five Towns"

I AM not very far distant from the Potteries; from the canal banks, the kilns, the huge chimneys, the smoke and haze of that unique region where everyone thinks, talks and dreams of pottery and pottery-making. Those who hate industrial regions and drab streets and the factory atmosphere will avoid this North Staffordshire area, where the craft of the potter reigns supreme, and where those "Five Towns" of Arnold Bennett's merge into one another to form the great federation of Stoke-on-Trent. I found a ride into this unique region quite fascinating, and I rode through Hanley, Burslem, Longton and Fenton, and mused upon the fame of Staffordshire ware and the inherited skill of the potters. I thought, too, of two of Staffordshire's immortal sons—Sir Oliver Lodge and Arnold Bennett, who gave us so many good novels and who took his famous character "The Card" from real Staffordshire life. Two days I spent exploring this great industrial conglomeration and in between my wanderings down dingy narrow streets and over scarred pit-banks, I rode into some delightful North Staffordshire scenery, and realised that some of enchanting Dovedale itself was in Staffordshire, not in Derbyshire; and that the beautiful Manifold Valley was as picturesque and alluring as anything one may find in Devon or Wales. It is good, sometimes, to ride into the realms of industry, and forsake the country lanes and by-ways.

Saint Swithun

COME the fifteenth of July and there is much talk in the countryside of Saint Swithun and of rain, and the prospect of 40 days' downpour if it happens to be rainy on the day devoted in the calendar to this old saint, about whom, by the way, I have never been able to glean much authentic information! Country-folk set great store by Saint Swithun's Day and, as I am not very anxious to have a rainy summer, I am "crossing my fingers" and hoping that the fifteenth of the month will be dry. Later in the month, I plan to ride westward into Wales, and again find rare delight in the beauties of Radnorshire and Montgomery, where the valleys are green, the hills majestic, the little streams flow like silver threads, the sheep graze upon the mountain slopes and all is very peaceful. Maybe I'll make my headquarters at Llanidloes, and from there take my daily rides into a land of green beauty.

A Reader from Ripon

IN a recent article, I made some brief references to the "Ripon Wakeman"—and my notes brought forth a most interesting and friendly letter from a good Yorkshireman in Thirsk, who, incidentally, tells me that he has been a regular reader of PRACTICAL MECHANICS since 1942. My correspondent tells of the ancient "Topley Fair"—held annually in July, and once famous far and wide as a centre of horse-dealing, and much frequented by gipsies. In the hill-country around Thirsk is the famous "White Horse of Kilburn," a famous landmark for many miles around. This interesting village of Kilburn is associated with Thompson, the famous wood-carver, generally known as the "Mouseman" because of his trade-mark of a carved mouse on nearly all his work. There are fine examples of his work in many old churches up and down the country. My good correspondent also mentions Shandy Hall, once the home of Laurence Sterne, the author of "Tristram Shandy," and I gather that there is a special "Cyclists' Sunday" every year, when riders make a pilgrimage to the place. I am grateful to this keen cyclist from Yorkshire for all his kindly comments, and for the information he sent me.

Moonlight Magic

THERE is romance in the moonlight, and every year I plan a ride when the moon is at the full, lighting up the road and sharpening the outlines of cottages, ricks, barns and all the familiar objects of my countryside. They all seem to take on a new and somewhat eerie appearance as I ride out of the village, and away into the lonely countryside where there are but few dwellings, just an occasional wayside inn, with its swinging sign ghostly under the pale light of the moon. At the corner of the old turnpike road by Trundells End is the ancient gibbet whereon malefactors were hanged in the grim years of the long ago, and I never pass it, sinister and forlorn, without a passing thought of the heavy punishments of those ages, when a man's life could be taken for what we to-day would consider but a trivial offence. I have been told that it is not so many years ago since a man was hanged at Trundells End for stealing two sheep!

Three Riders from "Brewopolis"

AS I cycle gently towards our village inn one sunny Sunday morning, timing myself so that I shall get to the inn door just as old Tom Sharples draws back the bolts and prepares to serve thirsty men, I espy three cycles propped up against the yard wall. Their owners enter the inn just before me, and soon we engage in friendly chat. I find that they have ridden over from Burton-on-Trent—the very metropolis of ale! We talk of the ancient town where I happen to have been born. We discuss its brewing fame and pass on to talk of its ancient Parish Church of Saint Modwen, the fragments of the old monastery beside the wide waters of the Trent. Men of much my own age are these good Burtonians who have ridden the thirteen odd miles to my adopted village, and we find many points of contact, and talk of many features of the town in the "old days." The "Statute Fair"' is still held in the town, every October, and we recall that in the "nineties" it was still the custom at this annual happy function for youths and girls to stand in the market-place, waiting to be hired out for a year's service on near-by farms! I can remember that the youth desiring employment as a shepherd would have a tuft of sheep's wool in his cap, to denote his calling! How remote it all seems now—but it was good to have that Sunday midday meeting, and my "travellers three" will be coming again.

The ruins of the great castle, dating from the reign of William the Conqueror.

Published about the 30th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by W. Speaight & Sons, Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia). Ltd. Sole Agents for South Africa—Central News Agency, Ltd. Subscription Rate (including postage): For one year, Inland and Abroad 14s.

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