A FOLDING OUTBOARD MOTOR BOAT

NEWNES

PRACTICAL MECHANICS

EDITOR: F.J. CAMM
JULY 1953

www.americanradiohistory.com
TELEVISION IN COLOUR

Over twenty years ago the late J. L. Baird demonstrated that it was possible to transmit television pictures in colour. Since that time, considerable sums of money have been spent in developing colour television and now it is reasonably certain that America will be transmitting pictures in colour as a standard part of their daily programmes next year. We are promised colour television in this country within the next five years.

It must not be concluded from this that America is more advanced in colour technique than we are; indeed, the reverse is the case. In this country the BBC is hampered by lack of the necessary money to install the special apparatus necessary, whilst individual radio firms are not able to devote very large sums of money for experimental work, although at least two firms have produced and demonstrated satisfactory systems.

Baird's method was elemental and not intended to represent the final system. He made use of two pictures of the same scene, superimposed one on the other, each in a different colour. Each picture was passed separately through a colour filter, and so passing through the appropriate colour. Unfortunately, two-colour pictures are inadequate and disappointing. So all colour systems to-day make use of the three primary colours of red, blue and yellow. All colour television systems make use of filters in front of the camera and whilst all credit is due to the members of this expedition, we must not forget the work of those backroom boys at the Admiralty, the Ministry of Supply, the Medical Research Council, the Royal Aeronautical Establishment, and dozens of important firms whose combined experience was freely drawn upon.

The second and later system is based on the use of coloured phosphors on the screen of the receiving set. The end of the cathode-ray tube is coated with dots of phosphor arranged in between parallel lines coinciding with the transmitting system in use, that is to say between 400 and 800 according to the country. These emit white light when struck by an electron stream. Phosphors emitting red, yellow and blue light can equally be used. There are, of course, other systems, some electro-magnetic and some entirely electronic.

Fair Comment

The placing of the Union Jack on Everest's hitherto inaccessible peak, coinciding as it did with the Coronation, was not only a physical achievement on the part of an Englishman but also a victory for British scientists and scientific apparatus. Those who have attempted to climb Everest before had not the advantage of scientific equipment to the same extent as the present expedition. For example, oxygen breathing apparatus of a light type suitable for such an ascent was not available. This time an oxygen breathing set with light alloy cylinders, each stencilled with the Union Jack, charged to a pressure of 3,300 lb./sq. in., complete with carrying frame, equipment and control gear and produced by an English firm, were available and contributed to the success of the expedition.

Earlier climbers, like the hero in Excelsior, ploughed the lonely furrow, and whilst all credit is due to the members of this expedition, we must not forget the work of those backroom boys at the Admiralty, the Ministry of Supply, the Medical Research Council, the Royal Aeronautical Establishment, and dozens of important firms whose combined experience was freely drawn upon.

A NATIONAL CAR MUSEUM

A National Car Museum is advocated by a well-known motorising journal. The purpose of such a museum would be chiefly educational for there is no quicker way for designers and engineers to traverse the road trodden by pioneers than to study their work. Already the detailed specifications of some of the interesting cars of the past have been lost, and old vehicles themselves must some day crumble unless they are properly cared for. The Veteran Car Club makes the legitimate claim that its members have found the best method of preserving these old cars—by owning, cherishing and keeping them fit for the occasional outing organised by the club. No one disputes that, but no one can deny that access to V.C.C.-owned cars is hardly possible any time that inspection is desired. Selected examples of 60 years of automobile progress need housing under a roof that is of sufficiently large area to cover them all; it is in this respect that the Science Museum falls down.—F. J. C.
An Easy-to-build Portable Speedboat Which Can be Constructed at a Very Low Cost

This folding speedboat is probably about the simplest of its kind, and the term folding is employed to distinguish it from the collapsible variety, usually constructed of canvas, which gets torn, and numerous struts, which either break or are lost.

The boat has six principal parts, two sides, two halves to the bottom, a transom and a frame which keeps the boat spread open when it is erected.

The Construction

The bottom is made in two halves, the seam between the two running centrally fore and aft and is rendered watertight by covering with canvas. This also allows it to hinge so that one half can be folded over the other. The sides are each hinged on either side of the bottom pieces in a similar manner, so that the boat, when in a folded position, resembles a folded screen. The bow of the boat is covered with a small canvas capping which serves to unite the extremities of the sides and bottom pieces, whilst the ends at the stern are united by a canvas back, which folds up when in the packed condition and spreads out to form a canvas transom when the boat is erected. The hinging of the sides is further assisted by three metal hinges on each side, a suitable one shown in Fig. 7.

For rowing, ordinary rowlocks are not used, but a simple piece of iron rod ½ in. in diameter is secured to the side of the boat and so as to project a few inches above it. The fastenings used to secure the various parts may be either rivets or screws; to those with experience of rivets this is the cheaper way, but it is a tricky job for the inexperienced, who are advised to use screws (½ in. No. 6 is the most suitable size), brass for preference, but iron may be used for economy if dipped in boiled oil before insertion. Since these may be purchased from any ironmonger as required they are not included in the materials list.

Obtaining Rigidity

The boat is rendered rigid amidships by a frame which slides into grooves on the sides and held there by small door bolts which engage with holes in the frame. Simple folding seats are employed, one at the transom and one amidships, which are dropped into position after erection.

The top of this rod is bent over in the form of a hook and the oars are provided with metal eyes which slide over the rods. Thin brass strip is used along the edges of the sides to prevent chafe, and the top edges of the side pieces are strengthened along their entire length by being battened on each side with ½ in. by ½ in. hardwood (Fig. 8). The midship frame is made from ½ in. ply and sawn from the solid piece.
July, 1953

It will be seen then, that the craft is entirely constructed from wood and rendered watertight with canvas, but since the canvas only covers the seams, there is no risk of perforation or splitting as in the case of a boat constructed wholly of canvas on a wooden frame. Thus, when assembled, the boat more nearly resembles one of the rigid variety than a collapsible.

The overall length is approximately 9ft., with a beam of 3ft. and a depth of 1½in. Folded, the dimensions are 9½ft. by 1½in, thus it can be easily carried on the roof of the car or stowed along a wall. The transom, frame and seats are, of course, packed on top of the folded hull.

Launching

From the folded position to complete erection ready for launching, a period of about four to five minutes at the most is required.

To erect, the folded boat is stood on edge and sides pulled outwards when the device will resemble the letter W; pressure is then brought to bear on the central bottom seam which corresponds with the apex of the central part of the W. This forces the sides out at the bottom and flattens the bottom of the boat so that the cross-section now resembles a flat-bottomed U.

An Expanding Device

The next stage is to insert the rigid transom, and to facilitate this an expanding device is used. This is composed of two pieces of wood about ¾in. by 1in, crossed and riveted together in the manner of a pair of scissors; and the ends of the longer arms are notched so that they can fit over the inner strengthening battens of the tops of the sides.

The device is placed in position and by pressing down on the junction of the two battens of which it is composed, leverage is obtained to force the sides outwards, when the wooden transom can be slipped home.

The central frame is inserted in a similar manner with the use of the expander, and when in position the bolts are shot, thus securing it rigidly in place. The seats merely rest in place and are in no way secured.

For the finish, varnish is best, one good coat of half varnish and half linseed oil as a primer and two light coats of neat varnish being sufficient.

All canvas joints are treated with marine glue as specified in the materials list. Tar or paint may be used but are messy and unsightly.

Materials

Plywood is the material suggested although masonite or similar material could be equally well employed. For the hardwood battens either American elm or oak could be used. If cheapness is a consideration,
ordinary English elm may be employed, but this twists badly in storage pending use. The following materials list contains suggested materials and they are given in the sizes in which they should be bought. All wood should be planed.

**MATERIALS**

For the Sides and Bottom:
- 4 pieces 1 in. pine plywood, each 10 ft. long and 14 in. wide.

For the Transom:
- 1 piece ply, 3 ft. x 14 in.

For the Frame:
- 1 piece 1 in. ply, 3 ft. x 12 in.
- 1 piece 3/4 in. ply, 5 ft. x 12 in.

For Battens:
- 10 pieces American rock elm or oak, 3 in. x 1 in., each 10 ft. long.

For Seats:
- 1 piece 1 in. ply, 5 ft. x 1 in.
- 1 piece 1 in. ply, 5 ft. x 1 in.

For Miscellaneous Strengthening Pieces:
- 1 piece of mahogany 3/4 in. thick, 5 ft. wide, 10 ft. long.

Canvas (extra stout):
- 1 strip 3 ft. x 1 in.
- 1 piece 3/4 in. x 1 ft.

Screws:
- Order as required, mostly 1 in. No. 6.

Marine Glue for Joints:
- (1 quart tin.)

The first stage of the work in constructing the boat will be to cut out the two sides and the bottom pieces. These, of course, are cut from the large piece of 5/16 in. plywood shown in the materials list.

Referring to Fig. 2, the upper part shows one of the side pieces whilst the lower shows one half of the bottom. The parts should be marked out and shaped in accordance with these diagrams, and it will, of course, be seen that it is only necessary to mark out one of each in this way, for the finished parts can then be used as templates for the others.

Great care must be taken to see that the two sides and the two bottom halves are exactly the same shape and in every way identical, and to make certain of this, it is as well to clamp them together for the final finishing off. The work on sides and bottom completed, the back board or transom may be cut out according to Fig. 3 from 1 in. plywood. Cut the notches at the top corners very carefully, as shown in detail A, lining them with thin brass strips as shown. The notch, it will be seen, is 5/16 in. deep and 1 in. long. It is as well to finish the job outright, so that the engine mounting block and seat batten may be fitted right away.

The Seat Batten

The seat batten should really be of L section, so that the groove in the rear edge

![Fig. 4.-Details of the stern seat which is supported by the rib on the stern board.](image)

(of the seat can drop over it, thus preventing the seat from drifting forward. The centre stretcher or frame may now be made according to Fig. 3, from 1 in. plywood.

*(To be concluded)*
About Circular Saws

With Particular Reference to the Pitch, etc., of the Saw-teeth

By N. CLIFORD

THE efficient functioning of a circular saw depends to a very great extent on the quality of the blade coupled with the correct design and spacing of the saw-teeth, suitable running speed, and similar factors. Unfortunately, any tool made of poor quality will soon become blunted and there will be an excessive waste of time spent in re-sharpening, with the added possibility that the re-sharpening itself will result in an alteration of cutting bevels, etc., that will lead to poor quality sawing.

Here the remedy is obvious. A good quality blade from a reliable manufacturer will still be economical even if it costs twice as much as a less efficient tool.

The design of teeth requires some consideration, however, and the typical layout of this is shown in plan and elevation in Figs. 1 and 2 respectively.

The "Gauge" of the saw (I) is the thickness of the actual plate. To allow the plate to run freely through the wood, the saw-teeth are bent to left and right alternately, the distance between the tips of two adjacent teeth across the blade being known as the "set" (S). The degree of set governs the width of saw-cut that is made. Too wide a set means waste in sawing, while too narrow a set causes friction between the saw and the wood, resulting in the overheating of the blade and the wood, hence it needs to be as large as possible, and of good, well-rounded shape.

The "Pitch" is measured by the distance travelled in feet per minute there will be a spindle speed of less than 500 r.p.m. for a 6ft. saw, to more than 6,000 r.p.m. for a 6in. saw. Correct speeds can be assured only by the use of a suitable motor for the size, etc., of the saw to be driven. Over-powering of the saw is equally as dangerous as under-powering.

Saw-sharpening is a job for the expert, but the home mechanic can satisfy himself that sharpening is done in accordance with the correct principles. Given proper design and spacing of teeth and rim speed, the greatest obstacles to sawing technique have been overcome, but the spindle collars must be set square and the bearings in good condition, for any inaccuracy at the spindle will be increased out of all recognition at the rim. Other points that will assist in defect-free sawing include the packing, and the accuracy of the adjustable fence, table, and roller feed, if forming part of the equipment.

The patrol boat Bold Pioneers, the first operational warship powered by gas-turbine engines, seen during advanced trials in the Channel. She and her sister-ship, the Bold Pathfinder, also completed, are the first of a new class. The gas-turbines enable the boats to carry a heavy armament at high speeds.

Fig. 1.—Edge-on view of saw-teeth.

Fig. 2.—Profile of circular-saw teeth.

Fig. 3.—Showing the "set" of saw-teeth.

Fig. 4.—Enlarged view of saw-tooth showing the top bevel.
PHOTOELECTRIC exposure meters are relatively easy to build, making use of a selenium cell and meter movement. Such meters can be accurate and reliable, while the cost of construction is only a small fraction of the cost of a ready-made exposure meter of this type.

The type of cell used in the meters to be described is that known as selenium barrier layer cells, and may be obtained from Megatron Ltd., 115a, Fonthill Road, London, N.4. For normal purposes a very large cell is not required. An average size is the 22 mm. by 40 mm. type, and this only costs a few shillings. Circular cells are also available, and can be used in exactly the same way as the rectangular cells. Cells of this type generate an electrical current when light strikes them. The strength of the current depends upon the intensity of the light, and may be measured directly with a suitable meter. The intensity of the light striking the cell is therefore shown by the meter pointer. The scale of the meter may be calibrated in exposure times, or bear numbers which may be referred to a table, or calculator, to ascertain the exposure.

Fig. 1 shows the simplest type of circuit and the kind of scale obtained. (Methods of calibrating the finished photometer are given later.) The cell elements are deposited upon a metal plate, or back, and this forms the positive connection. On the surface of the cell a metallic ring is deposited, and this forms the negative terminal.

The meter movement itself requires to be of sensitive type, especially if weak light values are to be measured accurately. A cell of the size mentioned will give an output of approximately 300 microamperes, when exposed to a light of 100 foot-candles intensity. Various new and ex-service meters and meter movements are obtainable. That used in the circuits to be described was one having a full-scale deflection of 50 microamperes, since comparatively dim interiors were to be dealt with. Some glide-path and other equipment has movements of even greater sensitivity. There is no need that the exact full-scale deflection be known.

As Fig. 1 shows, the scale is not very extensive, covering from only 1 second to 1/10th second. The scale may be increased by adding a series resistor, as shown in Fig. 2. This slightly reduces the maximum sensitivity. (E.g., the pointer movement is slightly reduced for dim light values.) The other end of the scale, however, is much modified, and can now extend to 1/500th or even 1/100th of a second. This arises because the resistor reduces the current which can flow, so that the current is fairly small, even with a strong degree of illumination.

As the value of the resistor is increased the pointer deflection is reduced for a given light intensity. A scale of up to 1/500th second was obtained with a 7,000 ohm resistor with the cell and meter mentioned. The pointer deflection may also be reduced by chunting the meter. (E.g., rendering it less sensitive by adding a resistor in parallel with it.) Two-range meters may be made by adding a small push-switch so that the resistor may be brought in at will.

Cell Mounting

Ready-mounted cells may be purchased, or cells may be mounted as shown in Fig. 3. The cell is held against a strip of insulated material with small clips, these being fashioned so that they bear upon the metallic ring on the surface of the cell. These clips are wired together (to reduce possible contact resistance) and form the negative pole. A strip of foil or thin metal under the back of the cell forms the positive pole. A sensitive meter should not be connected to a cell when the latter is strongly illuminated without a limiting resistor, or the meter movement may be deranged.

A method of reducing the light reaching the cell is shown in Fig. 4, where the cell is mounted in a recess. For use in dim light the cell may be directly exposed. When the light is strong or however, the grille can be folded over it. This may be made from metal, bakelite, or any other opaque material. The number and size of holes in it will determine the sensitivity obtained with the photometer when the grille is in position. The simplest method is to drill small holes one at a time until the required result is obtained.

Out-of-doors, the cell may be turned slightly downwards, or shielded from the sky with a hand. The actual manner in which cell, meter, and resistor are arranged is not important. In some instances the cell can be included in the meter case itself, the aperture being cut so that light may reach the cell. The meter movement should always be handled with care. If removed from its case, it should be kept free from dust or metal filings, etc., which may foul the moving coil gap. A new scale may be drawn upon stout paper or thin card. Alternatively, if the meter is already fitted with a scale, this can be retained, and the numbers referred to a table, or calculator, so that the exposure may be read.

Exposure Calculator

It will be seen that the scales in Figs. 1 and 2 are marked directly in fractions of a second. This is a method which is very convenient in practice, but such markings can only refer to one lens aperture and film speed. (F5.6, with a 30 deg. Sch. film, in the case mentioned.) With such markings, the experienced photographer can readily arrive at other figures for different apertures. For example, if it is necessary to stop down to F8, then the exposure must be doubled. Similarly, stopping down to F11 would require an increase of approximately four times in exposure.

A simple method of arriving at the aperture to be used with any particular shutter speed is shown in Fig. 5. Two discs are pivoted together, one bearing the apertures...
or stops, and the second marked with the shutter speeds. Assuming that the correct exposure at F5.6 is 1/100th second, then the shutter speed for other apertures is as shown. (E.g., 1/500th second at F2, 1/250th at F3.8, and so on.) If an exposure other than 1/100th second at F5.6 is indicated, then one disc is rotated until the correct exposure comes opposite F5.6. For example, 1/500th second at F5.6 would give readings of 1/250th at F8, 1/100th at F11, and so on. It will be seen that exposures of several seconds frequently become necessary when using apertures up to F22, F32, or F45. It should briefly be explained that the larger the "F" number the smaller is the aperture of the iris, or lens. Because of this the exposure time is increased so that sufficient light may still reach the film. Small, cheap cameras frequently have lenses of F11. Those of slightly more expensive make have lenses of F8 or so. The better class of camera usually has a lens which can be opened out to F3.5 or F4.5. High-class cameras have lenses as large as F1.4 or F2. If the "F" number of a cheap camera is not marked, it may be found by measuring the diameter of the iris, or aperture, and dividing this into the distance between iris and film. It will, therefore, be seen that the larger in diameter the lens is the smaller will be the "F" number. If a meter with ordinary scale is used, the numbers may be marked upon the vacant section of the larger disc in Fig. 5. For example, with a 50 microampere meter the markings would be from 0 to 50. An arrow may then be marked on the inner disc. This arrow is turned to the same figure as the pointer reading. The exposure for various apertures will then be shown.

If the "F" number of a cheap camera still may have lenses of F8 or so. The better class of camera usually has a lens which can be opened out to F3.5 or F4.5. High-class cameras have lenses as large as F1.4 or F2. If the "F" number of a cheap camera is not marked, it may be found by measuring the diameter of the iris, or aperture, and dividing this into the distance between iris and film. It will, therefore, be seen that the larger in diameter the lens is the smaller will be the "F" number. If a meter with ordinary scale is used, the numbers may be marked upon the vacant section of the larger disc in Fig. 5. For example, with a 50 microampere meter the markings would be from 0 to 50. An arrow may then be marked on the inner disc. This arrow is turned to the same figure as the pointer reading. The exposure for various apertures will then be shown.

If a meter with ordinary scale is used, the numbers may be marked upon the vacant section of the larger disc in Fig. 5. For example, with a 50 microampere meter the markings would be from 0 to 50. An arrow may then be marked on the inner disc. This arrow is turned to the same figure as the pointer reading. The exposure for various apertures will then be shown.

A Household Ozoniser

Constructional Details for Making Apparatus to Purify the Atmosphere of Rooms, etc.

Ozone is one of the most powerful disinfectants known and as a deodorant and means of freshening up the atmosphere of rooms it is unexcelled. It has an extremely simple method of generation and at once diffuses into the air of a room or apartment, penetrating to every corner of the room. Ozone is an invisible gas, possessing a characteristic odour. Every amateur experimenter who has worked with electrical apparatus in which sparks are produced must, at times, have noticed a peculiar smell in the vicinity, an odour which is not unpleasant, despite its unusual pungency. This odour is due to the formation of small amounts of ozone by the electrical apparatus.

In composition ozone is nothing more nor less than a condensed form of oxygen. This is, of course, its great virtue, for it readily oxidises all impurities in the atmosphere, reverting afterwards to ordinary oxygen.

Preparing Ozone

There are several methods of preparing ozone, but the most useful one and that utilised by the apparatus described in this article consists of subjecting a current of air to the silent electric discharge. Air consists mostly of oxygen and nitrogen and it is the oxygen of the air upon which the electric discharge operates, converting a proportion of it into ozone.

Ozonising pure oxygen. In this simple bench apparatus which employs the ozone tube shown in Fig. 1, oxygen is generated by heating a mixture of potassium chlorate and manganese dioxide in the test tube attached to the right of the ozone tube, the ozone generated by the passage of the oxygen through the tube being dissolved in water.
For the production of the necessary high-tension current, either a step-up transformer giving at least 1,000 volt output when operated on an ordinary A.C. supply, or, alternatively, a small induction or spark coil operated by means of an accumulator or through a motor-driven transformer, working off the mains, may be used. An ordinary bell transformer is quite suitable for working a small induction coil, particularly if it is only used intermittently.

On the whole, it is better to employ H.T. current from a small induction coil than from a motor-driven transformer operated directly off the mains, since, in the latter instance, the transformer output circuit would require careful earthing for purposes of safety, whilst, at the worst, the H.T. current from a small induction or spark coil can only give one a sharp shock if contact is inadvertently made with its output circuit.

An "Ozone" Tube

To form the "ozoniser" we require what is termed an "ozone" tube. In its simplest form it consists merely of a narrow piece of glass tubing about a foot or 18 in. in length. Down the tubing is pushed a straight length of bare copper wire, this wire being connected to one of the output or secondary terminals of the induction coil. On the outer side of the glass tube is wrapped a spiral of bare copper wire, this wire being connected with the other secondary terminal of the inductance coil, see Fig. 1. On passing a current of air or oxygen through the glass tube and operating the induction coil at the same time, the air issuing from the tube will contain three or four per cent. of ozone, a concentration which is amply sufficient to act as a disinfectant and deodoriser.

A better form of ozone tube consists of a narrow glass tube about a foot long containing within it a spiral of bare copper wire which is almost the entire length of the tube. This tube is supported concentrically within a wider glass tube approximately two-thirds or half an inch larger in diameter than the smaller tube. On the outside of the outer tube a layer of tinfoil is cemented with shellac varnish, giving the tube great elasticity and a good air-tightness. Contact from the secondary terminals of the induction coil is taken to the tube through a small step-through in the inner glass tube and to the tinfoil on the exterior of the outer tube, see Fig. 2.

If, under these conditions, the induction coil is operated and a current of air is passed between the two glass tubes, the air will issue from the tubes charged with ozone to the extent of from four to seven per cent.

For constant service in a household, it is, of course, necessary to have the ozonising apparatus mounted on an enameled or wooden wall panel screwed firmly in position to the wall of a room. The apparatus could conveniently be mounted upon a substantial baseboard in order that it may be carried about from room to room. A suggested layout is given in Fig. 3.

Layout of Apparatus

The diagram accompanying this article shows clearly the disposition of the ozonising apparatus upon its baseboard or wall panel. Note particularly that the ozone tube and its H.T. leads must be well insulated, otherwise current-leakage will occur, with diminution of the ozone efficiency of the apparatus.

In order to operate the apparatus efficiently, it is necessary to cause a current of air to flow through the ozonising tube. The air may be sucked through, pumped deodorising it and freshening up its atmosphere.

Ozone, however, should not be liberated in rooms in which there are valuable oil paintings, since the gas sometimes tends to attack the pigments of paintings, causing them to undergo slight colour changes. Apart from this precaution, however, the employment of ozone as a household disinfectant and deodoriser, etc., is not objectionable. By means of a simple ozonising apparatus such as the one described above, it is a perfectly safe procedure and one which is invaluable for the purpose of freshening up sick rooms, food stores and other apartments in which bacterial contamination is likely to occur.

As much as eight per cent. of ozone can be generated by passing pure oxygen through the ozone tube instead of ordinary air.

Oxygen may readily be prepared by heating in a test tube a mixture of two parts of powdered potassium chlorate and one part of manganese dioxide.

As a means of testing for the presence of ozone in a room, there is nothing better than the simple "starch-iodide" test. Make a five per cent. solution of potassium iodide and add to it about half its volume of starch solution. Immerse pieces of white blotting paper in this mixed solution for a minute or two and then hang them up to dry.

Preserve these "starch-iodide" papers in a box provided with a well-fitting lid. When it is desired to test for ozone, merely moisten one of the starch-iodide papers and wave it about in the air. The slightest trace of ozone in the atmosphere will manifest itself by the appearance of a pale blue colouration of the starch-iodide paper.
A System for the Quick and Accurate Location of Wrecked Personnel

(a) Minimum weight of equipment carried by survivor (radio beacon).
(b) Minimum physical and mental effort for erection and operation of radio beacon equipment.
(c) Maximum range of search.
(d) Continuous, positive, directional homing signal with constant or increasing angular accuracy down to a range of a few feet.
(e) Full operation at all times and under all conditions of visibility.
(f) Operation longer than the probable survival time of the wrecked personnel.
(g) Two way voice communication for maintenance of morale and operational reasons.

The successful manner in which the design of the "SARAH" equipment met the requirements of the ideal system were apparent in actual field tests under a wide variety of conditions.

Beacon Equipment

The beacon equipment (carried by the wrecked personnel) consists of (a) the radio beacon transmitter with antenna; (b) the speech unit; (c) battery; (d) interconnecting cables; (e) selector switch. The complete unit weighs 520z. As used by flying personnel, it is proposed that this equipment be attached to the life jacket, since this will provide a protective cover from the elements to the rescued person even when all else is lost. This requirement places strict limitations on size and weight which are met satisfactorily by the present design. A photograph of the beacon equipment is shown in Fig. 1.

Two sets of equipment are shown, one with provision for two-way voice communication, the other without such provision.

Speech Transmission

When the wrecked person is within visual or audible distance of the spotting or rescue aircraft or ship, he may depress a three position switch to "transmit" position and transmit speech. Modulation is by pulse repetition frequency variation of a 6,000 pulse per second signal.

Since the peak power in this condition is about quarter that of the beacon mode, the range is correspondingly reduced. However, speech transmission is only used when the ranges are very short so that greater power is unnecessary. Homing by the rescue aircraft or ship may continue during this mode. Battery capacity is adequate to maintain 20 hours continuous duty.

Fig. 2.—The beacon with antenna erect, fitted to airman's "Mae West."

Fig. 1.—Two sets of beacon equipment, the one on the right with provision for two-way voice communication.
of operation requires a definite effort to hold in any position but "beacon," to which it is returned by spring force, it is unlikely that it will be held depressed for long periods by confused or delirious, wrecked personnel.

It is important to note that beacons are non-compatible with one another, yet completely confused or delirious, wrecked personnel.

Rescue Receiving Equipment
The rescue receiving equipment is all of the units carried by search aircraft, helicopters, search and pick-up surface vessels and consists of:
(a) Receiver.
(b) Power pack.
(c) Aircraft search and homing antenna.
(d) Shipboard search antenna.
(e) Shipboard homing antenna.
(f) Shipboard homing antenna control unit.
(g) Voice transmitting antenna.
(h) Interconnecting cable as required.

At present the receiver and power pack are separate units. A new subminiaturised design, currently in late engineering stages, will permit attachment of power unit to receiver, thus making a single unit. Size and appearance is shown in Fig. 3.

Search and Homing Receiver Operation
In use, the receiver presents a cathode ray indication of the search area during the search phases. Any beacon within the area covered by the receiving antenna appear as spikes on a vertical reference trace. By time sharing methods, a right and left antenna on the aircraft are arranged to display beacon spikes either to the right or left, respectively, of the vertical reference trace. Directional information is thereby obtained. The right and left antenna patterns being inclined forward, they overlap ahead and provide means for homing on the beacon, or beacons, one at a time. The characterised time spacing of the pulses in the beacon pulse group offers an excellent means of separating beacons in the search area.

During the early search phases, before any beacon signals have been received, an automatic feature may be used by which the receiver tuning is swept back and forth at a slow rate over a four megacycle range (+2 megacycles from the nominal operating frequency). This permits frequency search over a band of ±2 megacycles thus ensuring that signals are not missed due to any mistuning effect.

When a beacon is observed, the scanning may be stopped instantaneously to permit homing operations. In addition to the automatic sweep feature, the receiver may be manually adjusted to a nominal operating frequency over the range of ±5 megacycles.

It is to be noted that as the aircraft flies over the beacon, the beacon signal suddenly vanishes, due to the vertical radiation pattern characteristic of the beacon antenna. By this method a fix is obtained. The width of the null will naturally vary with the altitude of the homing antenna.

The receiver is designed, developed and manufactured by Ultra Electric, Ltd.

Interlinking of Projectors for 3D

UNLESS film exhibitors have the room to accommodate a wide screen and are prepared to sacrifice some forward seating capacity for it, the showing of 3-dimensional films requires the inter-linking of two projectors so that they both run in synchronism instead of alternately as they do with non-steroscopic film. Keeping the two projectors accurately in step from start to finish has presented the cinema industry with a major problem which cannot, as might at first appear, be solved properly by mechanical coupling. In practice, projectors subdivide an angle of approximately 6 deg., making a rigid shaft out of the question, and flexible shafting introduces lost motion which is difficult to predetermine or control. The interlinking of projectors by electrical means is, however, made possible by the development by The General Electric Co., Ltd., of a modified "Twin Torq" motor.

Projectors in nearly all cases are driven by a 3 h.p. split-phase A.C. induction motor running at 1,440 r.p.m., and whilst this type of motor is generally regarded as a constant speed machine, it is, nevertheless, subject to small fluctuations of speed with varying loads. Consequently, if there is a difference between the load characteristics of two projectors, one motor will run at a speed slightly below that of the other. To correct this difference in speed for 3D operation, one G.E.C. Twin Torq motor (a 2-pole machine, having a 3-phase stator and a single-phase wound rotor fed from the mains through a pair of sliprings) is coupled to the driving motor of each projector, preferably by means of a direct chain drive from one motor shaft to the other. All four motors are then electrically connected as shown in the accompanying illustration.

Angular Displacement
Thus, if a split-phase motor loses speed due to an increased load on its projector, the Twin Torq motor directly coupled to it also loses speed. This tendency to lag creates an angular displacement between the Twin Torq rotors on each projector, causing unbalanced voltages to be induced in both stator windings, with the result that current now flows from one stator to the other. This flow of current has the effect of producing equal and opposite torques on the Twin Torq motors, causing both rotors to be pulled into step with each other.

The torque exerted by both Twin Torq motors is related to the mechanical difference between the two projectors. Where this difference in mechanical loading persists the Twin Torq rotors will not assume perfect alignment, but will be displaced from each other by a small angle, the value of which will depend upon the load and design of the motors.

Without practical experience over a prolonged period no accurate estimate can be given of the maximum out-of-balance forces likely to be met under all kinds of working conditions. One of the main causes of varying load can be attributed to the differing frictional losses in the bearings and other moving parts of the projector. Deposits of chemical emulsion from the film on the skids and guides of the projector, if not frequently removed, also increase friction and impose an added load on the motor. The G.E.C. have, therefore, developed the Twin Torq motor to exert a torque of 500 in., with a full load rotor displacement of 30 deg., and this is considered upon authority to be ample for normal requirements.

The Twin Torq motors must take charge from the moment of starting up until the projectors finally come to rest.

In addition to the Twin Torq motor a composite motor incorporating the split-phase and Twin Torq motors in one frame is also offered by the G.E.C. to manufacturers of new projection equipment.
The following notes explain fully the construction of a gas lighter which is quite easy and cheap to construct, and is a perfectly safe kitchen accessory.

**The Lighting Rod**

This is made from the plunger rod taken from an old cycle pump. The handle should preferably have no name on it, though this is immaterial. The leather washer and flanged disc should be removed, leaving only the 3/16 Whitworth screw which fits into the end of the rod. Next a miniature screw fitting lamp-holder to take a standard torch bulb is obtained, and from this is taken the fitting lamp-holder to take a standard torch base, about 1 in. dia.

Assembly

A length of flex is obtained sufficient to allow easy reach to the gas stove, and this is threaded through the grommet and down the inside of the rod then out at the end through the holes provided. One wire is then secured under the terminal on part A. The other wire is soldered up into a loop about 1⁄2 in. dia. The small fibre washer is next slipped over the screw and over this the screw socket B and then part A, which is the terminal lug. Next to this is another fibre washer and under it is the soldered loop of wire. The complete assembly is now fitted to the rod by the screw. In assembling, great care must be taken to prevent the socket B touching the screw and causing a short circuit. All this is shown diagrammatically on the drawing at the section X-X. After screwing up tightly the assembly can be tested with a meter, or, for those who do not possess a meter, testing may be effected by connecting up a battery and bulb and joining one wire to the socket and the other to the screw—if the bulb does not light everything is in order.

**The Micro-switch Assembly**

The micro-switch is of the 250 volt 5 amp. type. Through the switch run two parallel holes which are employed for fixing the operating arm bracket. This is a piece of metal about 1⁄2 in. wide by about 3⁄16 in. thick, which should be bent up to make an U-shape projection about 1⁄2 in. from the switch when fitted. This should now be suitably drilled to take the fixing bolts which pass through the switch. It should also have a hole in the end for screwing on the operating arm. This is of the same material as the bracket and is bent up to the shape shown in the side elevation. An adjusting screw should now be fitted to the arm in such a position as to engage the spring steel arm of the micro-switch. Two L-shaped pieces are now fitted as shown for taking the tension spring and its adjuster. This done, the micro-switch assembly may now be adjusted for correct operation. The tension spring is slackened off and the adjuster screwed to such a position that the switch is "on" when the lighter rod is not in its clip. The spring must now be adjusted so that on replacing the lighter rod in its clip the switch clicks "off." The essential dimension is the length marked r on the drawing. This cannot be definitely specified as it depends on the weight of the complete lighting rod, the weight of the flex and the strength of the tension spring. It should be of such a length that when the rod is placed on the end of the arm it descends a sufficient distance to make the micro-switch click off. Other dimensions are made to suit the materials, etc., at hand.

**The Transformer**

This is a bell transformer having secondary rappings at four, eight and 12 volts. The one the writer had was of cubical shape and, very conveniently, had a sliding metal cover, though this is not essential it is better for drilling purposes.

The base of the micro-switch should now be removed and two wires secured under the terminals. Two slightly longer screws should now be found to replace the ones which secured the base. Next drill two holes in the transformer cover to take the two screws, pass the screws through the cover and then through the switch base, and
Tobacco Shredding Machine
A Machine for Shredding Home-grown Tobacco

By W. R. B. ORME

This tobacco shredder has proved quite efficient, provided the leaves are all well compressed. If made into a slab 1 in. deep it should be cut with a sharp knife into sections slightly under 1 in. wide and not more than 6 in. in length. Some growers roll the leaves and bind them tightly with string from end to end. So long as the roll is 1 in. diameter and 6 in. in length, having squared ends, the shredder will operate satisfactorily, but the former method is the better.

Construction
The machine consists of an aluminium casting, the pattern for this being the biggest grower's roll. These form the channel in which the tobacco is made in the first upright to 2 fin. x 1/fin. (tapered for moulding). The sides 9/16 in. x 1/16 in. high and 3/16 in. thick, buttressed as at BSF at B, Fig. 4. A block of aluminium to slide easily along the channel, 1 in. x 1/16 in., by 1 in., is drilled and tapped 1 in. BSF. The base is threefold: 1. If it will not glow at all on removing the lighting rod, the tumbler switch being "on" either the adjusting screw needs screwing in, or the spring needs tightening, or there is a circuit fault. 2. If it continues to glow after replacing the rod, either the screw is too far in or the spring too tight. 3. If it glows brightly, this indicates failure of the element.

Assembling the Unit
A piece of wood, of a size to accommodate the transmitter, a miniature bulb-holder, and a tumbler switch is prepared, and to it the above components are fixed. Two wires are led from the bulb-holder and connected across the four-volt terminals of the transformer. The ends of the flex from the lighting rod are connected across the 110-volt terminals. One lead from the house mains is connected to the transmitter and the other to one side of the tumbler switch. The micro-switch is then connected between the remaining terminal on the transformer and that of the tumbler switch. This done, the spring end. One pinion is pushed if necessary and bored 1/16 in. and taper pinned when assembling. An engine valve spring is fitted to pull the cutter firmly on the face of the casting, adjustment being obtained by the two nuts at the end F, Fig. 1.

"Pusher" Shaft
The bottom "pusher" shaft, Fig. 3, is for forcing the cake of tobacco towards the cutter. This is threaded its full length—1/16 in. A length of 1/16 in. BSF studding, provided with a flat machined end, will do the job. A block of aluminium to slide easily along the channel, 1/16 in. x 1/16 in., by 1 in., is drilled and tapped 1 in. BSF. The red is screwed into this block and locked with lock nut, Fig. 3. The second pinion is pushed if necessary and drilled and tapped 1 in. BSF.

Cutter and Handle
The cutter is made in the form of a small wheel, being cut from a piece of steel approximately 1/16 in. thick, drilled and tapped 1 in. BSF at A (Fig. 4). Screw this on the cutter shaft with the handle tightly up to it. Then mark the blade in the form of a convolute, the edge commencing at G, 1/16 in. from centre of hole A, finishing at H. Whilest screwed together, drill and tap hole F in the handle (Fig. 5) 1 in. BSF, and run point of drill into cutter at G, Fig. 4. Drill hole E, Fig. 5, 1/16 in. clearance in handle and 1 in. BSF tapping in cutter and tap 1 in. BSF at B, Fig. 4. These two holes take hexagon set screws, which provide adjustment in or out of the blade and assist the drive from handle to blade. A 3/16 in. lock nut is fitted outside handle on cutter shaft. Dissemble the cutter from handle and grind convolute to a keen edge. The operating handle is 1-1/2 in. long and is set to miss the track of Fig. 1, which catches the shredded tobacco. When assembling, adjust blade and handle so that there is clearance at point H, Fig. 1, thus keeping blade in close contact with casting face at K.

Fig. 1. - Pusher shaft.

Fig. 2a. (Left) The aluminium casting for the body of the machine.

Fig. 2b. — Pusher shaft.

Fig. 3. — Pusher shaft.

Fig. 4 and 5. — Details of the cutter and handle.

www.americanradiohistory.com
Making a METRONOME

Constructional Details of an Instrument for Use in Practising Musical Scales and Exercises

The Metronome

The metronome is a very simple piece of clockwork, but differs from a clock in the fact that its pendulum is weighted at a point above its point of suspension. Those who have used a harmonograph will know that the rate of a pendulum may be slowed down considerably by such means, which in the metronome make it possible to use a short pendulum and thus ensure that the instrument is not unduly cumbersome.

Fig. 1 shows a front view of the pendulum. A is a small flat leaden weight firmly attached to the flat steel stem B, the length of which may be 7 in. At C, the point of suspension, is a brass boss, which carries the arbor shown in Figs. 3 and 4. This arbor not only serves as suspension for the pendulum, but has attached to it two pallets by which the escapement wheel is allowed to progress.

The mechanism

Fig. 3 is the side view of the mechanism and Fig. 4 a view looking from below, which shows the plate to which the parts are fixed, but for clearness the inside bearing of the pendulum pivot has been omitted. This plate is screwed to the underside of the floor marked E in Fig. 2. A slot is cut through this floor to allow the head of the pendulum to vibrate freely in the space above. The spring barrel is provided with the usual winding square and ratchet wheel and also with " stop-work " to prevent over winding. The latter is a small toothed wheel pivoted to the head of the drum (see Fig. 4), which gears with a single tooth upon the drum arbor. The teeth of this wheel are discontinued at one point, which when reached by this tooth prevents further winding.

The Lead Weight

Reverting to the pendulum, Fig. 1, D is a leaden weight that slides upon the stem, controlled by the light spring shown in the centre.

The Head of the Pendulum

The front above the floor E also is removable so as to bring into view the head of the pendulum and to admit of adjusting its rate.

A scale of speeds is fixed behind the pendulum and it is usual to mark it " presto," " allegro," "andante," etc.

A small brass plate should be fixed at the top of the case in which the head of the pendulum can be slipped to stop it, and for safety in transport, and the case should be mounted upon three ball feet.

There is a vacant space behind the board that carries the scale which acts as a resonator to emphasise the beats.

"Bristol" Sycamore Helicopter in Malaya

A BRISTOL SYCAMORE helicopter was recently flown by Bristol Freighter to Malaya for trials under humid tropical conditions, and for flight evaluation tests as a jungle ambulance aircraft in service with the R.A.F. The Sycamore will first be engaged on tropical trials extending over two to three weeks and will then be handed over to the R.A.F. Far East Casualty Evacuation Flight for about ten weeks.

The machine is the Mark 10 ambulance version of the Sycamore. It embodies two " Perspex " blisters which—without imposing aerodynamic penalty—increase the cabin width to allow two stretcher casualties to be carried with the portside behind the pilot. The new " Bristol "-designed lightweight stretchers are of tubular construction and, when not in use, can be compactly folded and stowed in the luggage compartment behind the engine bay. Both stretchers are secured by clamps. Beside the pilot's station is a swivel seat which enables a medical orderly to attend casualties during flight, and the back of the pilot's seat is reduced in height to give the attendant complete freedom of movement. In addition to the standard V.H.F. set for normal air-to-air communications, the Sycamore has special radio equipment to enable the crew to keep in touch with ground forces. A rope ladder is carried to allow the medical orderly to descend and examine touch-down points before landing in jungle country.

In dense jungle growth it is often necessary for a helicopter to rise vertically at take-off to as much as 200ft, to clear surrounding trees before beginning forward flight. This condition, particularly in a humid tropical atmosphere, must impose a stringent test on any type of helicopter and the Sycamore's performance will be carefully analysed from comprehensive day-to-day reports sent back to "Bristol."
The switch is completed by fitting the switch position indicator, constructed as shown in Fig. 9. The drum (a suitable tin lid can be used) has a bush soldered to it at its centre and a hole cleared through the metal. It then has the word "OFF" and the numbers 1-9 painted around its edge at equal intervals. An indicator for the switch is cut from tinplate and mounted on top of the perception unit as can be seen in Fig. 3. In the final setting up, the drum must be adjusted so that this index shows the correct setting of the switch.

The Indicating Unit

This unit is of quite straightforward construction. Fig. 10 shows the general appearance with measurements. As before, the measurements are by no means critical except where mentioned below. Eighteen m.e.s. lampholders are required and these are fixed to the spacers before assembly. The spacers fit together in the same way as the divisions of an egg-box. Two pieces of glass 12in. square with a sheet of tracing paper between them, are fixed to the front of the indicating unit. The method shown in Fig. 10 makes for simplicity, but if the necessary tools are available the glasses can be fixed by cutting grooves in the side-pieces and sliding the glasses in from the top. Some modification of the design will be necessary in this case. The back of the indicating unit should be secured with only a few screws so that it can be removed easily for replacement of bulbs. The "O" bulbs are wrapped with red cellophane and the "X" bulbs with green cellophane. To the face of the glass nearest the bulbs are fixed "Xs" cut from red cellophane, and "Os" cut from green cellophane. Some transparent cement should be used for this purpose. The appearance of the glass, looked at from the back of the instrument, is as shown in Fig. 11.

When an "O" bulb is switched on, the glass is illuminated by red light. This passes through the red "X" casting only a slight shadow on the tracing paper, but the green "O" intercepts the light and thus throws a dark shadow on the tracing paper. The "X" bulb produces an "X" on the screen in the same way.

When purchasing the cellophane, a simple test will establish the suitability of the colours. Two overlapping pieces of different coloured cellophane are held up to the light and the area of overlap examined. This area should be dark brown in colour, the darker the better, provided that the individual colours are not too dense.

The appearance of the glass, looked at from the back of the instrument, is as shown in Fig. 11.

When an "O" bulb is switched on, the glass is illuminated by red light. This passes through the red "X" casting only a slight shadow on the tracing paper, but the green "O" intercepts the light and thus throws a dark shadow on the tracing paper. The "X" bulb produces an "X" on the screen in the same way.

When purchasing the cellophane, a simple test will establish the suitability of the colours. Two overlapping pieces of different coloured cellophane are held up to the light and the area of overlap examined. This area should be dark brown in colour, the darker the better, provided that the individual colours are not too dense.

Cut "Xs" from red cellophane, and "Os" from green cellophane. Some transparent cement should be used for this purpose. The appearance of the glass, looked at from the back of the instrument, is as shown in Fig. 11.

When an "O" bulb is switched on, the glass is illuminated by red light. This passes through the red "X" casting only a slight shadow on the tracing paper, but the green "O" intercepts the light and thus throws a dark shadow on the tracing paper. The "X" bulb produces an "X" on the screen in the same way.

When purchasing the cellophane, a simple test will establish the suitability of the colours. Two overlapping pieces of different coloured cellophane are held up to the light and the area of overlap examined. This area should be dark brown in colour, the darker the better, provided that the individual colours are not too dense.
Assembling the Instrument

The memory switch is screwed into position in the perception unit by means of wood screws through the top of the unit into the hardwood endpieces of the memory unit. Terminal strip A should face the front of the instrument and terminal strip B the rear. The shaft of the memory unit passes through a hole drilled in the right hand side of the perception unit. The indicating unit is now wired up according to the instructions already given. These instructions are summarized here for convenience.

1. The left-hand rods of the ball railways are connected to the side-contacts of the correspondingly numbered "0" bulbs.
2. The right-hand rods of the railways are connected to the corresponding numbers on terminal strip A of the memory unit.
3. The positions on terminal strip B of the memory unit are connected to the side-contacts of the correspondingly numbered "X" bulbs.
4. The base contacts of all bulbs are joined together and brought to a terminal on the left-hand side of the indicating unit. (These last two terminals should be fairly close together.)
5. A wire is connected to the earthing bar and brought to a terminal on the left-hand side of the indicating unit. (These last two terminals should be fairly close together.)

The switch is now adjusted. The position of the moving contacts is noted; the drum is slipped on to the shaft, and with the grub screw loose, rotated until the number corresponding to that position is opposite the index. The grub screw is tightened and the working of the switch checked, any necessary adjustments being made. The bottom and back of the instrument are now screwed into position.

Note. The contact finger can be made from springy brass strip.

Fig. 12.—Circuit diagram of instrument. (Internal wiring of memory unit omitted.)

Testing the "Brain"

The instrument is now ready for testing, and the reader is advised to proceed as follows: A twin-cell cycle lamp battery is first connected to the terminals on the L.H.S. of the instrument (polarity is unimportant). The switch is placed in position 1 and a steel ball dropped through hole 1; an "O" should appear in position 1 of the indicating unit and an "X" in position 5. The switch is now rotated to position 2, when an "X" should appear in position 1. The switch is then passed through positions 3-9 when "X"s should appear in the appropriate squares. The reset button is then pressed and the steel ball placed in another hole, the switch being operated as before. The whole process is repeated for each of the holes in the perception unit. In this way the instrument is given a thorough and methodical testing, and any wrong connection can quickly be traced and put right. Fig. 13 shows the connections in detail (excluding the internal connections of the memory unit).

Switch position

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Fig. 13.—Table to be used in testing the instrument.

Fig. 14.—Suggested modifications for converting the instrument to fully automatic operation.

Additional wafer. Shaded portions earthed. Blank portions earthed via appropriate ball switch of perception unit.
shows in table form the positions in which an "X" should appear for various positions of the switch and steel ball.

**Finishing the Instrument**
The instrument can be finished in a number of ways, and this is a matter which must be left to the reader's preference. One thing however must be done; the holes in the base unit must be numbered legibly in accordance with the system used throughout this article, since these numbers are required in the course of play.

**Method of Using the Machine**
In order to avoid undue complexity, the selector mechanism for the memory unit has been designed to be operated manually. This selection can be made fully automatically by arranging for an impulse motor to drive the switch. The switch would then have to be modified so that it could turn continuously, and the action of dropping a steel ball through any hole could be made to cause the switch to stop in the desired position. An impulse motor is suggested for this operation because it stops instantaneously on cutting off the current, whereas an ordinary motor would tend to over-run. For readers interested in a fully automatic instrument a suggested circuit is shown in Fig. 14 together with the necessary modification to the switch. It should be borne in mind that these are merely suggestions to form the basis of experiments on the part of the reader.

The machine's opponent, on commencing a game, must decide which position he is going to fill initially. The switch is moved to this position and left there throughout the game. Placing the switch in one position and inserting the first steel ball in another position should not be allowed as this is denying the machine essential information.

**Beating the Machine!**
The machine is not infallible (it can hardly be made so using this simple system), but the method of beating the machine is well hidden and will not be discovered easily by those not in the secret. It is left to the reader to discover its "Achilles heel," which, however, is not to be found in "cheating" the machine by juggling with the selector switch.

---

**Reference**

Back to First Principles

6—Degradation of Energy

By W. J. WESTON

**The Answer**

The coefficient of friction is \( \frac{19.884}{37.008} = 0.536 \).

And the upward force needed is \( (19.884 + 14.984) \text{ lb.} = 34.868 \text{ lb.} \).

**The Problem**

A block of wood, weight 40 lb., rests on a horizontal plane 6 ft. long. When one end of the plane is raised 2 ft. the block begins to slide down: what is the coefficient of friction? If the vertical height is increased to 3 ft., what is the least force perpendicular to the plane that will maintain equilibrium?

**The Comment**

The raising of the plank calls for an ever-growing resistance of friction till it reaches its limit at 2 ft. up. Pressure down the plane is then the weight \( \times \sin \) of the angle of friction, i.e., 40 lb. \( \times \frac{1}{2} \) or 31 lb. It is this pressure that is balanced by the other component of the weight, 40 lb. \( \times \cos \) of the angle of friction, multiplied by the coefficient. The force perpendicular to the plank in the second case is wholly spent in adding to the reaction of the weight to the plank.

**The Answer**

1. Suppose \( \mu \) to be the coefficient of friction. Cos \( \theta \times 40 \text{ lb.} \times \mu = \sin \theta \times 40 \text{ lb.} \).

\[ \mu = \frac{\sqrt{\frac{32}{6}} \times 40 \text{ lb.} \times \mu}{\frac{32}{6}} = \frac{40 \text{ lb.}}{\sqrt{32}} = 4 \text{ lb.} \]

**The Comment**

Before the application of the 49 lb. force, there is already a tendency for the weight to move down the plane, a tendency measured by the component of 40 lb. weight parallel to the plane. This tendency is resisted by friction that has not yet reached its maximum (its limiting point): the 40 lb. needed to produce movement is the excess of this limiting friction over the force at the outset keeping the weight at rest. It is this limiting friction compared with the reaction to the surface that gives the coefficient of friction.

In the upward movement the effective force must equal this limiting friction plus the component of 40 lb. down the plane.

**The Answer**

The component of 40 lb. weight parallel to the plane is 40 lb. \( \times \sin 22^\circ = 40 \text{ lb.} \times 0.3735 = 14.984 \text{ lb.} \)

The maximum friction is \( \mu = \frac{14.984 \text{ lb.}}{40 \text{ lb.}} = 0.3735 \text{ lb.} \)

The component of 40 lb. weight perpendicular to the plane is 40 lb. \( \times \cos 22^\circ = 40 \text{ lb.} \times 0.9272 = 37.008 \text{ lb.} \)

**NEW AND FULLY REVISED EDITION (8th)**

PRACTICAL MOTORIST'S ENCYCLOPAEDIA

17/6, or 18/- by post from George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2
THE following article describes the construction of a self-blowing glass blowtorch which gives a large hot flame. A blowtorch of this type has many applications such as paint stripping, glassworking, soft and silver soldering and so on. It can be made quickly and cheaply, the time taken to make an actual model was less than half-an-hour and the cost only a few pence. If broken, it can be replaced rapidly.

The materials required are, 1 ft. of soft glass tubing, \( \frac{3}{4} \) in. outside diameter, a piece of wood, 1 ft. by \( \frac{3}{4} \) in., a second piece of wood, 6 in. by 1 in., and a piece of tinplate 3 in. by 1 in. If a bunsen burner is not available, the second piece of glass tubing and the tinplate should also be purchased.

Heating the Glass Tubing

The glass tubing is heated at its centre by means of a bunsen burner and, when quite soft, is removed from the flame and the hands pulled apart slowly but steadily. While heating the tubing in the flame, it should be rotated continuously so that it is evenly heated. This requires a little practice, for both ends of the tubing must be rotated at the same rate when the glass is soft. If a bunsen burner is not available, the short length of glass tubing is connected to a gas point by means of a length of rubber tubing, and the flame produced used in the same way. This flame will not be as hot as a bunsen flame and the tube will take longer to soften. Fig. 1 shows the arrangement using the short glass tube, and the appearance of the tube after heating and drawing.

The tube is now broken at the points XX by scratching with a file and tapping. The broken edges should not be too jagged, but a little jaggedness appears to help the operation of the blowtorch. The hole so formed should be between \( \frac{1}{8} \)th and \( \frac{1}{10} \)th of an inch in diameter. The exact size is best found by experiment, starting with a hole that is too small and enlarging it gradually, checking by lighting the blowtorch between each adjustment.

The Stock and Base

The piece of wood 1 ft. by \( \frac{3}{4} \) in. by 6 in., is next drilled as shown in Fig. 2 (a). The glass tube should be an easy fit in the \( \frac{3}{4} \) in. hole. The wood between the \( \frac{3}{4} \) in. hole and the \( \frac{3}{4} \) in. hole is cut away so that a wedge may be inserted to hold the glass tube firmly in position. This arrangement allows for rapid replacement of the glass tube if it should become broken. The tinplate is bent (b), the shaded portion being cut away. If desired, the stock can be carved to give a comfortable "pistol grip." To form the base of the blowtorch, a 3 in. wire nail is driven through the centre of the wood by 1 in. block of wood and the tip cut off. The nail fits freely in a hole drilled in the stock (Fig. 2a). The torch may thus be used as either a bench or a hand instrument.

On lighting the jet with the gas turned full on a large roaring flame of the type shown in Fig. 3 (a) or (b) should be obtained. Both are hot flames but if anything 3 (a) is the hotter.

Working Principle

The principle on which the instrument is based is quite simple. The jet is designed to produce a turbulent flow of gas; the turbulence commencing as near to the jet as possible. This condition causes air to be mixed with the gas, and a suitably sized jet gives the right proportion of gas/air. The size of the jet is not very critical since turbulence is far easier to produce than a smooth flow. However, if the jet is too small,

PRACTICAL MECHANICS HANDBOOK

By F. J. CAMM
12/6, or by post 13/-.

Obtainable from booksellers, or by post from George Newnes, Ltd. (Book Dept.), Tower House, Southampton Street, Strand, W.C.2.
THE general principle of the saw will be familiar to most readers, and care in the making and construction of the various parts will result in a machine that is rigid, yet remarkably flexible. Although primarily designed for coping saws; fret and junior hacksaw blades can be fitted enabling a wide variety of material to be rapidly cut in various shapes. The complete unit is light, compact, and weighs little more than the average sewing machine, but it is capable of cutting thin plywood with ease. The design is readily adaptable to individual requirements, and most of the material needed can be found in the average home workshop.

In describing the various parts all the necessary details are given, but it is taken for granted that each part will be properly finished off and the whole enamelled in appropriate colours. All nut and screw sizes are referred to as Whitworth, but in practice B.A. sizes should be used where they are more suitable, and the fullest use made of spring washers.

Cradle

The cradle (Fig. 1) for the saw frame is made from three pieces, the stand, the horizontal pipe and the spacer, which are screwed together for welding or brazing, the screws afterwards being removed. Care must be taken to get the pieces set up square, as an error at this stage would be very difficult to rectify afterwards.

Make the main support from sheet iron about 1/4 in. thickness. Cut the rectangle 21/2 in. by 5 in. and bend to shape in a vice, using a piece of pipe or round wood as a gauge. Drill the holes for the holding down bolts, the lamp bracket and the temporary set up screws.

The upright piece is 1 in. long and is made from thin gas tubing, cut to length and squared to fit the plate and the pipe. Drill the two pieces together using short tap screws, and check each knife edge with a set square to two pieces, holes to correspond with the holes and filed square at both ends. These pieces let into the arms and fastened with four 3/16 in. countersunk wood screws.

One end of a length of 1/2 in. stud iron into the lower tap hole and pass the other end through the horizontal pipe. Using a square of scrap iron with a 1/2 in. hole in it as a washer, draw the spacer tightly up against the end of the pipe. A double spring washer under the nut will counteract any expansion due to the heat during welding. Two or three small cylinders of wood or adhesive tape are fitted on the stud iron to keep it central in the pipe.

Weld the stand into one complete unit, then remove the stud iron and temporary screws and proceed with the main support for the cutting table. This consists of a 1 in. square of 1/2 in. sheet iron which is held in position on the end of the horizontal pipe by means of two 1/2 in. by 1 in. countersink screws. File a flat surface 3/16 in. long on the top and bottom of the pipe and drill two 1/2 in. holes right through the plate and the pipe. Bolt the plate in position and check its alignment with the upright spacer. These two must be at dead right angles to each other, otherwise the saw will cut the material at the same angle as the plate.

The final step is to make the saw frame, for the saw blade clamps, from 1/16 in. sheet iron and recess them into the wood. Fasten securely in position with 3/16 in. nuts and bolts (Fig. 3). The bottom brackets are fitted straight and closed together afterwards in a vice, using a piece of 1/2 in. metal as a gauge. Drill a 1/2 in. hole through the two pieces, 1/2 in. from the end, to take the retaining pin for the bottom clamp. In the top bracket drill a 1/2 in. hole and file it into a slot to fit the top clamp.

The main bearings consist of two brass plates let into the arms and fastened with four countersunk wood screws. A light saw cut, across the centre of each plate, fits on the knife edge of the spacer. Make sure the cut is at right angles to the centre-line on the arms, as a small error here will be much greater at the saw blade.

Small brackets are fixed to the sides of arms, at right angles to the bearings and these hold the arms loosely in position. A small tap screw passes through a slot in each bracket and is screwed into the side of the spacer (Fig. 2a). When the frame is in use the brackets clear the sides of the spacer and the 3/16 in. tap screws by about 3/32 in., and do not come into use unless a saw blade breaks.

The tension on the saw frame is maintained by a 3/16 in. round rod which couples together.

Fig. 1.—Component parts for the cradle.

Fig. 2.—Side and front elevations, and details of saw arms and bearing bracket.
a Handy Machine for the Home Workshop

By D. LYONS

Drill through the brass nuts from side to side and tap to take 3/16 in. or other suitable tap screws. When the blade is in position the nuts are run down to cover the slots holding the pins of the saw. The tap screws are tightened against the flat sides of the rod, keeping the nut secure and gripping the blade.

When fitting the top clamp through the bracket, the flat sides should be an easy fit in the hole, but the back and front must be clear, allowing the clamp to swing back and forward on the vee-shaped bearing.

Strut Wires
Two bracing struts of 1/16 in. flat steel tape are fitted to the arms to counteract any excessive bending of the wood when the frame is under tension. The steel ribbon normally used to bind parcels was used for this, but 1/16 in. clock spring would be a good substitute. If this is used, heat the ends to remove the temper before drilling the fixing holes. Drill the holes the same distance apart as the holes in the arms, so that when the tape is fitted it lies flat against the wood. When finally adjusted the tape should rise about 1/16 in. at the tension bolt. If it is too tight to do this open the holes with a round file until enough slack is obtained, but the amount of stretch in the tape is very deceptive so do not be tempted to file too much.

The tension bolts are 3/16 in. tap screws fitted with small brass tips, and inserted between the tape and the wooden arms. A nut and washer holds the screw against the pressure of the tape. To tension the arm, tighten the nut back until the strut is bow tight, and lock the screw in position with a second nut on the other side of the arm. The brass tips are slightly rounded on the top and are fitted to keep the tape central over the screw and spread the pressure evenly over the width.

Connecting Rod
This is made from 1/32 in. mild steel and is fitted with a 1/32 in. ball race at the top and a 1/16 in. ball race at the bottom (Fig. 5). When referring to the bearings these are the shaft sizes, the overall sizes being 1/16 in. and 1/32 in. respectively. Drill the two holes at 5/32 in. centres and try the ball races for a good fit. Slight looseness in the large hole will be taken up with the pinching screw, but a good firm fit must be obtained at the small bearing. Tinning the hole with solder will make up any slight discrepancy but, of course, this must not be overdone.

Mark out the shape of the connecting rod and cut away the surplus metal with a hacksaw, finishing off with a fine file. Drill and tap the hole for the pinching screw and make the cut into the large hole. Clear out the thread on one side of the cut and insert the screw. When this is tightened up the hole will contract and should grip the ball race firmly.

(To be concluded)
THE SHAPE OF WINGS TO COME

The Reasons for Sweptback Wings and the Problems Which They Introduce. Delta, V and Crescent Wings, and Possible Shapes for Supersonic Speeds


(Concluded from page 376 of the June issue)

THE conclusion which can be drawn is that there is a strong case for the delta wing in the smaller sizes and especially when the sweepback is 60 deg. or more. On very large aircraft of, say 200,000 lb. and upwards the delta becomes uneconomical and a V wing probably with strut mounted engines is then the obvious choice.

At intermediate sizes, around 100,000 lb. the choice is not so simple and the best solution may be a V wing with engines buried in the wing roots, which can be enlarged if necessary, as on the Valiant.

Supersonic Shapes

The drag coefficient of an aircraft wing is almost constant at subsonic speeds, but peaks up to a very much higher value at transonic speeds and then tetties down again to an intermediate value at supersonic speeds. The precise values are not easily obtained because the ordinary wind tunnel techniques break down at transonic speeds. The effect of sweepback as we have already seen is both to reduce the drag rise and to delay it to higher speeds. Fig. 17 shows the sort of pattern we get for wings of various angles of sweep.

As an example let us take a mach number of 8 and we see that the wing with the lowest drag is that with the greatest sweep, but the next lowest is a straight wing.

For very high speeds where the degree of sweep required would be impracticable it may, therefore, be better to have no sweep at all. Put another way, we must either have enough sweep to delay the compressibility troubles to speeds beyond the range in which we are operating or else we can hurry on the troubles by using no sweep at all so that all is well again at the operating speeds. What we must not do is fly in the troubled region of mixed subsonic and supersonic flow. If we favour the 'straight wing' we must make it very thin because the wing will then be working in pure supersonic flow where the drag penalty for thickness is great. It seems that before long we shall be forced to use thickness : chord ratios as low as 3 per cent. and 4 per cent. and the wing will, therefore, have to be of small aspect ratio in order to be sufficiently stiff and strong.

I imagine that it will be worthwhile to provide just sufficient sweepback to overcome any tendency to wing divergence.

We therefore arrive at the two alternative planforms shown in Fig. 18.

Of the two solutions the one using acute sweepback is theoretically preferable. There is always the possibility of wanting to fly at lower speeds when climbing, manoeuvering or if damaged in combat, and it is well not to have to worry about forbidden speeds at which the drag is high and there are uncomfortable trim changes.

The Landing Problem

One of the big problems will be to get such highly swept wings to give adequate lift at low speeds. There are also likely to be some difficulties with longitudinal and lateral stability.

We therefore arrive at the two alternative planforms shown in Fig. 18.

Take-off may present a problem, but the thrust necessary to fly at very high speeds is likely to be adequate for unassisted take-off unless the wing lift is very poor or the wing loading is very high.

Here then is a challenge—all sorts of mad ideas come to mind. Should we "unswep" the wings for landing as on the experimental Bell X5 in which the wings are pivoted about a vertical hinge as the root so that the angle of sweep can be varied in flight? (See Fig. 19.) It may be the answer although it is bound to introduce a penalty in weight and possibly in drag, too, but it can be done as proved by the Bell X5 and by the Westland-Hill Pierodactyl MkIV which flew as long ago as 1931. Birds often use this technique, but nature can make moving joints with much less weight penalty than we can and without having to consider the maintenance aspect in quite the same way.

The engine thrust to achieve the supersonic speeds must be at least comparable to the weight of the aircraft so we might possibly avoid the engines round to give lift instead of propulsive thrust. It sounds a bit complicated and the control problems are sure to be very involved, but it might be worth trying.

Perhaps the best way out of this difficulty is to avoid it altogether which we could do if we arranged for the high-speed aircraft to link up with a parent aircraft in flight, using a technique similar to flight refueling. This is not a very happy idea as we must be absolutely sure that the parent never...
gases unserviceable while its chicks are on a mission, and, moreover, that it never falls a time to use the aircraft to its best advantage.

We might even consider stopping the aircraft in flight by air brakes and forward-firing rockets and then letting it down on parachutes or by a retractable rotor as a helicopter. It is obviously impossible to do the helicopter scheme without fantastic complication and the parachute would be much too bulky to stow without severe drag penalty. We may then be forced to put up with the high landing speeds by using arrester gear. This, at least, is a practical suggestion, but it would involve great cost in runways and arrester gear. Alternatively, we might put up with the high landing speeds if we make the aircraft into a flying boat and land on water. Ernest Stout has suggested an aircraft of this type which appears to have very little more drag than an equivalent landplane and the water will certainly provide the necessary braking force smoothly and effectively. Fig. 20 shows how such an aircraft might look and we may be able to improve upon it still further by the use of hydro-skis instead of the planing bottom. It is one of my ideas of the shape of wings to come but, in spite of my faith in the future of water-based aircraft, I believe that there will always be a need for landplanes and an alternative solution applicable to landplanes will have to be found.

Atomic Power

Our discussion, so far, has been about the foreseeable development of fixed-wing aircraft using the types of propulsion which are already familiar to us. We have not even considered helicopters or guided missiles. Just around the corner are much more exciting things like space ships, artificial satellites and atomic-powered air liners. It is very tempting to plunge into speculation as to the shape of these future craft, but it is doubtful whether there is any value in doing so until our knowledge is on firm enough foundations to support the structure of a logical argument.

The atomic-powered air liner might be a possibility to-day, but it would have to be extremely large and would probably be uneconomical on account of the enormous weight of the screening necessary round the reactor unit. We could argue from that single premise that the aircraft ought to be a flying boat because of the high landing weight which, on a landplane, would mean a heavy undercarriage and the need for airfields with exceptionally long runways capable of taking very heavy loads. All of this is an expense which the tax-payer would be glad to dodge. The reactor unit and engine would be in the hull of the boat and the passengers would have to be housed in the wing or in the wing tip floats. We could now prepare a sketch of the atomic-powered flying boat, but it would not be altogether convincing because it would strike us as old-fashioned (see Fig. 21). We have, indeed, been applying the old arts of aircraft design to a new form of propulsion whereas a much more radical approach is needed. The jet fighters of to-day are not the Spitfires or Hurricanes of yesterday with new engines in them, but are of new shapes to suit the new conditions. What shape the atomic-powered aircraft will be is a subject deserving much thought when we know enough about the characteristics of the engine. Will the engine really weigh so much or will we again find that what we thought was fundamental is no more than a passing phase? Somehow, it seems unlikely that the atomic-powered aircraft will look old-fashioned. It will come as a challenge and a stimulus to new research in structures and aerodynamics, but this time Britain must lead and not wait to pick up the threads from a narrowly defeated enemy. There must, therefore, be a close understanding between the atomic research establishments and the aircraft industry. Needless secrecy will deprive the country of the chance to lead in the atomic age.

Acknowledgments

I should like to express my appreciation to Mr. C. H. R. Griggs, who is responsible for the artist’s impressions of future types.

I should also like to thank Avions Hurel-Dubois, the Boeing Aircraft Company, the Bell Aircraft Company and A. V. Roe and Company for the illustrations of their aircraft and Mr. J. Barlee for the photograph of the gannet.

Fig. 20.—Proposal for a supersonic flying boat.

Fig. 21.—An atomic-powered flying boat—an impression of what it may look like.
Nearly everyone knows, white, or "ordinary" light consists of a mixture of all the colours, violet, blue, green, yellow and red, as shown in Fig. 1, and when light falls on an object which absorbs or passage all waves except one, that particular one becomes visible to the eye and we say the object is blue, red, or whatever colour applies. So much for what is quite elementary knowledge. What is not so clearly understood, however, is that substances which we term "transparent," actually do offer a certain amount of resistance to the rays of light, so that the normal speed of light—which, in the open air is about 186,282 miles per second—is materially slowed down where it passes through glass, crystal, celluloid, water, or any other transparent substance. Everyone has, at one time or another, noticed that if a straight rod is put into clear water, it appears as though it were bent at the point where it breaks the surface. This "bending" applies also to a ray of light felling obliquely on a transparent object, but the short, or violet rays are bent more than the long, or red rays, and it is because of this peculiarity that light, passing through a prism or bevel glass, is seen spread out into the familiar rainbow spectrum. This progressive bending of light is known as refraction, and is the basis of all optical science.

Now, while all transparent substances refract light, there are some which do so in a most unusual manner, dividing the beam into two distinct rays, one of which is refracted in a much greater degree than the other. The ray which is refracted in the usual way is known as the "ordinary," while the second, whose degree of refraction is variable, is termed the "extraordinary" ray. The two most usual substances used to produce this effect are Iceland Spar (which is crystallised carbonate of lime) and Tourmaline, the former being far more commonly used.

If a crystal of this spar be placed over a figure, design, or other mark on paper, the image seen through the spar will distinctly double, as shown in Fig. 2, where the effect is demonstrated utilising the first two letters H and O. If a dot be made in ink and viewed in this manner, two distinct dots are seen, and if the spar be rotated the second dot will appear to travel round the first, just as the moon appears to encircle the earth, while first one, then the other, of the dots will alternate in shade from dark to light.

The phenomenon just described is the basis of the Polariscope, and it is by adapting the principle in such a way that one type of ray is discarded, or thrown out during its passage through the prism, that we are able to project a light ray which is moving, or vibrating in one plane only. In other words, instead of the light radiating in all directions like the spines on a cactus, it is made to radiate in one plane like the ribs of a fan.

To produce this effect, a very eminent optician named Nicol evolved a special prism which is shown in diagrammatic form in Fig. 3. He cut a crystal of Iceland Spar into two halves as shown, and after polishing the faces of cleavage as well as the outer faces, rejoined them to form a prism as shown at ABCD. The joined faces at AD were cemented with Canada's balsam, which formed, within the prism, a surface capable of reflecting the "ordinary" ray out through the side of the prism (see EFG), while the "extraordinary" ray was permitted to travel on through the whole prism emerging as depicted at EH, and now constituting a ray which could vibrate in one plane only, otherwise polarised light.

Now for a very remarkable effect. If two of these Nicol prisms are placed end to end and looked through in the direction of a source of light, they appear perfectly clear and transparent while their axes are in the same plane, but if one of them be rotated till its axis is at right angles to the other, we will find, on looking through them, that the light, however powerful, has totally disappeared, just as though it had been extinguished.

The Explanation

Fig. 4 gives an illustration of the reason for this seemingly magical phenomenon. If two grids of wire with very fine gaps between the bars are placed with both sets of wires running in the same direction and parallel, we can see through them, but if one is turned at right angles to the plane of the other, the part where they overlap seems solid. This is roughly what has happened in the case of the two prisms. The first one has stopped all light except that travelling in a horizontal plane; when we rotate the second it is in a position to pass only light in the vertical plane, but there is none to pass (having been screened out) so the result is no light at all.

When two prisms are used in this manner the first is termed the "polarizer" and the second the "analyzer." This combination, with certain additions and refinements, constitutes the instrument known as the "polarimeter," a device of great service in laboratories and particularly valuable in the sugar industry, for sugar has a peculiar pro-
Absolutely brand new, and unmarked. Originally designed for the export market, and exactly as fitted in radio diagrams covering £1000. It is 17 wave-bands, and a stereo-combination tone control. All knobs engraved, negative feed-back, and fly-wheel tuning. 11-135 metres in five ranges, and medium wave 118-550 metres. Our special PRICE, £18.15.6 and carriage FREE. Also the Home Market model with long, medium and short bands, gram, switch position and pick-up sockets. Our PRICE £10.17.6, carriage 4/5. Both chassis measure 11"in x 7in x 8in, and with valve line-up 6BE6, 6BA6, 6AT6, 6BW6, 6X4. Modernise your set now.

RADIO TELEPHONES
Brand-new transmitter/receiver, £3.75 each. Visual range. Complete in canvas carrying case and individually boxed in heavy transit case. Works off set of dry batteries or a vibrator from a 12-volt accumulator. Batteries or vibrators individually boxed in heavy transit case. Batteries or vibrators 37/6 each. July, 1953

This Precision-Built Power-Planer gives 12,000 cuts per minute

MYFORD PRI1 BENCH PLANER
Planes—rebates—bevels up to 4½in. wide. High-speed 3-blade rotor gives 12,000 cuts per minute. Entirely new, precision-built throughout. Produces rebates for door and window frames; square tapered cuts for furniture legs, lamps, etc. Only £17.10.0 and the finest 4½in. Bench Planer obtainable. Overall length 38in.

Send now for Publication 1100.
To THE BENNETT COLLEGE (Dept. G. 76), SHEFFIELD

Please send me free your prospectus on:

SUBJECT

NAME

ADDRESS

AGE (if under 21)

PLEASE WRITE IN BLOCK LETTERS

---

BENNETT COLLEGE can help you to success through personal postal tuition

THOUSANDS OF MEN in important positions were once students at The Bennett College. They owe their success to Personal Postal Tuition—the Bennett College way. You have the same chance to qualify for a fine career, higher pay and social standing.

SEND TODAY for a free prospectus on your subject. Just choose your course, fill in the coupon and post it.

---

One of these courses will lead to your advancement

Accountancy Exams  
Auditing  
Book-keeping  
Commercial Arithmetic  
Costing  
Modern Business Methods  
Agriculture  
Architecture  
Aircraft Maintenance  
Building  
Carpentry  
Chemistry  
Civil Engineering  
Commercial Art  
Diesel Engines  
Draughtsmanship  
Electrical Engineering  
Electric Wiring  

Shorthand  
English  
General Education  
Geography  
Journalism  
Languages  
Engineering Drawings  
Forestry  
Locomotive Engineering  
Machine Design  
Mechanical Engineering  
Mining  
Motor Engineering  
Plumbing  
Power Station Engineering  
Press Tool Work  
Quantity Surveying  
Radio Engineering  

Mathematics  
Public Speaking  
Police Subjects  
Salesmanship  
Secretarial Exams  
Short Story Writing  

Road Making  
Sanitation  
Short Metal Work  
Steam Engineering  
Surveying  
Telecommunications  
Textiles  
Wireless Telegraphy  
Works Management  
Workshop Practice  
and many others

GENERAL CERTIFICATE OF EDUCATION: R.S.A. EXAMS.
Colour Displays of Amazing Beauty

The most commonplace objects, when viewed by polarised light, acquire a coruscating variety of dazzling prismatic colours which is almost beyond description, and which must be seen to be believed. A few drops of a solution of such common substances as salt, sugar, borax, soda copper sulphate, and a hundred other everyday compounds, will, if placed on a glass slide and viewed by this magic light, reveal a positive unearthly beauty of kaleidoscopic and ever varying colours which no photographic or colour-printing process could ever hope to reproduce with the fainest approach to fidelity. Actual crystals, splinters of glass or pebble, thin slivers of ore of rock; in fact, almost any substance, will yield the most amazing results, while a small piece of micro or talc will, in due time, produce a positive revelation, changing as it does its entire colour scheme as the flexible material is bent or pressed.

By W. H. SHEPPARD

A Calendar Clock

All readers know that the long hand of a clock revolves 12 times to one of the short hand and it occurred to the writer that as there are 12 months in the year a clock mechanism might be used to give simultaneous readings of days and months.

To make a calendar like that shown in the accompanying drawing, take any old clock in which the gear train between the two hands works satisfactorily, and measure the size of the dial. Then mark out a dial like that on the drawing. In this case the outer circles are on a 5 in. pitch circle diameter, each small circle being 3 in. dia. Other sizes would be in proportion. Now remove the clock mechanism from the case; remove the hands; paste the calendar dial over the old one; replace the Lands and replace the clock mechanism from the case; and finally, turn the hand adjusting knob until the hands point respectively to the day and month. Each day turn the large hand to the next day until the number of days in the month indicated is reached, and the following day advance to "1." The small hand will follow automatically and indicate the month.

How to Make a Mechanical Calendar

Refinements

More ambitious readers may care to experiment with a ratchet and plunger on the adjusting knob or an electric solenoid to work from a press switch; alternatively, the calendar clock may be made fully automatic by a 64:1 reduction gear (in 2 steps of 32:1) from a mains unit (i.e., for 30 c.p.s. — suitable adjustments for other frequencies). The simple calendar described has, however, served the writer satisfactorily for several years.

How to mark out the dial.
The Editor does not necessarily agree with the views of his correspondents.

SIR,—Re Mr. W. J. Land’s letter (Practical Mechanics, April) concerning the heating of a space ship due to solar radiation, I feel there are one or two points that need answering.

As is well known, heat may be transmitted by three effects—convection, conduction and radiation. In a vacuum flask these are reduced to a minimum by its construction (see diagram) because:

1. Glass is a poor conductor of heat (about 1,000 as efficient as say, brass), and so loss of heat from the flask by conduction through the walls is slow.

2. Convection cannot occur since there is a vacuum between the walls, and thus no medium to carry the heat. A little can occur through the neck when open, but the loss is also very small.

3. The walls are silvered on the vacuum sides to reduce losses by radiation, and this is the point where Mr. Land makes an error. Heat may be transferred across the vacuum by electro-magnetic radiation, similar to visible light in every way, except that it has much longer wavelengths. Now, Kirchhoff’s law of radiation says, that, put it loosely, the more light a body reflects the less heat it will radiate. Thus, a silvered surface, reflecting some 90 per cent. of the light falling upon it, will be a very poor radiating surface, and so the loss of heat across the space between the walls of a vacuum flask is very slow.

The sun, separated from us by a good vacuum, transfers heat to us purely by radiation. Now, a space ship out in this good vacuum, will radiate heat itself, almost as fast, if not faster, than it receives it; hence, the rise in temperature of the interior of the ship would be very slow, indeed. It must be remembered that at any time rather less than half the surface area of the ship would be exposed to solar radiation, whereas all the surface would be radiating heat away. However, the temperature of the ship might tend to rise, and I estimate that, for a reasonable size of space ship, it would have been working since 1946, and I have renewed the battery, only once. It has never failed to work. I set the alarm at the required time by the small hand, as you would an ordinary alarm, wind up the clock, switch on a small switch, and the clock will go off at the setting.

The layout consists of a Goltone bell and buzzer. The only really popular copper-plating bath is the cyanide bath. The sulphate solution is of course suitable for copper, brass, bronze, pewter and white metals. Also, I am not too sure that the diagram in Fig. 3 (a and b) is correct. Whilst I have no pretensions towards theoretical electricity, I was always under the impression that electron flow left the source of generation from the positive pole and returned to its source via the negative pole, not as in the other direction as given.

Lastly, I cannot quite agree with the writer who is optimistic about the ammeter’s chances with chromium plating. The procedure was always under the impression that electron flow left the source of generation from the positive pole and returned to its source via the negative pole, not as in the other direction as given. The rise of temperature of the interior of the ship would be very slow, indeed. It must be remembered that at any time rather less than half the surface area of the ship would be exposed to solar radiation, whereas all the surface would be radiating heat away. However, the temperature of the ship might tend to rise, and I estimate that, for a reasonable size of space ship, it would have been working since 1946, and I have renewed the battery, only once. It has never failed to work. I set the alarm at the required time by the small hand, as you would an ordinary alarm, wind up the clock, switch on a small switch, and the clock will go off at the setting.

The layout consists of a Goltone bell and buzzer. The only really popular copper-plating bath is the cyanide bath. The sulphate solution is of course suitable for copper, brass, bronze, pewter and white metals. Also, I am not too sure that the diagram in Fig. 3 (a and b) is correct. Whilst I have no pretensions towards theoretical electricity, I was always under the impression that electron flow left the source of generation from the positive pole and returned to its source via the negative pole, not as in the other direction as given.

Lastly, I cannot quite agree with the writer who is optimistic about the ammeter’s chances with chromium plating. The procedure was always under the impression that electron flow left the source of generation from the positive pole and returned to its source via the negative pole, not as in the other direction as given.

(Continued on page 433)
**The Improved MOLE Self-Grip WRENCH**

**M. MOLE & SON LTD. BIRMINGHAM 3**

**THE INSTRUMENT THAT CAN SAVE AND MAKE YOU POUNDS**

Would you not consider it a real boon if you could multiply your sight six-fold and ensure that everything you examine was revealed in a white light?

Yet this miracle can be worked by you, if you choose to avail yourself of the benefits of the ULTRA LENS. It is invaluable.

The ULTRA LENS reveals every detail with startling magnification and bringing out points of weakness or strength and enabling you to gauge accurately the most minute of all measurements.

**THE ULTRA LENS COMPANY**

176, Oxenden Street, London, S.W.1.

---

**PHOTOGRAPHIC ENLARGER TIMER**

A first-class coincidence timer, constructed from an ex-Govt. unit giving 1 to 6-second exposures with each winding. Complete with Foot Switch, Calibrated Dial, Focusing Switch. Ready for connection to the mains and enlarger.

---

**EX-AIR MINISTRY WRAY PRISMATIC BINOCULARS.**


**EX-GOVT. BARR & STROUD RANGEFINDERS.**—80 cm. base. Original cost approx. £100. Perfect condition. £12.

**EX-R.A.F. MARCHING COMPASSES.**—As new, £1/1/-.

**OPTICAL KIT for simple Astronomical Telescope, 9/6.**

**EPISODE LENS with constructional diagram, 12/6.**

**ACROMAT OBJECT GLASSES.**—Diam. 50 mm., focal length 5 in. Perfect. 10/6 each.

New illustrated Catalogue on request. Satisfaction guaranteed on all purchases or full refund.

---

**CHARLES FRANK, 67-73, SALTMARKET, GLASGOW, C.1**

Phone: BELL 2106-7

---

**WILCO ELECTRONICS**

204, LOWER ADDISCOMBE ROAD, CROYDON.
HERE'S VALUE! ELECTRIC MOTORS


New, complete, with 2025 Vatt. A.C. engine, Wire protectors, and Dip-proof sleeve bearings.

Complete with plug, 0.64. post and packing.

Unpaid, delivery Free. 35/-

Carr, Pixeling 79.

NEW AIR ALTIMETERS

Ex R.A.F. Complete, with Thyratrons. Min. specification. Model B. 0-20,000 ft. in 3 parts.

With 3 m.m. base. (Worth Double.) Post & Packing 18/-

Send for free new illustrated catalogue.

PRIDE & CLARKE Ltd.

(D.G.M.F.1) BOCKING ROAD.

LONDON, S.W.9

Brixton 4251.

PRACTICAL BARcRAGANS

FIELD TELEPHONE SETS. -Each complete with sapper call, hand telephones and Battery Box, for easy installation, 60/- each. Post 22/6.

NEW THERMOMETERS


NEW PRESSURE STOVES


NEW ALTIMETERS

Ex R.A.F. Complete, with Thyratrons. Min. specification. Model B. 0-20,000 ft. in 3 parts.

With 3 m.m. base. (Worth Double.) Post & Packing 18/-

Send for free new illustrated catalogue.

PRIDE & CLARKE Ltd.

(D.G.M.F.1) BOCKING ROAD.

LONDON, S.W.9

Brixton 4251.

PRACTICAL BARGAINS

FIELD TELEPHONE SETS. -Each complete with sapper call, hand telephones and Battery Box, for easy installation, 60/- each. Post 22/6.

NEW THERMOMETERS


NEW PRESSURE STOVES


NEW ALTIMETERS

Ex R.A.F. Complete, with Thyratrons. Min. specification. Model B. 0-20,000 ft. in 3 parts.

With 3 m.m. base. (Worth Double.) Post & Packing 18/-

Send for free new illustrated catalogue.

PRIDE & CLARKE Ltd.

(D.G.M.F.1) BOCKING ROAD.

LONDON, S.W.9

Brixton 4251.

PRACTICAL BARGAINS

FIELD TELEPHONE SETS. -Each complete with sapper call, hand telephones and Battery Box, for easy installation, 60/- each. Post 22/6.

NEW THERMOMETERS


NEW PRESSURE STOVES


NEW ALTIMETERS

Ex R.A.F. Complete, with Thyratrons. Min. specification. Model B. 0-20,000 ft. in 3 parts.

With 3 m.m. base. (Worth Double.) Post & Packing 18/-

Send for free new illustrated catalogue.

PRIDE & CLARKE Ltd.

(D.G.M.F.1) BOCKING ROAD.

LONDON, S.W.9

Brixton 4251.

PRACTICAL BARGAINS

FIELD TELEPHONE SETS. -Each complete with sapper call, hand telephones and Battery Box, for easy installation, 60/- each. Post 22/6.

NEW THERMOMETERS


NEW PRESSURE STOVES


NEW ALTIMETERS

Ex R.A.F. Complete, with Thyratrons. Min. specification. Model B. 0-20,000 ft. in 3 parts.

With 3 m.m. base. (Worth Double.) Post & Packing 18/-

Send for free new illustrated catalogue.

PRIDE & CLARKE Ltd.

(D.G.M.F.1) BOCKING ROAD.

LONDON, S.W.9

Brixton 4251.

PRACTICAL BARGAINS

FIELD TELEPHONE SETS. -Each complete with sapper call, hand telephones and Battery Box, for easy installation, 60/- each. Post 22/6.

NEW THERMOMETERS


NEW PRESSURE STOVES


NEW ALTIMETERS

Ex R.A.F. Complete, with Thyratrons. Min. specification. Model B. 0-20,000 ft. in 3 parts.

With 3 m.m. base. (Worth Double.) Post & Packing 18/-

Send for free new illustrated catalogue.

PRIDE & CLARKE Ltd.

(D.G.M.F.1) BOCKING ROAD.

LONDON, S.W.9

Brixton 4251.

PRACTICAL BARGAINS

FIELD TELEPHONE SETS. -Each complete with sapper call, hand telephones and Battery Box, for easy installation, 60/- each. Post 22/6.

NEW THERMOMETERS


NEW PRESSURE STOVES


NEW ALTIMETERS

Ex R.A.F. Complete, with Thyratrons. Min. specification. Model B. 0-20,000 ft. in 3 parts.

With 3 m.m. base. (Worth Double.) Post & Packing 18/-

Send for free new illustrated catalogue.

PRIDE & CLARKE Ltd.

(D.G.M.F.1) BOCKING ROAD.

LONDON, S.W.9

Brixton 4251.
LETTERS TO THE EDITOR
(Continued from page 430)

cess is tricky at its best, even to those having experience of the process, as the shoddy chromium plate on the market will bear witness, and I would not be optimistic of the novice's chances of success. Taking the subject all round, I would say silver is undoubtedly the one which is most likely to prove successful to the beginner. - S. H. CANE (Hackney, E.9).

The Author's Reply
SIR,—I must express my thanks to Mr. Cane for pointing out an error in the current density quoted in my article on electroplating. This current density, as calculated by Mr. Cane should be 0.02 amp.sq. in. and not 0.2 amps sq. in.

With regard to the other points made by Mr. Cane, I have the following observations to make.

Admittedly, the most versatile plating bath for copper, is, as he suggests, the cyanide bath, but this bath is quite complex in composition and moreover is of an exceedingly poisonous nature. It was my intention, where possible, to avoid suggestions of a cyanide bath and to this end I included copper plating as merely an initial exercise. In order to make the record complete, I may include a formula which is admirably suited for plating ferrous metals, and which is comparatively innocuous.

Copper sulphate 2 oz.
Sodium potassium tartrate 5 oz.
Distilled water 2 pints.

I can assure Mr. Cane that the diagram in Fig. 3 (a and b) is perfectly correct as far as it goes. Of course it makes no attempt to explain the current flow in the electrolyte. This flow is quite complicated and involves the migration of positive ions to the anode, and negative ions to the cathode. That is not the whole story, for besides ions of the radicals concerned, hydrogen ions and hydroxyl ions are also present, and these are taken into account in any complete theory. Any radio engineer will be able to confirm that the electron flow is from the negative pole to the positive pole and, of course, what is true of electron flow in a radio circuit is equally true of electron flow in any simple circuit.

Mr. Cane thinks I am optimistic about amateur's chances with chromium plating. In face of this I can only repeat what I have already said in the article, and that is, that if the instructions are followed carefully and exactly, there is no reason why an amateur should not obtain successful results. I am mentioning shoddy chromium plate, Mr. Cane does not tell the whole story, and I am sure that he will be the first to admit that a good deal of shoddy plating has been due to shortages of material and the use of unsuitable substitutes, e.g., the shortage of nickel for use as an intermediate plating on ferrous metals. The only real difficulty that I have encountered with chromium plating, is getting the action to start, and therefore the amateur by constantly passing a somewhat higher current density than that calculated from the formula. - E. HARRIS MORGAN (Winklesigh, N. Devon).

Stenciling
SIR.—I wish to reproduce printing matter such as letterheads on a duplicator stencil. I have a stencil cutting machine for cutting stencils on a printing machine, but the type will not penetrate the wax coating.

To the Editor—Please will prepare stencils for this type of work, but one has to order a complete ream and this is too expensive for small orders.

SIR.—I have examined these commercial stencils and I am inclined to think that they are prepared as follows:-

1. An unwaxed stencil is printed upon using a wax-resisting ink. 2. The stencil is then waxed. 3. The printing ink is now dissolved away leaving the stencil ready for the duplicator.

I have a photographic stencil-outfit, but it is not much use for reproducing business heads, as it means a long exposure. A long exposure is necessary in order for the light to penetrate the paper; this long exposure, unfortunately, allows a certain amount of light to penetrate the printed matter, rendering the stencil useless. Gestetners will prepare a positive of printed matter on photographic film for about 10/ per run again, but the cost is too high for small runs. - M. G. LIESS (Gloucester).

(READER'S SUGGESTIONS ARE INVITED.—Ed.)

RE INFORMATION SOUGHT

Revolving Lampshade
SIR.—If Mr. Ball is prepared to accept a reduction of lighting efficiency to produce a revolving motion in a lampshade, he may be interested in my "aquarium lamp," which forms a novel interior decoration and provides a subdued light suitable for television viewing, etc.

The lamp is in the form of a cylinder, mounted on a normal stand, and presenting a typical aquarium scene, devoid of fish. When the current is switched on the "tank" is illuminated, when fish appear and slowly begin to move and swim around.

The lamp comprises an outer cylinder, of green parchment or Crinothene, with aquarium scenery painted on. There is a chrome rim at the top, with a mesh indrawing, and a rim at the bottom supported by a "Spider" on the lampholder of a plain chrome 1½" lamp standard.

An inner revolving cylinder of clear cellulose acetate is provided, with opaque representations of exotic fish thereon. A fan, made of very thin balsa wood, with a laminated balsa rim, is fixed in the top. A similar rim only in the bottom maintains the cylinder symmetrical. This inner cylinder rotates on a steel point affixed to the underside of the fan, bearing in a centre pop in a brass disc located at the top of a second "spider."

The accompanying sketch illustrates the position of the main components, and the entire assembly can be produced from readily available materials on the inevitable kitchen table. - R. W. DIXON (Nottingham).

Shaded Pole Motor
SIR.—The shaded pole motor is a variety of the single-phase A.C. induction motor. It is well known that a simple single-phase motor is not self-starting and special methods are needed to start it. The commonest method is the use of a starting winding which is connected in a special way to the single-phase mains which also feed the principal winding. In this way the current passing through the starter winding, and therefore the magnetic flux produced by it, is out of phase with the current and flux on the principal winding.

The effect of these magnetic fluxes waxing and waning at different times and at different positions of the main components, and the result that the motor is dragged round by the magnetic fields. (I hope some of your more technical readers will not quarrel with this description which is meant to be vivid rather than meticulously accurate.)

When a simple motor for light duty, such as driving a gramophone turntable is required, sufficient phase difference can be created on each pole face by "shading" the pole. A slot is cut longitudinally along each pole face near the middle and a copper band is passed through the slot and made to embrace half the pole face.

The effect of such a closed band is to retard the growth (and also decay) of the magnetism in the portions of the pole face it embraces, since every change of magnetism in that portion causes a current to flow in the copper band which in turn sets up a counter magnetism which resists the change of magnetism causing it. In this way the shaded portion carries magnetism which changes rather later than that on the unshaded portion. In this way a suggestion of magnetism passing along the pole face is created and the motor is self-starting.

It will be appreciated that a shaded pole is entirely dependent on varying magnetism. There is no squirrel-cage winding which will be unaffected. - G. E. BRIDON (Chelsea).

Model Boat Building

Ey, J. CAMM
5/6, By post 5/6
From GEORGE NEWNES, LTD.,
Tower House, Southampton St., Strand, W.C.1.

NEWNES PRACTICAL MECHANICS
433

Shaded Pole Motor
THE amateur photographer will find in this book the necessary knowledge for ensuring the production of a first-class photograph at all times, and not depending on luck rather than judgment. To assist in reaching such proficiency, the book has been prepared by experts having an intimate knowledge of the many difficulties and disappointments that confront the beginner. In this new and extensively revised edition the chapter dealing with colour photography has been enlarged considerably and contains information covering "Ektachrome," "Kodachrome," "Dufaycolor," "Ilford Colour Films," "Agfacolor" films, "Paticolor" films, and the Johnson Colour Screen Process. The section devoted to flash-light photography has been brought up to date, and includes information on flash bulbs, flash holders, and portable electronic outfits.

New 7in. Heavy Duty Saw

THE Wolf R57 has been designed as an industrial heavy duty machine quite distinct from the portable saws which are being produced for the popular electric tool market.

Much care and close attention has been paid to the correct balance of the machine. This is so perfected that it can be used throughout the longest working period with practically no operator fatigue.

The motor is mounted transversely at a right-angle to the blade; the drive being by means of heavy helical gears. Thus the saw rests in a perfectly balanced position on the main piece of the work which means extra safety, less effort and a clean cut.

Balanced running is assured by means of the dynamical balancing of all moving parts.

Smooth operation, easy guiding and feeding ensures straight, dead-on-the-line cutting.

The cutting line is kept clean by the introduction of a volute on the inner surface of the guard which causes the sawdust to be ejected at the rear of the machine behind the operator.

The saw blade is completely guarded and safe to operate under all conditions. The lower part is guarded by a pressed steel telescopic guard, the mechanism of which is completely sealed from sawdust, etc.

Depth of Cut

The depth of cut is adjustable to a maximum vertical cut of 2-1/2" at 1600 rpm. Bevel cuts are made up to an angle of 45 deg. and to a depth of 2-1/2". Angle adjustments are quickly and easily made by a conveniently placed pointer. An adjustable ripping guide is provided as part of the standard equipment.

A wide selection of blades is available for sawing timber, wallboard, plywood, stone-work, light sheet metal, corrugated asbestos sheets, etc.

A combined rip and cross-cut blade of the finest Sheffield Crucible steel is supplied with each machine. For a smoother cut a cross-cut blade is recommended, and for a finer finish there is the planer blade. Other blades include a fine-tooth pattern for fast and fine cutting of wallboard and composition board.

For cutting plain and corrugated sheet metal, light sheet metal, corrugated asbestos, etc.

A wide range of blades is available for cutting plain and corrugated sheet metal. Light sheet metal, corrugated asbestos, etc.

A combined rip and cross-cut blade of the finest Sheffield Crucible steel is supplied with each machine. For a smoother cut a cross-cut blade is recommended, and for a finer finish there is the planer blade. Other blades include a fine-tooth pattern for fast and fine cutting of wallboard and composition board.

For cutting plain and corrugated sheet metal, light sheet metal, corrugated asbestos, etc.

A wide range of blades is available for cutting plain and corrugated sheet metal. Light sheet metal, corrugated asbestos, etc.

A strong steel carrying case is also available.

International Radio Controlled Model Society

THE rules and entry forms are now available for the Fourth International Radio Controlled Models Contest to be held at Southend-on-Sea, Essex, on the 25th and 26th July this year.

The contest on July 25th is for model boats, and will be held at Southchurch Park, Southend-on-Sea. On July 26th the contest for model aircraft will be held at Southend Airport, Rochford, N.R. Southend.

The aircraft contest is being held in conjunction with the S.M.A.E., and with the sanction of the Federation Aeronautique Internationale and the Royal Aero Club.

A sincere welcome is extended to all radio control enthusiasts to attend the events.

I shall be pleased to supply any further information concerning these contests—R. Ing, 36, Sunny Gardens Road, Hendon, London, N.W.4.
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.

SITUATIONS VACANT

The engagement of persons answering these advertisements for positions of skilled labour is subject to the conditions laid down in the Employment of Minors Order 1944 unless he or she, or his employer, to whom notice has been given in accordance with the requirements of the Schedule to that Order.

B.B.C. PLANNING AND INSTALLATION SERVICES.

Safety first is the watchword for all new installations. Work done to the highest, most reliable standards in the industry. With over 50 years' experience in design and installation of electrical plant and services for all types of buildings, B.B.C. services can be recommended with confidence.

FOR SALE

HOBBIESTS, HANDICRAFTS, COMMERCIALS, INDUSTRIES - ELECTRICAL ITEMS: 68% coniferous, 32% deciduous, plus 10% plus. Sawn, planed, dressed, or sanded. A wide variety of sizes and types available to meet your exact requirements. F. W. Whitton, New Mills, Stockport.


Synchronised Clock Motors, 120, 110, 90 volt, 1.1/2, 2, 3, and 4 horse-power, with or without inching motor. H.W. Burgess, 217, Liverpool Road, Hackney, E.4.

AMAZING DEVICE, cuts perfect square holes 3 inches in diameter, with any circular saw; 1/2 inch per minute. Price 10s. 6d. paid for photo details. 6/-.

ELECTRIC TOOLS FOR HOMES, INDUSTRY, BUILDING, AND SPORT. F.Booker & Sons, Bury St Edmunds, Suffolk.

BUILD YOUR OWN PHOTO EQUIPMENT. A wide range of cameras, enlargers, printers, dryers, timers, motor drives, etc. 40 POWER TOOLS You Can Make at Home. A.S. Brown, 17, Manchester Road, Manchester, M.A. 3.


CAR BODY REPAIRING. Complete A.B.C. course. Illustrated. 6/-; pips free. A.P.S. (Pip), Second. Norfolk.

SMALL DENTISTS' SYRINGES, beautifully made, all metal instruments by leading makers. All parts are strong and machined from solid. Smooth positive action. Lampadex, Company Limited, Piston red calibrated 0.20. Ideal for precision work in dental surgery, etc. £1 1/2 in lots. L. & H. S., 14, Rathbone Place, W.1.

BUD MOROGAN, The Model Specialises. J. & W. Travers Limited, Station Road, Parth, Model Railways and Railways, with a complete range of stock for the model railway enthusiast for your 1934 price list, price 3d.

HOBBIESTS, HANDICRAFT WORKERS, please note the following: Cleansing agent, 10/-; Moulding compound, 10/-; Soap, 5/-; Plate, 5/-; Metal powder, 10/-; Resin, 10/-; Wax, 10/-; Pigments, 10/-; Styrene, 10/-; Vinyl, 10/-.
SPARKS’ DATA SHEETS
are the Safest, Simplest and Finest Constructional Sheets of Guaranteed and Tested Radio Designs.

ALL-DRY BATTERY DESIGNS

THE " POCKET PAN." 1-valve Med-
wave portable. Good phone sounds.
THE " CHUGMY." 3-valve portable.
Pipe 250kva results. MI, waves.
THE " MIDDY." 5-valve MI-waves. Fins
speaker results. VPolar.
THE " DOSUN." B. A more powerful
version of the above.
THE " CHUSSER." 5-valve T.R.F.
circuit. Good range and power. MI, waves.
THE " SKIFFER." 4-valve High sens-
tivity T.R.F. circuit. Fine any waves. MI-
waves. t.
THE " COVETTE." 5-valve all-wave
superhet. Good range and very selective
ideal for a portable.

MAIN OPERATED DESIGNS

THE " CUB." 3-valve Rect. MI, waves.
Fine tone and power.
THE " KINNEY." A. An economy version
of the above for A.C. mains.
THE " ENTERPRISE." A. 3-valve +
rect. T.R.F. circuit. 6 watts on radio and P.O. economy design.
THE " UNIVERSAL." (D). As A.C./D.C.
version of the above. Fine power.
THE " MAINS PORTABLE." (D). 3-valve
Rect. MI waves. Self-contained aerial.
Radio-is-also-Boo.
THE " CONSUL." (D). All-wave super-
het. 4 watts on radio and P.O.

IMMEDIATE DELIVERY

E.I.C.

CHEMISTRY APPARATUS
Send 3d. stamp for
COMPLETE PRICE LIST

Books Only:
Experi-
ment 1-3d.
Formula 6d.
Chemistry 1/6.

HARC COURSES FROM
PER MONTH

L. ORMOND SPARKS (M)
2A. HIGH ST., SWANAGE, DORSET

BECK
(Edale lace Dept.) A
50 HIGH STREET,
Stoke Newington, London, N.16

H.A.C. SHORT WAVE EQUIPMENT

HUNT & CO.,
STEPLEC MILL, EXETER

WIRING ACCESSORIES

HARIS ENGINEERING CO. (Dept. P.M.)

CABLE.-TRS Flat Twin. 1.044. 5,5/-. :
CABER.-TRS Flat Twin. 1.044. 5,5/-. :
CABLE.-TRS Flat Twin. 1.044. 5,5/-. :

IMMEDIATE DELIVERY

Soldering Irons.—Our new streamlined
Soldering Irons work from any A.C. Stanley
450 watts. All post 6d.

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THIS VALUABLE BOOK

HIGHTSTONE UTILITIES

Soldering Irons.—Our new streamlined
Soldering Irons work from any A.C. Stanley
450 watts. All post 6d.

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

www.americanradiohistory.com
Casting in Type Metal

I WISH to cast some small human figures in metal (lead tin alloy), using a plaster of Paris mould. Unfortunately, the pattern I have is much too large. I wish to cast the figures about two-thirds the size of the pattern (tin, high). I have even a method outlined, using gelatine. The figure is cast at its normal size in gelatine, with a small amount of a powdered enlarging agent added, to give the cast stability. The gelatine cast is reduced in size (by osmosis) in alcohol would, we think, be unworkable in your case with such tiny figures.

The idea of using casts in gelatine and then reducing their size by shrinking in alcohol would, we think, be unworkable in your case with such tiny figures. I have seen a method outlined, using gelatine. The figure is cast at its normal size in gelatine, with a small amount of a powdered enlarging agent added, to give the cast stability. The gelatine cast is reduced in size (by osmosis) in alcohol and when both high) and were done then by modelling in plasteline on a piece of glass, one side, the front, of the figure on one side of the glass and the back of the figure on the other side. Glass was used so that the two halves could be seen through it and made to correspond and be in alignment. Then a wooden box was made without bottom or top, just four sides. All four sides were then sawn through to make two shallower boxes. These were clamped on each side of the glass so that they too came into alignment and each enclosed its respective half of the figure. There were each box and filled with liquid Portland cement and when both were set and dry they were removed from the glass. The plasteline came away with the cement and had to be dug out, leaving perfect impressions.

We should have mentioned that at the feet of each of the models a coned runner was cast in type metal which can be procured in one of many colours. Hence, strictly speaking, the term is one which can be applied almost any proprietary range of paints or enamels. The term does not, of itself, imply anything specially disconnected. You will be able to obtain a light blue or a beige-coloured paint or enamel from any ordinary paint shop or colour merchants, or from your nearest branch of 'Polychromatic' Co., Ltd., Corporation Street, Birmingham.

These so-called polychromatic enamels may be of any nature, cellulosic or otherwise. "Polychromatic" is not a distinctive trade, nor is it in any respect a trade name. It forms no indication of the actual nature of the enamel. As we have remarked, it merely indicates that the enamel is one which may be obtained in many colours. These enamels for cycle and motor-cycle use do not usually require any undercoat. They may be applied either by brush or by spray.

The coatings are usually sufficient for any enamel of this nature. It is of the utmost importance, however, that the metalwork should be well degreased before the enamel "takes" to the metal surface easily. Apart from this essential requirement of adequate cleanliness and degreasing, there is no special point regarding the application of motor-cycle enamels. Degreasing is best done by immersed part of a solution of caustic soda in water, 10 parts of caustic soda in 90 parts of water.

Cleaning Old Prints

I HAVE a number of old engravings (prints) that are dirty and spotted with brown marks. Please tell me a method of removing them without damaging the subject. — H. P. Cayley (Aylesbury).

It is difficult to advise on the cleaning of old prints without knowing exactly what is the nature of the marks. The brown marks can be due to iron, which may have been a part of the paper and may have extruded from the surface in the form of a brown stain. A chlorine-containing substance is usually employed to generate dry chlorine which will remove stains of this kind, but it should be remembered that chlorine is a lung-irritant gas. Indeterminate stains can be dealt with by carefully dabbing them with a solution of sodium chloride, using a camel hair brush. For ink stains citric acid is put on to the stain and then moistened, being carefully removed after short time, depending on the nature of the stain. The use of citric acid in this way can follow the treatment with sodium chloride. These marks can be dealt with, oftentimes, with hydrogen peroxide, while "foxing" can be carefully treated with a chlorine-containing substance like Milton.


Purifying Soot

PLEASE let me know if common chimney soot can be purified for medicinal use. I am experimenting and I think soot has a lot of virtues which could be used for aments. — J. W. Bishop (Southport).

We do not advise you to experiment with common chimney soot as a medicinal agent, for you will find that it has more vices than virtues in this connection. Tar water is medicated in the pharmacy with a few medicinal attributes, but this does not apply to soot water which is mainly of use as a fixative. The soot contains various toxic materials. If you attempt to purify the soot you would extract these toxic materials and you would be left with ordinary carbon which would be of no value either positively or negatively to you. Chimney soot may be looked upon as being powder containing a high proportion of carbon mixed with various organic oils and other liquids.

If, however, for experimental purposes you wish to purify common chimney soot, the best and the easiest way of doing this is simply to take a quantity of the soot and to heat it to redness for about half an hour. This will result in the contained impurities and toxic materials being driven off, but at the same time much of the carbon will be oxidised away to form the gas carbon dioxide so that the purification process will be a wasteful one.

Plant Crystals

CAN you please describe the process used to produce crystals from plants for viewing under a microscope? — H. Haigh (Grays, Essex).

We are not perfectly certain of what you mean by your mention of "producing crystals from plants for viewing under microscope," but we are assuming that you are referring to what are commonly called by botanists, 'crystallisation," the Greek raphis, a needle, these crystals being
The attached sketch will show you a simple method of producing a flash and "Aladdin." Removing "Static" from Tissues

THE spelling "NOREG" instead of the usual "NORGE" is intentional. Arne Garborg associated himself with the movement to create a Norwegian literary language based on the peasant dialect derived from the Dano-Norwegian literary medium.

In honour of his work the stamps are, therefore, inscribed "NOREG." As many thousands of these stamps were issued the present value is only a few pence.

Removing "Static" from Tissues

CAN you please tell me of any method to rid tissue paper of "static" produced when printing on the same side of the paper has been packed and delivered. In the manufacture of the paper we do not know of any method to rid tissue paper of "static" but a more safe method is to use a flashlight bulb.

Fixed Focus Enlarger

WE wish to construct a fixed focus enlarger, for photographic work, from 3½in. x 2½in. to postcard. Will you please outline a method, and also a specific enlarger? I have an unused box camera (f7.7) be of any use for the purpose? — J. T. Stock (Nottingham).

Either the f7.7 lens box camera or the fixed focus enlarger, for photographic work, will need to be provided with the necessary repairs. — D. Wharton (St. Albans).

THE manufacturers state: "The question of neutralising static electricity in tissues has always been a difficult problem, and the possibility of removing electricity from the paper in a useful manner is not yet known."

We suggest you try maintaining a steam atmosphere in your printing room. Alternatively, you can remove, say, ½in. from the floor of the room which has these uninsulated wires and fit a steel plate, perhaps caselading the top face to overcome further damage. This method involves the risk of the base distorting, but actually this is not a serious factor, because when the base is once moulded a light on the machine table it automatically resumes the original position, thus any discrepancies are not transferred to the plate.

We feel that either of the above methods will prove satisfactory; particularly the latter idea, because it allows the replacement of the plate should at a later date it become fractured or worn.

Filtering Rainwater

My water supply is rain caught from the roof. Could you please tell me how I can make a simple portable filter to take, say, one pint at a time for drinking? — R. J. Edwards (Perthshire).

YOU can best purify rainwater directly from the roof by filtration through a mixture of three parts of charcoal and one part of clean sand (not sea sand). To this mixture may be added, if desired, one part (by volume) of activated alumina which may be obtained from Messrs. Peter Spence & Co., Ltd., Widnes, Lancs. The admixture of the sand and the alumina is not absolutely necessary, but it forms a great aid to the activity of the charcoal. Any charcoal will be suitable for the purpose, particularly nut or shell charcoal or beechwood charcoal. You will be able to get charcoal suitable for the purpose from one of the following firms: Messrs. Alfred Shirley & Co., Ltd., Oakwood Chemical Works, Shireoaks Road, Worksop. Messrs. Thomas Hill-Jones, Ltd., Bow Common Lane, London, E.3. Lydbrook Chemical Co., Ltd., Lydbrook, Glos. Suggested design for fixed focus enlarger

Wood Distillation, Ltd., Cannop, Coleford, Glos.

The charcoal or charcoal mixture is packed loosely in a non-metallic pipe, such as a 2½ft. length of seaweedware drainpipe. This is bunged firmly at the lower end and a trickle pipe is passed through this. Arrangements are made for the roof water to trickle through the charcoal column and to pass out via the exit pipe, a convenient tap being attached to the latter. The construction of these charcoal filter-columns is really very simple, and we do not think that you will experience much difficulty in getting first-class results with your experiments. Water which has been filtered through any of the above media is, of course, eminently suitable for drinking purposes.

Information Sought

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

J. R. Douthwaite writes: "I have a " Versa Vice " No. 3 machine vice which has several drill holes up to 5/16in. in the bed, due to carelessness. I would like to have any suggestions to offer on filling these up."

Alternatively, you can remove, say, ½in. from the floor of the room which has these uninsulated wires and fit a steel plate, perhaps caselading the top face to overcome further damage. This method involves the risk of the base distorting, but actually this is not a serious factor, because when the base is once moulded a light on the machine table it automatically resumes the original position, thus any discrepancies are not transferred to the plate.

We feel that either of the above methods will prove satisfactory; particularly the latter idea, because it allows the replacement of the plate should at a later date it become fractured or worn.

Filtering Rainwater

My water supply is rain caught from the roof. Could you please tell me how I can make a simple portable filter to take, say, one pint at a time for drinking? — R. J. Edwards (Perthshire).

YOU can best purify rainwater directly from the roof by filtration through a mixture of three parts of charcoal and one part of clean sand (not sea sand). To this mixture may be added, if desired, one part (by volume) of activated alumina which may be obtained from Messrs. Peter Spence & Co., Ltd., Widnes, Lancs. The admixture of the sand and the alumina is not absolutely necessary, but it forms a great aid to the activity of the charcoal. Any charcoal will be suitable for the purpose, particularly nut or shell charcoal or beechwood charcoal. You will be able to get charcoal suitable for the purpose from one of the following firms: Messrs. Alfred Shirley & Co., Ltd., Oakwood Chemical Works, Shireoaks Road, Worksop. Messrs. Thomas Hill-Jones, Ltd., Bow Common Lane, London, E.3. Lydbrook Chemical Co., Ltd., Lydbrook, Glos. Suggested design for fixed focus enlarger

Wood Distillation, Ltd., Cannop, Coleford, Glos.

The charcoal or charcoal mixture is packed loosely in a non-metallic pipe, such as a 2½ft. length of seaweedware drainpipe. This is bunged firmly at the lower end and a trickle pipe is passed through this. Arrangements are made for the roof water to trickle through the charcoal column and to pass out via the exit pipe, a convenient tap being attached to the latter. The construction of these charcoal filter-columns is really very simple, and we do not think that you will experience much difficulty in getting first-class results with your experiments. Water which has been filtered through any of the above media is, of course, eminently suitable for drinking purposes.

Information Sought

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

J. R. Douthwaite writes: "I have a " Versa Vice " No. 3 machine vice which has several drill holes up to 5/16in. in the bed, due to carelessness. I would like to have any suggestions to offer on filling these up."

Alternatively, you can remove, say, ½in. from the floor of the room which has these uninsulated wires and fit a steel plate, perhaps caselading the top face to overcome further damage. This method involves the risk of the base distorting, but actually this is not a serious factor, because when the base is once moulded a light on the machine table it automatically resumes the original position, thus any discrepancies are not transferred to the plate.

We feel that either of the above methods will prove satisfactory; particularly the latter idea, because it allows the replacement of the plate should at a later date it become fractured or worn.
HANDICRAFTS
with each B.T.H. LATEST TYPE MOULDED IN G.E.C. GLASS TYPE CRYSTAL DIODES
You Can Become a REAL CRYSTAL SET NOT A TOY Polished wood cabinet, but high quality Crystal Set included.

WHATCROFT WORKS, WELLINGTON STREET, BATLEY, YORKS.
Telephone: BATLEY 416.

PARKER'S SHEET METAL FOLDING MACHINE

Heavy. Vice Model. Capacity 18 gauge 1 1/2 x 1 1/2 wide. Loose Attachments, if Required. Price 9/- each. Trial of Snap Making.

Model 220 Price 45/- Attachments 1 1/2 per (12) Cardboard. With Attachments 5/-.

PARKER'S FOUR IN ONE REVOLVING DRILL VICE

Converts to Accepts up to 8 in. dia. Drill. Price 2/-

Send for details.

A. B. PARKER

HIGH GRADE SURPLUS
ELECTRONIC COMPONENTS

SPECIAL OFFER PARMKO TRANSFORMERS—Prim. 10/-50. Sec. 2/-50. 63/1.25. 93/1.50. Price 75c. 10. 75c. 12. 5c. 5. 75c. 6. 5c. 5. 4c. 4. 3c. 3. 2c. 2. 1c. 1.

HEAVY DUTY POTENTIOMETERS BY BRITISH ELECTRIC—Type 7. 6 1/2 In. Ports. 1,900 ohms. 63/1.50. 75c. 1. 63/2.50. 1. 75c. 3. 63. 4. 5c. 5.

ZENITH TRANSFORMERS—Prim. 10/-50. Sec. 5/-50. 63/1.25. 93/1.50. Price 75c. 10. 75c. 12. 5c. 5. 75c. 6. 5c. 5. 4c. 4. 3c. 3. 2c. 2. 1c. 1.

RED BOOKWORKS—Prim. 10/-50. Sec. 5/-50. 63/1.25. 93/1.50. Price 75c. 10. 75c. 12. 5c. 5. 75c. 6. 5c. 5. 4c. 4. 3c. 3. 2c. 2. 1c. 1.

REFILL YOUR OWN BALL PEN KOLCOLD REFILL KIT

FREIGHT FREE 3/6 PER OUTLET COMPATIBLE WITH LEADERS, BENGAL, ETC. INSTRUCTIONS AND TOOL Contains ink for Blue, Violet, Red. 5/-15 Refills.

G. H. HOLMES

Catalogue Cheap. Stamp for postage.

WELEYB AIR PISTOLS

Marvellously accurate for target practice etc. No license required to purchase for use on unoccupied premises.

Write for Catalogues of AIR PIPETTES, AIR HAPERS and WELEYB & SCOTT LTD., 168, Westminster, Birmingham Eng.

GENERAL CERTIFICATE OF EDUCATION EXAM.

THE KEY TO SUCCESS AND SECURITY.

Essential to entire any walk of life. Whatever your age, you can now prepare at home for the important new General Certificate of Education (G.C.E.) (Intermediate) or the (Advanced) by means of your own subject on "NO PASS—NO FEE".

SEND FOR FREE 15/- PAPER BOOK full details of how you can obtain the valuable Certificate is given in our 36-page Guide—FREE and without obligation.

Address: CIRCULAR SAW SPINDLE ASSEMBLIES

Complete range for sizes from 6 in. to 12 in. With Ball Bearing. Two sizes of spindles and 7 styles of blades complete. 6/-11. 93/- each.

CUTTING PRODUCTS


CIRCULAR SAW SPINDLE ASSEMBLIES

Complete range for sizes from 6 in. to 12 in. With Ball Bearing. Two sizes of spindles and 7 styles of blades complete. 6/-11. 93/- each.

CUTTING PRODUCTS

LEARN THE PRACTICAL WAY
A specially prepared set of radio parts from which we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service a radio set. Whether you are a student for an examination, starting a new hobby, intent upon a career in industry, or running your own business—this Course is intended for YOU—and may be yours at a very moderate cost. Available on Easy Terms.

WE TEACH YOU: Basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) Complete Radio Receiver Testing & Servicing.

POST IMMEDIATELY FOR FREE DETAILS
TO: E.M.I. INSTITUTES, Dept. 744X
Grove Park Road, Chiswick, London, W.4

Name __________________________
Address ________________________

Surplus Bargains

FRACTIONAL H.P. EX-R.A.F.

1/16 H.P., BRAND NEW ELECTRIC MOTOR

Made by Bovers

EACH ONLY 37/6 Carr. 2/6

Not to be confused with smaller, cheaper types. Size 11/2 x 21/2 x 24 in., weight 16 lb., volts 220-240, & 400-480, A.C. or D.C. 2,000 r.p.m. (ideal for Polishing, Grinders, Washing Machines, etc. Existing spindle can be extended to suit new motor. Please state speed required.) Post 1/2 pair extra.

BATTERIES, unused ex-Arm. Patice 6 v., 7/6, Carr. 2/6

POCKET WATCHES, new foreign import (German), 1/6. Plus post and ins.

WATERPROOF BLOUSES, ex-Services, unused yellow lightweight material, elastic waist and cuffs, zip front, 9/6 incl. (Ditto gaberdine material, same price.)

LEATHERETTE LUMBERS (new), 20 ft., 5/- Post 1/3. (Ditto gaberdine material, same price.)

WATERPROOF LEGGINGS, 5/- pair incl.

SHORTS, Nat. Service, unused kaki or white. Made waist size, 29/6 incl.

TROUSERS, new khaki or white drill, with waist belt. State meas., 9/6 incl. (Ditto grey flannel, 22/6 incl.)

ARMY BOOTS, reconditioned Grade I. (Ditto, Wellingtons, 15/- incl.)

SHOES, ex-Naval (bulk), 12/6 incl.

BOILER SUITS, ex-Services, recdtd., new blue (state chest and height). 13/6 incl.

TRUGGROOTS, rubber, reconditioned sound, 85/- incl. (Ditto Wellingtons, 14/- incl.)

Send S.A.E. for Latest Lists

Money Back Guaranteed

AUTO COLLECTIONS LTD.
15, LAWRENCE STREET, NORTHAMPTON

Watson's Special Offers

Motor Generators.—Unused. Input 24v. Two outputs 200/240v. 60w. and 100/140v. 30w. Can be used as motor on 12v. or 24v. Less than the value of the balancers. Price 8/6. Carr. 4/6.

E.M.I. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

VIBRATION ABSORBING MOUNTINGS.—Steel frame, 3 ft. x 2 ft., with four rubberised feet. 3/6 Post 1/3.

BALLLEGS.—Brand new, 1 in. x 3 in. x 3 1/2 in. each, £10 for 20. 8/- incl. 12/- incl. When sending, please include 1/3 Post 1/3.

V.R.O.P.E.S.—1/3 section, 62/1/2 in. x 6 in., 7/- incl. 12/- incl. By 2 tranquillised per pair. Post 2/6.

BOMBRIGHT COMPUTER.—The most complete instrument offered. Kits of interesting parts, gear and worm wheels, motors etc. In metal transit case. £3 for 24/6 Carr., £5 for 72/6 incl.

LANDING LAMPS.—7 in. diam, easily fitted on bicycle. Matt black finish. 5/6 each, 10/- pair. Post 1/3.


OIL CANS.—The Rolls-Berge and similar makers, 1 in. suction and delivery hopefully made, and will deal with a large volume of liquid. Price 3/- each, Post 6d.


MINE OR METAL DETECTORS.—A fine instrument for detecting concealed metal objects. Mounting in metal transit case. 8/- each, Post 1/3.

COILED SPRING ENDLESS BELTS.—Steel, 100 lb. tension. 100 feet. Price 10/- incl.

VIBRATION ABSORBING MOUNTINGS.—20 ft. length, four for 10/- incl.

BATTERY CHARGERS.—Metal rudders, with interesting parts, gear, worm wheels, built to a high service specification. 4/6, Carr. 2/3.

MAP CASES.—Transparent perspex with hinged front. 3 in. x 6 in. Price 4/6 incl. Post 1/-.


FLEXIBLE LEADS.—20 ft. length, four conductors, 1 in. x 3 in. each. For 10/- incl.

MOTOR GENERATORS.—Input 24v. Two outputs 200/240v. 60w. and 100/140v. 30w. Can be used as motor on 12v. or 24v. Less than the value of the balancers. Price 8/6. Carr. 4/6.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

MOTOR GENERATORS.—Input 24v. Two outputs 200/240v. 60w. and 100/140v. 30w. Can be used as motor on 12v. or 24v. Less than the value of the balancers. Price 8/6. Carr. 4/6.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.

R.C.A.F. TOOL BOXES.—Size 6 in. x 4 in. x 3 in., dovetailed and metal bound. Price 10/6 incl. 13/- incl. Size 8 in. x 4 in. x 3 in. Price book value. 15/- incl.