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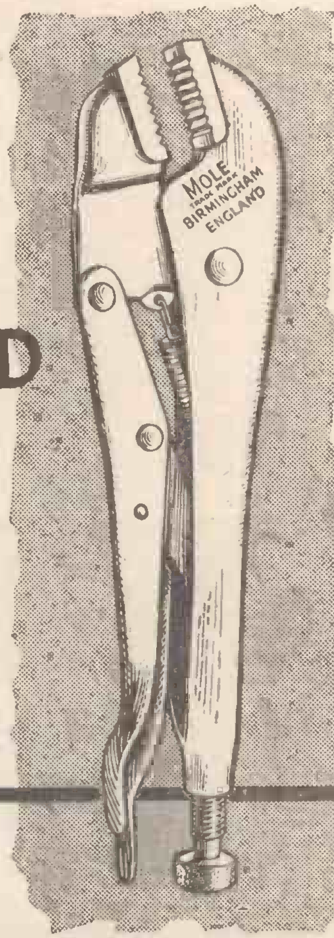
PRACTICAL MECHANICS

EDITOR: F. J. CAMM
APRIL 1958

The New London Planetarium

CONTENTS

...but the modern man has a THIRD HAND



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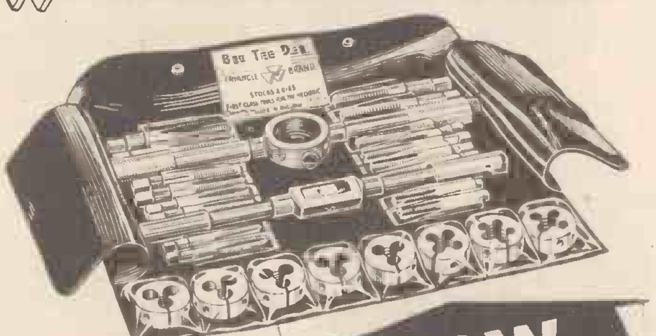

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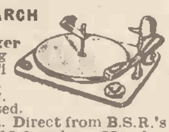

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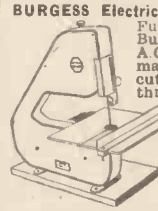

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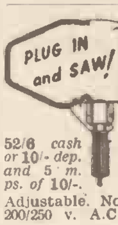

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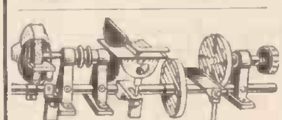

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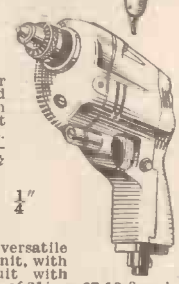

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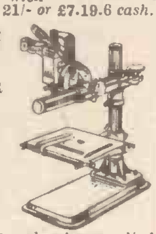

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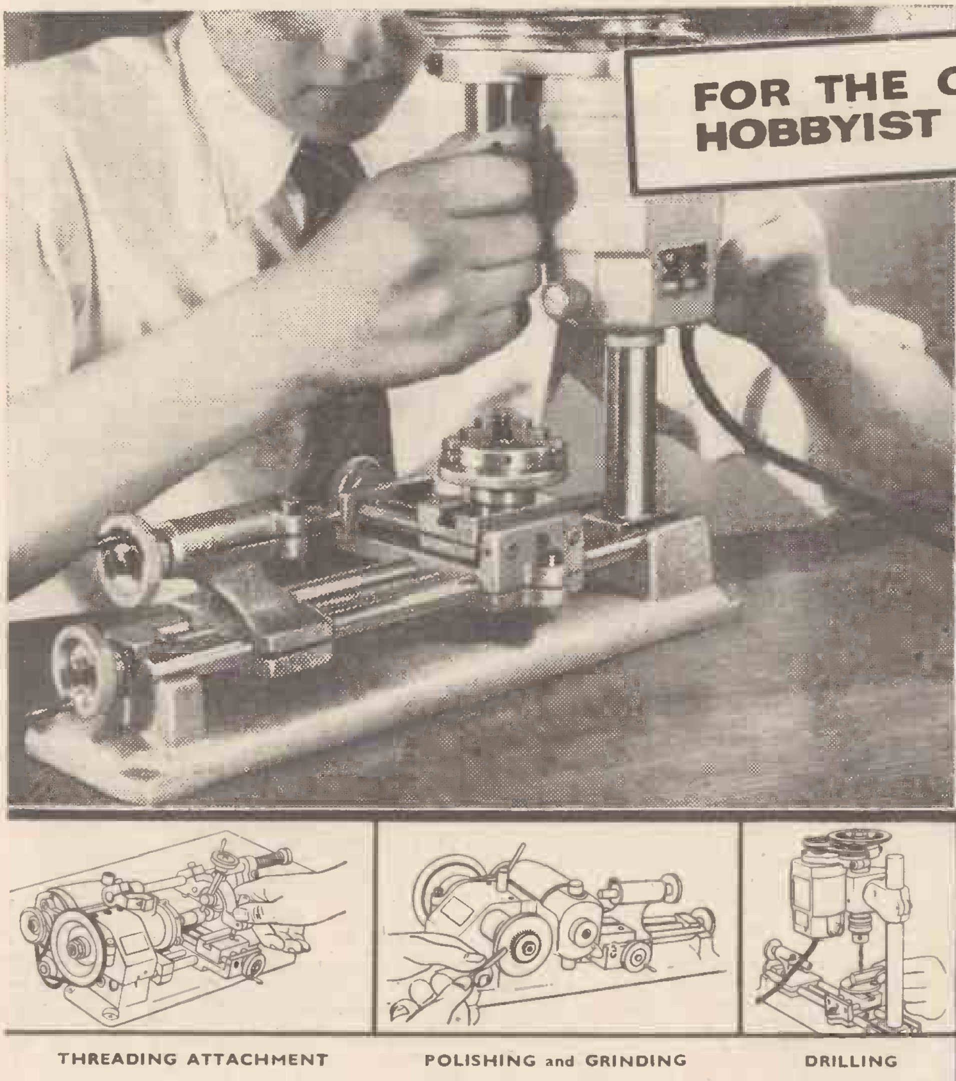

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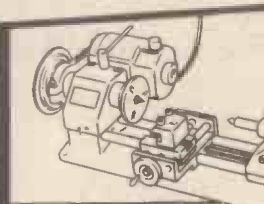

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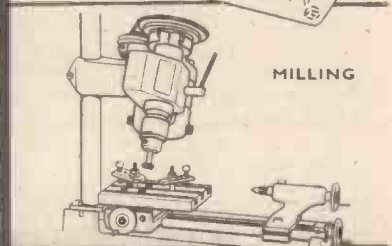

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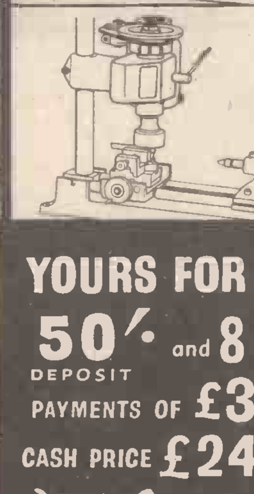

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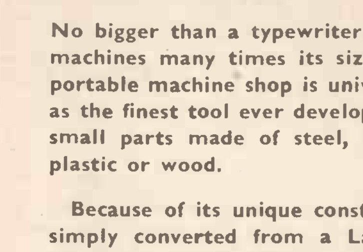

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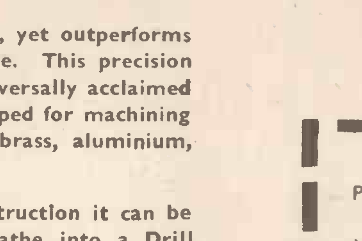

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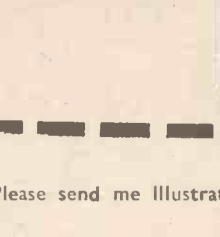

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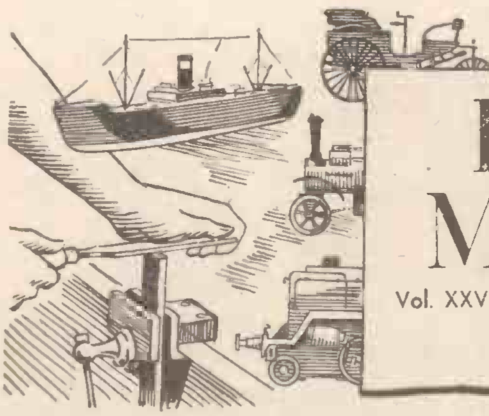

Practical Mechanics

Vol. XXV. No. 290 APRIL, 1958

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

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CONTENTS

CONTRIBUTIONS

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

FAIR COMMENT

"THE PRACTICAL PHOTOGRAPHER" SUPPLEMENT

THIS issue contains the first of "The Practical Photographer" Monthly Supplements. The ever-increasing interest in photography has made this supplement necessary—and in it each month we shall include articles to appeal to all keen camera users interested in obtaining the best possible results from their cameras and from their negatives. Since the war there have been many major developments in camera techniques. Photography has become more scientific, and large numbers of people now do their own developing, printing and enlarging instead of relying upon the local chemist. Photography has, indeed, become not only a fascinating hobby but almost a necessity to other hobbies and professions. If you are a keen model maker, you like to keep a pictorial record of your models. If your hobby is gardening, you can keep a permanent record of your summer garden display of flowers, some outsize marrow or runner bean. You can keep a record of your family as it grows up, of relatives and friends, parties, holidays, and special occasions. A holiday is incomplete without a camera, for it enables you to live again those pleasant times.

The amount of space, however, which we could devote to this subject was limited if we were not to interfere with the normal policy of the paper. In this supplement, however, the amateur photographer will have, so to speak, a paper all to himself, with the contents entirely devoted to all aspects of his particular subject. This supplement may be detached from the issue and preserved separately. We shall, of course, welcome contributions from photographers. There will be a special advice bureau to deal with photographic questions.

All correspondence and contributions should be addressed to: "The Practical Photographer" Supplement, PRACTICAL MECHANICS, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

OUR SUPPLY OF TECHNICIANS

IN these exciting scientific days, when almost with every day announcements of new inventions, new discoveries and new achievements are made, opportunities abound for those prepared to equip themselves with the necessary knowledge for the high-paid jobs of the future. Our mode of living, our scientific thought and beliefs, are undergoing a rapid metamorphosis and our way of life to-day will certainly not be the way of life of the citizen of 50 years hence. The appalling fact has to be faced, however, that youth to-day is not preparing itself to become the technicians of the future. It is true that the Government has embarked on a £100,000,000 programme to expand our technical colleges, but little has been done for the ordinary unscientific school, such as the secondary moderns and the grammar schools. None of these is at present geared up to the needs of industry and their curricula do not take account of scientific tendencies. Only two years ago Britain had a full-time student population of 29,000 learning science and technology. It had increased to 31,000 one year later. Not a very marked advance in view of the opportunities. Yet in the sixth forms of our grammar schools about 50 per cent. of the boys are taking science. To keep up with the demand it needs to be about eight out of every 10. These schools are desperately short of physics and chemistry laboratories and the opportunities for teaching are remote. Indeed, the equipment is inadequate to teach existing scholars without taking into consideration the expanding demand. It is true that some of the new schools being built have good laboratories, but some of the older schools have none at all. Some of the more brilliant pupils leave and go to other schools.—F.J.C.

The May issue will be published on Wednesday, April 30th. Order it NOW!

FACTS ABOUT ZETA

The Results Obtained at Harwell

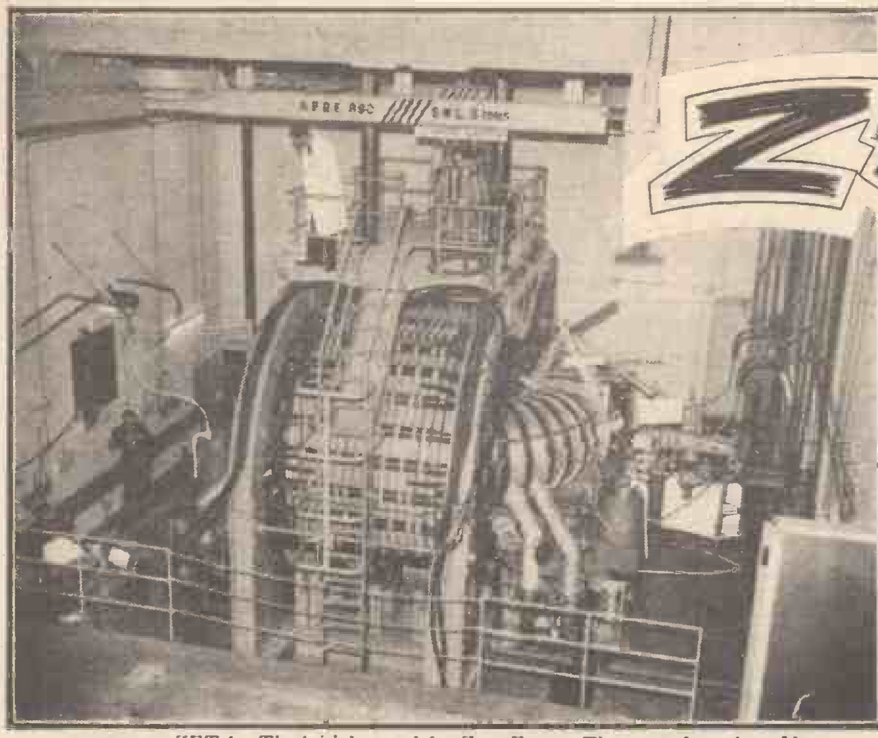


Fig 1. ZETA. The initials stand for Zero Energy Thermonuclear Assembly.

RESEARCH at Harwell with the latest apparatus has led British scientists to the conclusion that control of thermonuclear reactions for electricity generation may well be a possibility for the future, though its practical application is still a long way off.

The operation of present atomic power reactors is based on the fission (or splitting) of atoms. The possibility now being explored is the harnessing of power from the fusion (or joining) of atoms which provides the heat for the stars.

Results obtained from the Harwell apparatus ZETA suggest that "thermonuclear neutrons" have been obtained, but further experiments will be necessary before this can be proved conclusively. Temperatures reached in this apparatus have been as high as five million deg. C., higher than the measured surface temperatures of any star.

Many major problems have still to be solved before its practical application can be seriously considered and the work must be expected to remain in the research stage for many years yet. If it proves ultimately possible to construct a power station operating on the fusion of deuterium, the oceans of the world will provide a virtually inexhaustible source of fuel.

Results Obtained

On August 12th, 1957, a large experimental apparatus for studying the controlled release of energy from thermonuclear reactions was started up at the Atomic Energy Research Establishment, Harwell. On August 30th, this apparatus was first operated under conditions that produced nuclear reactions; neutrons emitted in these reactions were observed when deuterium gas was heated electrically to temperatures in the region from two to five million deg. C. The hot gas was isolated from the walls for periods of two to five thousandths of a second. The heating process was repeated every 10 seconds. The high temperatures achieved, together with the relatively long duration for which the hot gas has been isolated from the tube walls are the most important experimental results obtained so far. Whilst much longer times (perhaps several seconds) are required for a useful power output there appears to be no fundamental reason why these longer times, together with much higher temperatures, cannot be achieved.

The source of the observed neutrons has not yet been definitely established. There are good reasons to think that they come from thermonuclear reactions, but they could also come from other reactions, such as collision of deuterons with the walls of the vessel, or from bombardment of stationary ions by deuterons accelerated by internal electric fields produced in some forms of unstable discharge.

Fig 2.—A model of ZETA.

In the ZETA apparatus the number of neutrons produced by each pulse of energy as the current was doubled was roughly that which might be expected from a thermonuclear reaction at the measured temperatures. These temperatures have been definitely established.

The reaction being studied in ZETA is that in which deuterons (nuclei of the heavy hydrogen isotope deuterium) collide with one another and fuse to form heavier nuclei, releasing energy and some neutrons in the process. For fusion to be possible the deuterons must have enough energy to overcome the initial electrical forces of repulsion between them; this necessitates heating the deuterium gas to temperatures of millions of degrees Centigrade. The hot gas must be kept away from the walls of the container otherwise it falls in temperature.

How ZETA Operates

The principle adopted in ZETA is to pass a large electric current through the deuterium gas. This current sets up an electric discharge in the gas (analogous to the discharge in a neon advertising sign) which heats it and also produces an intense magnetic field around the column of hot gas. This magnetic field causes the discharge to become constricted and hence heated still more. Since it also causes the discharge to wriggle about, this field by itself is not enough to keep the discharge away from the walls. The wriggling has been suppressed by applying an additional steady magnetic field parallel to the axis of the tube.

In ZETA the discharge chamber is a ring-shaped tube or torus of one metre bore and three metres mean diameter, containing deuterium gas at low pressure. The tube is linked (i.e., encircled over part of its length) by the iron core of a large pulse transformer. See the model in Fig. 2. A current pulse of electricity is passed into the primary winding of the transformer from a bank of capacitors capable of storing 500,000 joules of energy. This pulse in turn induces a very large unidirectional pulse of current in the gas, which forms a short-circuited secondary for the transformer. Peak currents up to 200,000 amperes have been passed through the ionised gas for periods up to five milliseconds. The current pulse is repeated every 10 seconds.

The temperature of gas discharges may be determined from measurements on the light emitted by the gas atoms, but measurements of this kind in these experiments present problems because, at the temperature of the discharge, the hot deuterium atoms are completely stripped of their electrons and, therefore, do not emit a line spectrum. One method of solving this problem is to mix with deuterium a small quantity of some heavier gas and to study the spectral lines emitted; the random motion of the high-energy impurity atoms which make many collisions with the deuterium atoms, and so reach the same energy, causes the spectral lines to broaden, owing to the Doppler effect, and the amount of broadening is a measure of the ion energy.

OUR COVER SUBJECT

THE LONDON PLANETARIUM

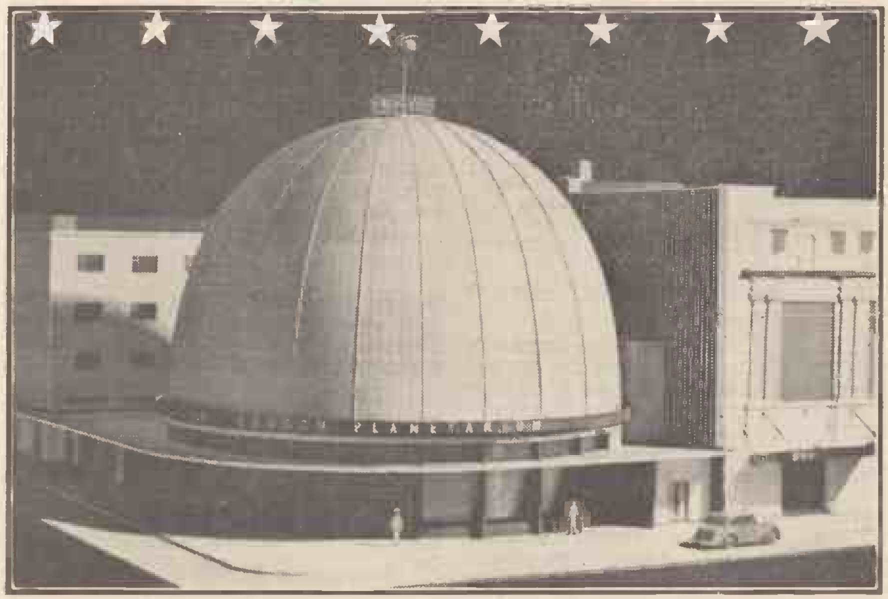


Fig 1.—The architect's model of the planetarium building.

THE WONDERS OF THE UNIVERSE ON VIEW IN LONDON

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

THE LONDON PLANETARIUM was opened to the public on the 20th March. It is the first Zeiss planetarium to be set up in the Commonwealth.

The Building

Fig. 1 shows the architect's model of the building which is sited between Baker Street Station and Madame Tussaud's Wax Works. A first floor auditorium with comfortable seating for 547 persons is provided. The roof of the auditorium is a perfect hemisphere of 67 ft. diam., true to an accuracy of 1/4 in. This is made from aluminium sheeting, perforated with millions of minute holes to obviate undesirable acoustic effects. The inner surface of the hemisphere is painted white and this forms the projection screen on to which the artificial night sky is projected. The entire hemisphere is covered by a concrete bee-hive shaped dome clad with copper sheeting. The building stands almost 90 ft. above the ground and the uppermost point of the dome carries an illuminated model of the planet Saturn.

The Projector

At the centre of the auditorium on a platform stands the wonderful £70,000 Zeiss projector (Fig. 2).

The prototype, produced by Zeiss, on which the London Planetarium is modelled, is often termed a "dumb-bell" model, from the characteristic shape of the twin star globes on a central cylindrical framework (Fig. 3). This model projects stars for the Northern and Southern hemispheres. Rotation of the dumb-bell on axis H_1H_{11} enables the projector to show the night sky for any latitude. The orientation of the dumb-bell is shown in Fig. 4.

The general layout of the projector (Fig. 3) will be more fully appreciated from a careful study of the parts denoted by capital letters which are taken in alphabetical order.

- *A.* Star globes each containing 16 star field projectors fed with a 1,000-watt lamp, to provide, in all, 9,000 stars of the Northern and Southern hemispheres.
- *B.* Projectors for the Dog Star—Sirius.
  Algol in Perseus, Mira Ceti in Cetus, Delta Cephei in Cephus. } variable stars.
  Megallanic clouds.
  Globular clusters.
  Nebulæ.
- *C.* Projector for the Milky Way.
- *D.* Projectors for the Sun with its Aureole. Zodiacal light and Gegenschein.
- *E.* Projectors for the naked eye planets.
  Mercury E1.
  Venus E2.
  Mars E3.
  Jupiter E4.
  Saturn E5.
- *F.* Projector for the Moon.

N.B. Readers with bound volumes may like to refer to "The Planetarium: its History, Design and Use", P.M., September and October, 1955.

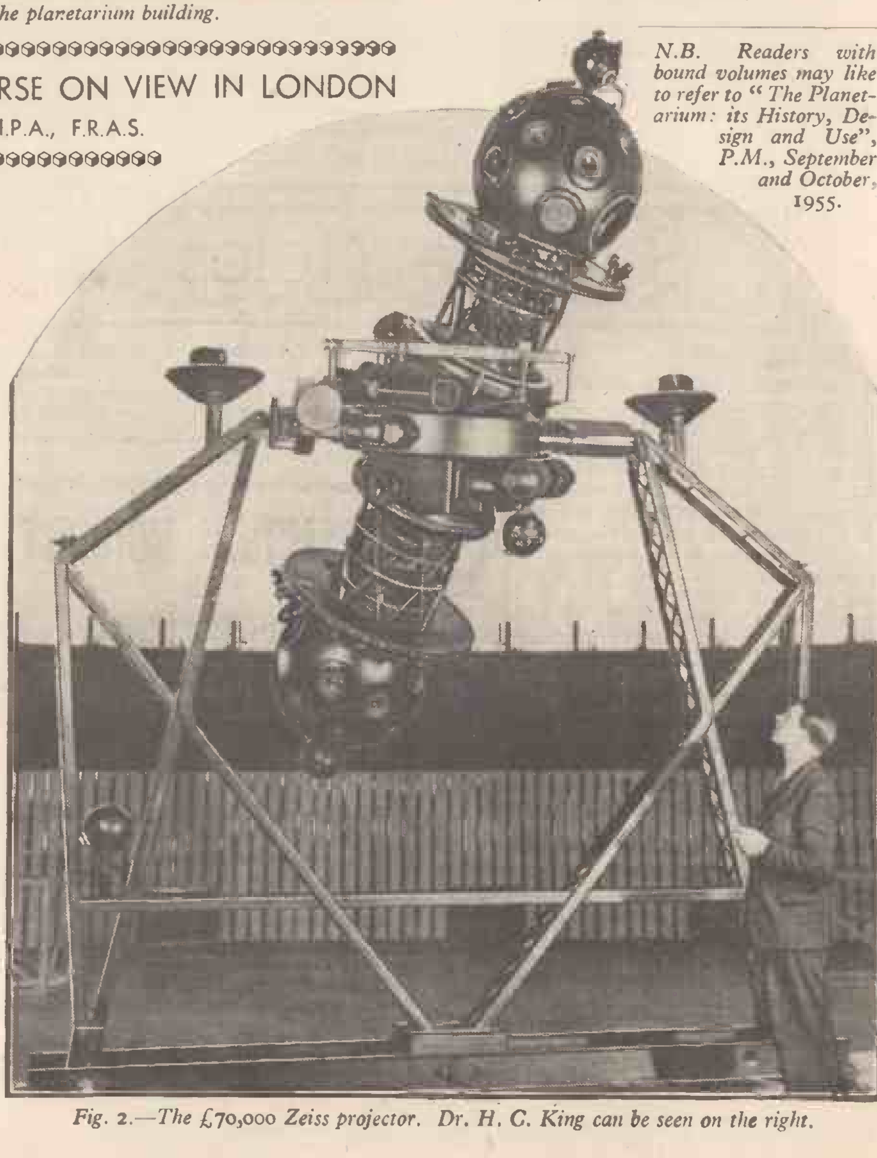


Fig. 2.—The £70,000 Zeiss projector. Dr. H. C. King can be seen on the right.

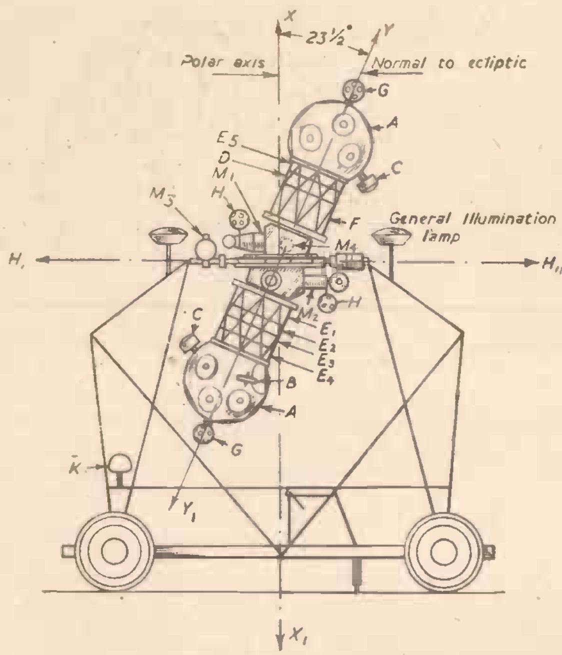


Fig. 3.—Simplified diagram of planetarium projector.

G. Projector for the names of the constellations.

H. Projectors for the Equator. Ecliptic. Hour circle grids of reference.

K. Projector for the meridian.

Electric driving motors are denoted by the capital letter M.

Motor M_1 provides power for the annual motion about axis YY_1, normal to the ecliptic.

Motor M_2 provides power for the daily (diurnal) motion about axis XX_1, the polar axis.

Motor M_3 provides power for change of latitude about axis H_1H_{11}.

Motor M_4 provides power for precession.

When the projector is not in use the platform can be lowered and the projector then moves into a plate glass cage in the foyer of the planetarium building. The projector *per se* is a marvel of engineering and optical skill, comprising over 29,000 individual parts, 170 gear and worm wheels and 230 ball races.

Capabilities

The London instrument can project all stars of the 1st and 2nd magnitude plus 8,900 stars from the 3rd to the 6th magnitude—a brightness range of 100. All these stars are accurately spaced and positioned on the artificial sky. Further, it can project the sun, the moon, the naked eye planets, meteors, nebulæ, star clusters and auroræ.

Sitting in the comfort of the auditorium one can see the night sky from any latitude at any time of the past or future. An idea of how the heavens will appear on the dome and the scene inside the planetarium can be obtained from our cover. All the more prominent features of the night sky can be clearly defined. In the new planetarium, the horizon is that of London's skyline complete with silhouettes of St. Paul's, Westminster, Greenwich Observatory, The Tower and the cranes of the Pool of London.

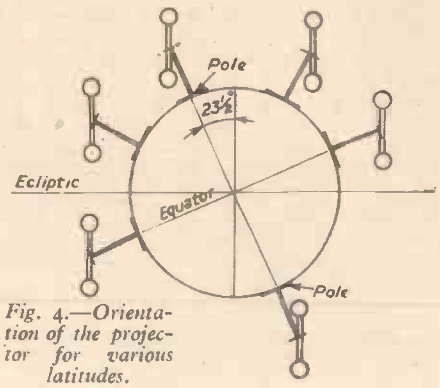


Fig. 4.—Orientation of the projector for various latitudes.

The Programme

The admission charges are from 2 shillings in the morning to 4 shillings in the late evening. Presentations will be given in the mornings, afternoons and evenings of each weekday. On Sundays the presentations will be in the afternoon and evening only.

Mornings will be devoted to the presentation of astronomical events of special appeal to young people. Evening presentations will be directed to adult audiences.

The lecturer in charge is Dr. H. C. King, well-known author of books on astronomy and optics.

Science Notes

British Mono-rail

THE construction of a mono-rail is one of the suggested solutions to the problem of reducing the journey time between the centre of London and London Airport, and the practicability of using this form of transport for the link and the technical problems involved in the construction and running of such a system are under consideration.

Before a system of this kind could be brought into public use in this country, long and rigorous tests would have to be conducted over a trial length to satisfy the exacting safety requirements of the Ministry of Transport and Civil Aviation.

Man Had Plant Ancestors

AN American professor of biology and his associates have, after extensive study, concluded that man and all other animals share a common ancestry with the brown seaweeds dating back some billion years.

Sun-powered Satellite Possible

A CHEMICAL battery, using acridine dyes and powered by the sun, is possible. If used in a satellite it would last as long as the satellite itself. By putting these dyes first in the light and then in shadow it is possible to release electrical energy. A satellite circling the earth, first in the sun and then in the earth's shadow, could make use of this principle.

Ionised Air as a Pain Killer

ELECTRICALLY-CHARGED air blown into the room of a patient suffering from burns has the effect of a narcotic in killing pain. Even the dressings on the burns can be changed without conventional drugs. How the new treatment works is not known, but it has a similar effect to a tranquillising drug.

Rocket to the Moon

IT is thought possible that a rocket could be fired to the moon this year. It would not be a manned rocket, but one carrying a marking dye. Alternatively, it might circle the moon. Such a project would not be very much more difficult than launching an earth satellite.

Uranium Refining Efficiency

THE process for extracting uranium from its ores has reached the stage where it can obtain 99.99 per cent. of the metal. In the liquid-liquid extraction process the clay, rocks, etc., which contain the ore are dissolved first in acids and then tributyl phosphate-kerosene is added to extract the uranium.

Windows in Fish

IN order to watch its internal organs at work, windows have been screwed to the underside of a fish. By this method it is possible to watch the gut of a fish while it is still living and feeding. The fish is put under anaesthetic, the body cavity opened and the window, which is made of mica, bolted in place.

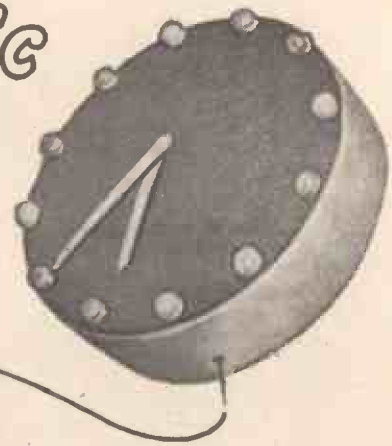
Southern Auroræ Spotted by Radar

NEW ZEALAND scientists report that for the first time radar has been used to spot auroræ in the southern hemisphere. The radar echoes show that the average height of the auroræ is 66 miles.

Radiation Amount Reduced

THE Atomic Energy Commission has reduced by two-thirds the level of radiation permitted for atomic workers. A new limit on the total radiation dose for a worker over 18 has been introduced. This is five rems per year instead of the previous 15 rems.

A Contemporary Electric Wall-Clock



An Ideal Timepiece for the Modern Home

By A. GRIFFITHS

THIS clock needs a minimum of work in the making, and little or no manual upkeep, it is cheap, reliable, and above all, modern.

Clock Units

Electric clock units cost about 25s. and there are two types. One kind is self starting and is convenient and easy to fit, as no starting knob is necessary. If the electricity supply is unreliable in your area, a non-self-starter is better. With a self-starter, a few minutes break in the supply would not be detected and the clock would run slow. Electric clock units are available from H. Franks, 58-60, New Oxford Street, London, W.C.1.

Coloured Plastic Pegs

Apart from the coloured pegs, obtainable from a handicrafts suppliers who supply schools (as these pegs are generally used in Primary schools) the rest of the clock is usually already in the handyman's scrap box.

The Clock Body

The type of body made for the prototype needed a large lathe to turn the round frame, but if one is not available, the body can be square or even hexagonal.

As the clock units are usually about 3in. dia. and 3in. deep it is easier to build up the body as shown in Fig. 1. This frame consists of three thicknesses of wood of about 1in. thick, screwed or glued together. Chipboard such as "Weyroc" could be used. It must be turned to about 12in. dia. and a hole of about 5in. dia. made right through the centre to accommodate the unit.

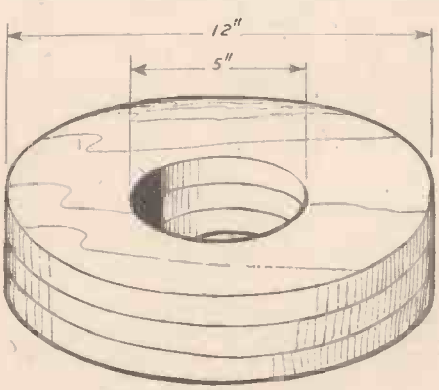


Fig. 1.—The clock body.

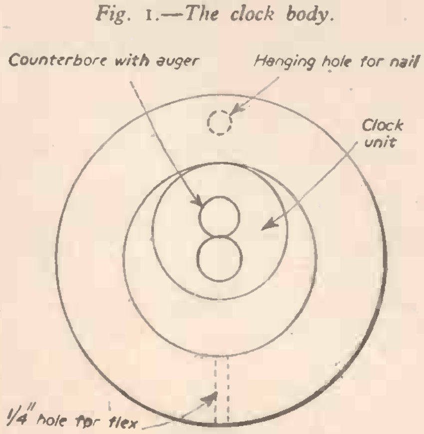


Fig. 2.—Positioning the clock unit.

Clock Face

The clock face is made of any board up to $\frac{1}{2}$in. thick with a fairly close grain. The face should be bevelled sightly after gluing to the body.

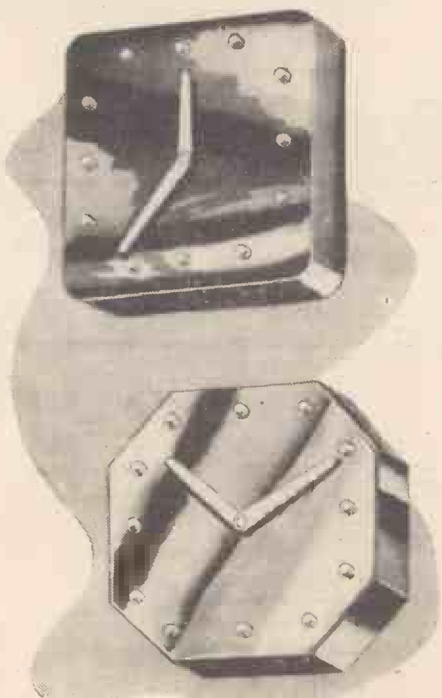


Fig. 3.—Some alternative shapes.

As can be seen in Fig. 2, the clock unit is eccentric to the spindle for the hands, and also as the gears on the face of the unit protrude it is necessary to counterbore the inside of the face to accommodate them. This can be done easily with an auger bit.

One or two short wood screws will hold it in when the rest of the clock is finished.

Coloured Pegs

These plastic pegs are used in Primary schools for children to fit in perforated hardboard and not only add a contemporary look to the clock, but can easily be changed for different colour schemes. Before drilling the holes for the pegs try the drill out on another piece of wood, to get an easy-fitting size.

Hands

As with most modern fittings these are best made to suit individual taste. They could be made as in Fig. 5, but the prototype had plain straight hands; whatever style you use, you will need the parts shown in Fig. 6.

These parts can be made on a small lathe, if available, but if not, plastic polythene tube can be used. The parts, if brass, can be sweated on to the hands, but if polythene the procedure in Fig. 7 is best, when a quick drying plastic adhesive can be used. The hands can be made of sheet plastic, thin wood, or thin metal as preferred, for it will be found that the clock mechanism is sturdy enough to operate without counterbalanced hands, even if they are of metal.

Finish

This will again be decided by personal taste, but the following are suggestions for various colour schemes and shapes.

The chip board used gave a rough finish on the clock sides. With judicious use of a plastic filler or even putty and a finish of cream emulsion paint it can be made to blend in with the wallpaper and thus not appear deep and cumbersome. It could even be surrounded by a collar of wallpaper in the same way as a birthday cake.

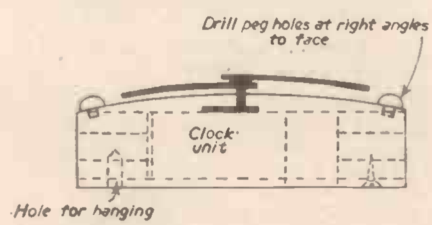


Fig. 4.—Side view of clock.

The flex used was a light coloured plastic covered wire which matched the wallpaper and thus was not very noticeable.

Wall Fixing

The problem of how to hang the clock was simply solved by drilling a hole of about $\frac{1}{4}$in. dia. and 1in. deep in the back so that it could easily be fitted over an ordinary nail in the wall. This can be seen in Fig. 4.

Clock Back

The back of the clock has no external

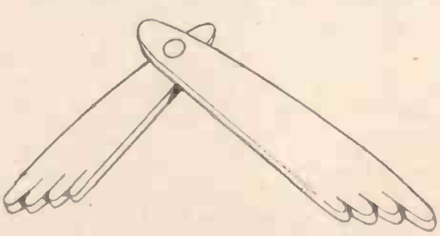


Fig. 5.—Alternative shape for the hands.

fitting except in the case of the non-self-starting type, when about three short studs or even the plastic pegs can be used to keep the clock away from the wall so that the starter knob does not foul. The back piece, shaped to cover all the clock, is of hardboard and can be painted with emulsion paint to suit the sides.

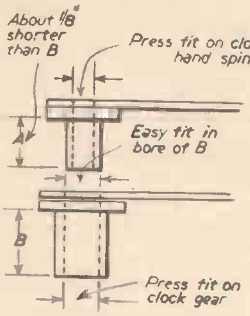


Fig. 6.—Parts required for fitting the hands.

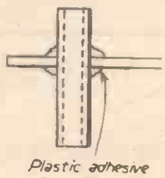


Fig. 7.—Gluing polythene hands.

Clock Face

The most vital painting of all is the face. In the prototype it was made glossy black to show up the plastic peg colours. In the arrangement of the pegs it was found best to place four of the same colour, either white or orange at three, six, nine and twelve o'clock, and fill in the other hours with symmetrical and contrasting colours. As the pegs are easily removable different colour schemes can easily be tried out.

Fused Plugs

It is worth while remembering that fused 5-amp. plugs can be purchased to safeguard the clock if connected to a power circuit.

Square and Octagonal Clocks

A few alternative shapes are shown in Fig. 3, which might appeal to those who have not the facilities to turn a large round one.

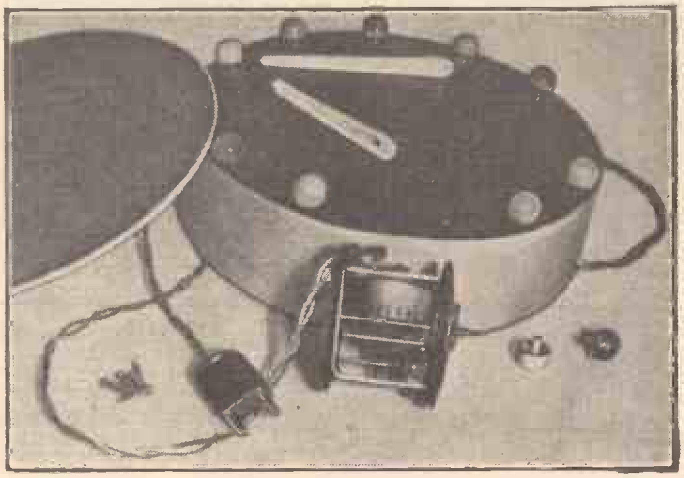


Fig. 8.—The parts for the clock.

The square and octagonal shapes can be made to look even better with bevelled faces forming four triangular bevels in the square face and eight in the case of the octagonal one. Fig. 8 shows all the parts ready for assembly.

Slide Projection in Restricted Space

Comments on the Design in Our November, 1957 Issue

By R. J. AMOR

THE plans given in the Nov. 1957 issue, for a "Daylight Cinema" will produce an image which is upside down. It may be found inconvenient to insert film-slides, etc., inverted.

The problem resolves itself into several requirements.

1. The projector must be conveniently placed.
2. The image must be big enough and clearly seen in daylight at a fairly wide angle.
3. The apparatus must be easily stored or set up.

The idea of a cabinet is a good one. In the cabinet, room must be provided for reflectors to take up the distance from projector to screen, also the image must be reversed to allow for back projection.

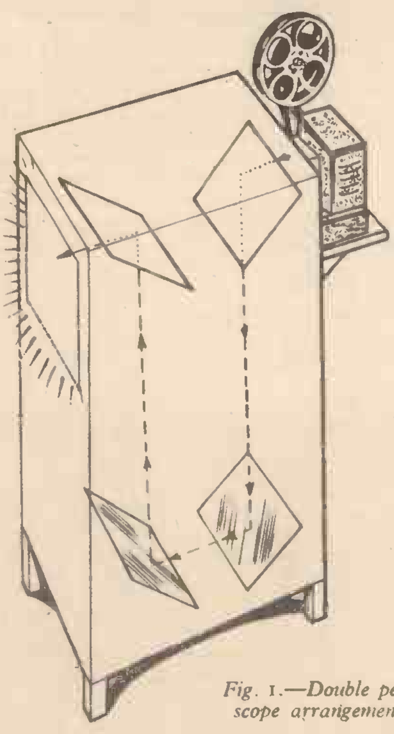


Fig. 1.—Double periscope arrangement.

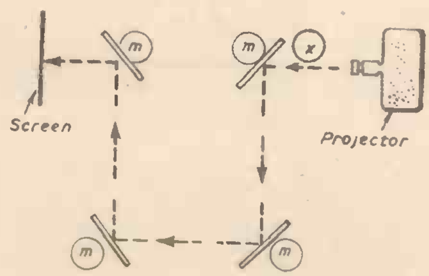


Fig. 2.—Position of an extra mirror.

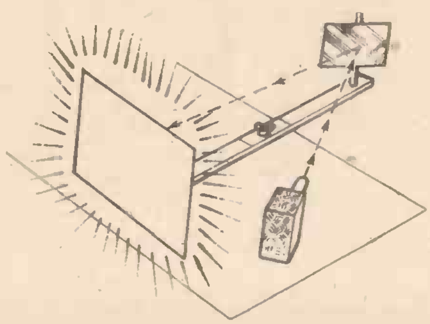


Fig. 3.—Arrangement for classroom use.

The distance measured for an image of 21in. from a standard film is 6ft. to 8ft. according to the projector lens. This means that the cabinet must accommodate that length of throw. It could be done by using a sort of double periscope as shown in Fig. 1.

The double periscope results in an image reversed from right to left. By turning the projector at right angles and placing a mirror at X (Fig. 2) at 45 deg. to the line of throw, the image will be right.

Therefore a cabinet will be required about 4ft. high and as wide as the screen, with the projector on a shelf at the rear. The five mirrors would have to be surfaced silvered and so arranged in size as to fit into the cabinet. There would have to be some arrangement that would allow of varying the distance from screen to projector if different projectors were to be used. Of course, it would be better to tailor-make the cabinet for one projector.

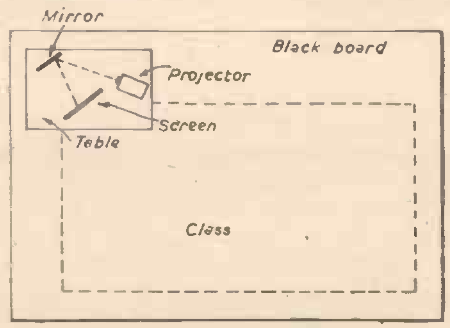


Fig. 4.—Classroom with apparatus in position.

A device used in the corner of a large well-lit classroom is shown in Fig. 3 (the cabinet idea was too space taking).

The screen is 21in. × 16in. sandblasted plastic screwed to a frame on two legs. From the centre of the frame at the bottom an adjustable arm extends to the rear. At the end of the arm is a mirror about 12in. × 10in., adjustable for height, turn and angle. The arm rests on the table at one point to make the screen stand securely.

The apparatus is placed on a table in the corner of the room with the projector alongside. The image is projected to the mirror, thence to the back of the screen (Fig. 4).

This enables a teacher to work the projector, use the blackboard, maps, etc., while the class view the screen.

The mirror should be located about 3ft. from the back of the screen.

By M. S. A. GLOVER

Automatic Timed Switching for Your Radio, Bedroom Heater, etc.

A TIME-SWITCH was required to perform two operations in every 24-hour period. As a commercial model was comparatively expensive the writer decided to build one from readily available components, but designed to be more flexible in application than the usual commercial unit. The time-switch (Fig. 2) is used to control a Dimplex electric radiator in a bedroom, the radiator being switched on for two hours in the morning before getting up, and for two hours in the evening before bed-time. The flexibility of this design allows the time-switch to be arranged to turn the radiator on at 5.30 a.m. and off at 7.30 a.m., on at 9 p.m. and off at 11 p.m., but on Sundays on at 6.30 a.m. and off at 8.30 a.m., to allow for an extra hour in bed! The "on" period of two hours is, of course, purely arbitrary and may be made as long or short as may be required.

Many other uses will doubtless suggest themselves to readers; shop window lighting could be controlled daily, but left off at week-ends; a radio set could be switched on each morning for the news or some daily programme, any difference in time from day to day being easily allowed for; in fact, almost any electrical apparatus could be controlled for predetermined periods.

The total cost of the time-switch amounts to less than 70s. and the current consumed in operation is negligible; in fact, it is too small to be measured by the meter.

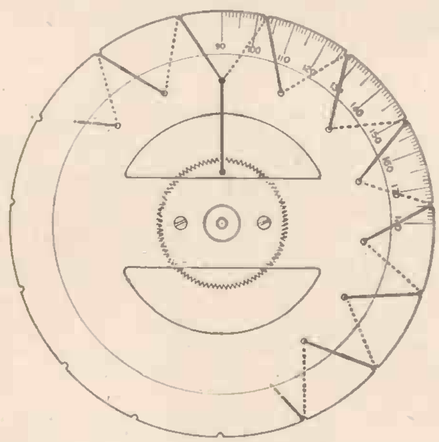


Fig. 1.—The protractor disc.

General Details

The "heart" of the time-switch is a Sangamo A.C. synchronous motor, type S7, geared to 1/168 revoutions per hour, i.e., one revolution per week. This electric motor is bought for 30s., the gearing being built-in to the motor casing. The motor is silent in operation and users of these motors have claimed up to 8-10 years running with no attention.

The motor is arranged to drive a disc, around the circumference of which are arranged contacts as required. In the writer's case the "on" periods required were all of equal length so the contacts were made from a length of wire, threaded through holes in the disc and over the circumference at the appropriate points (see Fig. 1). The length of the "on" time is then controlled by the width of the copper brush which presses on to the disc as a "pick-up" (see Fig. 3). Should "on" periods of different lengths be required, then the contacts on the disc must be made of different widths. They could be made of fine copper sheet, cut to size and folded over the edge of the disc and riveted through. Each contact should then be joined by wire soldered to the copper and passing round the disc from one contact to the next.

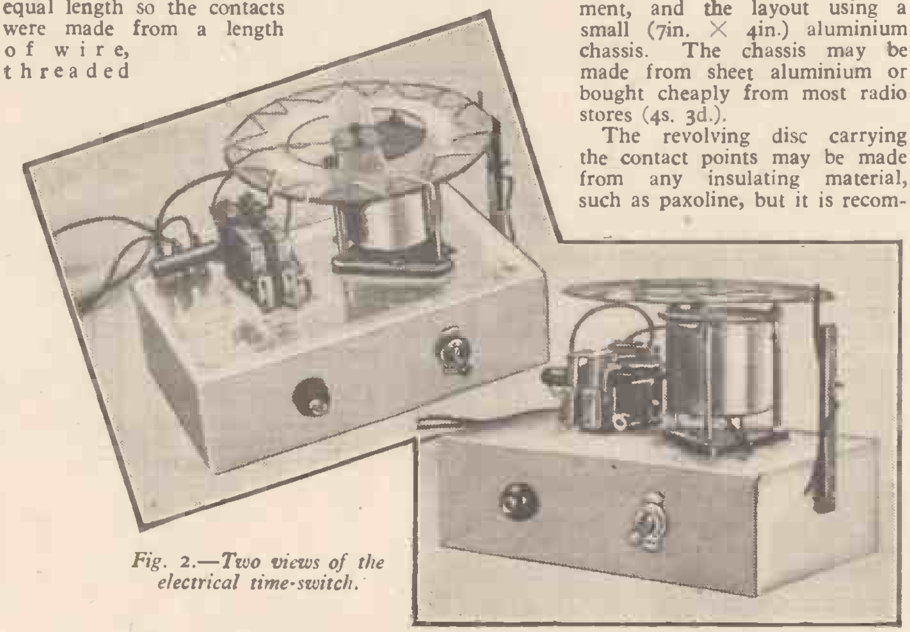


Fig. 2.—Two views of the electrical time-switch.

Such a contact arrangement will, of course, only pass the smallest of current, so it is necessary to use a relay to switch the actual apparatus to be controlled. A suitable relay is made by Londex, Ltd., 207, Anerley Road, S.E.20, and costs 29s. 6d. It is type ML/AC and will pass 4 amp. at 250v. This relay is obtainable with two pairs of contacts and if a heavier current capacity is required these may be connected in parallel, thus doubling the capacity, i.e., 8 amps. at 250v. The contacts are of the "make" and "break" variety, so the relay could be used to turn apparatus off should this be required.

A neon signal lamp may be incorporated but this is not absolutely necessary and merely serves to show that everything is working.

Construction

Figs. 4 and 6 show the circuit arrangement, and the layout using a small (7in. × 4in.) aluminium chassis. The chassis may be made from sheet aluminium or bought cheaply from most radio stores (4s. 3d.).

The revolving disc carrying the contact points may be made from any insulating material, such as paxoline, but it is recommended that an ordinary circular celluloid protractor be used. Such a protractor is obtainable in various sizes from any stationer, the five inch size is most suitable and costs about 9d. A protractor is useful as it is insulating, and is already marked in degrees, which greatly simplifies marking out. One hour is represented by 2.143 degrees and the positions of the contacts can easily be worked out from this. In the writer's case the "on"

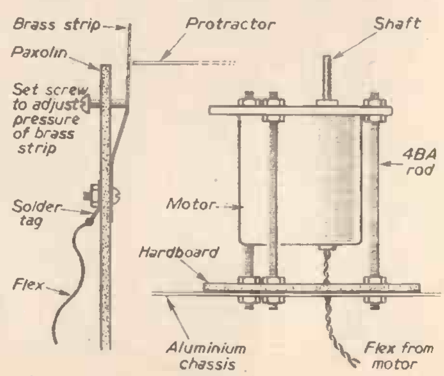


Fig. 3.—Arrangement of the brass strip and details of the motor mounting.

period was from 5.30 to 7.30 a.m., and from 9 to 11 p.m., with the exception of Sunday when the "on" period was 6.30 to 8.30 a.m., the contacts were, therefore, arranged according to the table shown.

The period for which the apparatus is switched on is controlled by the width of the copper brush, the width is derived from the equation:

$$W = \frac{\pi d}{168} \text{ inches (per hour)}$$

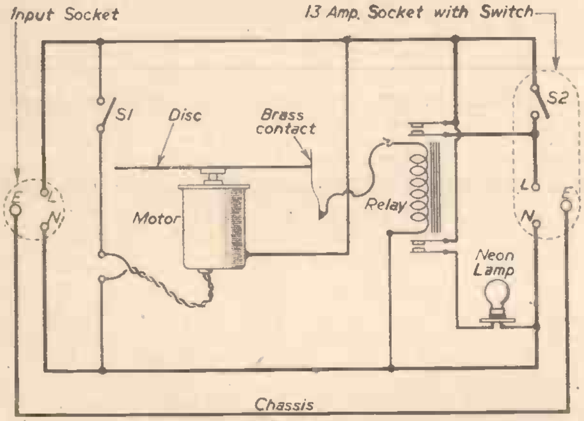


Fig. 4.—Theoretical circuit. S1 = Bulgin On-off switch, S2 = 13 amp. On-off switch. S2, L, N and E enclosed in dotted line comprise a combined 13 amp. socket and switch.

Thus the width of the brush for a 5in. protractor and a two hour "on" period is:

$$\left(\frac{\pi \times 5}{168}\right) \times 2 = .187 \text{ inches}$$

The protractor should be attached to the motor shaft, an old gearwheel with a diameter of 1in. or thereabouts and a bush

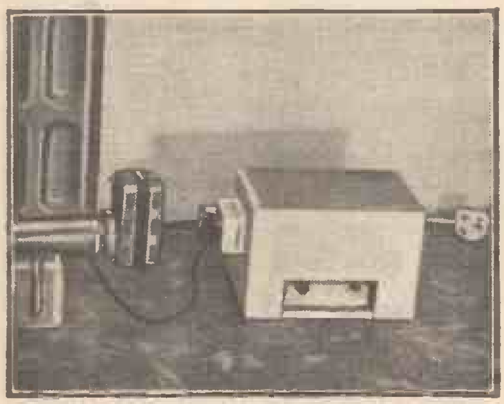


Fig. 5.—The completed time-switch in use.

fitted with a grub-screw is a simple method. The bush should be drilled out to the diameter of the shaft on the motor, and the protractor fitted to the gearwheel with two 6 B.A. nuts and bolts. Care must be taken to see that the protractor is mounted centrally on the motor shaft.

TABLE OF TIMES AND DEGREES		
Sunday	12 midnight	0°
Monday	5.30 a.m.	11.79°
	9.00 p.m.	45.00°
Tuesday	5.30 a.m.	63.21°
	9.00 p.m.	96.42°
Wednesday	5.30 a.m.	114.64°
	9.00 p.m.	147.86°
Thursday	5.30 a.m.	166.07°
	9.00 p.m.	199.29°
Friday	5.30 a.m.	217.50°
	9.00 p.m.	250.71°
Saturday	5.30 a.m.	268.93°
	9.00 p.m.	302.14°
Sunday	6.30 a.m.	326.79°
	9.00 p.m.	353.57°

Motor Mounting

Next the motor should be mounted on the chassis. As the body of the motor is "live" when the apparatus is "on," it must be insulated from the chassis if a metal chassis is used. A simple method of mounting is shown in Fig. 3, using a small piece of hardboard or other insulating material. Three lengths of 4 B.A. threaded rod (obtainable from radio stores) are used, and the three large holes in the chassis must be big enough to give clearance to the 4 B.A. nuts. If the top cover of the motor is removed, it will be useful as a template to mark three holes in the chassis, which should be drilled ⅛in., and three holes in the hardboard, which should be drilled to the diameter of the three lengths of threaded rod which support the motor.

The hardboard should now be bolted to the chassis, taking care to see that the nuts on the ends of the threaded rods are central in their ⅜in. holes and do not touch the surrounding metal of the chassis. The two leads from the motor are very delicate and it is safest to take them to a small tag-board which is screwed to the chassis near the motor. These wires may now be soldered in place to prevent accidents.

The Contact Brush

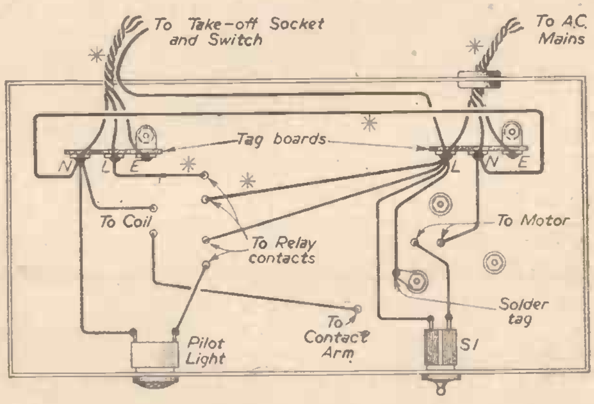
With the motor correctly positioned, the contact brush should be made up and fitted. The "brush" should be made from a small piece of springy brass—the contact arm from a bicycle battery is a convenient source. The end of the arm should be carefully filed to the required width (for a 5in. protractor one hour = .0935in.) and the lower end drilled for bolting to a small paxolin strip as shown in Fig. 3.

A set-screw is fitted to the paxolin strip to adjust the pressure of the brush on the rim of the contact disc. The motor should have been mounted in such a position that the rim of the contact disc is directly above the side of the chassis, in which case the paxolin strip carrying the brush may now be fitted to the side of the chassis and adjusted so that the brush bears lightly on the edge of the contact disc.

Now the other components should be fitted to the chassis, the relay being screwed in place (two threaded holes are already provided in the base). The indicator lamp and the "Bulgin" type on-off switch are self-supporting, holes of a suitable diameter being drilled for them in the side of the chassis. It will simplify wiring up if two more tag-boards are fitted, one to take the "input" flex and one for the "output." Two small soldering tags should also be fitted, one to the nut and bolt holding the brass brush in place, and one to one of the motor supporting rods. The time-switch is now ready to be wired up and this should be done in accordance with the circuit diagrams (Figs. 4 and 6). The wires shown as heavy lines in Fig. 6 should be of an adequate gauge to take the current to be consumed by the apparatus to be operated. Similarly the "input" flex from the main should be of a heavy gauge.

The Cabinet

Finally, a cabinet to house the time-switch must be made from plywood or other suitable material. The constructional dimensions will depend on the type and size of the chassis used and must be determined to suit individual requirements. It will be convenient to take the output leads to a suitable socket. If a switched socket is used and a fourth lead is taken from the switch-contact to the main-input tag-board on the chassis, the socket will be "live" at the predetermined times or will be "live" whenever



✳ *These wires must be of adequate current capacity to supply apparatus in use*

Fig. 6.—Wiring diagram.

required if the switch is thrown. This enables the apparatus to be switched on at times other than those predetermined, this will be found useful, especially when a heater is controlled by the time-switch. Of course, the motor must never be switched off once it is running correctly as this would upset the timing and involve resetting.

The time of switching the motor on must, of course, be chosen, and the protractor finally tightened, by means of its grub-screw, to the motor shaft in the appropriate position. The timer is shown in use in Fig. 5, where it is operating the author's electric bedroom radiator.

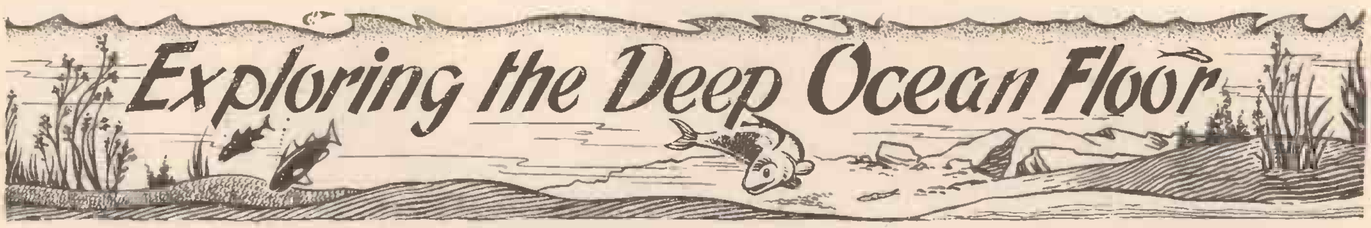
BOOKS Received

Mathematics for the Practical Man. By George Howe. 150 pages. 24s. 6d. net. Published by D. Van Nostrand Company.

WRITTEN primarily for the man who finds that his knowledge of mathematics needs refreshing, this book will probably also be useful for the student. The author assumes a knowledge of elementary arithmetic and the book then deals with advanced arithmetic, algebra, geometry, trigonometry, logarithms co-ordinate geometry and calculus.

"Electro-matic Vehicle-actuated Road Signals." 105 pages. Published by Automatic Telephone & Electric Co., Ltd.

ALL the aspects of road control by means of traffic lights are dealt with in this illustrated booklet, published by the makers of electro-matic systems. The book is intended as a guide to both the traffic expert and the layman interested in road problems.



Exploring the Deep Ocean Floor

(*Concluded from page 306, March issue*)

A Paper by A. S. Laughton, M.A., Ph.D., of the National Institute of Oceanography, read to the Royal Society of Arts on Wednesday, 20th November, 1957, with Sir Ernest Goodale, C.B.E., M.C., a Vice-president of the Society, in the Chair

COMING up to the foothills of a seamount, we reach areas where there may be sands or gravels interspersed with areas of ooze, sometimes undulating, suggesting a sediment cover following the contours of buried features, sometimes with a few isolated rocks possibly thrown out by a near-by volcano. Here we have found some indications of fairly strong currents that have not previously been expected. Fig: 5 shows ripple marks caused by currents on a sandy bottom at a depth of 720 fathoms. Now the fact that we see ripple marks here and not in the deep plain areas does not necessarily imply that the currents are absent in the plains, since they will only leave their mark in places where the bottom material is sandy, and in general we do not find sand on the bottom in the deep basins. But deep-sea photographs were the first evidence we had that there were currents near the bottom in the deep sea strong enough to make ripple marks.

Fig. 5. (Above).—Ripple marks on a sandy bottom at a depth of 720 fathoms. The distance between crests is about 1ft. They are caused by currents moving from left to right.

When we get on to the steep sides of the seamount, which may be as steep as one in two, we find a great variety of scenery. These are large areas of boulders, sometimes several feet across, lying half embedded in sand and ooze, often with the long, wire-like sea pens attached to them, sometimes there are pockets of barren sediment, shingle and sand. Then, on the peaks, we find bedrock—the material of which the whole seamount may be made—exposed and swept clear of all accumulating sediment by currents that have scoured and rounded the rock faces (see Fig. 6). It is very difficult from the photographs to obtain a positive identification of the rocks we see, and so we try to get samples by dredging or coring in the same place. On one occasion we were saved from an erroneous interpretation of the rocks in a picture by subsequent dredging. The appearance of the loose rocks, which had parallel striations on them, suggested the type of layer foundation associated with sedimentary rocks, which would be extremely difficult to explain in this locality. Our dredge samples, however, showed that the striations were not bedding planes, but were caused by layers of bubbles in a rapidly cooling underwater lava flow which had become accentuated by later sediment deposition.

The shallower we got, the more abundant became the life that we saw. Most common were the hydroid or coral type of animals. These are really colonies of thousands of small polyps, similar to jelly fish, which are attached to central stalks of brittle, calcareous material. This group includes the very decorative sea fans and sea ferns, and long sea pens and the corals and the great variety of sea anemones (Fig. 7). The sponge family is also found very frequently in our pictures. The commonest is a small, round sponge, rather like a puff ball, which is usually seen on muddy bottoms. But in one area we found some huge, vase-shaped sponges, up to three feet in diameter. Such a sponge is shown in Fig. 8. This is not the soft, horny type of sponge used in the bath, but is brittle and spiky, being made largely of silica.

Fig. 7. (Above).—Profuse growth of corals, sea fans and sea pens at the top of a seamount in 73 fathoms.

Fig. 6. (Left).—A panoramic view of exposed bedrock on the side of a seamount at a depth of 720 fathoms. The bareness of the rock suggests currents.

We are occasionally lucky in photographing a fish, but the fish is not always obliging enough to be in the centre of the picture and often we see just the tail or head, as in Fig. 9, or perhaps only its shadow. We are then prepared to revert to the angler's practice and speculate on the size of the one that got away. The identification of fish is extremely difficult, especially the larger ones which are rarely caught by nets, since they swim too fast. It is quite likely, therefore, that some of the fish we photograph have never been seen before, and it is necessary to extend the classification to include them.

Underwater photography is an extremely useful and simple method of exploring the sea bottom, and an extensive collection of photographs from representative areas will outline the field for more detailed studies.

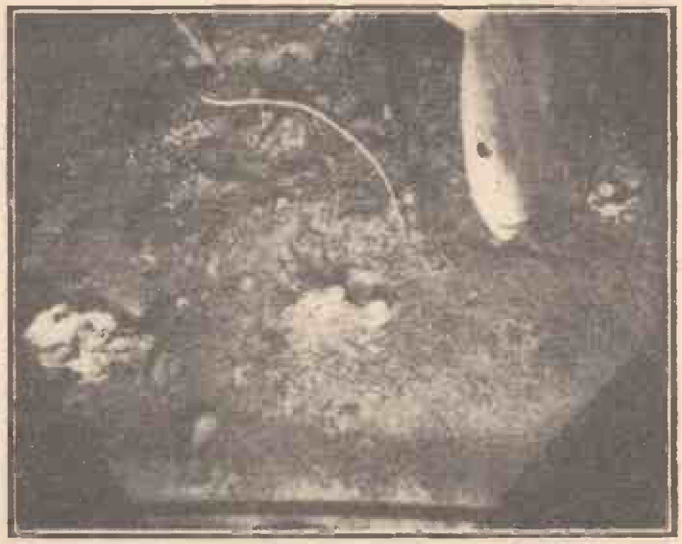


Fig. 9 (Right).—A large fish at 250 fathoms on a seamount on the mid-Atlantic ridge. The fish, which is probably 10ft. long, has not been identified.

Fig. 8 (Left).—Giant sponge, 3ft. in diameter, one of the many in the area, at 238 fathoms on Ampere Bank.

In itself, it cannot go very far, but in collaboration with sampling, both with dredge and trawl, we may find out a lot more about the deep-sea environment.

Other Techniques

I have discussed two of the techniques that we use for exploring the deep ocean floor, echo sounding and photography, but there are many others equally important that I have not been able to describe in detail. A great deal of work has gone into the design and use of apparatus for obtaining samples of the ocean floor. The simplest method, and one which can be used with any type of bottom, muddy or rocky, is dredging behind a very slowly moving ship. When you remember that the dredge may be two miles down and as many, or more, miles astern, you can appreciate that a great deal of wire is necessary, and that the tension at the inboard end is very great. It is often difficult to know whether in fact the dredge is on the bottom or streaming astern. In soft sediments we gain more information by sampling the different layers in a vertical column, which is done by driving in a tube and retaining the sample trapped inside. Cores of up to a hundred feet have been obtained in this way, representing sedimentation during the past few million years. Study of these cores can tell us about climatological changes during this period which affect the species of foraminifera composing the sediments and about the geological history of the area.

I have already mentioned the seismic methods that form a large part of our exploration. Measurements of magnetic field, gravitational field and heat flow all contribute to our knowledge of the sea floor structure. I have not made any mention so far of a method of exploration that is still in its infancy. This is by personal descent in a bathyscaphe, a pressurised submarine capable of descending two or more miles into the ocean abyss. There are two bathyscaphes in operation in Europe, the *Trieste*, which is operated in Italy, and the other, *F.N.R.S.3*, is run by the French Navy. There is no doubt that in the future the bathyscaphe will become a powerful tool of deep-sea exploration, but it is still an expensive and somewhat limited machine and its potential has not yet been fully developed.

You will have gathered, I hope, that the field for exploration of the deep-sea floor is extremely large, and what I have described is a minute portion of it. More and more countries are turning their eyes seawards in search of new sources of food and minerals, and the interest in oceanography is growing. But the inherent difficulties of seagoing exploration do not permit the work to be done quickly, and it will be many years before we can travel in imagination across the floor of the great oceans and make use of Nature's reserves protected by three miles of water.

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Soft Solder and Similar Alloys

Their Composition and Characteristics

By V. F. ROBERTS

SOLDERING is the union of two metals with the aid of a metal of lower melting temperature. The metal used to make the joint must also have adequate strength and the power to "wet" the metals to be joined.

Tin will satisfy the above requirements as far as copper, iron and lead are concerned; these metals are the basis of many alloys in general use. An example of the above is found in the manufacture of the mild steel containers known as "tin-cans."

The addition of lead to tin not only produces a much cheaper alloy but also lowers the melting temperature while retaining the requirements of a solder.

The Melting Temperature

When lead is added to tin a new constituent is formed which has a much lower melting temperature than either lead or tin. The new constituent, known as a eutectic, contains 62 per cent. of tin and 38 per cent. of lead and melts at 326 deg. F. Lead melts at 621 deg. F. and tin melts at 450 deg. F.

Fine tinman's solder is of the above composition (62 per cent. tin and 38 per cent. lead) and, therefore, has a rapid solidification temperature at 326 deg. F. This alloy is very similar to the solder used for radio work which must solidify rapidly to prevent the formation of dry joints.

Coarse tinman's solder contains 50 per cent. lead and 50 per cent. tin. It is cheaper than the fine solder, but solidifies over a range of temperature from 420 to 326 deg. F.

Plumber's solder, the composition of which comprises 40 per cent. or less of tin and the remainder lead, has an even wider range of solidification temperature over which the metal is in the pasty stage and is capable of being wiped.

Other metals are often added to solder to increase the strength of the joint (antimony), or to lower the amount of contraction as the joint solidifies and cools (bismuth).

Low Melting Point Alloys

The alloys of lead, tin, bismuth and cadmium, known by various names such as Rose's alloy, Wood's metal and the cerro-alloys owe their low melting temperatures to the formation of eutectics as in solders.

An alloy of 27 per cent. lead (melting point 621 deg. F.), 50 per cent. bismuth (melting point 520 deg. F.), 13 per cent. tin (melting point 450 deg. F.) and cadmium (melting point 610 deg. F.) forms a low melting point eutectic alloy of 150 deg. F. Such an alloy can be used for filling pipes before bending; the filler can be run out by immersing the pipe in hot water.

MAKING & USING Archery Equipment

No. 2.—Making a Long Bow, Arrows and Targets

By F. HOOK

Concluded from page 275, March issue.

THE reader, having made the flat bow, will no doubt wish to try his hand at making one of the traditional long bows upon which the fame of the English archer has been founded.

A stave 6ft. in length and of 1⅛in. × 1⅛in. sawn section must be purchased. Examine the length of the stave when it arrives. There may be a slight curvature in the length on one side. The concave side of the curve should be used for the back of the bow.

Smooth all sides of the stave with a finely set smoothing plane so that the finished size is but a trifle over 1in. square. Then mark out the position of the handle as in the case of the flat bow, working from the centre point in the length of the stave.

On the back of the stave draw a line down the entire length, then ¼in. on either side of this centre line at each end mark the width of the stave at the nocks. Plane down to these lines (Fig. 15).

Now turn the stave over on to its side and from the handle to each end mark lines to a point ½in. from the *back* of the bow. Plane down to these lines, as shown in Figs. 16 and 17.

The stave will now have a section at the handle of 1in. × 1in. and at each extremity of ½in. × ½in.

A flat bow in use.

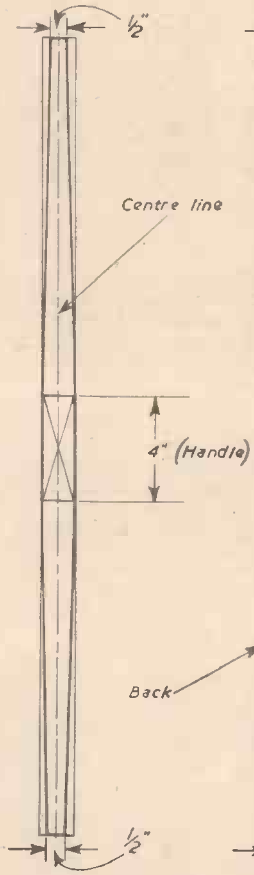


Fig. 15.—The shape of the bow from the front.

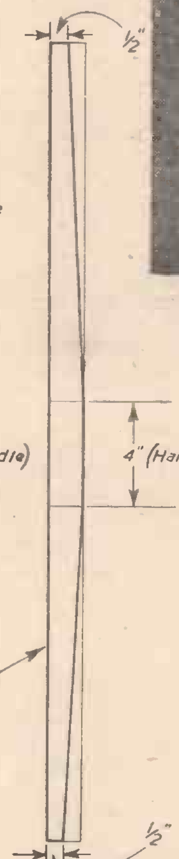


Fig. 16.—The shape of the bow from the side.

This square taper must now be worked down carefully to the section shown in Fig 18.

Work carefully from the square portion of the handle from which no material must be removed, to the given shape at each nock. Do not remove any wood from the back of the bow except at the finishing stages when the edges of the back must be very slightly rounded.

After filing in the two nocks the tillering should be performed as described for the flat bow. Bear in mind the weight of the pull required and watch the curve of each limb of the bow carefully to make sure that they are perfectly even. Work out any irregularities with the scraper and glass-paper.

Finally, when the tillering is completed a handle riser 4in. × 1in. × ½in. is glued to the belly side of the handle. When it is dry it may be smoothed up to be comfortable to the grip and finally bound with leather.

When the whole bow has been smoothed up with fine glasspaper and the tillering is quite satisfactory it may be oiled or varnished as required.

Making Arrows

The reader is warned that making arrows is more difficult than making the bow. Perhaps this statement might be modified by saying that an arrow is not very difficult to make, but to make 12 exactly the same is.

It can readily be appreciated that to obtain uniformity in shooting every arrow should be the same weight and be perfectly straight. To this end one may now purchase arrows made of light alloy-tubing which is one step in assuring accuracy.

The most common source of material for arrows is 5/16in. dia. birch dowel rods from the handicraft shop. If you are on good terms with the shopkeeper he will not

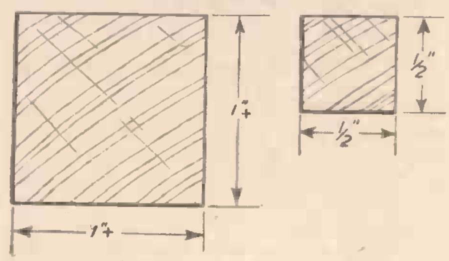


Fig. 17.—Sections at handle and ends of stave.

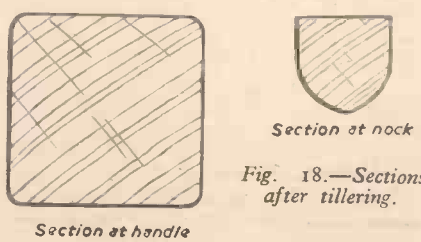


Fig. 18.—Sections after tillering.

mind you sorting through the stock to find a dozen of the straightest rods. See also that the grain runs straight through the whole length of the rod. The most common lengths of arrow are the 26in. and 28in., so that 30in. dowels will be needed.

If some of the rods are curved they may be straightened by heating and bending.

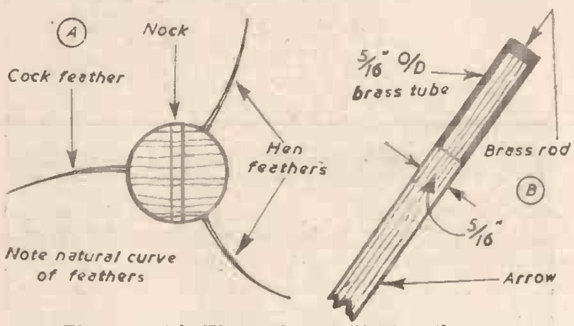


Fig. 19.—(a) The nock and (b) the pile.

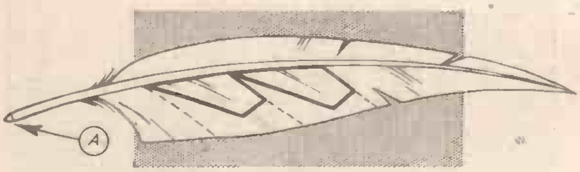


Fig. 20.—How two or three flights might be cut from one turkey feather.

After cutting the rod to length it must be smoothed down with glasspaper. Remember equal weight is aimed for, so do not be too strong with the glasspaper on some and not on others. If you have a letter balance you can weigh each arrow as work proceeds to obtain uniformity.

In passing it is interesting to know that arrows are weighed by the weight of English silver coins. Thus an arrow for a bow with a pull of 30lb. would be about 3s. 6d. or 4s. This means it would weigh as much as three shillings and a sixpence or four shillings.

The nock is cut in one end of the birch dowel at right angles to the direction of the grain, as shown in Fig. 19. The depth of the nock is $\frac{1}{4}$in. and the width is cut by using three hacksaw blades held in the frame side by side. Due to the slope on the pegs on the hacksaw frame this method is not always easy as there will be an uneven tension on the blades. An alternative method is to bolt the blades together and bind with cord to form a handle leaving about 3 or 4in. of saw available for use.

At the opposite end of the arrow a " pile " must be fitted to take the impact of the arrow as it strikes the target. This is a piece of 5/16in. brass tubing. A small plug of brass rod (9/32in. dia.) is soldered into the end. The arrow is shouldered down so that the pile is a good push fit. The pile is eventually secured by putting into the pile a few granules of resin, warming the pile until the resin melts and then quickly pushing the pile on to the arrow. Clean off and polish with fine glasspaper.

Fletching

The three feathers glued to the end of the arrow are to give it a straight flight. A badly fletched arrow will wobble in flight. Here again uniformity is the order of the day so that good results may be achieved.

Feathers from the wings of turkeys are best, but those from geese may also be used. Remember there is a left and right to feathers and the feathers for an arrow should if possible come from the same wing or be all right or all left wing feathers.

The wide part of the feather is stripped off from the quill as shown in Fig. 20. Commence at point A with a single edged razor blade and try to take about 1/16in. of quill with the web of the feather. The diagram shows how two or three flight feathers might be cut from the one turkey feather. The piece of quill must be sanded down to an even thickness after having cut out the approximate shape of the flight feather with a template.

The cock feather is the one which is at right angles to the line of the nock and so will be at right angles to the length of the bow. The two hen feathers are spaced at 120 deg. round the arrow. The cock feather is glued on first as shown in Fig. 21. A quick drying glue such as balsa cement is most useful. It is also waterproof.

When the three flight feathers are glued firmly in position the final shaping must be undertaken to make each feather identical in area. The most usual way of doing this is to burn the outline by one of various gadgets. A wire can be bent to the right shape, heated in a gas ring and quickly

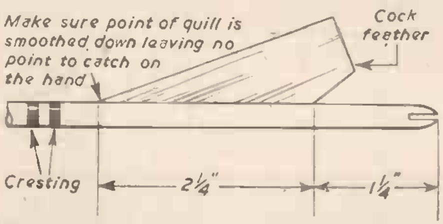


Fig. 21.—Gluing the cock feather in position.

applied to each feather in turn, or a sheet metal cutter also heated to redness may be used as shown in Fig. 22. Other ideas will suggest themselves to the mechanic such as the electrically heated wire method whereby a piece of fire element wire is bent to shape and wired in series with an electric fire. The question of insulation must be carefully attended to in this contrivance and only those with a sound knowledge of electrical matters should try this method.

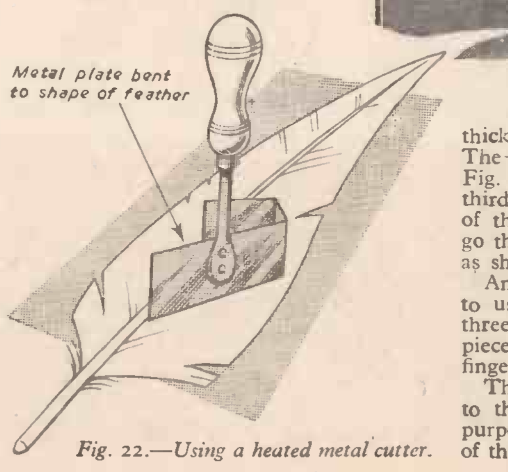


Fig. 22.—Using a heated metal cutter.

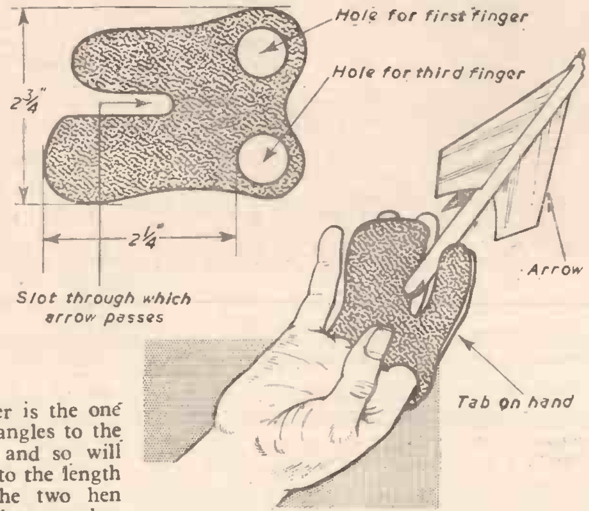


Fig. 23.—Details of the shooting tab.

Finally check that the leading end of each quill is secured closely to the arrow shaft so that there is nothing to catch into the hand when shooting.

Cresting the Arrow

The cresting is a number of coloured bands painted on the arrow just in front of the feathers so that the archer may easily pick out his arrows from the target. Use waterproof paint for the job and separate the bands of colour with a thin black line, put on after the colours are dry.

Shooting Tabs, Bracers and Quiver

When the bow has been finished and strung and the set of arrows completed the archer is ready to try his hand at some shooting. However, to make the shooting more comfortable various small items are required.

The bow string is drawn back with the first three fingers of the right hand and the repeated release of the string and its friction over the fingers can soon cause soreness. The finger tab is cut from some soft but

Fig. 24.—Bracers in use.

thick leather using a razor blade or scissors. The approximate dimensions are shown in Fig. 23 and the two holes for the first and third fingers must be cut to suit the fingers of the archer. The second finger does not go through a hole but passes behind the tab as shown in the illustration.

An alternative method of construction is to use an old glove cut away to leave the three fingers needed and to sew on some pieces of thick leather to the front of the fingers.

The arm guard or bracer (Fig. 25) straps to the left arm just above the wrist. Its purpose is to protect the arm from the recoil of the string and to provide a smooth surface

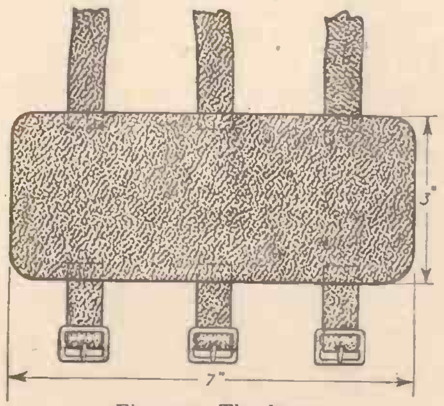


Fig. 25.—The bracer.

against which the string can strike, thus sending the arrow smoothly on its way without deflection. When using the bracer, watch carefully to see that there are no projections into which the string can catch. If there is any obstruction the bracer must be slightly modified to obviate this difficulty. Bracers are being used in Fig. 24.

The Quiver

A quiver is a useful piece of equipment and can be made from a strip of leather about 18in. × 8in. It is wound round in a tube and if holes are punched along each edge with a leather punch it can be sewn together with thongs. A piece of circular leather can be thonged to the bottom end of the tube. A suitable leather belt can be made and secured to the top of the quiver.

Some archers like to use a ground quiver which is stuck into the ground near the shooting point. This quiver is made from a rod of ¼in. diameter steel about 30in. in length, the top of which is formed into a circle of about 4in. diameter.

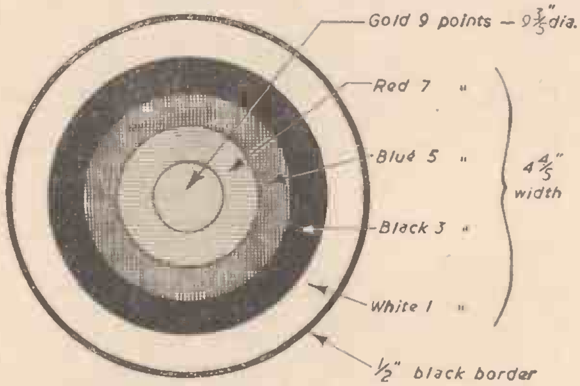


Fig. 26 (Left).—Colours and dimensions of the standard target.

Targets

The standard target is 4ft. in dia. and is usually painted on to white duck material, but any other material may be just as effective if not so durable.

Material for the target is best sized first of all, and some whitening mixed in with the size will give a good foundation for marking out.

The "bulls-eye" or "gold" as it is called by the archer is a circle 9 3/5in. in dia. Each succeeding ring, the red, the blue the black and the white are each 4 4/5in. wide. Around the white is a ½in. black border, see Fig. 26.

Poster colours give a good matt finish. Matt oil paints will, of course, give a more weatherproof finish.

The circular target is mounted on a foundation of plaited straw about 3in. thick and the whole target is then stood on a wooden stand so that the centre of the gold is 4ft. from the ground.

These straw bosses are expensive to buy and there is a lot of work in making them up. An easier way is to buy two bales of straw and stand them on top of one another on a small platform of stakes about 18in. off the ground (Fig. 29). In Fig. 27 and in the background of Fig. 29 can be seen the stand for a circular target.

At this point it may be interesting to explain why the archers in Fig. 29 are crawling on their hands and knees behind the target! When arrows miss the target and hit the ground they have a knack of slithering along just under the grass. It is sometimes very difficult indeed to locate these spent arrows and co-operation from all in making a methodical search is called for. This task can be avoided by hanging some old tarpaulin or similar cloth behind the target so that the arrows which miss will be stopped in flight close to the target.

The following books dealing with shooting technique may be of interest to the beginner:

1. "Modern Archery," by Frank L. Bilson.

2. "Some Bowyers' Notes," by Kenneth O. Arton.

3. "Archery Handbook," by Edmund H. Burke.

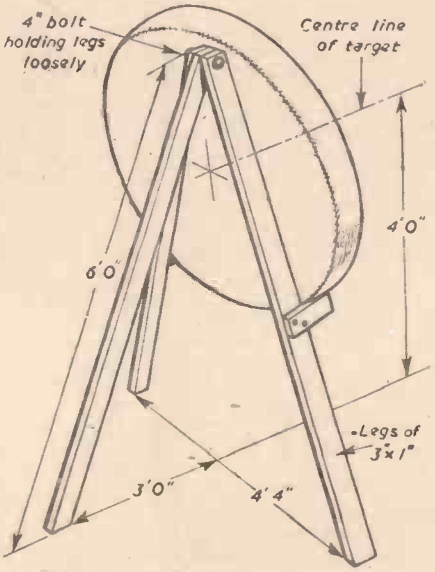


Fig. 27.—Details of the wooden target stand.

Fig. 28.—View of a standard target in use.

Indoor Archery

During the winter shooting may be carried on indoors where a distance of over 20 yards is available. For such ranges a 2ft. target is used. For indoor shooting it is a necessity to have a blanket, tarpaulin or similar screen behind the target to take the impact of arrows which may miss the target.

Fig. 29 (Right).—A methodical search is called for to locate spent arrows which have missed the target.

Safety Precautions

The bows described in these notes are not toys, but are very dangerous weapons to be used with the utmost care; with the same care as one would exercise with a .22 rifle. Never, on any account, point a drawn bow at any person, even in fun. When shooting at targets watch out that no person is walking anywhere near or behind the target. Spectators should always be stationed behind the firing point.

Bows and arrows should never be left around on the ground or grass. Should they become damp or wet the moisture must be wiped off as soon as possible. It is strongly advised that the bow and arrows should be stored in a specially made case when not in use so that they will not warp.

Readers wishing to take up the sport are advised to join an established archery club, where they will be able to learn how to handle their equipment properly and will have access to competition work, besides enjoying the society of others.

AUTOMATIC TRAIN CONTROL
How it Works

A Brief Description of the System and its Job

THERE are two main types of signals on any double-track stretch of British Railways—stop signals and distant signals, which warn the dri/er of the position of the stop signals.

The B.R. system of A.T.C. shown diagrammatically in Fig. 1 operates on a non-contact magnetic principle. Two powerful magnets adjacent to each other are fixed in the centre of the track at rail level 200 yards on the approach side of the distant (warning) signal (Fig. 2). The first magnet is of the permanent type and the second an electro type controlled by the signalman. The equipment on the loco-

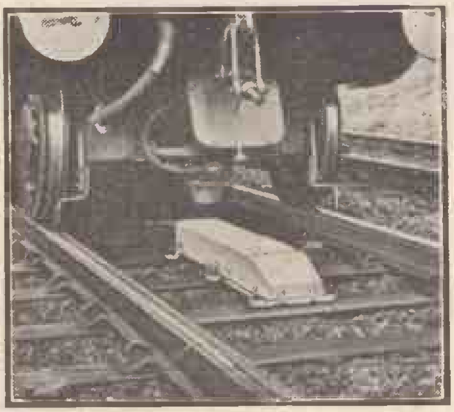


Fig 2.—A train approaching an A.T.C. installation.

motive consists of a device cabled to a receiver fitted below the locomotive, which responds to the magnetic field of the track magnets. This receiver is connected electrically to apparatus in the locomotive cab and on approaching a warning signal in the "clear" position the receiver is influenced by both magnets, which causes a bell to ring in the cab, indicating to the driver that the line ahead is clear.

If the signal is set at "caution," the receiver is influenced by the permanent magnet only, the result of which is to cause a horn to sound continuously until the driver acknowledges the warning by depressing a resetting lever. This action simultaneously sets a visual indicator in front of the driver, normally displaying an "all black" aspect, to show a "black and yellow" spoked aspect, which serves to remind the driver that he has acknowledged the warning indication received and should take control of the locomotive brakes and be prepared to halt at the stop signal.

each time a driver meets a green signal and the "warning" is given whenever he encounters a signal showing any aspect other than green.

Automatic Train Control does not, nor is it intended to, relieve a dri/er of his normal and inescapable responsibility for observing the signals on his route and acting promptly on their indications. A.T.C. is an aid to the driver, particularly in inclement weather, and is one of a

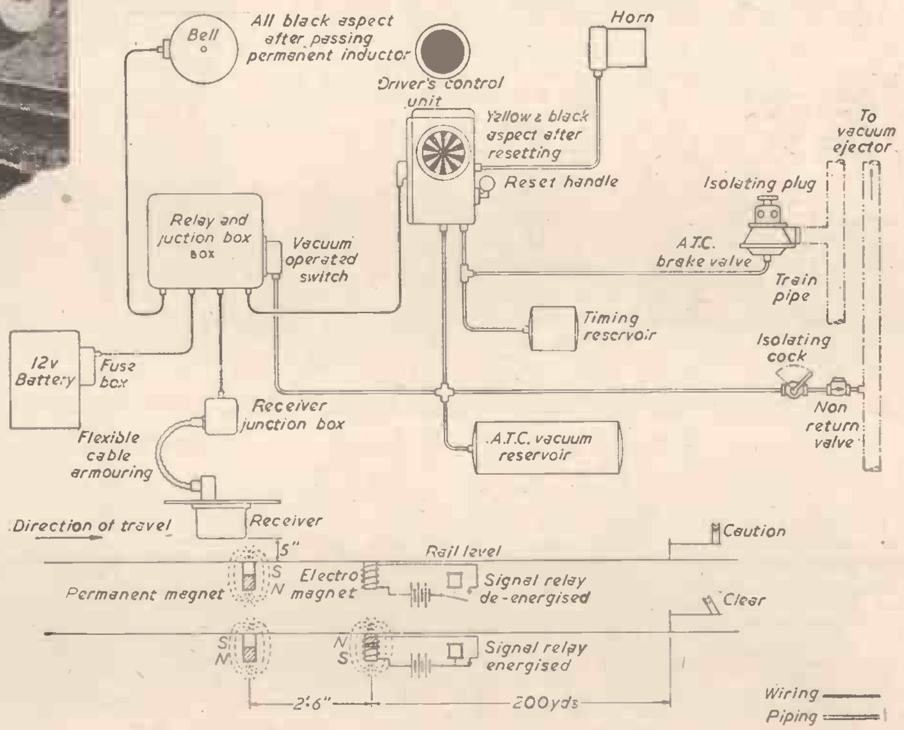


Fig 1.—A.T.C. shown diagrammatically.

Automatic Braking

Failure to carry out the acknowledging action results, after a three-seconds delay, in the operation of an automatic brake valve, which gives progressively a full brake application on locomotive and train and brings it to a halt, without any action whatsoever on the part of the driver or fireman.

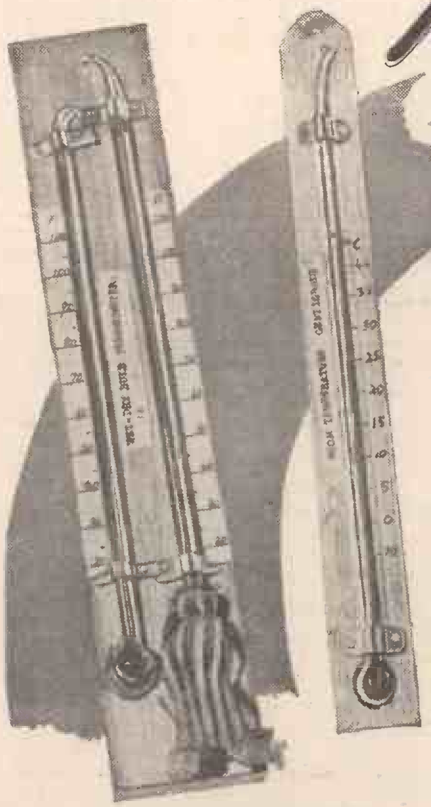
When the system is applied to colour-light signals the "clear" indication is given

number of safety measures which are being extended under the British Railways modernisation programme. These include the widespread replacement of semaphore signals by colour-light signals, the installation of more track-circuits (which automatically indicate the presence of a train to the signalman and apply appropriate safeguards), and the provision of more power-operated signal boxes in replacement of those which are manually operated.

Make Your Own Thermometers

Part 2.—Completing the Room Thermometer : Calibration : A Baby's Bath Thermometer

By E. V. KING



(Continued from March issue)

AT the moment the glass will have the appearance of Fig. 10a. Now heat the open end of the glass in a yellow flame (turning all the time) and after a few seconds turn the flame on to full air and roaring hard. Now get the tip of the blue cone to heat the glass about 1in. in from the end, keep turning and direct the end so that any alcohol spurting out will do no harm. When the glass is red hot and soft quickly remove it from the flame and pull each end of the glass very forcibly and quickly. Do not procrastinate or do this gently. If all is well the glass will stretch out into a filament a yard or so long. Break this with pliers about 1in. from the tube proper. Dispose of the dangerous filament in the dustbin. If the glass is too hot to hold pliers may be used.

Verify that there is still a small capillary hole in the tube (a magnifying glass will help). If you pull the glass out while still in the flame you may break the filament and the end will seal over. If no hole is left, in the next process the bulb of the thermometer will burst.

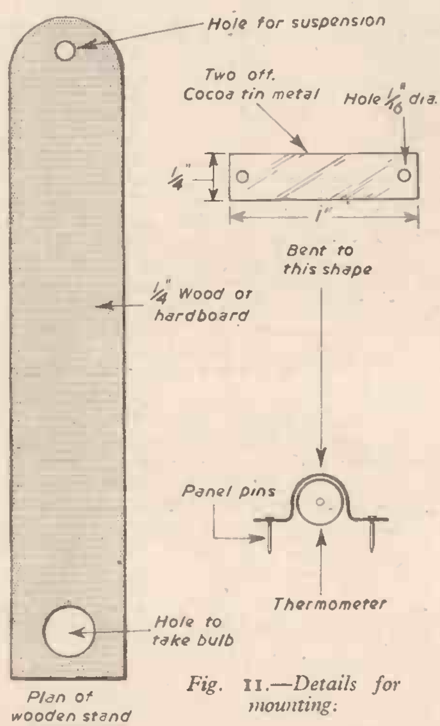


Fig. 11.—Details for mounting:

Adjusting the Amount of Liquid in the Stem

If the amount of fluid is incorrect, on a cold day the liquid will disappear into the bulb or, conversely, on a hot one it might reach the top of the sealed tube and burst the bulb.

Since the thermometer is to be used in a room we may take the normal temperature as 60° F. and the maximum as about 100° F. in the middle of a very hot heat wave.

Place the thermometer in a jar of water at 100° F. Fluid will exude from the top and should be soaked up with blotting paper. When the expansion is complete let the tube cool down to room temperature. If the fluid goes down completely into the bulb your bulb is too big. If it only goes down an inch or so your bulb is too small. It should go down to about the half-way mark.

Sealing the Thermometer

Place the thermometer back in the water at 100° C. When the fluid has completely expanded again quickly heat the tip of the drawn-out tube and a small blob will form (Fig. 10d). Remove the tube and let it cool. With experience the operator can fashion a small loop or hook during this process.

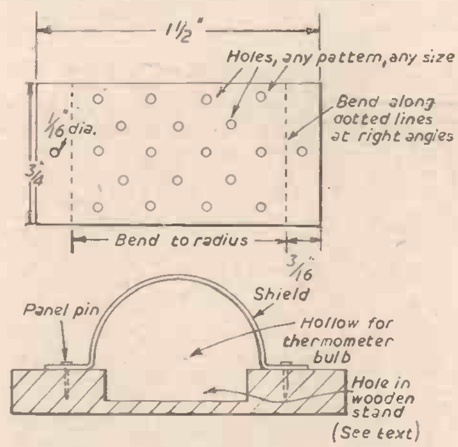


Fig. 12.—The tinplate protection shield.

Take care not to boil the alcohol near the end of the tube or it will blow a small bubble which will then burst. The tube will not then be sealed and will lose alcohol by evaporation over the next year or so. If a bubble does form, reheat until another blob forms.

When completed, the thermometer must be sealed and have no air bubbles in the bulb or air in the stem. When the alcohol contracts it leaves a vacuum (or, strictly, alcohol vapour) in the tube.

As stated, any small air bubbles may be removed by the shaking method.

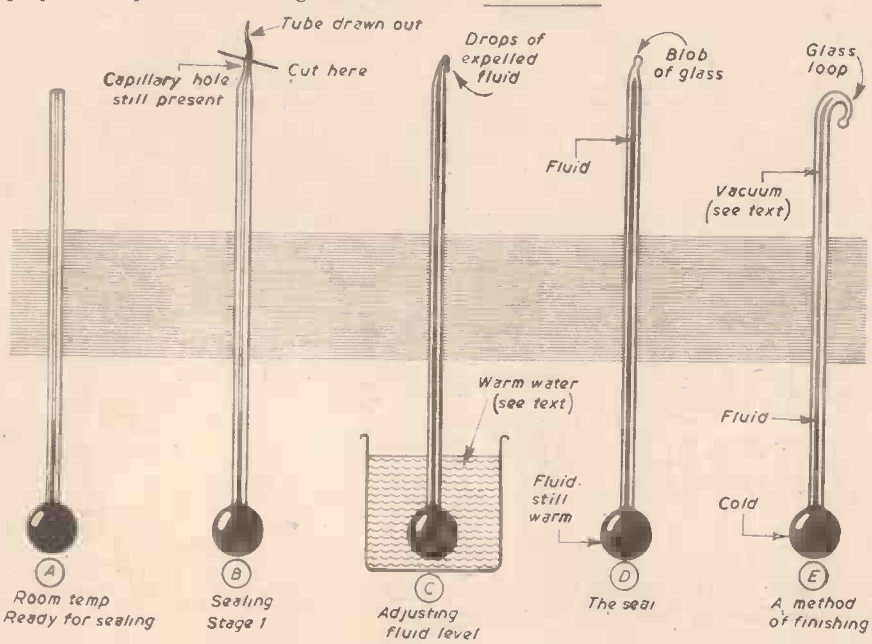


Fig. 10.—The sealing process, stage by stage.

Mounting the Thermometer

The prototypes were mounted on small wooden blocks cut out from orange boxes. Other mounting methods will suggest themselves to readers. Those who make plaster casts might fashion a holder of plaster. Perspex, plywood and cardboard have been used by the author.

A small piece of wood about ½in. thick,

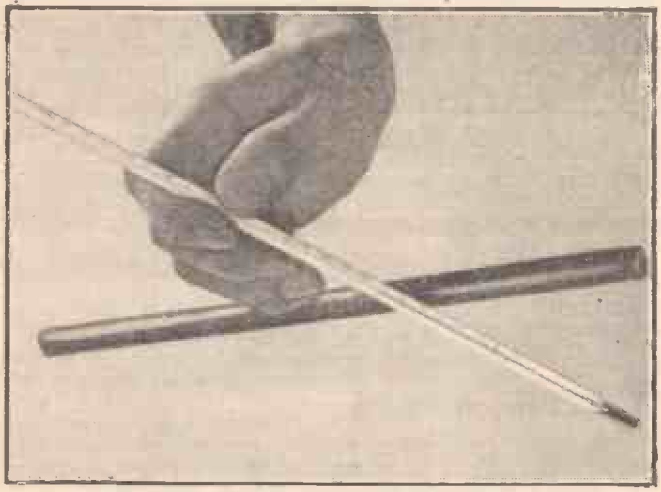


Fig. 13.—A commercial standard thermometer.

2in. longer than the thermometer and about 1½in. wide is suitable. It is sandpapered smooth and a hole drilled as shown in Fig. 11. This hole should be just a little bigger than the bulb of the thermometer; it need not go right through the wood.

Two small tinplate clips are then made

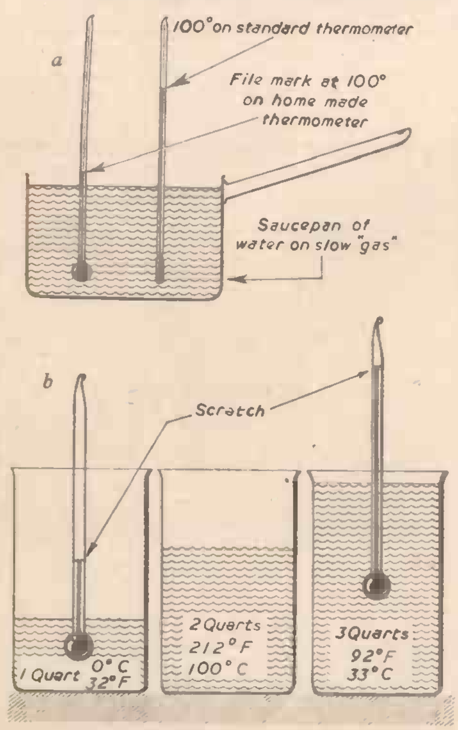


Fig. 14(a).—Calibration with a standard thermometer ; (b) calibration without a standard thermometer.

from a cocoa tin or other thin metal. These fix the bulb and stem to the wooden stand, small panel pins and a small hammer being used with great care.

Remember that glass will not bend, the clips can *hold* only.

A small hole may be made at the top of the wood for hanging purposes.

The Bulb Shield

Refer to Fig. 12 and make a small tinplate shield from a cocoa tin. The size will depend on the size of the bulb, but if it is ½in. dia. the measurements given will suit. Mark out and drill the holes while the metal is part of a larger sheet and cut it out afterwards. Finally, bend it round a piece of pipe or a dowel.

The shield thus made is placed over the bulb, being held by small panel pins or shoe brads. Free ventilation must be left round the bulb or it will not respond to quick changes of temperature, such as when all the windows are opened on a frosty day.

Calibration

Method A. If you have a standard thermometer (Fig. 13 shows a suitable one) with which to do the marking, proceed as follows. Take a large saucepan of cold water with the standard thermometer and the one you are making in it. Heat it gently, stirring the water all the time (Fig. 14a). Both the thermometers will slowly rise. Make tiny file marks at any suitable two temperatures. For instance, when the standard one says 60 deg. F make a tiny mark on the one being calibrated and when the standard one says 100 deg. F make another mark. Between these two points there are 40 degrees or four lots of 10 divisions. The scale will be made later.

Method B. If you do not have a standard thermometer you may still achieve accurate calibration by using the principle of additive mixing of water at different temperatures. The resultant temperature is easily calculated and, by using boiling and freezing water temperatures, we have our "set points of reference." Remember that boiling water cannot be used as a set point with alcohol thermometers.

CHART FOR ADDITIVE MIXING OF WATER

Boiling water (at sea level), 212° F. or 100° C.
Ice cold water, 32° F. or 0° C.

Parts of boiling water	Parts of ice cold water	Resultant temperature	Resultant temperature
4	1	176° F. or	80° C.
2	1	149° F. or	66° C.
1	1	122° F. or	50° C.
1	2	*92° F. or	33° C.
1	3	77° F. or	25° C.
1	4	68° F. or	20° C.

*Used in example in text.

A chart is shown above which may help readers who wish to check their thermometers or mark special set points. For the theory of additive mixing refer to any text book or encyclopedia on Heat, the chapter concerned is usually titled "Specific Heats."

Place some ice in a large vessel, preferably surrounded by a blanket to save wastage of ice. Keep stirring it and place the thermometer in it. When the fluid ceases to fall it is at freezing point. Mark it with a small file scratch at this point; 32 deg. F. is now fixed.

Take one quart of boiling water and two quarts of the "freezing" water just made and mix them quickly and throughly. Mark quickly the place to which the thermometer rises. This will be the 92 deg. F. mark. (Fig. 14b).

The reader will observe that between these two points there lies 60 deg. or six divisions of 10 deg. each. The scale is made from this information (Fig. 15).

Making the Scale

This is prepared in the first instance on plain white paper, then stuck on to the wood, making the marks coincide with the scratches already made. The scale can be transferred to the wood by means of carbon paper, the marks then being inked in properly with Indian ink. A good effect may be obtained by painting the wood with black Indian ink and letting it dry, then making the figures and marks with white Indian ink. Go over this when dry with clear spirit varnish (obtainable at artists' stores). If paper is stuck on, and this is the quickest method, it should be heavily spirit varnished (cellulose lacquer used for chromium protection, or clear nail varnish may be used) to prevent steam or rain bringing the paper away from the wood.

It is assumed that you do not have a standard thermometer and are using Method B. It is also assumed that the completed thermometer has a scratch at 32 deg. and another at 92 deg. Refer to Fig. 15 and proceed as follows:—

1. Place the thermometer on a piece of plain white paper and make two dots corresponding to the scratch marks.
2. Measure the distance between them in millimeters.
3. Calculate one-sixth of this. In one

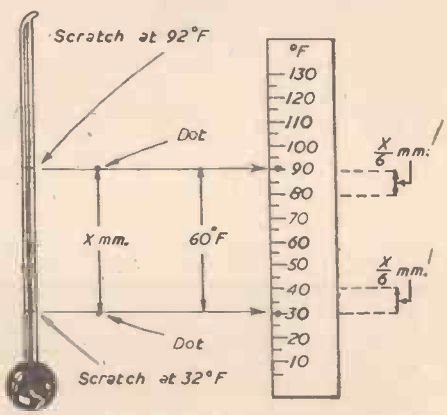


Fig. 15.—The marked thermometer and scale.

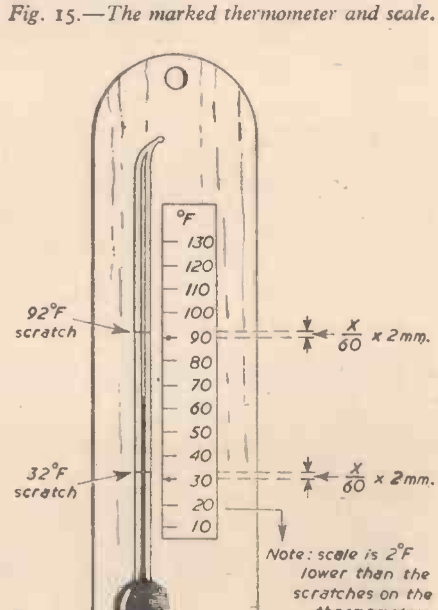


Fig. 16.—The scale attached to the thermometer stand.

prototype shown, distance was 30mm. and this divided by six meant that between every 10 degrees there were 5mm. You could work in 64ths of an inch if you wish.

4. The scale can now be made as in Figs. 15 and 16. The long lines are made 5 mm. apart in the example above. These marks are then divided in half by somewhat smaller lines. If you wish to make a very accurate instrument these lines must then have four equally spaced dots placed between them. The scale may now be marked from, say, 10 deg. to 130 deg. F. as shown.

5. Now work out the amount of "deviation" between 30 and 32 deg. F. in mm. For example, in the example above, 10 deg. on the scale was 5 mms. Thus for 2 deg. the number of mm. was 1. The deviation was 1 mm.

6. Now cut out the scale and stick it to the thermometer base so that the 30 deg. mark is exactly the deviation distance below the 32 deg. scratch mark on the thermometer (see Fig. 16).

7. Check that the deviation distance is also present at the 92 deg. mark. If it is not you have not made the scale correctly. Varnish the scale when it is dry.

Limits of Accuracy

The accuracy is limited by the constancy of the capillary bore, the ability of alcohol to expand the same amount for the same temperature rise anywhere in the range, the accuracy with which you were able to mark the two trial readings and the accuracy with which you have made the scales. Some instruments made to retail at about 3s. 6d. are only accurate to within about two per cent, and you should be able to make yours at least as good as that.

Fig. 19.—A baby's bath thermometer.

The additive mixing of waters will introduce a small error which can largely be eliminated by preheating the containing vessel to about the temperature to which the mixed waters will rise.

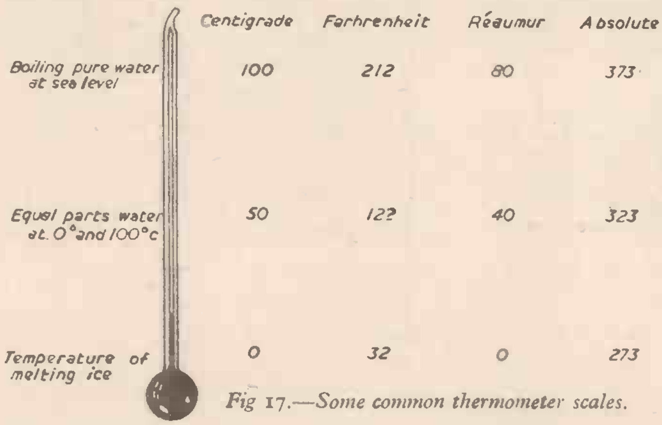


Fig 17.—Some common thermometer scales.

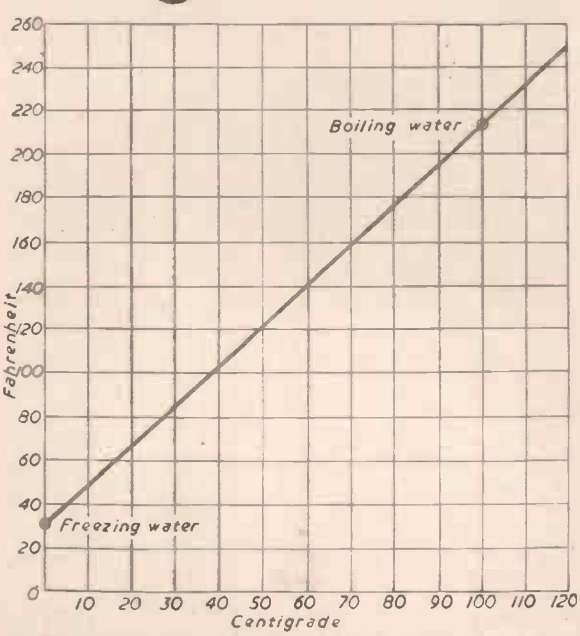


Fig. 18.—Graph for the conversion of Fahrenheit to Centigrade.

Using Centigrade Scales

This scale is easier to use but it is not used in this country save in laboratories. To convert to Fahrenheit from Centigrade multiply by 9/5 and add 32 to the answer, i.e., 45°C equals

$$\left(45\times\frac{9}{5}\right)+32=\frac{405}{5}+32$$
$$=81+32=113°F.$$

To convert to Centigrade from Fahrenheit take off 32 and multiply the answer by 5/9, i.e., 113°F equals

$$(113-32)\times\frac{5}{9}=81\times\frac{5}{9}=9\times5$$
$$=45°C.$$

A graph is sometimes useful for conversion from one scale to another and one is shown in Fig. 18. Some common thermometer scales are shown in Fig. 17. The Réaumur scale is used in Russia and the Absolute by scientists.

Making Your Own "Standard" Thermometer

After you have made a few thermometers it is advisable to make a standard of your own very carefully and accurately. Mount it on an aluminium sheet on which you can scratch the scale with a scriber or needle point.

In making most of the following suggested thermometers you will find this standard useful as it saves additive mixing to obtain any required temperature.

A Baby's Bath Thermometer

Make an alcohol thermometer, taking it up to 160°F. before sealing the tip. Now place it in water at 100°F. and make a clear file mark right round the tube. Fill the mark with green (or other colour) paint or cellulose. This is the correct temperature for the bath. Now take a cork from a wine bottle and cut a small slice from one end, about 5/16 in. thick. Burn a hole through the two parts and slide them out on to the thermometer as shown in Figs. 19 and 20. You may stain the corks some bright colour if you wish. Arrange the corks so that the thermometer will float horizontally on the surface of the water. When not in use it is kept in a small "ink" type bottle which can be fixed to the wall by a metal band.

Alternatively you could make a similar thermometer and mount it on aluminium as previously stated.

The thermometer will break if placed in boiling water.

Greenhouse Thermometer

This must be made of metal or of well-varnished wood. It must go up to 160° and down to 20°F. A couple of marks should be made to show the danger positions for the type of house being used. A "cool" house should show a mean temperature of

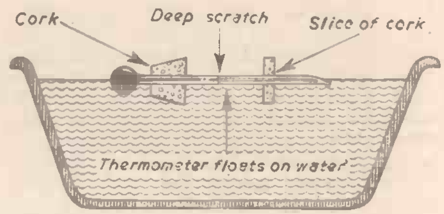


Fig. 20.—The baby's bath thermometer in use.

Fig. 21.—A photographic thermometer (dish development).

55° to 65° by day, should never fall below 45°. A "warm" house should never fall below 55° and a "hot" house never below 60°F. One thermometer could be made having three marks, the minimum for each type of house. The maximum permissible temperatures vary according to what is being grown.

Photographic Thermometer

For the time/temperature method of development a convenient point or points may be marked with a file on a suitable alcohol thermometer. A dish development thermometer is shown in Fig. 21.

(To be continued)

The author's trailer on the road and ready for towing.

SEEKING economical holiday accommodation, the designer turned his mind to caravans and trailers and dismissed the large-sized caravan, which would limit the car to main and secondary roads, in favour of a light trailer which could be taken into the lanes; where the car would go, so would the trailer. It was required to be simply constructed in timber, and with no double curvature on the panelling to ensure that ply could be used for the sheathing. Hardboard, whilst being ideal for large, flat surfaces, did not appear to be the answer to the rather sharp curves required in the eventual design.

It was decided to build on to a standard boat trailer.

The shape of the car was used to give the basic profile to the trailer, thus giving a continuity of line on car and trailer which is very pleasing. It ensures a good flow of air past the trailer at speed, and here it is interesting to note that the trailer has been towed at 65 with no sway or yawing, this probably being due to the individual sus-

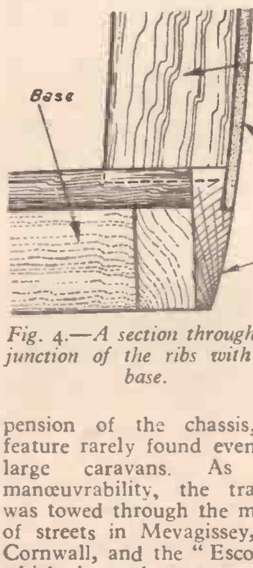


Fig. 4.—A section through the junction of the ribs with the base.

pension of the chassis, a feature rarely found even in large caravans. As to manœuvrability, the trailer was towed through the maze of streets in Mevagissey, in Cornwall, and the "Escort" which is used to tow succeeded in making the greater than 1 in 4 incline out of that township along the coast.

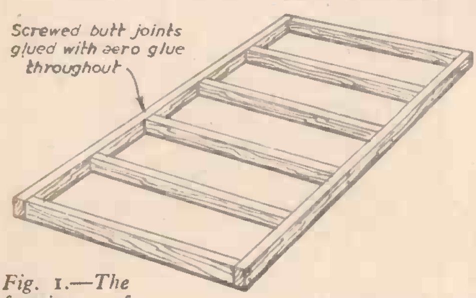


Fig. 1.—The framing of the base.

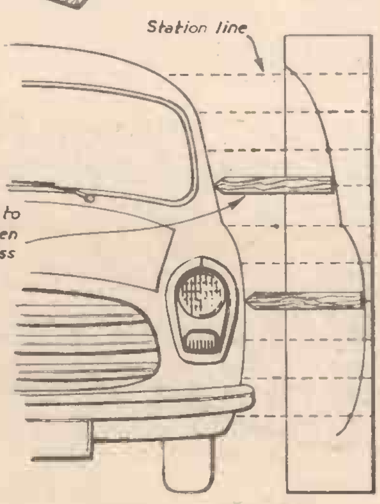


Fig. 2.—Method of matching the profile of the trailer with that of the car.

Construction

The floor consists of $\frac{3}{4}$in. R. B. Douglas fir ply on a framing of 2in. × $1\frac{3}{4}$in. softwood, screwed and glued throughout, as shown in Fig. 1, using $3\frac{1}{2}$in. No. 8 screws. The plywood was chosen as, in spite of costing more than boarding, it went on in two panels and thus cut the possibility of splashed

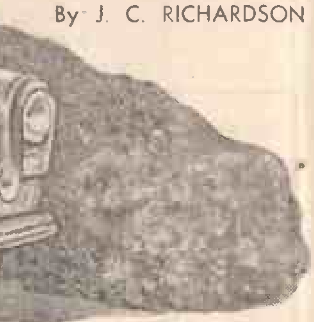
Fig. 3 (Left).—Method of cutting several ribs from one piece for reasons of economy.

In the group of photographs shown on the right, details can be seen of the ribs and longeron construction and also the sleeping accommodation. Notice the neat appearance of the windows and the smart exterior the shaping gives to the trailer.

Camping Trailer

It Can be Built for a Total Cost of £45

By J. C. RICHARDSON



water entering when the road wheels threw up the inevitable clouds of spray from a wet road surface.

Following the Car's Profile

Hardboard templates were prepared from the car and used to set out the ribs on $\frac{3}{4}$in. plywood offcuts purchased from a local joinery works. The templates were prepared as shown in Fig. 2 by making 6in. stations on the hardboard, which was temporarily strutted up adjacent to the car, and a short length of batten was used to mark the station lines with a series of points which, when linked, repeated the profile on the hardboard ready to be cut to shape. The ribs of ply were arranged on the plywood offcuts to minimise the waste, as shown in Fig. 3.

Jointing the Ribs

The joints were straightforward halved joints, arranged to carry the profile around the ribs; the joints are best positioned at points where there is a definite shaping, thus facilitating lining the sections of the rib. The joints were made with aero glue and screwed with $\frac{3}{4}$in. No. 8 C.S. screws, joints being at least 6in. long to ensure that the ribs were not rendered weak. In fact, the joint portions proved to be stronger than plain plywood, though all plywood is immensely strong, in bending along the axis of the veneers. Fig. 7 shows the build-up of typical ribs, though this will vary according to the profile of the car for which the trailer is built.

The ribs should be spaced at 2ft. maximum centres and housed into the base plywood (see Fig. 4), the checkouts for the longerons being made by two saw cuts and a sharp chisel blow (see Fig. 8). The checkouts for the longerons should be slightly shallower than the depth of the longerons to facilitate fairing them off ready for the subsequent plywood sheeting. This is illustrated in Fig. 9.

The longerons are fixed in place by one screw each as well as glueing. The structure, although seeming very light at this stage, becomes remarkably rigid when the ply skin is fixed back on to it. The whole assembly giving a stressed skin finish. The structure will now appear as in Fig. 5.

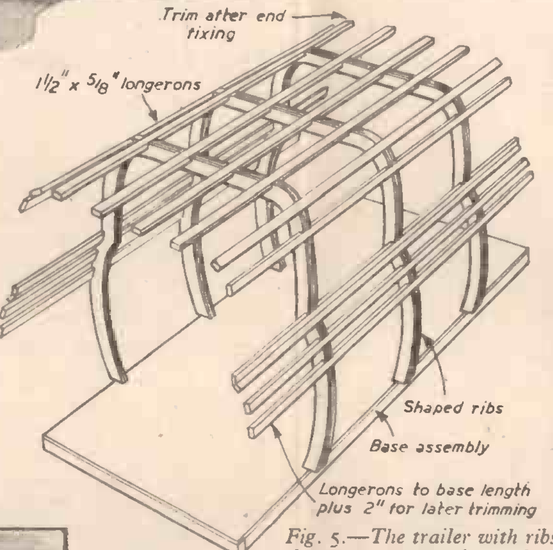


Fig. 5.—The trailer with ribs and longerons mounted on the base.

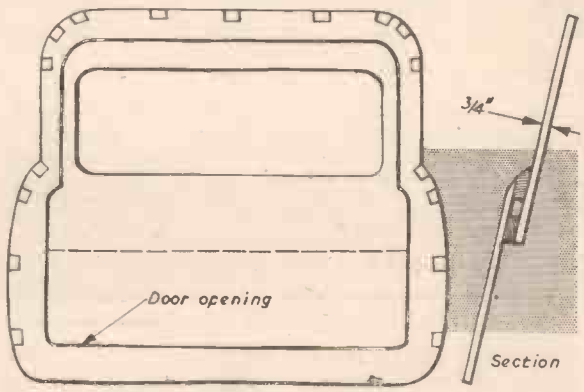
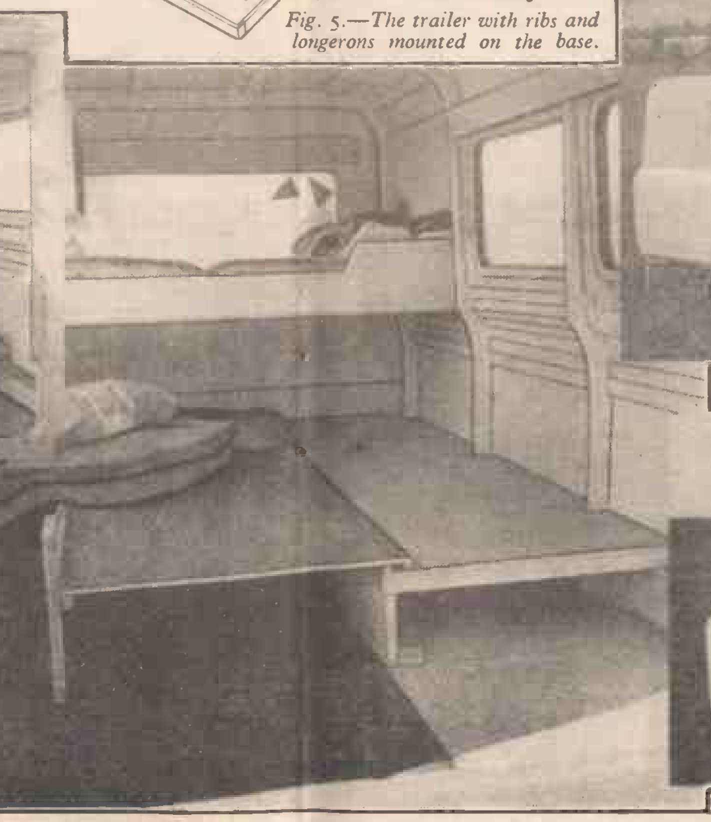
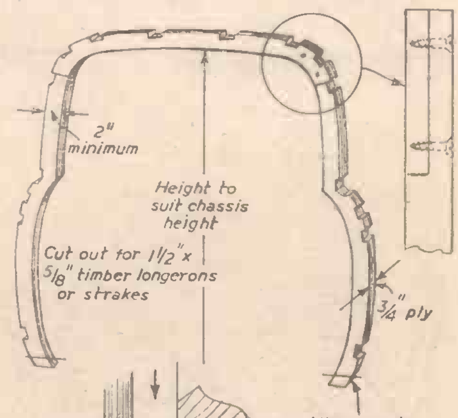
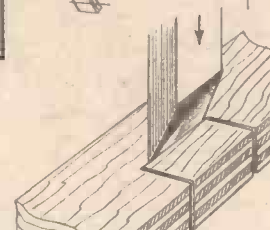


Fig. 6.—Details of the ends.







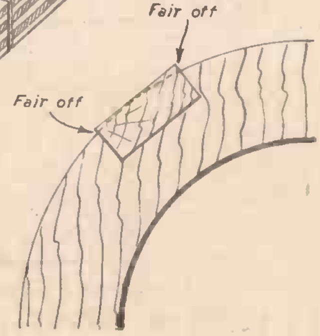


Fig. 7 (Top Right).—The build-up of a typical rib.

Fig. 8 (Centre Right). — Method of cutting the checkouts.

Fig. 9 (Bottom Right).—How the longerons are faired off.

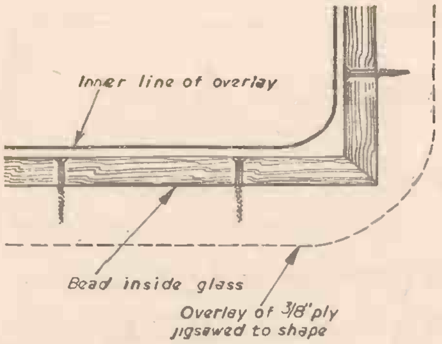


Fig. 10.—*How the rounded corners of the windows are formed.*

Making the Ends

The ends are next prepared, and here again ½in. and ⅜in. plywood is used to give rigidity. The cut outs for door and windows were made with a jig saw attachment on an electric drill, the shape of the sides is carried round by blocking out with hardwood then shaping after gluing and removal of screws (see Fig. 6.) The profile of the panel at each end and the checkouts for the longerons, are marked by offering up the panel to the superstructure and pencilling the outlines of the longerons on to the back of the panel. When the cut outs are made the panels may be pushed into place between the longerons and the joints made by gluing and screwing as at the ribs. The bottom of each panel is securely screwed to the base assembly.

To obviate difficulty in glazing and to preserve the appearance of the windows the rounded corners are formed as shown in Fig. 10. Square openings for the glass are cut, and shaped fillets are applied on the outside with square beads to trim inside, the glass being bedded in putty.

Sheeting of 4mm. marine ply can now be fixed over all sides by glueing and screwing thus providing the stressed skin. If the trailer is kept down below 8ft. long the ply can be continuous in length, avoiding jointing. Provided the glue is used freely throughout, the trailer will now be entirely weatherproof.

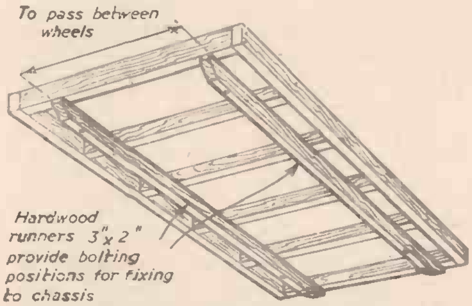
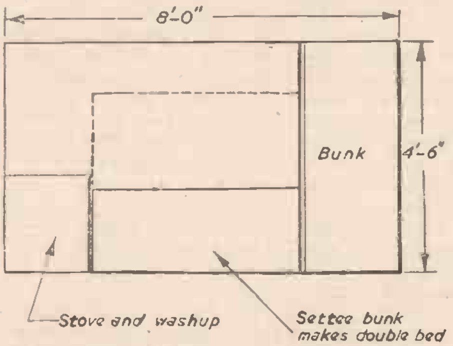


Fig. 12.—*Underside view of the base framing.*



Figs. 13 *and* 14 (*Above and Right*).—*Sleeping arrangements for two adults and a child.*

Window openings may be added as desired and details of the sashes and the method of construction are shown in Fig. 11.

Wheelboxes must be made, and shape and dimensions will depend on the trailer and the type of wheels used. Fig. 15 shows one of the author's wheelboxes and the methods of construction. Notice how the side is cut to the profile of the mudguard.

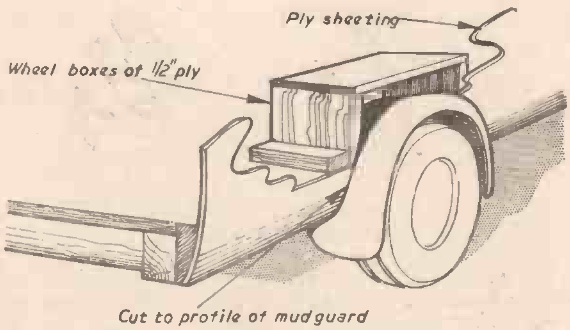


Fig. 15.—*Details of the wheel-boxes.*

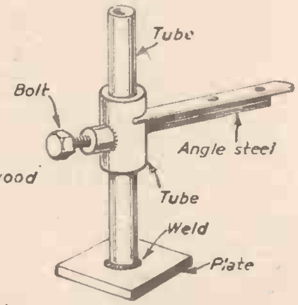
Suitable trailers such as the Pratt boat trailer can be used both for boats and the camping trailer described here. The trailer is easily removable, being fixed with wing nuts and being jacked up by means of the jacks shown in Fig. 16, to run the trailer out from underneath.

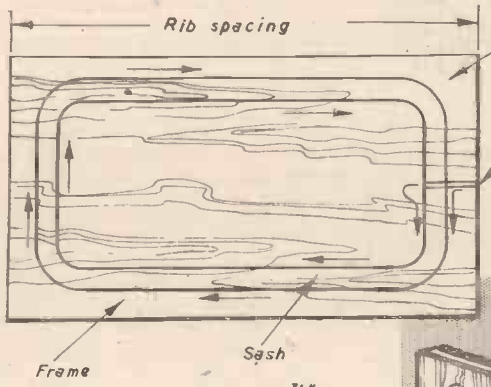
Hardwood runners are fixed underneath the base of the camping trailer body as shown in Fig. 12. These provide bolting positions for fixing to the chassis.

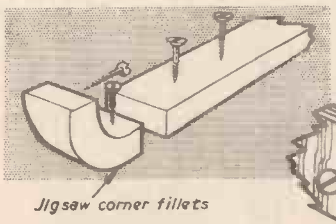
The sleeping arrangements for two adults and a child are shown in Figs. 13 and 14, but these, of course, can be varied to conform to individual requirements as can the whole layout of the trailer interior. The photographs give a good idea of the layout in the author's trailer and also further information as to construction.

This article is not intended to provide step-by-step instructions, but merely to give ideas on which the reader can base his own design.

Fig. 16 (*Right*). —*Details of one of the jacks.*







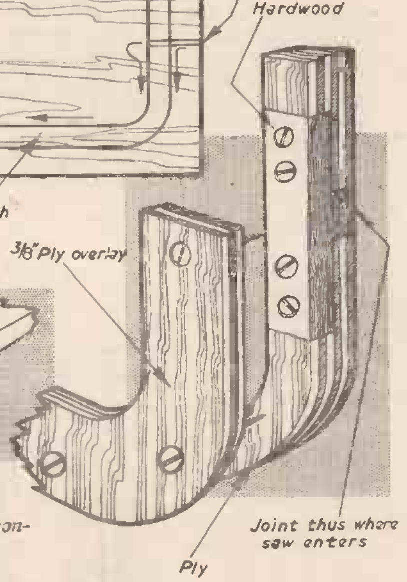
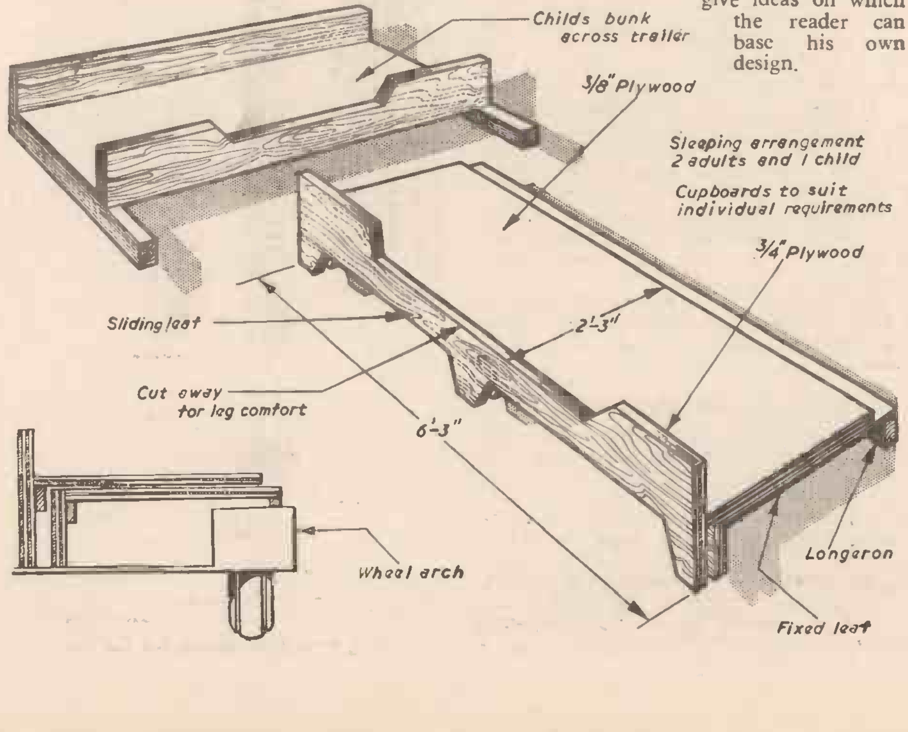
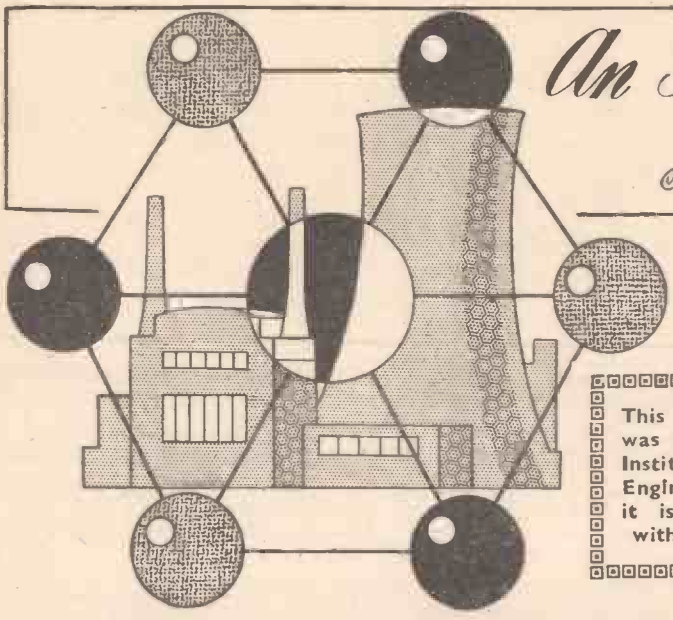


Fig. 11.—*Method of constructing the sashes.*





An Introduction to Nuclear Power

By P. T. FLETCHER, B.Sc.(Eng.), M.I.C.E., M.I.Mech.E., M.I.E.E.

(Concluded from page 281, March issue)

This is a paper which was presented to the Institute of Marine Engineers recently and it is reproduced here with their permission

APART from its size and the design and arrangement of the fuel elements, a boiling reactor employing light water will not differ markedly from one using heavy water. Neither need there be any essential difference between the design and arrangement of the fuel elements in a light water reactor of the boiling as opposed to the pressurised type. Attention will therefore be confined to the pressurised light water system.

The Shippingport reactor vessel has a height of 33ft. and a nominal wall thickness of 8½in. The internal diameter of the cylindrical portion is about 9ft. The core assemblies are supported in a stainless steel cage consisting of a barrel, a bottom plate and top support grid. This cage is nearly 8ft. in diameter and slightly over 13ft. in height. The active section of the core is some 6ft. in mean diameter and 6ft. high.

The seed and blanket elements are of nearly square cross-section throughout most of their length, but are fitted with transition pieces at each end to terminate in the form of a round tube. The lower tubular ends fit into holes drilled in the bottom plate, whilst the upper ones are locked into the top support grid.

The cooling water is maintained at a pressure of 2,000lb. per sq. in. abs., corresponding to a saturation temperature of 636 deg. F. It enters the bottom of the reactor vessel at a temperature of 508 deg. F. and 90 per cent. of it flows upward between the fuel plates and rods. The remainder by-passes the core to cool the walls of the reactor vessel and thermal shield. The water leaves the vessel at a temperature of 542 deg F. to pass through the heat exchanger and is then recirculated to the vessel by means of a canned-motor pump.

The seed elements contain a total of 114lb. of highly enriched uranium whilst the blanket contains 12 tons of uranium oxide.

Gas Cooled Graphite Reactor

Like the heavy water reactor, the gas cooled graphite moderated reactor can operate with solely natural uranium as its fuel. Furthermore, it requires no unusual materials in its construction. In order to compete effectively as a power producer, however, the gas coolant must be pressurised, whilst the employment of graphite as a moderator implies a large critical size, so that a pressure vessel of considerable dimensions must be envisaged. As a coolant, gas has an advantage over water in that its top temperature is not limited by its pressure but can be readily increased to the maximum permitted by the material of the fuel element can.

Reactors of this kind will form the spearhead of Britain's nuclear power programme and will stem from the prototype recently commissioned at Calder Hall, which has already been described.

Apart from the use of higher gas pressure, the gas cooled reactor offers further scope for development in the choice of coolant. Carbon dioxide is cheap, whilst its nuclear properties are sufficiently good to permit its use with natural uranium fuel. For the same reactor heat output and range of temperature, the blower power varies very nearly inversely as the square of the molecular weight of the gas and inversely as the cube of its specific heat at constant pressure. The suitability of different coolants can thus be judged by comparing their blower power in relation to that of carbon dioxide. On this basis helium would require only slightly less blower power and nitrogen over twice as much, but hydrogen would need only 1/6th of the blower power of carbon dioxide. Before using hydrogen as a coolant, however, its compatability with the reactor materials would require investigation and other engineering problems must be solved.

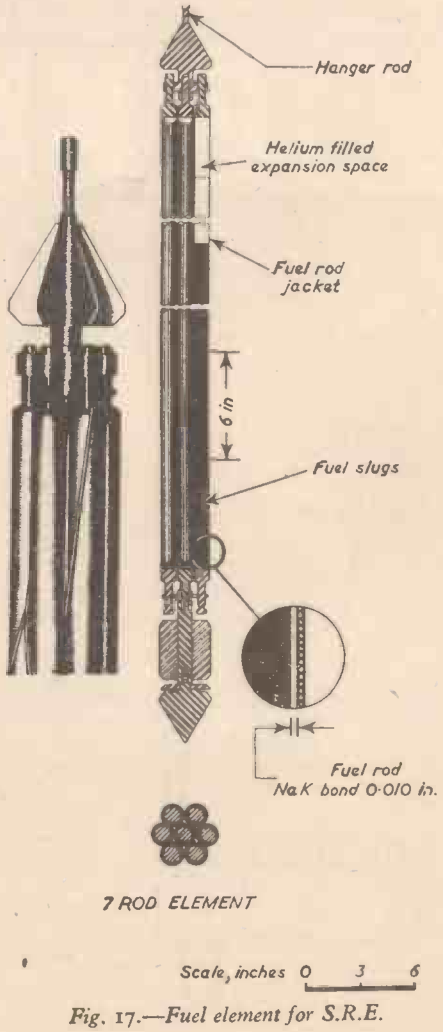


Fig. 17.—Fuel element for S.R.E.

Sodium Graphite Reactor

The replacement of water or gas by sodium as coolant enables high power outputs to be achieved without pressurisation. Furthermore, since the boiling point of sodium is 882 deg. C., no limitation is imposed on the coolant temperature by the coolant itself, so that heat can be transferred from the reactor at a temperature limited only by metallurgical considerations. Conversely, apart from its marked chemical reaction with water, sodium oxidises very rapidly in air. Also, on irradiation in a reactor, it becomes highly radioactive, emitting 2.76 MeV gamma radiation with a half-life of about 15 hours. The primary coolant system must therefore be shielded.

The American programme for sodium graphite reactors calls for the construction of a Sodium Reactor Experiment (SRE) to develop 20 MW heat, followed by a Sodium Graphite Reactor (SGR) developing 250 MW heat.

Fig. 17 shows the fuel element of the SRE. It takes the form of a bundle of seven rods, each of which consists of a 6ft. high column of 6in. long uranium slugs, ¾in. in diameter, in a stainless steel can. The wall thickness of the can is 0.01in. The uranium is enriched to contain 2.80 per cent. of uranium 235. The clearance space between the slugs and the can is filled with sodium-potassium alloy in order to provide a thermal bond. This alloy extends a few inches above the slug column to a free surface, above which is a helium-filled space to accommodate volume changes due to thermal expansion and any gaseous fission products released during operation. The rods are prevented from touching one another by spirally wrapping the outer six rods with 13 s.w.g. stainless steel wire at a pitch of about 10in.

Graphite readily absorbs sodium, thereby destroying its value as a moderator, so that contact between the two must be prevented. In the present instance, the necessary protection is afforded by enclosing the individual graphite blocks in a zirconium can. The graphite assembly for the SGR is shown in Fig. 18. Each such assembly is attached by means of zirconium studs to a spacer plate at the top and a supporting pedestal at the base, both of stainless steel. The pedestal is loosely spigoted into the grid plate at the lower end of the reactor vessel. The spacer plates at the top of adjacent graphite assemblies nest together and are maintained in place by a clamping band round the outside of the whole core. The fuel element is lowered through the central hole in the graphite assembly to rest on the internal ledge at the lower end of the pedestal.

The sodium coolant enters the lower end of the reactor vessel into a header chamber below the grid plate. It then flows upward through the central holes in the graphite assemblies to take up heat from the fuel elements located in them. Some 7 per cent. of the incoming coolant, however, is diverted to a secondary header chamber formed between the grid plate and the base plates of the graphite assemblies. This coolant flows upward between adjacent graphite assemblies in order to remove heat from them. Sufficient space is provided for this flow by making the distance across the flats of each graphite assembly slightly less than the lattice pitch to give a clearance of 1/10in., which is maintained by dimples on the can sides.

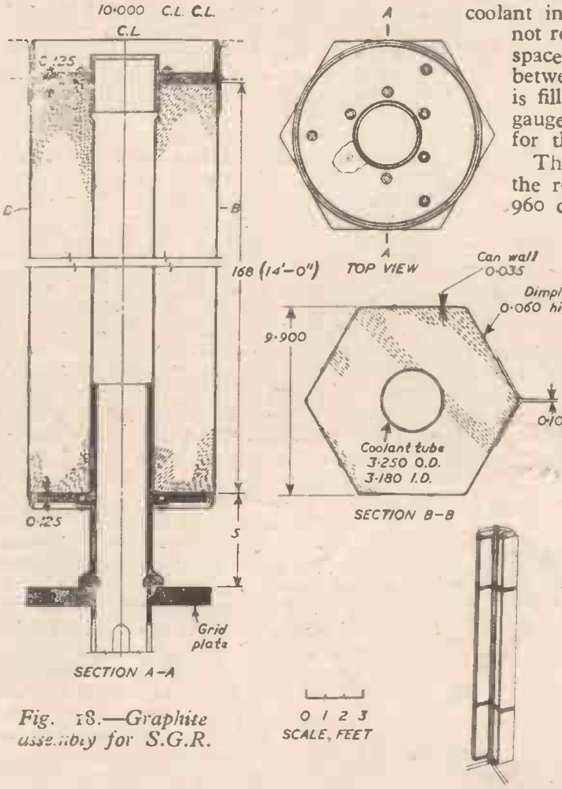


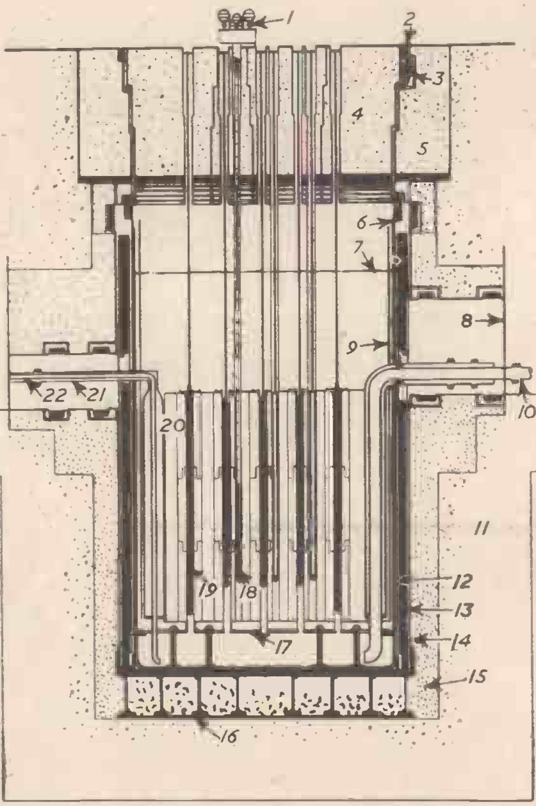
Fig. 18.—Graphite assembly for S.G.R.

The SRE graphite assemblies are similar except that the lattice pitch is 11in., and the gap between adjacent assemblies is .170in. Also the central hole is 2.80in. in diameter and the height of the graphite assembly is 10ft. Similar graphite assemblies without the central hole make up the side reflector.

Fig. 20 shows the general arrangement of the SRE reactor. As a safeguard against loss of coolant, the sodium inlet and outlet lines pass through the reactor vessel above the core, which is therefore always flooded with sodium. The normal level of the sodium is 6ft. above the top of the core. The core region is 6ft. high and about 6ft. in diameter. The entire core and reflector is contained in a stainless steel tank 19ft. deep, 11ft. in diameter and 1½in. thick. A stainless steel inner liner ¼in. thick assures a 2½in. thick stagnant layer of sodium at the inner surface of the core tank to minimise thermal stresses due to variations in sodium temperature. The core tank is surrounded by a 5½in. thick steel thermal shield. Immediately outside this shield is the outer tank, which acts as a further safeguard against loss of coolant in the event of failure of the inner tank. The outer tank is surrounded by thermal insulation approximately 1ft. thick, which in turn is enclosed by the concrete biological shield. At the interface between the insulation and concrete is a steel liner to which steel pipe is tack welded for the circulation of a concrete coolant in the form of toluene, which does not react chemically with sodium. The space above the sodium level and between the core tank and outer tank is filled with helium at 3lb. per sq. in. gauge to provide an inert atmosphere for the sodium.

The sodium temperature at inlet to the reactor is 500 deg. F and at outlet 960 deg. F.

Fig. 19.—General arrangement of SRE. (1) Control element drive; (2) seal; (3) roller; (4) rotatable shield; (5) ring shield; (6) bellows; (7) sodium level; (8) diaphragm; (9) inner liner; (10) main sodium inlet line; (11) biological shield; (12) core tank; (13) thermal shield; (14) outer tank; (15) thermal insulation; (16) bearing plate; (17) grid plate; (18) control element; (19) fuel element; (20) moderator element; (21) guard pipe; (22) auxiliary sodium inlet line.



Applications of Nuclear Power

Central Power Stations

Undoubtedly, the most urgent application of nuclear power in this country lies in replacing coal or oil firing in central power stations. Support for this view is very clearly given by Table 1 which shows the anticipated rise in this country's electrical requirements and the corresponding requirements for coal with or without the assistance of nuclear power.

The figures quoted for nuclear installed capacity up to 1957 are based on the programme outlined in the White Paper, Command No. 9389, dated February, 1955. The corresponding figure for the year 2000 is hardly more than an inspired guess. The coal requirements under this nuclear power programme are seen to be about as much as the coal industry will be able to meet. Whether or not electric power from nuclear stations is cheaper than that from conventional ones, it follows that, without nuclear power, this country would soon be suffering from an acute power famine.

This conclusion leads to the prospect that in ensuring a supply of electric power at any price, the price may be high. Fortunately, however, the price of electrical power from the first nuclear stations will not be greatly more than that from present-day conventional stations. Furthermore, the situation should be reversed in a few years. The reason for this prediction is to be found in the comparative make-up of electricity costs from conventional and nuclear stations. Typical comparative figures are given in Table 11, at the top of the next page.

The nuclear station is seen to exhibit something like three times the capital charge associated with the conventional station. This disadvantage of the nuclear station, however, is largely offset by its smaller fuel charges, which are about half those of the conventional station.

As time goes on, the capital costs of both conventional and nuclear stations should come down. Due to the greater proportion of the total electricity cost attributable to capital charges in the nuclear station, however, the same percentage reduction in capital costs will show to better advantage in the nuclear station than in the conventional one. Furthermore, whilst the cost of hydrocarbon fuel will certainly continue to rise, a similar situation with regard to nuclear fuel is unlikely to occur before the

TABLE I—ELECTRICITY AND COAL REQUIREMENTS

Year	Total installed capacity, MW	Units per year	Nuclear installed capacity, MW	Coal required per year (tons)	
				Without nuclear power	With nuclear power
1955	20,000	7×10^{10}	—	40×10^6	40×10^6
1965	35,000	12×10^{10}	2,000	60×10^6	60×10^6
1975	60,000	20×10^{10}	15,000	100×10^6	65×10^6
2000	150,000	50×10^{10}	100,000	250×10^6	55×10^6

TABLE II

Item	Cost of electricity in pence/unit sent out	
	Present conventional stations	First nuclear stations
Capital charges	0.14	0.43
Fuel and operating charges	0.41	0.23
Total ...	0.55	0.66

end of the present century. There are thus strong reasons for anticipating a rise in the cost of power from conventional stations and a fall in the cost of power from nuclear stations.

Marine Application

Nuclear power plants, due to their high capital costs, can generally only find commercial application where the load factor is high and the power output large. The earliest commercial application of nuclear power in the marine field is thus likely to be in large oil tankers where the load factor may be as high as 90 per cent., and the power requirements exceed 10,000 s.h.p.

The enhanced importance of capital cost in marine applications leads to consideration of reactor types which are favourable from this point of view. Entering into this consideration is that of size, since reductions in size lead to increase in cargo space. On the score of both capital cost and size the pressurised water reactor shows to great advantage, and is, in fact, the type of reactor used in the American nuclear-powered submarine *Nautilus*.

A further improvement in the direction of reduced capital cost and size is obtained by substituting sodium for water as the coolant, as proposed for the second American nuclear-powered submarine *Sea Wolf*. However, the gain in this case is only some 10 per cent. reduction in space or weight, due to the increased amount of shielding required against radiation emitted by the sodium activated on passing through the core. In the case of the *Sea Wolf*, the shielding accounts for more than 35 per cent. of the weight of the whole power plant, whereas the corresponding figure for the *Nautilus* is less than 30 per cent.

Despite its greater size, the gas-cooled reactor can nevertheless show two advantages over the liquid-cooled reactor for marine use. If helium is employed as the coolant, then, since helium is not activated on passing through the core of the reactor, shielding of the coolant circuit outside the reactor shield can be dispensed with. Secondly, temperatures sufficiently high for a gas turbine cycle can almost certainly be achieved without undue development, so that the reactor coolant can also serve as the working fluid in the turbine and the customary heat exchanger between the two be omitted. In this way the space and weight of the plant should be reduced by a factor of about two-thirds of that occupied by the liquid-cooled reactor plant.

One of the greatest differences between a marine and central power station plant would be in the type of reactor shield. For central power station applications, concrete, despite its enormous bulk, is still the most economical shielding material. For marine applications, a less bulky shield must be provided and would probably take the form of a very dense material, such as lead, close to the core, to absorb gamma radiation from it. A thin lining of a boron-containing material on the inside of this gamma absorber would effectively mop up all thermal neutrons escaping from the core. Only fast neutrons would then remain to be dealt with, and these would probably best be attenuated by an iron-water shield with an admixture of some form of boron.

Studies made to date indicate that under the most favourable conditions a nuclear marine power plant is not as economical as a conventional one. The discrepancy, however, is sufficiently small to justify the effort now being devoted to the development of this type of plant.

An Elliptical Compass

This Instrument, Which Can be Made at Home, Simplifies Ellipse Drawing

By H. NICHOLLS

THIS compass was originally made to draw projections of circular holes at an angle, and is equally suitable for drawing ellipses.

Construction is shown in Fig. 1. The legs of a pair of dividers are cut off near the hinge, and a ⅛in. hole drilled in each. A length of silver steel is soldered in each hole, forming two extended legs. One leg is splayed out into a fork to keep the instrument vertical when in use.

The compass proper is made from a pencil compass, the leg carrying the needle point being sawn off and soldered to a brass sleeve, which is made a sliding fit on the straight leg. It will be seen that when this leg is set at an angle to the paper and the pencil compass revolved around it, the sleeve will slide along the leg and the pencil point will draw a true section of a slice through a cylinder at the angle at which is set.

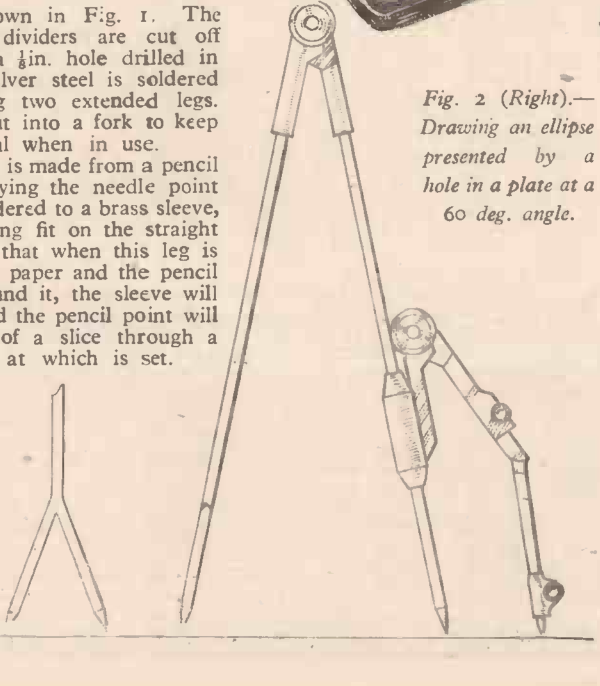


Fig. 1 (Right).—The completed instrument for drawing ellipses.

Using the Instrument

If it is required to draw a projection of a hole through a plate at, say, 60 deg., the procedure is as follows:

After drawing the view of the plate and hole at the required angle, as shown in Fig. 2, the necessary centre lines are drawn and the edges of the hole are projected, giving the minor axis of the required ellipse to be drawn.

The leg carrying the compass is then set at 60 deg. with the points of both legs resting on the paper.

The point of the straight leg is placed on the centre of the ellipse to be drawn and the forked end centrally placed over the centre line. The compass pencil point is then set to the minor radius "M" (Fig. 2), and holding the instrument perfectly vertical, the compass is revolved around the straight leg. The resulting figure will be a true projection of the hole.

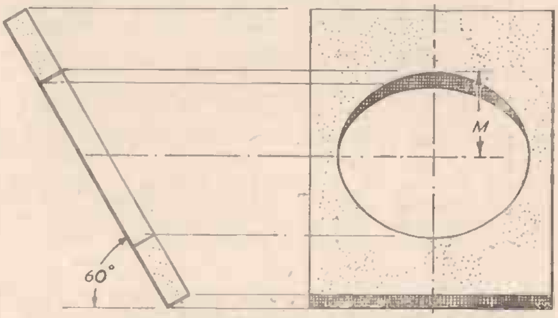


Fig. 2 (Right).—Drawing an ellipse presented by a hole in a plate at a 60 deg. angle.

When it is required to draw an ellipse to a given size, draw in the centre lines, mark in the major and minor axes, set the compass to the minor radius, place the point of the straight leg on the intersection of the centre lines, and adjust the angle of the legs until the pencil point coincides with the major radius.

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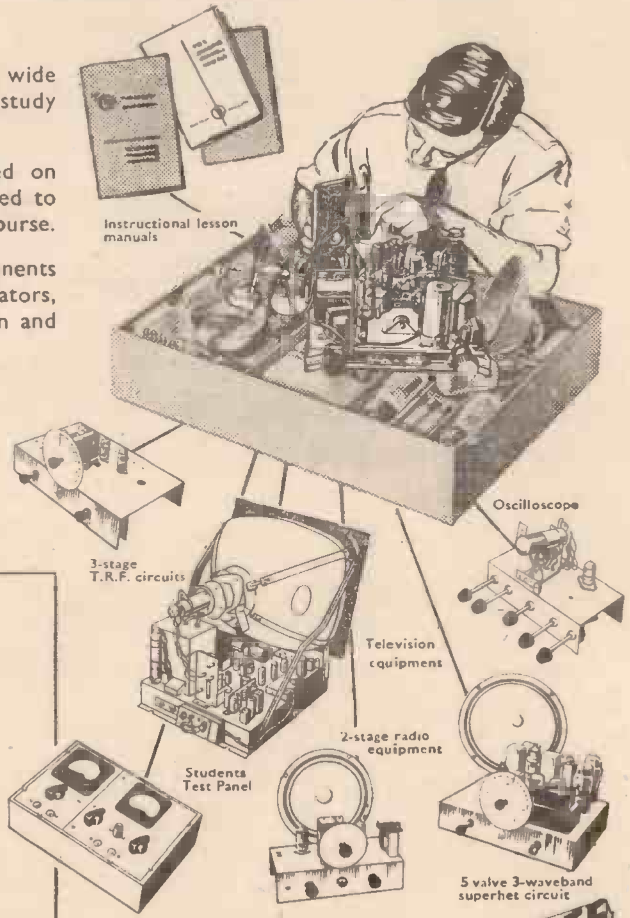

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A Rocking Horse

By JOHN MACKENZIE

A Children's Favourite Which is Strong and Durable

FIRST cut out and shape the seat as in Fig. 1. Any available wood may be used, but hardwood will reduce the risk of splinters. Cut the slot as shown in Fig. 1. The wood should be 1in. thick. It is important that the edges of the seat should be rounded to a fairly large radius and the whole well sanded.

The Rockers

To make these, use ¾in. conduit with walls about 3/32in. thick. The exterior quality is the harder, and it is inadvisable to use the interior quality as it may buckle with use.

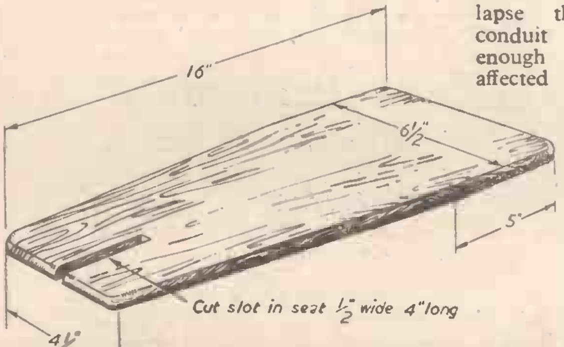


Fig. 1.—Details of the seat.

Take two pieces 6ft. 2in. long and bend them to the shape in Fig. 2. The bending operation is quite easy, using the following method:

Obtain a piece of rough timber about 3ft. × 3in. × 3in. and bore a hole, as shown in Fig. 3. Ream out the lip of the hole at both ends as shown.

To bend the conduit, stand the piece of timber upright with the hole uppermost. Support the timber in the left hand and insert the conduit through the hole. By tilting the timber to the left and bearing down on the conduit with the right hand it can be bent very readily, the fact that great force is not required helps to prevent overbending.

It is a great help if the bending plan shown in Fig. 2 is drawn out full-scale with a piece of chalk on the workshop floor.

The bending must be done gradually by inching the conduit through the hole and putting in numerous small bends close enough together to give the effect of one smooth bend. This conduit will take a fairly sharp bend in this fashion before there is any sign of the tube collapsing; even if there is a slight collapse this exterior conduit is strong enough to be unaffected in strength for this purpose. Packing the tubes is quite unnecessary. It is not important that the bends should follow Fig. 2 accurately, but it is important that the two pieces are identical, that the bottom bend is a smooth curve and that in each piece the two ends of the conduit are in line. When matching the two pieces place them together, and if it is found that there is a discrepancy try reversing one of the pieces, as it may be a closer match the other way round.

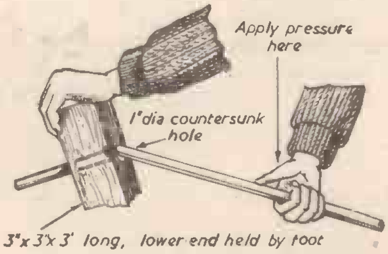


Fig. 3.—Bending the conduit.

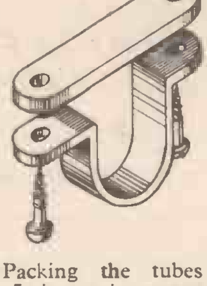


Fig. 4 (Right).—The conduit fixing saddle.

Fixing to the Seat

Obtain eight conduit-fixing saddles of the type which are in two pieces, as shown in Fig. 4. The conduit is fixed to the seat, using the saddles as in Fig. 5. Screw up the saddles fairly tightly with the bottom of the pieces of conduit 12½in. apart at the middle point.

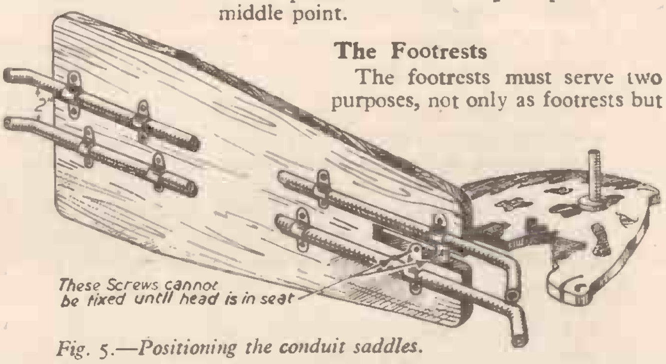


Fig. 5.—Positioning the conduit saddles.

The Footrests

The footrests must serve two purposes, not only as footrests but also as a means of preventing the pieces of conduit from moving apart at the bottom.

There are two ways in which this may be done. Take a thin piece of steel about 18in. × 4in. × 1/16in. and screw it to the conduit with four small self-tapping screws in the position shown in Fig. 7. To this piece of steel screw a piece of wood 18in. × 4in. × ¾in. with woodscrews.

The second method is the one used in the horse in the photographs and is quite effective. Drill two holes in each piece of conduit parallel to the floor. The holes should be drilled right through the conduit and should be large enough to take any available 2in. C/S woodscrews. Countersink the outside hole in each case.

Take a piece of hardwood 12½in. × 4in. × ⅜in. and screw it into position between the pieces of conduit, using the 2in. C/S woodscrews. The wood should be flush with the top edge of the conduit as in Fig. 8, this gives a ⅛in. clearance when the horse is on the floor. It it should just touch the floor then the edges of the wood may be taken off with a rasp.

A piece of wood 18in. × 4in. × ½in. should now be screwed to the top of this.

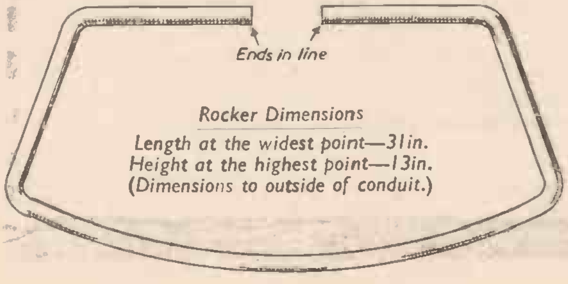


Fig. 2 (Left).—The shape of the rockers.

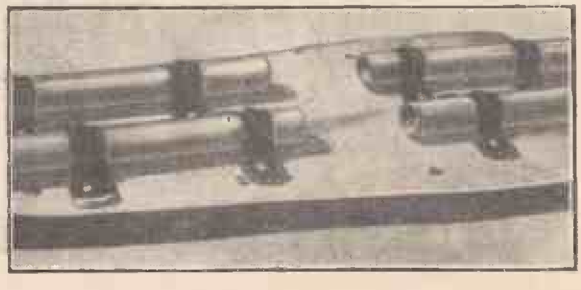
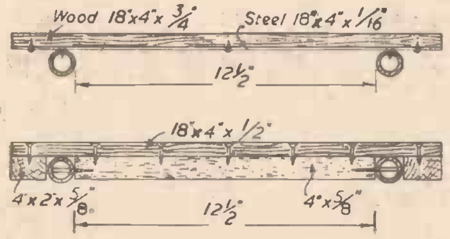


Fig. 6 (Right).—How the ends of the conduit are fixed.



Figs. 7 and 8 (Left).—Fixing the foot rests.
Fig. 9 (Right).—Cutting the head.

If the first piece of wood was fitted flush to the conduit then the second piece will rest on the conduit which will then take all the downward strain.

As a further safeguard screw a piece of wood 4in. × 2in. × ⅝in. hard up against the conduit on each side.

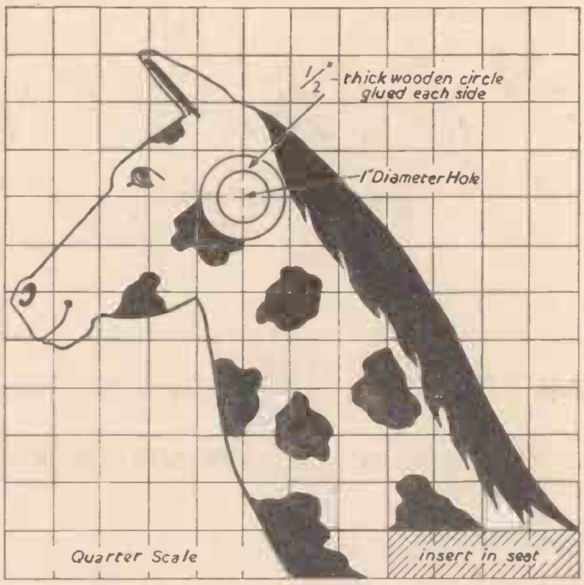
The head should now be cut from ½in. plywood as in Fig. 9. Cut the 1in. dia. hole in the position indicated.

Cut two discs of ½in. plywood as shown and cut a 1in. dia. hole in each. Glue these discs on each side of the hole in the horse's head and insert and glue a 7in. length of 1in. dowel.

Smooth down the edges of the head with sandpaper and fit it into the slot in the seat. Glue with a good, hard-setting glue. Screw the conduit fixing saddles up tightly.

The head should be painted white or brown with black markings and the seat and footrests any bright colour. The exterior quality conduit is galvanised, and therefore is a reasonable silver colour and should be left unpainted.

Readers may prefer to use their own conception of a horse's head, but it is most important that the horse's ears should point well forward as an upright ear would be most dangerous.



A Simple Gas Blowpipe

Simple Apparatus for Small Work

THE simplest form of blowpipe is that used by jewellers. It is simply a tube with a mouthpiece at one end and a jet at the other, the jet is held near the flame of a spirit lamp and on blowing into the mouthpiece a needle-like flame is produced which is well suited to small work (see Fig. 1).

For model making, however, something a little more powerful is required, without going to the other extreme and using equipment such as treadle-bellows-operated blowpipes suitable for heavy brazing, etc.

The blowpipe described below and shown in Fig. 2 is quite simple to make and will prove a useful addition to the amateur mechanic's workshop.

The materials required are:
6in. thin brass tube, ⅜in. diameter.
4in. thin brass tube, ⅛in. diameter.
A ⅛in. gas tap with rubber pipe connection.
Rubber tubing to suit requirements.

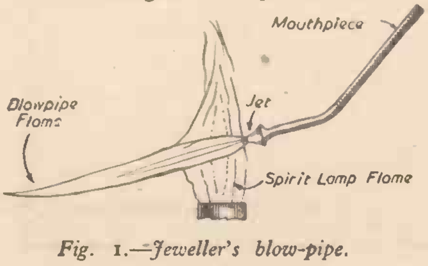


Fig. 1.—Jeweller's blow-pipe.

Bending the Tube

First take the ⅜in. tube and file a deep nick into it, nearly through the tube, at an angle of about 45 deg. as shown in Fig. 3. Bend the tube as shown by the dotted lines until the nick is closed up again, and solder up the gap with a soldering iron and soft solder. Silver solder would be better, of course, but the blowpipe itself does not get hot enough to melt the soft-soldered joint. Now file down the threaded end of the tap until it will just push into the longer end of the bent ⅜in. pipe (see Fig. 3 again), and solder the tap into the tube, taking care to make the joint gas tight.

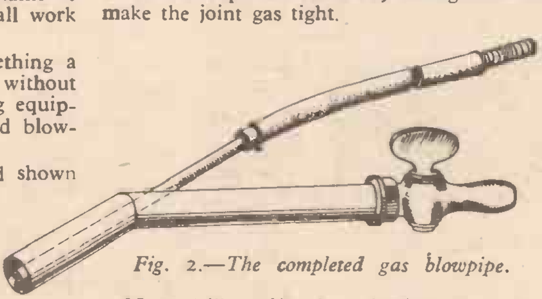


Fig. 2.—The completed gas blowpipe.

Next drill a ⅛in. hole behind the bend and in line with the centre of the short end of the ⅜in. tube, push the ⅛in. tube into this hole until the end is just inside the end of the ⅜in. tube and central with it, and solder in position. Reference to Fig. 2 will make this clear. The blowpipe is then finished.

The angle between the small pipe and the large one forms a hook to hang the implement up by. To use it, connect a rubber tube about 1ft. long on the ⅛in. tube and fit a small tubular piece of bamboo cane about 3in. long in the other end.

The tap should be connected by a piece of rubber or flexible metallic tubing to a gas jet. The size of the flame is regulated by the tap and the air jet is controlled by blowing hard or gently.

A Handy Tool

A soldering iron in the accepted sense of the term is not required with a blowpipe, of course, but a little "poker" like Fig. 4, is a very handy thing to use. It is made of a piece of ⅛in. copper wire pushed into a bradawl handle, the tip of the wire being pointed, bent as illustrated and tinned in the same way as an ordinary soldering iron.

Hold the blowpipe in the left hand, the poker in the right and grip the wooden mouthpiece between the teeth. The poker should be fairly long, say, about 6in. so that you do not inadvertently blow the flame on to the fingers as you might do with a short poker. With a little practice you will find you can pick up little blobs of molten solder on the poker and apply them where required. Flux can be applied in the same manner; it does not matter about cooling the poker by dipping it into the flux, as being so small it heats up again immediately it enters the flame. The solder will run like water if the work is clean, provided with flux, and hot enough.

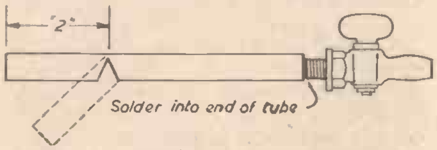


Fig. 3.—Making the 45 deg. bend.

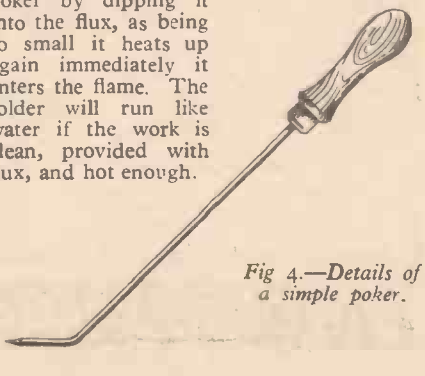
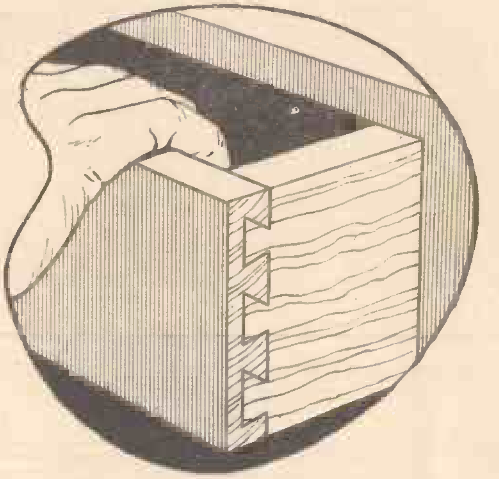


Fig 4.—Details of a simple poker.

Woodworking Joints

No. 3 of a Short Series—The Dovetail

By W. J. Stannage



THE dovetail joint, of which there are several variations, calls for careful cutting and precise marking out if the joint is to fit together as it should. However, if these two points are kept in mind, and the job is not rushed, perfect workmanship can result.

Fig. 1 shows an end view of a housed or housing dovetail such as could be used when fitting a shelf in a bookcase. Both dovetail and housing run unbroken for the complete length of the timber and cutting is quite simple if the following method is followed.

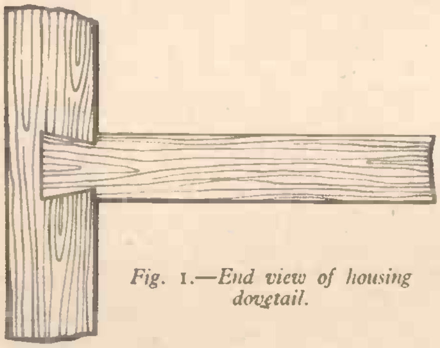


Fig. 1.—End view of housing dovetail.

Cutting the Housing

Fig. 2 shows how the housing is cut with the aid of a fence. This is simply a length of fairly thick timber, one side of which is planed away to the required slope. The fence is now clamped in place across the width of the timber directly over one side of the housing, but making provision for the width of the saw cut. The tenon saw is used to make the cut, and it is held against the slope of the fence, thus guiding it at the required angle. The cut is continued to the base of the housing and the fence is then reversed, again clamped in place, and the other side of the housing cut.

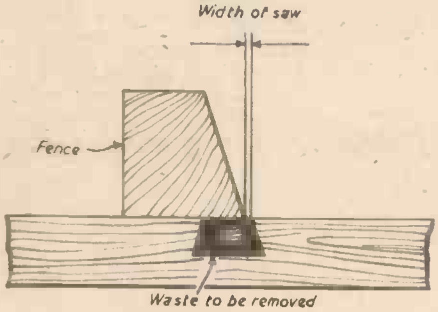


Fig. 2.—Set up for sawing the housing.

Cutting the Dovetail

The dovetail which fits into the housing is set out as shown in Fig. 3. The marking gauge or mortise gauge is used to mark off the width of the dovetail across the end of the timber which, of course, must be perfectly square. The shoulder line is now marked off, this being equal to the depth of the housing, and finally the slope of the dovetail is set out on each side. The shaded portions in the sketch denote the timber that will be removed. The three stages of the removal of this waste are seen in Fig. 4. First a notch is cut with a chisel along each shoulder line, as described in a previous article. Its purpose is to act as a guide to the saw. The saw cuts are then made down to the lines as shown in the second stage. The third operation is to use a sharp chisel to cut away the unwanted timber. When the chisel is to hand, it is again employed to remove the waste material from the housing. If the reader possesses a router this can be used for levelling off the base of the housing, but this is not strictly necessary as careful use of the chisel will produce the desired result.

The Slope of the Dovetail

In some woodworking instructions the slope is given as a definite figure such as one-in-eight, or perhaps one-in-seven. Fig. 5 shows such figures in more practical form, but in this case the slope is one-in-six. It will be seen at "A" that a 6in. × 1in. piece of thin metal has been marked off with a line running from corner to corner. The shaded material is cut away so giving a triangle. The sloping side of this triangle is the slope of the dovetail. If we refer again to the fence shown in Fig. 2 it will be obvious that this template can be set against the end of the timber and the slope marked off thus giving guide lines to which the wood is planed.

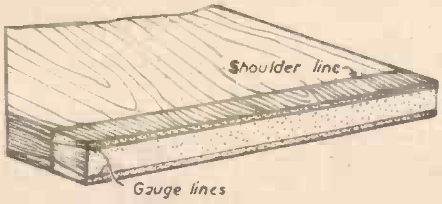


Fig. 3.—Dovetail marked off for cutting.

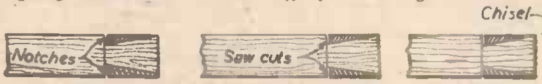


Fig. 4.—Three stages in cutting a dovetail.

A Through Dovetail

However, for the making of the more common type of dovetails a second template is an advantage, and this also is seen in Fig. 5. It consists of another piece of thin metal of the required length and width, bent to the shape of the letter "L." With the aid of the first template the slope of each side of the dovetail is marked off as seen, and the unwanted material cut away.

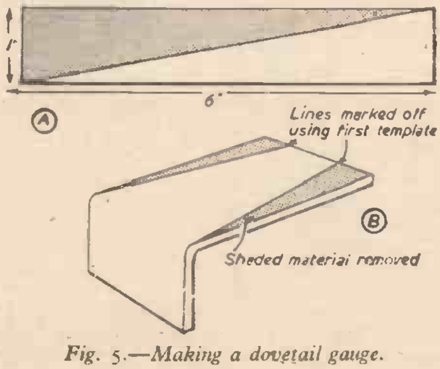


Fig. 5.—Making a dovetail gauge.

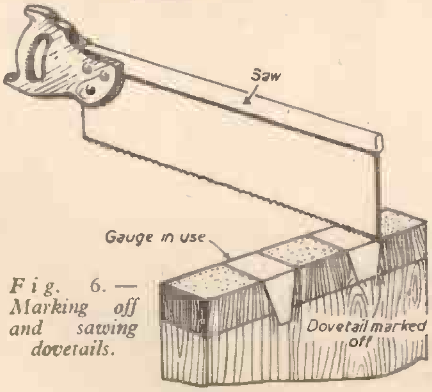


Fig. 6.—Marking off and sawing dovetails.

This template, or gauge, is used as seen in Fig. 6 which shows it placed over the end of the wood to enable the position and size of the dovetail to be marked off. The illustration shows the gauge in use and a dovetail marked off with its aid. A tenon saw is used to cut down each side of the dovetail, taking care to keep the saw cuts to the outside, or waste side of the lines. The saw is also used to cut in from the ends of the timber, so removing as much of the material as possible. The job will now appear as shown in Fig. 7, with only the waste material between the dovetails remaining.

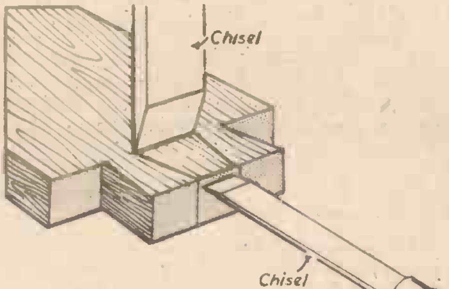


Fig. 7.—Chopping waste.

This remaining material is removed with the chisel as shown. The chisel is first used to cut down a fairly deep notch back at the shoulder line and is then brought into use from the end to remove a chip of the wood. Cutting is then resumed at the shoulder line to cut a fresh notch and the chisel is again used at the end. From this it will be seen that no attempt is made to cut a very deep notch at one operation as this could not be accurately controlled. When the half-way stage is reached the timber can be reversed and chopping commenced anew from the new face thus presented.

Marking the Sockets

When the dovetails have been cut in this manner the sockets which receive them must be marked off. This is done by clamping the timber to be marked in the vice and holding

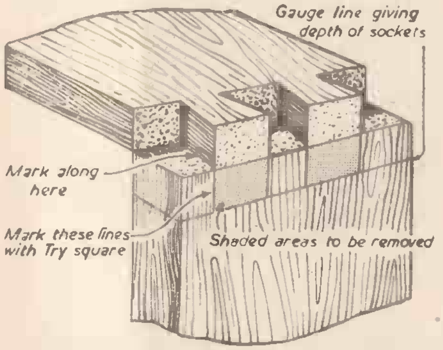


Fig. 8.—Sockets being marked off.

the dovetails in position where they serve as templates and can be marked around to give the exact locations of the sockets. Fig. 8 depicts this operation. However, this marking only gives the positions of the cuts on the end of the timber. The depth of the sockets is marked off with the gauge, and this measurement is equal to the thickness of the dovetails. The lines marked off from the actual dovetails and gauge line must be joined up to provide guide lines to be followed when sawing, and this operation is done with the aid of the try square. These lines are also shown in Fig. 8, and to clarify matters the waste material is again shaded.

The waste material is removed by chopping, after the tenon saw has been used to cut down the lines marked with the try-square, and the operation is similar to that shown in Fig. 7.

The Lapped Dovetail

The dovetail just described is known as a "through dovetail," the name denoting that the dovetails pass through the entire thickness of the timber. Another type of dovetail, shown in Fig. 9, is the "lapped dovetail" and it will be obvious that in this case the dovetail does not pass through the timber, but is hidden from view.

Construction of the lapped dovetail does not vary greatly from the making of the through variety except in the setting out. The first consideration must be the thickness of the actual lap as the marking gauge will be set to the thickness of the timber *less* the thickness of the lap. This figure represents the length of the dovetail also.

The cutting of the socket for this type of dovetail is carried out by holding the tenon saw at the required angle and cutting as deep as possible. It will be found that it is not possible to cut with the saw to the

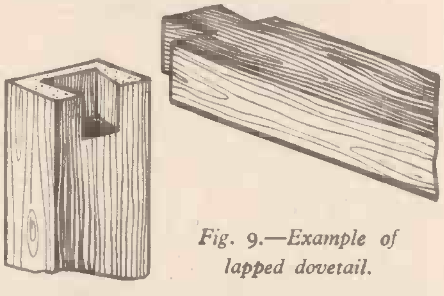


Fig. 9.—Example of lapped dovetail.

complete depth of the socket and the cutting will have to be completed with the chisel. This part of the job may appear to be tedious but is not so provided that a good edge is kept on the chisel.

When making dovetails it is not a good idea to try them together too often as such treatment is inclined to loosen them. Mark out carefully, cut carefully, and then knock together just to make sure that the fit is accurate. If made as they should be, a gentle tapping with the mallet is all that is required to drive them into place. If all is well take apart, apply the glue, and knock together again.

Simple Conjuring

These Tricks Will Baffle Your Friends

THE first thing you must learn in conjuring is palming. By that expression is meant that a small article such as a coin is gripped in the palm of the hand in such a way that the hand appears to be empty.

Take a coin in the right hand between the thumb and forefinger, and with the left hand make a motion of grasping the coin, the thumb being underneath and the fingers above (see Fig. 1). As you close your left hand, relax the pressure on the coin, letting it fall into the palm of the right hand, at the same time keeping your eyes fixed on your left hand to give the impression that the coin is in that hand. You then open the left hand and show your friend that the coin has disappeared. The best way to practise this trick is to do it in front of a mirror, at the same time remembering the following points:—

(1) When you appear to grasp the coin in your left hand it should be closed immediately.

(2) You must keep your eye on the left hand to give the impression that the coin has been transferred to it.

(3) The right hand after retaining the coin, should drop to your side without attention being drawn to it.

Simple Card Tricks

The following simple tricks are performed with an ordinary pack of playing cards.

To prepare the pack in readiness for the first trick, place all the red and all the black cards together. You then ask your friend to select a card, at the same time holding the pack so that he takes it from amongst the red ones. Then tell him to replace the selected card, but this time hold the pack so that it is replaced amongst the black cards. Upon glancing through the pack you will easily discern the selected red card from amongst all the black ones.

The Turned Card

Ask your friend to select a card and, while he is looking at it, face the bottom card of the pack and turn the pack over. You will now find that owing to the bottom card being faced, the pack, while appearing the same, has been reversed. Then ask your friend to slip the chosen card into the pack, taking care that the pack is carefully squared so that the cards do not overlap. A handkerchief should then be placed over the cards, and under cover of the latter, reface the bottom card and turn the pack over so that it is once more in its original position. Upon glancing through the pack the chosen card has apparently turned itself over.

Fig. 1.—Palming a coin.

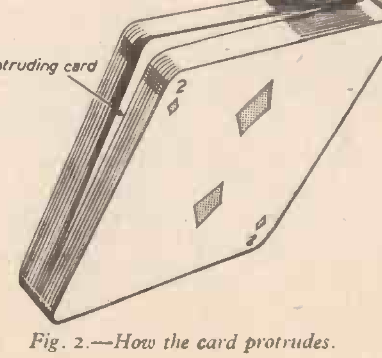


Fig. 2.—How the card protrudes.

Producing a Chosen Card

We now come to something slightly harder. For this trick prepare a discarded pack of cards in the following manner. Clamp the

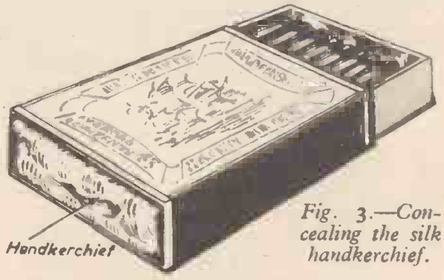


Fig. 3.—Concealing the silk handkerchief.

pack between two pieces of wood or a vice if available, leaving exposed a small margin on one side of the pack. Then sandpaper the exposed edge until one end is slightly narrower than the other. Now ask your friend to select a card, and while he is glancing at it turn the pack round. When the card is replaced you will find that it will protrude slightly (see Fig. 2). Shuffle the cards well, place them behind your back and run your fingers along the edge of the pack. You will then find the selected card.

The Mysterious Handkerchief

A candle is placed in a candlestick on the table, and a box of matches half open is placed beside them. In the empty space at the back of the match-box a silk handkerchief is placed (see Fig. 3). You now show both hands empty to your friends, then pick up the match-box and light the candle. As you close the match-box the handkerchief is pushed into your hand. Hold your hand in front of the candle and let the handkerchief expand, giving the impression that it has been produced from the rays of the candle.

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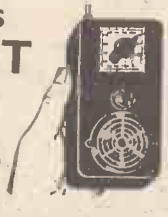

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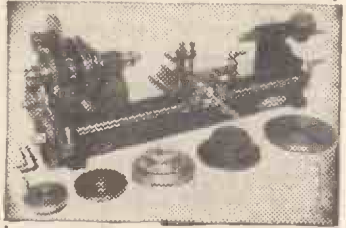

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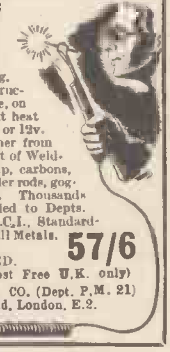

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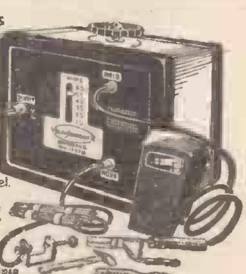

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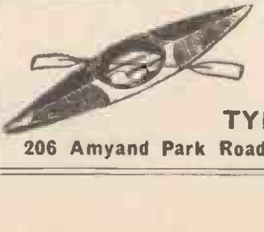

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To get the best results the hull must, of course, be light and hollow and the simplest way of achieving this is to build up the sides on to a base piece and a deck as shown in Fig. 1. The shape of these pieces is shown in the plan, Fig. 2, and it should be an easy task to enlarge to full size from the measurements given. The base piece might be either ⅜in. or ¼in. thick. Cut round with the fretsaw, and then use it as a template for marking out the deck. This deck piece will have the opening shown in Fig. 2 cut in it to form the cockpit. When the two pieces are cut they are held together at the bow and stern by two shaped blocks of wood, the bow block being 1¼in. deep and ⅜in. wide and the stern block ¾in. deep and 2½ in. wide. Glue and nail these blocks in place, the work at this stage being as shown in Fig. 3. The two sides of the hull are cut from 1/16in. plywood, or preferably from thin plain wood as plywood laminations may come apart should the moisture penetrate the paint on the outside.

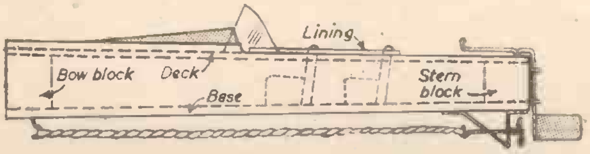


Fig. 1 (Left).—A side view showing construction.

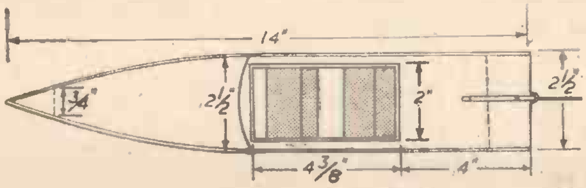


Fig. 2.—A plan view and dimensions.

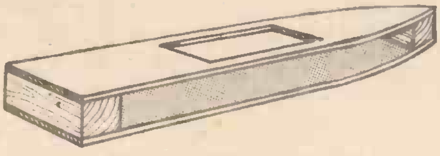


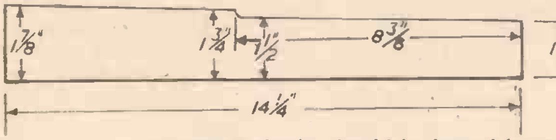
Fig. 3.—The boat before adding the sides.

The Sides

The correct shape for the sides is given in Fig. 4 and it must be noted from this diagram that the front top edge towards the bow is raised slightly so as to accommodate the spray hood, which is made from a piece of tinplate bent to shape and sprung between the sides. Both sides may be cut in one operation, thus assuring accuracy. For fixing, use glue and fine brass brads, the holes for the latter being carefully bored at close intervals and the glue brushed in between the veneer and the deck and base, a little at a time as the nailing proceeds.

Sandpaper off all the edges when the glue has set. To make the hull perfectly watertight and waterproof, it must have first a coating of red lead paint, followed by two coats of ordinary paint, a sufficient interval being allowed between each successive coat for thorough drying. A finishing coat of enamel should be given to the entire hull, including the top of the deck.

Fig. 4 (Right).—The shape of the sides.



The Brackets

To form the brackets to take the elastic drive, a hook and a 4½in. piece of stout strip brass will be required. The bow hook is screwed into the bow block as shown in Fig. 1. The rear bracket is made up as shown in Fig. 5. Holes must be drilled for the small round-headed screws which fix the bracket to the hull, and one through the double thickness of the metal where the wire passes to hold the elastic. Set the bracket in place and bore the holes for the screws before driving them in. Now cut off a piece of brass wire and at one end form a fairly large loop to take the elastic.

To form the propeller cut out from stout brass or tinplate the shape shown in Fig. 5.

To make a really strong job of the joint between the shaft and the propeller, a short brass sleeve, similar to that found on clock pinions, should be soldered to the latter. It is then passed over the shaft and soldered to it. Before putting on the propeller a glass bead should be threaded over the shaft; this helps to lessen the friction between the bracket and the propeller stem. Five strands, or more of elastic, should be looped between the brackets, the actual number of strands being determined by the thickness. The elastic should be of the same quality as that used for model aeroplanes and for preference ⅛in. wide and 1/32in. thick. Rub a little glycerine on the elastic before beginning to wind up as this helps to preserve it.

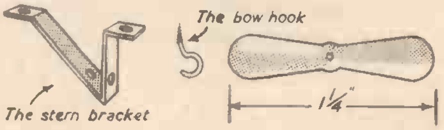


Fig. 5.—The bow hook and rear bracket.

The wood lining to the cockpit consists of thin mahogany bent round and tacked in place.

The seats are cut from pieces of scrap wood to fit in the cockpit as shown and the Perspex or celluloid windscreen can be glued in place. The rudder is made from wire, with a plate soldered on and is hung in screw eyes.

Try These on Your Friends!

Word Posers

1. What is the longest word in the English language? We do not mean a word like "smiles" (because it has a mile between the beginning and end).

2. What is the longest word you know containing only one syllable?

3. Give a word of one syllable which, when you shorten it by removing some of the letters, becomes a word of two syllables.

4. Write a sentence including all the letters of the alphabet, repeating as few letters as possible.

5. Give a word containing the five vowels in their correct order.

6. There is no such word as ENY. What letter can you put in front of it to make a word?

Answers

1. Floccinaucinihilipilification. This word figures in The Shorter Oxford English Dictionary.
2. Strengths (nine letters).
3. Plague becomes Ague.
4. The quick brown fox jumps over the lazy dog (nine repetitions).
5. Abstemious or Facetious.
6. D, making Deny.

Alphabetic Division

Can you supply the figures that are replaced by letters in the following division sum?

The Problem	The Answer
B7)DDBEF(GBD7	37)88319(2387
7J	74
EJB	143
EEE	111
BGE	321
GFK	296
GHF	259
GHF	259
...	...

In all sums of this type the greatest difficulty is getting a start. There is a valuable clue in the present example; it is that B7 × B = EEE. The full working is shown above.

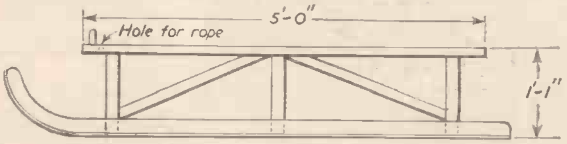
Letters to the Editor

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

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

SLEDGE DESIGN

SIR,—The sledge illustrated in the December issue could have been much better designed. Sledges as used in rough conditions, i.e., uneven slopes, may strike projections in the ground, or tree roots, etc., in which case the legs of the sledge illustrated by you would break off at the roots if a child of any weight were on the top.



Mr. P. Brown's improvements to the sledge design in our December issue.

Leg construction along the lines of force reaction as shown would give an immense strength against end loading, and support the same top weight.—R. BUDD (Warwicks).

Space Station Construction

SIR,—Regarding Mr. Green's letter on "Space Station Construction" in the February issue. He is rather badly at fault in what he says concerning the shifting of masses. He states, in brief, that if a mass is large—then a large force is necessary to move it.

Your correspondent could prove the falsity of this without going out into space. Figure a mass of, say, 20 tons, hanging motionless at the end of a chain some 20ft. in length. In the most literal sense, a small child could set this ponderous weight a-swinging. And, once in motion, additional small impulses would speed it up if so desired. Forces of an equally trivial order would suffice to arrest its motion.

Out in space this swing is replaced, of couse, by a continuous forward motion. It is true that if the pushing agent is of inconsiderable mass it must recoil very rapidly. To stop its travel, this agent would have to be equipped with a jet reaction-device. Incidentally, we should not overlook the fact that these auxiliaries could be fitted to the mass itself (limpet-fashion, perhaps) to give it an impulse.

Finally, for the *assembling*, winches and blocks instead of being an aid could prove an intolerable nuisance. At least, this would be true in the early stages. At a later occasion, when the vehicle was being rotated and artificial gravity generated, these adjuncts might render good service.—P. BOWN (Northampton).

A PISTON PROBLEM

SIR,—Re "A Piston Problem" in your January issue of PRACTICAL MECHANICS, may I offer another interpretation of the problem?

Accepting the provision that the crankshaft rotation is maintained at a constant *angular velocity*, and by eliminating the usual linkage of crank pin to piston and replacing it with what is called the infinite connecting rod as shown in the sketch, we are able to clear the problem of an extraneous side issue, viz., the influence due to connecting-rod oscillation.

By the sketch it is obvious that, at the half-stroke positions on line A-A', the velocity of crank pin must be equal to that of the piston, and on approaching top and bottom of stroke on line B-B' there must be a great difference between the crank pin and piston *vertical* velocities.

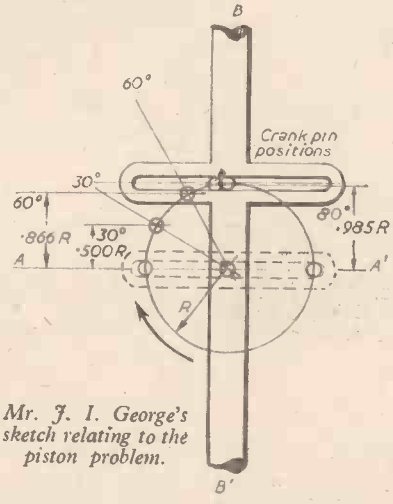
Reference to trigonometrical tables of sines will provide the clue to what is happening as the crank pin rotates through each quadrant of its revolution.

Let us assume a clockwise direction of rotation starting from A in the left-hand upper quadrant and tabulate the ratios as under:—

Angular posn.	Vertical distance	Differences	
A 0°	A 0	0	
1°	.01745 × R	.01745	.17365 Piston travel in first 10°.
10°	.17365 × R	.15620	
20°	.34202 × R	.16837	
30°	.50000 × R	.15798	
40°	.64279 × R	.14279	
50°	.76604 × R	.12325	
60°	.86603 × R	.09999	
70°	.93969 × R	.07366	
80°	.98481 × R	.04512	
89°	.99985 × R	.01504	.01519 Piston travel in last 10°.
B 90°	1.00000 × R	.00015	

From the above figures it will be obvious that the piston velocity is gradually, but constantly, declining in value—a consideration which governs the entire problem, as this value gradually falls to zero.

The ratio of these values at 0-10 deg. and at 80-90 deg. is 11.433 to 1, and again at 0-1 deg. to 89-90 deg. has risen to 117.67 to 1, which shows the great falling off in piston travel at extreme ends of two alternate quadrants, with an equivalent gain in the remaining alternate pair.



Mr. J. I. George's sketch relating to the piston problem.

To obtain the actual distances travelled by the piston it is, of course, necessary to give a definite value to "R," the crank radius.—J. I. GEORGE (Brighton).

Institute for Inventors

SIR,—We believe that many of your readers would be interested in this Institute's efforts to introduce the inventors of new products and new techniques to manufacturers. The need for such a service has never been greater in this country which faces unprecedented competition overseas as a nation and whose individual manufacturers are in ever keener mutual competition.

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(Continued on page 355)

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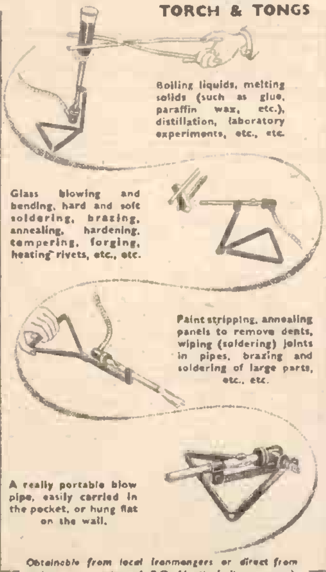

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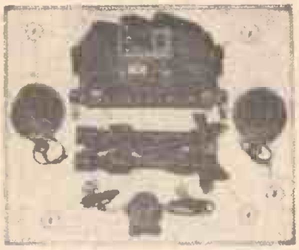

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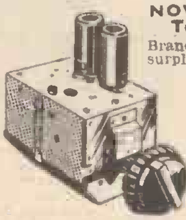

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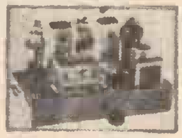
BEGINNER'S SUPERHET



All the components including metal chassis, valves, metal rectifier, coils, tuning condenser, etc., etc., required to build the "Beginner's Superhet" as described in the January issue of "Practical Wireless" are available as a parcel. Price £3. plus 3/- post and insurance.

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Suitable Wales, London, Midlands, North, Scotland, etc. All the parts including 2 EF80 valves, coils, fine tuner, contrast control, condensers and resistors. (Metal case available as an extra.) Price only 19/6, plus 2/6 post and insurance. Data free with parts or available separately 1/6.

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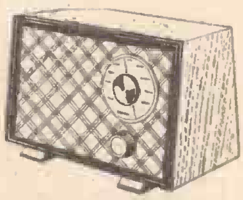

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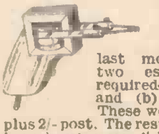

A 7-second solder gun of the type costing £3-£4 was described in last month's issue. Only two essential parts are required—(a) the transformer and (b) the push switch. These we can supply at 13/6, plus 2/- post. The rest of the parts you will have in your own "junk" box. Copy of the article concerned given free with the kit.

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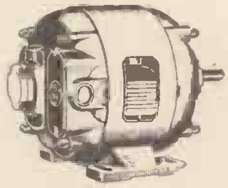

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an intermediary, providing a common meeting place for these two vital arms of industry. It is a task which urgently needs to be expanded and one which can be undertaken satisfactorily only by an impartial and non profit-making organisation, which is indeed what we are.—Gen. Sec., INSTITUTE OF PATENTEES AND INVENTORS.

Telescope Mirror Making

SIR,—Re the article on "Telescope Mirror Making" by J. Parker in the January issue, may I pass on a few hints?

It is quite unnecessary to put a handle on the back of the mirror. I notice Mr. Parker takes it off for polishing. It is far better to work without it right from the start. Also the thickness of both tool and mirror should be not less than 1/6 of the diameter, due to the fact that thinner glass is inclined to bend while being worked.

Grinding is done more quickly if you use only the following grades of carborundum: grade 80 or 100 for roughing out and obtaining the approximate shape, grade FFF for removing pits left from grade 80 and trueing up. Carborundum Aloxite, Superfine Optical Smoothing Powder as a pre-polishing grade, which quickly removes the pits left by FFF, and is then used to get perfect contact by means of the pencil-line test.

Roughing out the curve to the required depth for a 6in. F/8 mirror takes 15-20 minutes. Widening the curve to the edge of the mirror and making the mirror roughly spherical takes another 20 minutes. Change to grade FFF, etc. The whole process of grinding takes about 3 hours in the case of an F/8 mirror, when it will be ready for polishing.

To save a lot of scrubbing when changing grades use instead a sheet of polythene, which will keep the workbench clean. Each sheet is taken off carefully and thrown away.

These grinding powders need not be labelled since the difference in grain size is obvious to anybody.

The grinding action is carried out by using the circular stroke. Full length stroke at first and ⅓ stroke from then on. With this stroke it is not necessary to walk around the work-table, and so a sturdy workbench may be used. Even in polishing I have never yet found it necessary to walk around the table. To speed grinding, tool and mirror are inverted after every wet while using ⅓ strokes.

The depth in the centre of the mirror is found by the simple formula $S = \frac{r^2}{R_2}$ where S is the depth, r is the radius of the mirror, R is the radius of curvature. For a 6in. F/8 this works out to $\pm$.047in. and may be measured exactly by standing a straightedge across the mirror and inserting engineer's feeler gauges between mirror and straightedge. This method is very quick and exact but must not be used in later stages, since it is liable to scratch a "fined" surface. However, the curve should not alter during fine-grinding. To inspect the mirror for pits, hold it face up to a bright light and look through the back. Pits will stand out as bright specks.

The mirror is ready for polishing when an ordinary window frame is clearly seen through the mirror at a distance of 6ft. or more. The reflection test, as described, is unnecessary.—HEIN OTTENS (Durban).

H. M. Sell Retires

MR. H. M. SELL, manager of the London branch of the famous firm of Bassett Lowke Ltd., makers of scale models, has retired after 45 years' service. After having joined the company in 1913 he served his apprenticeship as an engineer and, apart from the period of Army service in 1914-18 war, has been continually at the London branch.

The late Mr. W. J. Bassett Lowke and Mr. H. M. Sell were old friends of the writer. They were both known throughout the model-making world, and certainly every model-maker in this country must at one time or another have met Mr. Sell either in the shop or at exhibitions.

Mr. H. M. Sell.

During his 45 years he has met and negotiated business with people from all walks of life, including many colourful personalities from abroad. His cheerful and alert personality is well known, and his wide knowledge of the model industry is unique.

Bassett Lowke have had their London office for 49 years, and Mr. Sell was the last of three managers during that period. He is succeeded by Mr. R. D. Dimock, another man long experienced in the model trade.

F. J. C.

Dirt and Damp-proofing

SIR,—May I offer some suggestions for the benefit of Mr. A. Armstrong (Fife), "Dirt and Damp-proofing Charts," February, 1958, page 257.

I had the same problem in my workshops and solved it by using the products of a firm specialising in transparent covering materials, Ians, Ltd., Quay Buildings, Newcastle-on-Tyne.

For large wall charts I obtained some of their acetate sheet and made a number of "envelopes" consisting of a thick cardboard back, acetate sheet front and bound round three sides with adhesive cloth tape. The charts are slipped in as required. Hanging them by Bulldog clips and drawing pins is less destructive than putting pins direct into the charts.

I also use this material for completely covering notice boards in the workshop.

Also sold by the above firm is some smaller blue-tint transparent sheet which is suitable for making into holders for drawings and process sheets. If Mr. Armstrong can obtain some sheet of X-ray negatives he will find that the chemical deposit can be dissolved off in warm water and the clear sheets can then be used for making drawing envelopes.

If a more permanent covering for drawings is required, use a transparent self-adhesive material that is pressed on with an iron. I paste the drawings on to cardboard, cover with this material and then as the most vulnerable part is likely to be the edges, bind with cloth tape. The result is a drawing impervious to oil and dirt; one that will stand up to regular workshop use.—W. DUXBURY (Birmingham).

PUZZLE CORNER

Why Two Engines?

IT is obvious that when two engines are drawing a train the pulling power of the two is twice as much as one. Yet it is impossible to get the two engines to run at exactly the same speed. If one engine goes faster than the other it pushes or pulls the slower one in addition to the train itself. Therefore, what is the point of having two engines?

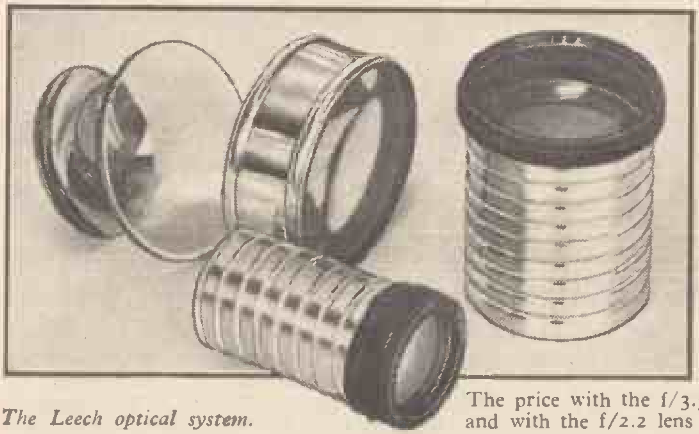
Answer. The fallacy lies in the assumption that it is impossible to balance the speeds of the two engines, and that no allowance has been made for a slight difference in speeds. In a good many cases, the coupling between the two engines is made specially extensible, so that when, say, the leading engine increases its speed, it elongates the coupling which assumes normal when the second engine reaches the speed of the first. If the two engines are exactly identical and travelling at the same speed, each does half the work, but the moment the leading one goes a little faster, the whole train accelerates. The slower engine is thus relieved of some of its effort in drawing the train and uses the released power in increasing its speed. Of course, the difference in speeds must be very slight, and of short duration. When the mean speeds are the same, the mechanical forces just described adjust slight differences in speed.

TRADE NOTES

A Review of New Tools, Equipment, etc.

PROJECTOR OPTICAL SYSTEM

FROM the Hummel Optical Co., Ltd., New House, 67-68, Hatton Garden, London, E.C.1, come details of a complete optical system for incorporation in a 2in. × 2in. projector. It is supplied complete with an assembly drawing and includes either a f/3.5 lens or a f/2.2 lens (both of 4in. focus), a mounted condenser, a heat filter and a metal mirror It is marketed under the trade name Leech, and should be of great interest to the colour transparency enthusiast. The price with the f/3.5 lens is £6 13s. 9d. and with the f/2.2 lens £8 6s. 9d.



The Leech optical system.

Adjustable Step Blocks

THE adjustable step blocks shown in the photograph are designed to avoid the use of shims, clamps and solid blocks when clamping parts for machining. The blocks are available in different heights, all with

Adjustable step blocks.

the same sized meshing serrations, so that they are fully interchangeable. The interlocking as can be seen from the photograph gives added security compared with flat steps. The blocks are made of case-hardened, tempered steel to a tolerance of .004in. and can be used with all types of machine tools. Prices per block range from 3s. to 19s. and they are also available in sets. Full details are available from Insley Industrial Supply Co., Ltd., 21-22, Poland Street, London, W.1.

Stanley Hammers

THESE well-known hammers are to become available in this country soon. Initial production will be of a range of claw hammers from 16oz. to 24oz.

Handles are made from specially selected straight-grained white hickory, shaped to fit the hand. Special steel is used for the heads, and the face and neck are hardened and tempered to prevent chipping. The heads are secured to the handles by a special process which entails the pre-shrinking of the ends of the handles and the use of special wedges, and double tapered eye sockets. The triple wedged head is required to withstand a 2 ton straight pull test.

Metal Protecting Paint

AUTO-GRADE GLOPANE NEVERUST is a radical development of the Standard Glopane Zinc-rich paint and conveys a degree of protection comparable with that obtainable from hot dipped galvanising processes. Unlike standard grades of Glopane, however, the new material has a considerably increased tolerance of heat and temperatures well in excess of boiling water can be withstood indefinitely.

Glopane Neverust Auto-grade is a two part self curing material. It is supplied in the form of a zinc paste together with an activator packed separately.

When applied, the dry film acts in precisely the same way as does a hot galvanised coating and has an extremely tenacious hold upon base metal in addition to its characteristics of great hardness, resistance to heat and complete imperviousness to the solvent action of such liquors as petroleum, kerosene, cellulose paints, oils and greases.

This new material is stocked by most garages and ironmongers and is packed in cartons containing sufficient material to treat 30 sq. ft. of surface, retailing at 10s. per carton.

Distributors are J. H. Sankey & Son, Ltd., Essex Works, Ripple Road, Barking, Essex.

PLIABLE METAL SLOTTED STRIP

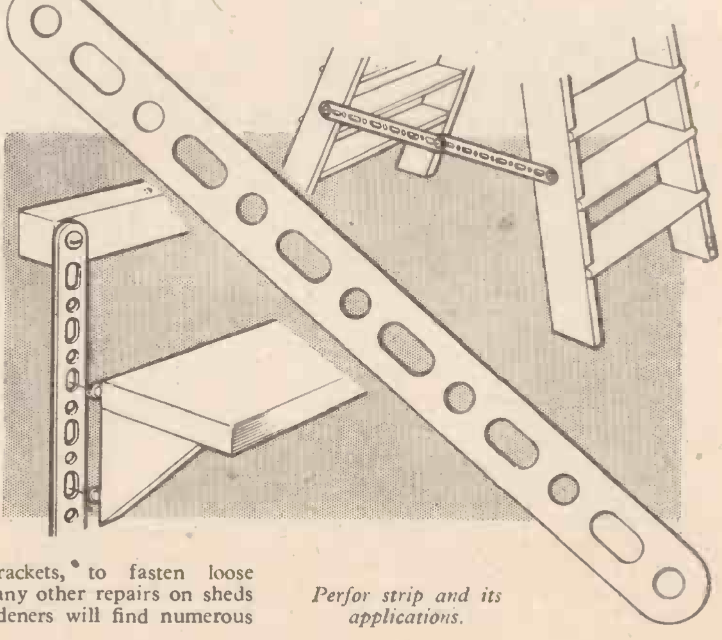
Perfor Strip

A NEW material of great use to the handyman is now being manufactured by Silencers (Bolton) Ltd., Waterloo Street, Bolton. It is known as Perfor strip and is a pliable metal slotted strip made in either 12in. or 24in. lengths. Conveniently slotted along the whole of its length, it can be readily joined together or fixed in any position. The main quality of Perfor strip is, however, the fact that it can be easily bent to form awkward shaped brackets or stays.

Applications for this material are almost endless; the motorist, for example, can use it for such jobs as making exhaust pipe brackets, number plate brackets and fixing car wings to the body. The householder who does his own repair jobs can use it to make shelf brackets, to repair broken step ladders, etc., etc. It can be used in the workshop to make tool racks, and to repair work benches. Out of doors it can be used to repair fencing or gates, for making gutter brackets, to fasten loose timbers and for many other repairs on sheds and garages. Gardeners will find numerous applications for Perfor strip in the repair of greenhouses, summerhouses, and garden frames, whilst a possible use would be for garden cloche clips. Farmers would find it particularly useful for repairs to henhouses, doors, water troughs, gutters, gates and fences.

These are just a few of the uses to which Perfor strip can be put, and many more will occur to the man who is in the habit of doing his own repairs. It is packed in boxes of a dozen strips: the 12in. length retailing at 16s. and the 24in. at 26s.

The sketch below gives some examples of the types of use to which this material can be put.



Perfor strip and its applications.

Your Queries Answered

A Lathe Fault

PLEASE advise me re a 6in. Centre lathe. The trouble is "back taper" when turning a bar held by chuck. This is nearly .004in. in 6in. The headstock, geared type, is in fairly good condition (i.e. bearings), but since the lathe bed is of an irregular pattern, a method of setting it over is not readily apparent. How can I remedy the fault?—W. G. West (London, N.22).

THIS error has been caused by either re-planing the bed incorrectly or the headstock casting being rebored when fitting new bushes; the latter is probably the real cause of the misalignment. The only practical solution is once again to bore the holes, if there is no form of adjustment to overcome this problem. We must point out that this work is a matter for a machinist with some degree of skill and the necessary machine for the task. If you do not possess either of these, then you may unfortunately, again clamp the headstock in position and find that the error has increased.

Boring with headstock casting already on the bed is no doubt the best way to correct such a misalignment, and if you can arrange a boring head taking the drive from a countershaft, and if care is taken to see the bar is really rigid, then you can bore the holes in this manner. New bushes complete the work.

Pottery Painting

I WISH to paint pottery as a handicraft, prior to final firing, and I shall be greatly obliged if you can tell me how to make up a suitable oil for mixing the colour powder and the name of any proprietory oil which can be bought in suitably small quantities.—C. F. Taylor (Gateshead).

THE medium with which to mix the colour powder is fat oil of turpentine and it will probably need to be thinned with ordinary turpentine. Fat oil may be so thick that it cannot be worked without thinning. You could make it yourself by pouring some best quality turps (from a chemist) into a saucer and exposing it to sunlight for a couple of weeks in the open air. You can get it in a bottle from a wholesale chemist or from James Hetley & Co., 35, Soho Square, London. We know of no other oil which would be suitable but some colours, especially opaque pigments, can be applied mixed with ordinary gum arabic. Just sufficient of the gum should be used to bind the colour together. However, the gum is chiefly employed for glass painting stained glass windows.

Cement for Floor Tiles

I HAVE a number of rubber or rubber type floor tiles which I wish to stick down to a concrete floor.

Could you give me a suitable formula for a mastic or cement?—R. Osborne (Co. Durham).

CASEIN mixed with sodium silicate and lime makes an efficient adhesive mixture for rubber to stoneware. Dried casein is soaked in an equal weight of water for two hours. The casein swells, then the sod. silicate and lime is stirred into the requisite consistency.

QUERY SERVICE RULES

A stamped, addressed envelope, a sixpenny, crossed postal order, and the query coupon from the current issue, which appears on the inside of back cover, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Treating Thatch

CAN you give me a formula for a solution with fireproofing and insect killing properties as used on thatched roofs.—H. Morris (Surrey).

A SOLUTION which Rural Industries, Bureau, advise as suitable for fireproofing *straw* is as follows:—
28lb. ammonium sulphate.
14lb. ammonium carbonate lump.
7lb. borax lump.
7lb. boracic acid.
14lb. alum lump.
To render this insect killing we suggest the addition of 5lb. of copper sulphate (or alternatively, 5 per cent. cuprinol).

Dissolve the above in 50 gallons of water. Soak the straw in this solution and allow to drain over a tank on slats for three hours. This quantity will proof 500 sq. ft. of thatch.

Proportional Compasses

I WAS recently shown an old pair of proportional dividers. They bore, besides the usual "Line" scale, three scales marked "Circles," "Planes" and "Solids," respectively. Could you tell me how these last three scales are used?—D. Walsh (Barking).

THE four scales on the Proportional Compasses are as follows:—Lines: The index gives the proportion between length of the long and short legs of the compass and the proportionate distances between the points.

Planes or Plans; Index gives proportion between the long and short legs, arranged to equal the square root of the index number so that should you set the plan index to three and open the long legs to the length of side of a square the other legs will give the length of a square of one third the area.

Solids: The index divides the length of the legs in proportion to the cube root of the index numbers. Should you set solid index to three the long legs being set to the length of the sides of, say, a tank, the other legs will give the length of sides of a tank of one third the capacity.

Circles: For polygons. The index is set to give the correct length of side when the long legs are opened to the length of radius of the circle circumscribing the polygon. The index setting being equal to the number of sides required of the polygon.

Copper Mirrors

I AM interested in making a copper deposit on glass chemically, and have been experimenting with this for some time, using a formula of copper sulphate, Rochelle salts and sodium monoxide, and using formaldehyde as a reducing agent. Of course, the glass has to be weakly silvered (completely transparent) with silver nitrate for the copper to take to, but after a time I find the formaldehyde develops hydrogen. This penetrates the copper deposit and results in blistering and pin holes; also the mirror reflection is uneven. Could you suggest a different formula (preferably without having to weakly silver the glass first)?—S. Watkins (Bournemouth).

IT is probable that the pinholes are due to one or two causes. Either the glass plate has not been *perfectly* cleaned, or the chemicals used (in particular the copper sulphate) are not absolutely pure. It is essential that the copper sulphate be of "Analytical Reagent" purity. Normal copper sulphate contains iron sulphate as an impurity and this would certainly interfere with the deposition of copper.

To prepare the glass plate for silvering, first immerse in strong nitric acid for a few minutes, and then transfer to a solution of chromic acid in dilute sulphuric acid (50 gms. of chromic acid in 300 cc.s. of dilute sulphuric acid). The plate is next washed in alcohol and rinsed in distilled water. The plate may be dried, but it is preferable to keep it in distilled water until required.

The method used by you is probably the most satisfactory for the deposition of copper. As an alternative to the use of formaldehyde as a reducing agent, metallic zinc in contact with the silvered face of the mirror could be tried. It is known that this method works quite well for the production of copper films on iron and steel.

The following methods will, under certain conditions, produce a deposit of metallic copper and are suggested as bases for experiment, but it is not known whether they will produce results acceptable for the purpose required. In both cases a preliminary thin film of silver would almost certainly be necessary.

(1) A concentrated solution of copper sulphate is heated with a very strong solution of sugar.

(2) A concentrated solution of copper sulphate is treated with a 1 per cent. solution of hydroxylamine hydrochloride.

Simple chemical methods for the production of metallic films have never proved entirely satisfactory and have been superseded to a large extent by the method of evaporation of the metal in a vacuum. This latter process gives excellent results with a great many metals. Its main drawback is the high initial cost of the apparatus required. If only a small number of "copper mirrors" are to be prepared, this high cost would make the process uneconomical. On the other hand, if large scale production is envisaged, it might be worth investigating.

"Flamboyant" Finish

I WISH to renovate my cycle and to finish it in "flamboyant" finish. Could you inform me where I can obtain the necessary enamel and the method of application. I have a small spray plant if necessary or can it be applied with a brush?—P. C. H. Coupland (Glam.).

THE "flamboyant" cycle finishes to which you refer are usually composed of a dyed aluminium powder dispersed in a clear transparent lacquer. They are readily applied to clean metal surfaces by means of a brush, and they can be applied in one or more coats according to the effect desired. You can obtain these paints from almost any cycle dealer.

Fireproofing Fabric

PLEASE inform me of the best method of rendering cotton fabrics fireproof.—H. Wilkinson (Halifax).

THERE are a number of different fireproofing substances, all of which are easy to apply to cotton fabric. Among the best is ammonium chloride, ammonium phosphate, alum, borax, boric acid, calcium chloride, magnesium chloride, stannous chloride, sodium silicate and sodium tungstate. Any of these materials may be used either singly or in admixture, five parts of the chemical being dissolved in 95 parts of water and the fabric being immersed for about 15 hours in the resulting solution, afterwards being hung out to dry without rinsing. Alum is very often used for the purpose, but sodium tungstate has gained the best reputation as a fireproofer.

A good mixture is the following:

Ammonium chloride (sal ammoniac), 15 parts; boric acid, 6 parts; borax, 3 parts; water, 100 parts.

The water is heated to near boiling point and the ingredients are dissolved in it. This is a particularly cheap fireproofer, but it has a tendency (like many others) to make the fabric or fibre coarse and harsh to the touch.

Barometer Overhaul

CAN you please tell me how to remove an air bubble from a simple type mercury barometer? Information on the overhaul and adjustment of such an instrument would be appreciated.—P. Bayne (Norwich).

THE mercury should be removed, washed in detergent and water in a china bowl. It should then be washed in benzene, allowed to dry thoroughly and if not perfectly clear washed with nitric acid. Wash with distilled water finally in any event. Solid particles may be removed on a filter paper or by repeated pouring from one vessel to another, when they will adhere to the sides.

The barometer tube is very difficult to clean. The above materials used one at a time will dissolve practically all known impurities and will not attack the glass. The "U" tube type of barometer is especially hard to deal with in this respect. Finally rinse with alcohol and place the tube in boiling water, but do not allow any water to enter the tube. The alcohol will boil away. The alcohol vapour left will diffuse out of the tube if it is cooled and heated alternately about twenty times.

Filling a Barometer is easy on the type where the tube is a separate part but where the containing vessel and the tube are in one ("U" tube type) it is difficult.

Filling the Separate Tube Type.—Invert tube and place in the top a thistle funnel previously drawn out to a capillary tube. Pour in the *clean dry* mercury until the tube is full. Now you may place your finger over the end and invert the tube ensuring that no air bubbles rise from your finger's position. When the end is in the container of mercury remove the finger gently. The column will drop to about 760 mm. If air entered as you removed your finger you must start again.

If there is no room to get your finger into the containing vessel, fit a long but small rubber bung into the tube. This may be removed by using small forceps under mercury level. Alternatively a small steel wire bent at right angles near the end fitted with a metal plate covered with a rubber pad my be held tightly over the end of the tube until it is under mecury level.

Filling the "U" Tube Type.—Place the tube in this position on a mercury tray:

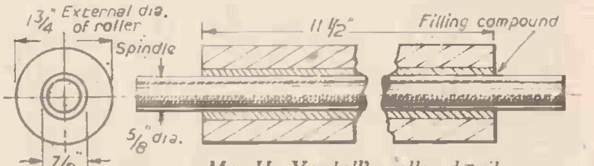
"U" tube filling position.

Using the draw out thistle funnel, fill the small branch of the "U" tube completely. Put the finger on the end and slowly invert the tube until the mercury has gone round the bend. Gently put the tube back to the original position and fill the short length again. Repeat until the whole of the tube is full of mercury. Then slowly put the assembly upright. Some mercury will come out as the column drops to balance air pressure. If a scale is fitted you must now draw out a little mercury at a time until the distance between top of fluid in long tube and short tube *reads* same as a standard barometer at the place in question. If the scale is an adjustable one, the above procedure is not necessary, but some fluid should be removed to allow for a fall in pressure or it will run out over the room.

If you are careful to fill as directed so that no air is in the apparatus, you can check the scale by actual measurement against mercury height and no standard barometer is required. For very accurate work, allowance has to be made mathematically for expansion of the glass, the mercury and the base on which the scale is fixed.

Rubber Roller Repair

THE sketch below gives particulars of a rubber roller from the wringer of an electric washing machine. This has become unserviceable due to the breakdown of the



Mr. H. Yendall's roller details.

compound in the ⅝in. dia. annular space between the inside of the roller and the steel spindle. Can you advise me how to refill this gap?—H. Yendall (Bristol).

PUSH the roller off the central mandrel and clean surface thoroughly. Now wrap the mandrel with stout brown paper which has been thoroughly dressed with Croid Aero glue until the wrapped mandrel is a tight fit when the roller is passed over it. It should be so packed that it is a *tight* fit to poke into the sleeve again. Allow 48 hours for this wrapped paper packing to dry and set, then smear with rubber solution and while slippery ram it into the annular space *between* it and the roller and paint the ends with a good oil paint.

Tobacco Tar Solvent

COULD you give me a solvent for tobacco tar, etc., that accumulates in pipes and cigarette holders?—H. Metcalf (Hereford).

ETHER is the best solvent for tobacco tar and nicotine. We would caution you not to use this solvent in a room where there is a naked flame or a fire. This cannot be too greatly emphasised.

Information Sought

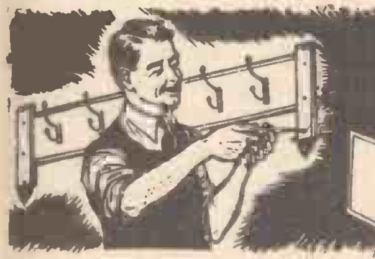
Readers are invited to supply the required information to answer the following queries.

Mortising Saddle

I HAVE a (twin rectangular bar bed) woodturning lathe which I want to use for slot mortising. Can you suggest some kind of saddle I might make, with forward and vertical movement?—W. J. OSBORNE (Stratford-on-Avon).

Plastic Fishing Lures

I READ recently in an American magazine of a method of making fishing lures from a plastic. The plastic, as a liquid, is poured into moulds. Different colours can be mixed and the cast is flexible. Can you give me further information?—W. TEEBOON (New Zealand).



ARE YOU A RAWLPLUG HANDYMAN ?

Every household handyman will become a Rawlplug enthusiast when he has discovered how quickly and easily fixing jobs can be done. Rawlplugs are used for firm fixings in masonry but there are other Rawlplug devices for thin and hollow materials. Also there are tools to make hole boring simple.

HANDY SHILLING BOXES 8, 10, 12, 14

When you have a Rawltool (or a set of tools) you can buy Rawlplugs to the sizes you need in these handy shilling boxes. They are in assorted lengths to cover light and heavy household fixing jobs.

POPULAR TOOL 1/8

When you see this card hanging in a shop you know you can get a cheap strong tool for making holes for No. 8 Rawlplugs. Made from best tool steel they cost only 1/8 each.

Larger Tools are made and if you are interested ask your dealer to show you the Rawlplug 4 in 1 and 8 in 1 Tool sets.

Everything you need OUTFITS

POPULAR OUTFIT 3/- **HOUSEHOLD OUTFIT 5/6** **HANDYMAN OUTFIT 11/9**

For the beginner the Rawlplug Popular Outfit at 3/- provides a "jumper" for masonry, assorted No. 8 Rawlplugs and appropriate screws and a 16-page booklet which gives all the information needed to make a success of household fixing jobs.

The Household Outfit at 5/6 provides more Rawlplugs and Screws and a useful Rawlplug and Screw Gauge. The Handyman Outfit at 11/9 provides the choice of No. 8 or 14 Rawlplugs with appropriate screws and a No. 14 Toolholder with No. 8 and 14 "jumpers" to fit. Also the Rawlplug and Screw gauge and instruction book.

RAWLPLUG DURIUM Registered Trade Mark

FOR SILENT DRILLING OF MASONRY AND TILES

With Rawlplug DURIUM Drills you get faster silent drilling of masonry and tiles—with fine accuracy. Sizes are from No. 6 to No. 30 at prices from 9/6 each. With each drill you get a free re-sharpening voucher.

FREE RE-SHARPENING

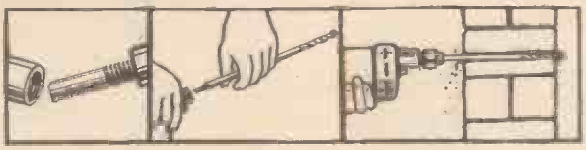
FOR DRILLING GLASS, CHINA, VITROLITE, etc.

use the special Durium Glass Drill in nine sizes from 6/6 to 10/3 each.

DURIUM GLASS DRILL

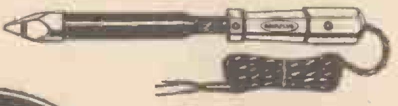
LONG SERIES DURIUM DRILLS

For penetrating walls these drills can be fitted with extension shanks to increase the drilling length to 12" or 16", ¾" to 1" diam.



Don't Scrap it—Solder it

No handyman should be without this sturdy electric soldering iron which can be supplied with standard bit at 32/6 or Pencil or Hatchet bit at 33/6. Voltages 100/110, 200/220, 230/250 Volts Universal A.C./D.C. Consumption 110 Watts.

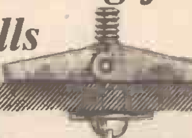


SIX MONTHS GUARANTEE

RAWLPLUGS WALL PLUGS

Further details of Rawlplug Fixing Devices and tools can be obtained from your local Ironmongers, Hardware Dealer, Builders Merchant or Stores. If in difficulty write to :—

For making fixings to Cavity Walls or Ceilings



RAWLNUTS

A tough rubber bush with a threaded metal insert in one end. The Rawlnut is pushed into the hole in the partition or cavity brick and the action of turning the screw causes the rubber to bulge into a rivet shaped head at the back of the material. Various sizes are made.

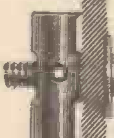
RAWLANCHORS

Flexible metal legs are fitted with a tapped end. The Rawlanchor is pushed into the hole and the action of turning the screw causes the legs to collapse into "butterfly" wings at the back of the material. This device is ideal for soft wallboards where it becomes permanently embedded. Sizes are for ⅛", $\frac{3}{16}$" and ¼" whit screws.

SPRING TOGGLES

A spring actuated device specially suitable for making fixings to ceilings. When the twin members are pushed through the hole into the void they spring apart and then rest on the laths or the reverse face of the material. Sizes are for ⅛", $\frac{3}{16}$" and ¼" whit screws.

GRAVITY TOGGLES



A metal member suspended off centre on the end of a screw. When inserted through the hole into the void the pull of gravity causes the long end to fall, it is then drawn against the reverse face of the material by turning the screw. The one size for $\frac{3}{16}$" whit screws covers most fixings needs. There is a heavy type of Gravity Toggle for taking standard carriage bolts.

A RAWLPLUG FIXING DEVICE

Send this coupon for further details of Rawlplug Fixings for thin and hollow materials, together with 3d. stamp to cover postage.

Name ....

Address ....

.... County ....

The Rawlplug Co. Ltd. Dept. JES, Cromwell Rd., London, S.W.7

THE RAWLPLUG COMPANY LIMITED, CROMWELL ROAD, LONDON, S.W.7

B566

TAKE UP PELMANISM
And Overcome Worry

WORRY uses an immense amount of vital force. People who worry not only use up their energy during the day by worrying but they rob themselves of that greatest of all restoratives, sleep. People who worry can't sleep. They lose their appetite. They often end up by getting really ill. How often have you heard it said, " I am worried to death " ?

What do you suppose would happen if a person who was putting himself into mental, moral and physical bankruptcy by worrying, were to convert all this worry energy into constructive action ? In no time at all he would have accomplished so much that he would have nothing to worry about.

Nothing is more discouraging to a worrying person than to have someone say, " Oh, don't worry, it will all come out right " !

This is not reassuring at all. The worrying one can't see how it is going to come out all right. But if the men and women who worry could be shown how to overcome the troubles and difficulties that cause worry, they soon would cease wasting their very life-blood in worrying. Instead, they would begin devoting their energies to a constructive effort that would gain them freedom from worry for the rest of their lives.

You say that sounds plausible, but can it be done ?

It can be done, and is being done, by Pelmanism every day in the year. This is all the more remarkable because to-day the whole world is in an upset condition and people are worrying to an unusual extent. Yet, every mail brings letters to the Pelman Institute from grateful Pelmanists who have ceased to worry.

People to-day are all too prone to complain that they just have to worry. But once they become Pelmanists they cease this negative form of thought.

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THE Cyclist
Editor : F. J. CAMM
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Phone : Temple Bar 4363
Telegrams : Newnes, Rand, London

WHAT I THINK By F. J. C.

This Year's Show

THE experiment of the biennial cycle show will be put to the test this year when the Cycle Show at Earls Court opens on November 15th to 22nd, inclusive. The industry has had two years to prepare plans and new designs, and it will be interesting to see whether the bicycle itself has claimed their attention or whether the gradual move toward mopeds predominates. For mopeds must now be seriously considered not only as a new market but as a serious competitor for the utility bicycle market which largely constitutes the bicycle trade. The sporting element, unfortunately, is too small to be of great interest to the bicycle trade. Its demand could not sustain an industry and the clubman is too selective in his choice to be interested greatly in mass-produced bicycles. The smaller manufacturer obtains a fair share of his business, although most firms to-day manufacture Clubman models. That is why I am glad to note that the industry, in its national campaigns in the press and on ITV, is tending to concentrate more on the pastime and less on the sport.

It is unfortunately true that cycle racing has long ceased to be a spectacle which will interest large sections of the public. Massed-start racing has done more to revive interest in this aspect than track events and time trials. These individual branches of the sport are excellent and necessary in their way, but the industry requires the larger market and it is to this market that this year's exhibition should be designed to appeal. We hope, therefore, we may see some interesting and necessary if not revolutionary changes in design at this year's show. A complete breakaway from tubular construction, for example, is overdue. The present method of juggling about with standard lugs for tubular construction very much cramps design. As with motor bicycles, tubes can be quite satisfactorily dispensed with and, in fact, strength increased without increasing the weight. Indeed, in some cases the weight can be considerably reduced.

The 40 m.p.h. Speed Limit

THE new 40 m.p.h. speed limit was introduced on a large number of roads in the London traffic area on March 15th, when over 50 lengths of main roads totalling 83 miles came under the new limit which is being tried out on the recommendation of the London and Home Counties Traffic Advisory Committee. On about 21 miles of the roads selected, the normal speed limit of 30 m.p.h. was previously enforced and on the remaining 62 there was no limit. The interest in this experiment is in the effect it will have primarily upon the speed of traffic in known congested areas and also its effect upon road safety. There is a strong school of thought which plumps for the abolition of the speed limit altogether. It bases its argument on the fact that all limits are honoured more in the breach than in the observance, that it is impossible to enforce the limits anyway, that they have contributed nothing to road safety, since as limits have been introduced, accidents have increased, and that existing laws, apart from speed limit laws, are quite adequate to deal with the situation. Most motorists drive at speeds up to 40 m.p.h. anyway, in 30 m.p.h. areas and with perfect safety. The only risk they take is that of a prosecution for exceeding the limit. In view of the congested state of our roads the 30 m.p.h. limit which was introduced by Mr. Hore Belisha when he was Minister of Transport is unrealistic. "Speed with safety, safety fast," should be the slogan to-day.

Another regulation now in force is that drivers are forbidden to park their vehicles within 75 feet of a pedestrian crossing on roads where the 40 m.p.h. limit applies, or on roads where there is no limit.

Other roads are being considered for the new speed limit, and if the experiment is successful, it may be extended to places outside London where the 30 m.p.h. limit is unrealistic.

Helvellyn rising behind Patterdale.

Dynamo Lighting Law

I AM glad that the Minister of Transport has decided not to proceed with his previous proposal to end the existing permission for bicycles to be temporarily unlighted if they are stopped for traffic reasons. The threatened new regulations are thus abandoned and dynamo users may breathe more freely. A joint memorandum prepared by the cycling bodies pointed out that the cyclist who uses dynamo lighting was able to show a good light whenever circumstances required him to do so. The new regulations would have seriously discouraged the use of the very efficient dynamo lighting in use to-day and may have caused it to be abolished altogether.

Cycle Publicity

DURING March the Joint Publicity Advertising of the Cycle Industry was carried by six national daily papers and six Sunday papers as well as in a large number of provincial and local newspapers. The manufacturers through their advertising agents arranged with the weekly journal, *Tit-Bits* (circulation over one million weekly) a Why-To-Buy-A-Bike contest in which members of the public were invited to arrange in order ten reasons out of a choice of 15 why they should buy a bicycle. The prizes were 20 bicycles. The selection of *Tit-Bits* for this contest was a wise one. In its early years *Tit-Bits* did a great deal to popularise cycling and regularly carried a cycling feature. It was also well supported by the cycle trade. The late F. T. Bidlake and other famous writers such as Frank Urry, regularly contributed to its pages.

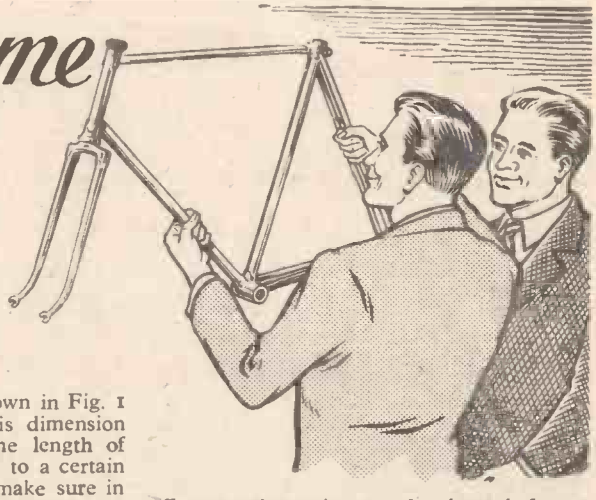
Russia Again

MANY years ago the French *L'Auto* ran a competition for flying bicycles and a competition was actually won by a cyclist who managed to pedal his bicycle into a lucky breeze for about 100 feet., with the wheels off the ground. Of course, the human being is not capable of developing sufficient power to propel a flying bicycle, but I see that Russia now claims to be experimenting with pedal-operated plus light motor-powered aircraft of the ornithopter or flapping wing type. Of course, there is no reason why with motor assistance, such machines should not work.

The Story of the Wheel

I WOULD invite all my readers interested in bicycles and wheel transport to apply for a free copy of "The Story of the Wheel," which has just been published by the Public Relations Department, Educational Section, Dunlop Rubber Co., Ltd., St. James's House, St. James's Street, London, S.W.1. According to this booklet the wheel was first introduced about 5,000 years ago by the Egyptian Pharaohs. We are also told that the Egyptians drove on the right of the road and the Greeks to the left. This is a most interesting 16-page booklet on the history of wheels through the ages.

The Hand Built Frame



Some Tips to Help You Order

CYCLE frames can be purchased ready-built in many shapes and sizes with accessories already fitted, but it is seldom that the individual can find a frame which has every feature he wants. If the size and angles are right, probably it has unsuitable fork rake or the colour is wrong. The answer of course is to have a frame specially built and specify every dimension and fitting. When you visit the lightweight builder he will want to know your requirements and it is a great help to him if you know these approximately before entering the shop.

Size and Shape

Frame size is measured from the top edge of the saddle lug to the centre of the bottom bracket spindle (see Fig. 1); to find out your own frame size, measure the inside leg measurement from fork to instep, deduct the length of crank (6½in. or 7in.) and depth of saddle, say 3in. This will leave the frame size. If the inside leg measurement is 33in. frame size would be 23in., using 7in. cranks.

The angles decided upon will largely depend on the purpose for which the frame is required. The tourist, to whom comfort and stability are important, will want angles somewhere in the region of 70 deg. to 72 deg., while the track rider will require an upright and lively frame with angles of perhaps 74 deg. to 75 deg. head and 73 deg. seat tube. The modern road racing frame has its seat and head tubes parallel at 72 deg.; the clubman requiring a good all round machine will have angles of 73 deg. head tube and 71 deg. seat tube. These angles are, of course, often varied to suit individual preference.

It must be decided before the machine is made what type of headset is to be fitted, as the lugs used in brazing up the head are different according to the type of ball race. Where the head clip type of fitting is used the fork stem is lengthened and is also split so that, when the clip is tightened on to it, it will clamp on to the handlebar stem.

Fork Rake

Fork rake is measured as shown in Fig. 1 and an average is 2½in. This dimension too will have an effect on the length of the wheelbase. It will depend to a certain extent on the head angle, but make sure in any case that, when the wheel and mudguard are fitted, there will be enough clearance for the foot in the forward position.

Bottom Bracket Height

The usual height for a bottom bracket is 10½in. with 6½in. cranks and 11in. with 7in. cranks. Measurements, of course, must be associated with the size of wheels it is intended to use. An 11in. high bottom bracket is only 10½in. high when 26in. wheels are fitted instead of 27in.

Width of Fork Ends

If the purchaser has in mind the use of one particular set of wheels with the frame being ordered, the builder will space the fork ends to suit, but in any case it must be decided whether a Derailleur three-speed gear is intended or merely a single gear (i.e. for track work). If the machine is not intended for the track, remember that it is easier to pack out the width of a double-sided, fixed gear hub to suit wide fork ends than it is to force apart fork ends which are too narrow.

Construction Material

The usual material offered for frame construction is Reynolds 531 tubing, although there are alternatives. Some frame makers offer an alternative to the lugged frame, i.e. the welded construction. Here lugs are dispensed with and the tubes welded together. The lugged-frame makers usually cut away the shape of the lugs and file them down at the edges, both to lighten them and to give an attractive appearance.

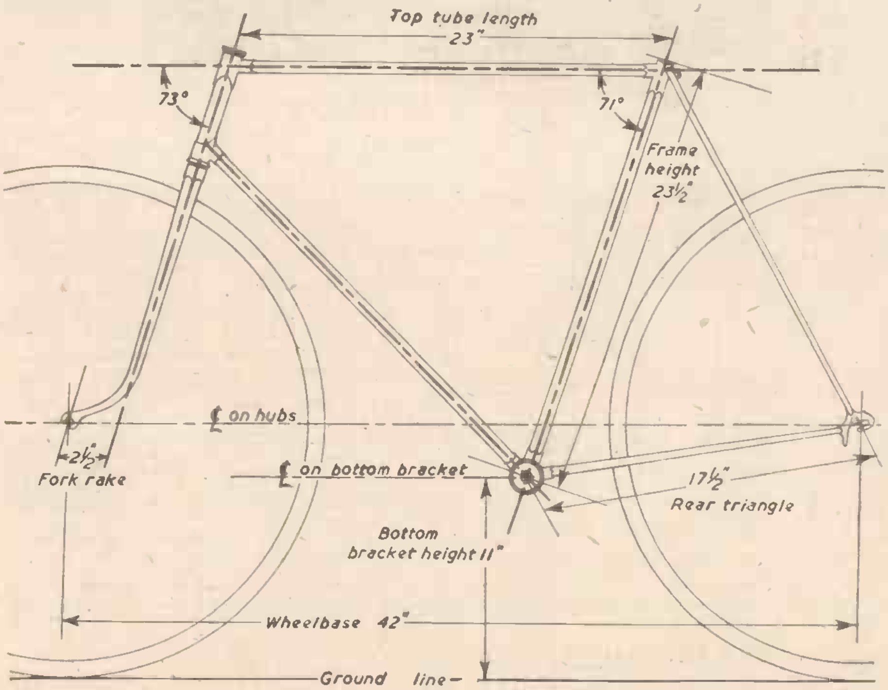


Fig. 1—How to draw up your own frame design

Fittings

All the lugs, brackets, etc., to be added must be specified before the frame is made. Pump pegs may be fitted either 15in. or 18in. apart, wherever required, on the down tube, the top tube or the seat tube, or they may be omitted altogether and clips used. On some patterns of front and rear drop-outs the mudguard eyes are part of the fitting, but sometimes they are added to the front forks and rear chainstays at a point a few inches above the drop-outs. Grease nipples are usually fitted as a matter of course, but extra ones may be fitted at the purchaser's request. Fittings to accommodate brake cables and Derailleur gears of various types can be added also and any special fittings required, e.g., rear lamp bracket, pannier bag fittings, etc. Usually, unless requested not to, the maker will drill the front fork crown and the bridge across the seat stays for brake fitting.

Drawing the Frame

You will ensure by this method that all the dimensions for which you ask are possible. Fig. 1 shows a good example. Draw the ground line first, followed by the bottom bracket centre line the required height above it (11in.). Next put in the hub centre line 13½in. above the ground line (for 27in. wheels). Use a protractor to set off the centre line of the seat tube to the angle required (71 deg.). Measure off the frame height along it and draw in the top tube centre line parallel to the ground line. Mark in the required length of the top tube (a length approximately the same as the frame height is normal) and then, using the protractor, mark in the centre line of the head. Where the line of the head crosses the hub centre line add on the fork rake as shown in Fig. 1.

If the wheelbase is required to be as short as possible, mark off 17in. from the centre of the bottom bracket to the hub centre line to find the position of the rear drop-out. 17in. is usually the smallest size rear triangle possible (17½in. is used in the example). If a longer wheelbase is required (say 44in.) measure this off from the front hub centre along the centre line to find the rear hub position and then join this point to the bottom bracket. To draw in the down tube, draw in the front wheel with compasses, roughly estimate the clearance depth of fork crown, etc., and then join to the bottom bracket.

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The Practical Photographer

APRIL, 1958

Monthly Supplement to "Practical Mechanics"

Choosing the Right Camera

Characteristics of the Main Types Summarised

THE easiest way to classify the many types of camera available is by means of film size and we will deal with the most popular type first—the ubiquitous 120 camera.

The Box Camera

If you merely want a camera to use once a year on holiday and will be content with the sort of picture normally pasted into the family album, the box camera could satisfy you. It is relatively cheap (under £5), it is simple and robust and, to the uncritical eye, produces good results. It is, of course, very limited in its application—sunshine is almost a necessity, it cannot photograph moving objects and the snapshots produced with it may not enlarge well.

The Folding 120

This type of camera usually incorporates some kind of lens diaphragm, more than one shutter speed and some form of range adjustment, but the more elaborate models in this group may have a f3.5 lens, a 9-speed shutter and, perhaps, even an uncoupled rangefinder. They will fold into quite a small space and usually have a case which makes them easy to carry. They can, of course, depending upon the quality of lens and shutter fitted, undertake a much wider field of work than the simple box camera. A f6.3 lens means that the camera can produce an adequate snapshot in dull weather, in shady locations and in a well-lighted room. A speed of 1/100 sec. will permit the photography of moving objects (provided that they are not moving too fast), and some method of range adjustment is usually fitted. This type of camera may have a direct vision viewfinder in addition to the type with a small mirror and glass screen.

The prices of this range of cameras are, of course, higher: a simple model with, say, shutter speeds of 1/25, 1/50 and 1/100 sec. and a f6.3 lens would cost between £5 and £10. A more elaborate version with f4.5 lens, a 9-speed shutter and including, perhaps, an uncoupled rangefinder would cost about £20, and the top-priced camera in this class would include a high-grade f3.5 lens, 9-speed shutter, synchronised for flash, a rangefinder, etc., and might cost anything up to about £50.

12 on 120 Cameras

Still using 120 size film, these cameras take 12 pictures $2\frac{1}{4}$in. × $2\frac{1}{4}$in. instead of eight $2\frac{1}{4}$in. × $3\frac{1}{4}$in. Their characteristics are similar to those of the 120 type, except that the camera is generally smaller and as lenses of a shorter focal length are employed, wider apertures are more common. The only objection to this size of film will come from the photographer who objects to the square picture on artistic grounds, but there can be no doubt that 12 is a very convenient number of pictures on one film. This type of camera can be used for all normal work; holiday pictures, indoor portraits, photographing children and pets, and where a shutter with speeds up to 1/500 sec. is available, most types of sporting activity can be included, too.

A typical folding 120 camera.

A further variety of this camera is available with a rigid lens mount, obviating the use of bellows. Prices range from about £10 to £50 or more.

The Twin-lens Reflex

This is one of the most important types of camera and one favoured both by the amateur and the expert. The chief feature which distinguishes this type is the two lenses coupled together; one for taking the picture and the other for viewing it while focusing. The two lenses are matched so that the same field of view is included in each and while the picture is focused to the photographer's satisfaction on the ground-glass screen, the same adjustments have been made to the taking lens. Shutters are of the "between lens" type. Prices are very wide in range, depending upon the type of optical equipment of the camera. A twin-lens reflex can be purchased for about £20 and for practically any price between that and well over £100. These cameras can be used for almost any type of photography, except sporting subjects (due mainly to their bulk), and are the aristocrats of the 120 world.

16 on 120 Cameras

This type takes a smaller picture than the 12 on 120 and the rectangular shape of the picture is restored, but, of course, measures only $2\frac{1}{4}$in. × $1\frac{5}{8}$in. Prices of this group range from about £10 to £50 and fast lenses with apertures of f2.9 and f3.5 are common. The higher price range includes cameras with double exposure prevention devices, coupled rangefinders and shutters speeded from 1 sec. to 1/50 sec. and synchronised for flash.

Some 120 models are available, which, by means of masks, will take eight $3\frac{1}{4}$in. × $2\frac{1}{4}$in, shots, 12 $2\frac{1}{4}$in. square shots, or 16 $2\frac{1}{4}$in. × $1\frac{5}{8}$in. shots. Almost all models are of the bellows type.

A high-class British-made miniature camera.

127 Cameras

These may take eight pictures, 4cm. × 6.5cm., 16 4cm. × 3cm., or 12 4cm. square. There are not many cameras using this size of film, but those there are are of many types —bellows cameras, rigid lens mount types and single and twin lens reflex cameras. There is also a pseudo reflex which is the box camera of the reflex world. Prices vary a great deal —the compact little bellows version is available secondhand for as little as £10. The rigid lens type can be bought secondhand for between £20 and £30. This camera has generally, however, been superseded by the 35mm. camera.

The 35mm. Camera

More types of camera are available using this size of film than any other, and it is impossible to mention them all. Prices vary a great deal according to the quality of the lens equipment and the refinements included in its construction. Owing to the short focal length of the optical equipment wide apertures are common and usually not less than f3.5.

Cheap Models Available

Although some 35mm. cameras are extremely expensive, there are many less elaborate types which may be purchased secondhand for as litle as £8 or £10. These usually have no rangefinder, but include a multiple speed shutter, double-exposure prevention device and optical viewfinder. The inclusion of a coupled rangefinder among its equipment, usually puts the camera in the over £30 range and often this type of camera has a better class lens. Older models of expensive cameras come into the £20 to £40 class when purchased secondhand, but the post-war models of these cameras are well up into the £100 class. One of the chief advantages of these cameras is the wide range of alternative focus lenses which can be fitted for special work—wide angle for architectural work, long focus for close work, etc. etc.

Single-lens Reflex

Another version of the high grade miniature is the single lens reflex and there are several models available, all highly priced. Here the subject is viewed through the taking lens by means of a mirror which is swung out of the way when the release is pressed to take the picture. One of these cameras indeed includes a coupled rangefinder in addition to reflex focusing. With some single lens reflexes interchangeable lenses are available.

Yet another camera takes pictures 24mm. × 24mm. on 35mm. film and the film is wound on by means of a spring motor. 24 pictures can be taken in quick succession at a speed of three or four per second.

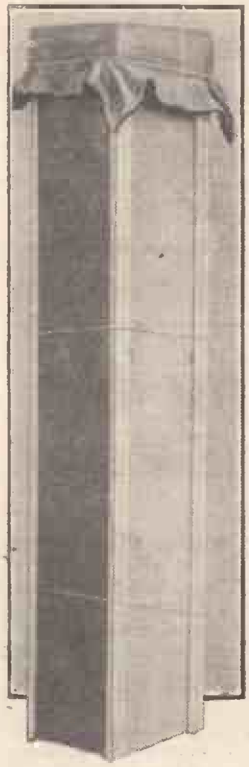
It will be seen then that the 35mm. camera with its interchangeable lenses and high-grade optical equipment, its handy size, coupled rangefinder focusing and cheap film, can be used for almost every subject. The only snag is that 35mm. negatives must be enlarged with the attendant risks of blurred outlines and unsightly grain, although fine grain films and developers and high-grade lenses minimise the risk. To keep photography on an economic level the 35mm. user must process his own film and enlarge his own prints.

There are other types of camera not mentioned here, including the larger stand cameras and some unique models, but the main types are reviewed and perhaps the prospective camera buyer will be helped a little in his decision. Prices include both new and secondhand models, but are only intended to be taken as examples. Exact prices will be available from your local camera dealer.

A Negative Drier

Avoid Dust Contamination

By A. BRODIE



The completed film drier.

DUST, in extreme cases, can make a strip of negatives dry with a texture like glass-paper; at the other end of the scale, even one speck of dust on a negative can ruin it. Many an amateur photographer has limited space in which to carry out processing and difficulty in finding a place free of dust in which to dry a length of film is often a problem. However, negatives can be kept free of dust while drying by using the following described protective film drier, which is both cheap and easy to make and can be packed flat when not in use.

The following materials are required:

Piece of ordinary hardboard, 3ft. 6in. by 2ft.

Eight lengths of single channel ½in. batten, each 3ft. 6in. long.

Small tin of impact adhesive.

Three large elastic bands.

Method of Construction

Saw the hardboard into four panels, each 3ft. 6in. long by 6in. wide. Sort the battens into four pairs and stick the two members of each pair together with the adhesive so that their ends will show as at A, B, C and D, in Fig. 1. When satisfied that the battens are firmly stuck, slide the hardboard panels into the batten channels to make sure there have been no errors in measurement. The smooth surface of the hardboard should face inwards. The reason for this is that accidents can sometimes happen, and any inadvertent contact between the length of wet film and the inside of the drier will result in far less damage than if the rough surface of the hardboard had been facing inwards.

The assembly from the top will now appear as in Fig. 1. To obtain rigidity in the assembly, first remove the opposing panels, a and b; the two remaining panels will then be enclosed by the battens to form AB and CD. Stick these panels to their respective battens as shown. This will reduce the assembly to four parts, consisting of the two single panels, a and b, and the two units AB and CD.

Next, bore two small holes about 2½in. apart and ½in. from the top of the panel in unit AB; repeat this on the panel CD opposite. The positions of the holes are shown at 1, 2, 3 and 4, in the diagram. Reassemble the whole and space the three elastic bands equidistantly round the body of the drier; they will hold the assembly together without difficulty. Take a piece of thin string or a leather bootlace, pass it in turn through the holes at 1, 2, 3 and 4, return to 1 and tie off. Thus formed are the two lines from which the strips of film will hang. Place the drier on a level surface, cover the top with a fluffless cloth, fasten the ends of the cloth with the topmost elastic band and the drier is complete (see heading photograph).

Method of Use

After washing the film, soak it for a minute or two in water containing a few drops of wetting agent. Drain the film, fix a hooked clip at one end of it and carefully lower the length of film (free end first) into the drier, slipping the hook of the clip over one of the strings at the top. Take the cloth and cover the top of the drier, easing the topmost elastic band over the ends of the cloth. A deep-sided lid of three-ply wood to take the place of the cloth could be made.

If excess moisture is removed from the length of film with a photographic sponge or squeegee before insertion in the drier, drying will be greatly speeded up.

This drier will take two 120-size films at once comfortably. The reader can vary the size of the drier to suit requirements merely

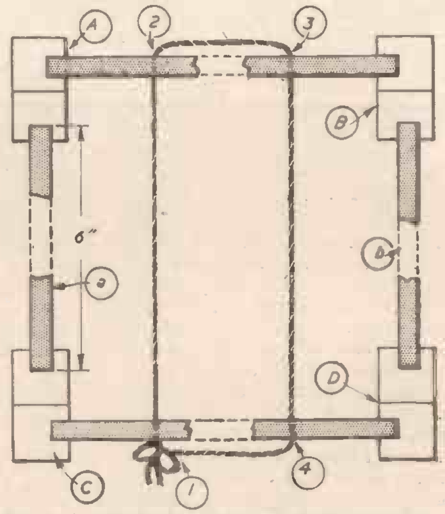


Fig. 1.—Constructional details of the film drier.

by substituting panels of a different width in place of panels a and b.

A word or two of caution. Erect the drier in the position in which it is intended to receive the washed film. Do not move it with the wet film inside.

There are no nails in the construction and, therefore, nothing to snag or damage the film. No heat or draught is required to assist the drying.

A Combined Printing Box and Safelight

A Device to Simplify Your Contact Printing

By L. C. M.

Fig. 1.—The completed printing box and safelight.

As can be seen from Fig. 1 the printer consists of a light plywood box carrying a conventional printing frame at the top and having an electric lamp mounted

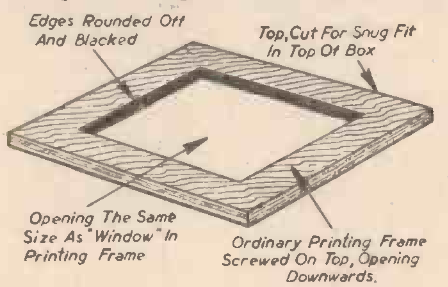


Fig. 2.—Details of the lid.

in the bottom. The box was made from such odd pieces of wood as were to hand. The sides are of 3/16in. three-ply (Fig. 3), but hardboard or some similar material could be used. The sides are merely screwed or pinned to small square posts in the corners. It will be seen from Fig. 1 that a small door is provided in one side through which a safelight or screen can be inserted. The corner posts end just below this slot, and wooden runners fitted to carry the safelight. The corner pieces extend up to the under side of the runners. Similar runners are fitted above the safelight as well to cut out any light leaks past the edges of the safelight. Above the upper set of runners a further set of short corner posts are fitted, which in turn off just below the edge of the box.

The Lid

This carries the printing frame and rests on the top of these corner posts, which should be of such a length as to bring the top of the lid flush with the top of the sides. The lid (Fig. 2) is a piece of the same three-ply from which the sides were made, and has a rectangular hole cut in it slightly larger than the aperture in the printing frame. The edges of this hole are bevelled off with a file and sandpaper and then blacked to prevent risk of reflections causing a dark band near the edge of the print. The lid is fixed to the face of the printing frame by small screws.

Make the lid a snug fit in the top of the box, so that although it is easily removed and replaced it does not slide about while the clamping springs are being manipulated.

The door covering the safelight slot is of double thickness. The inner piece of wood just fits into the slot so as to eliminate light leaks from this point when the door is closed. One hinge in the middle of the door is quite sufficient, as it is very light.

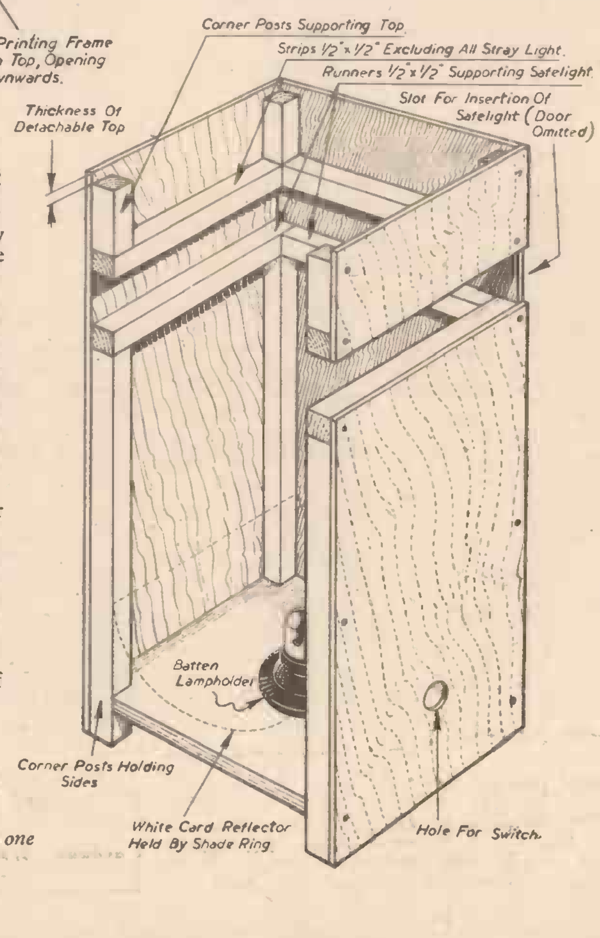


Fig. 3.—A perspective view with one side and the top removed.

The moulding round the base is for decoration only.

Lampholders and Connections

The lamp is mounted in a batten holder which is screwed to the three-ply bottom. A piece of white card covers the bottom and is held in place by the shade ring of the lampholder. This serves to cover up the wiring and the back of the switch and also acts as a reflector.

Wiring

Check that the switch is suitable for mains voltages. The lead is merely a few feet of ordinary lighting flex led through a hole at any convenient point near the bottom of the box. A hole in the side opposite to that carrying the door and switch would probably be most suitable. Tie a knot in the flex just inside the box so that an accidental pull

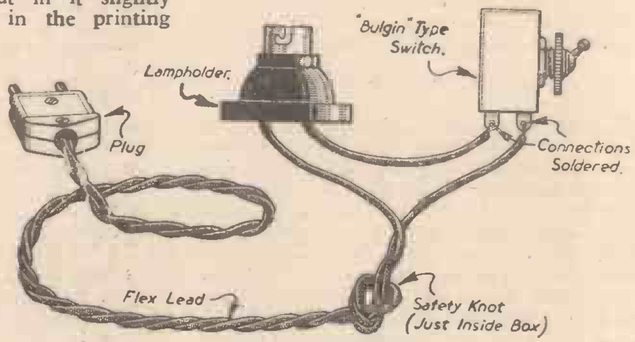


Fig. 4.—The wiring.

will be taken by the side of the box and not by the connections. The connections to the switch will probably have to be soldered to small lugs on the back of the switch. Watch that these are not bridged by a strand of flex or blob of solder.

No dimensions have been given so far as these depend on the size of printing frame normally used. However, in the proptotype the frame is the 3¼in by 2¼in. size and the box is 6in. by 5in. by 9½in. high. The safelight consists of a sheet of amber gelatine bound with passe-partout between two pieces of glass. The box could be made larger to take the standard 7in. by 5in. safelight.

Using the Printing Box

When used as a simple printer the safelight is completely removed. If desired, it can be replaced by a piece of ground glass of the same size to diffuse the light or to cut down its intensity when printing from a thin negative.

It will be found that with such factors as light strength and lamp-to-negative distance constant, very little experience will enable exposure times to be estimated near enough four times out of five. Doubtful cases can easily be test-stripped with an opaque card in place of the screen. A 25-watt pearl bulb is suitable for most negatives, and is also about right for a safelight. For an unusually dense negative a 40-watt bulb can be substituted, which will cut the exposure time by nearly half.

Finish is a matter of choice; a coat of varnish might be useful, as in the event of the box getting splashed, the varnished surface is easily wiped clean and dry.

When used as a safelight, the lid is completely removed. As the safelight glass is below the top edge of the box the light is somewhat directional and can thus easily be kept away from any such undesirable spot as the enlarger baseboard.

An Adjustable Focusing Stand

Ideal for Copying and Macrophotography

By L. C. MASON

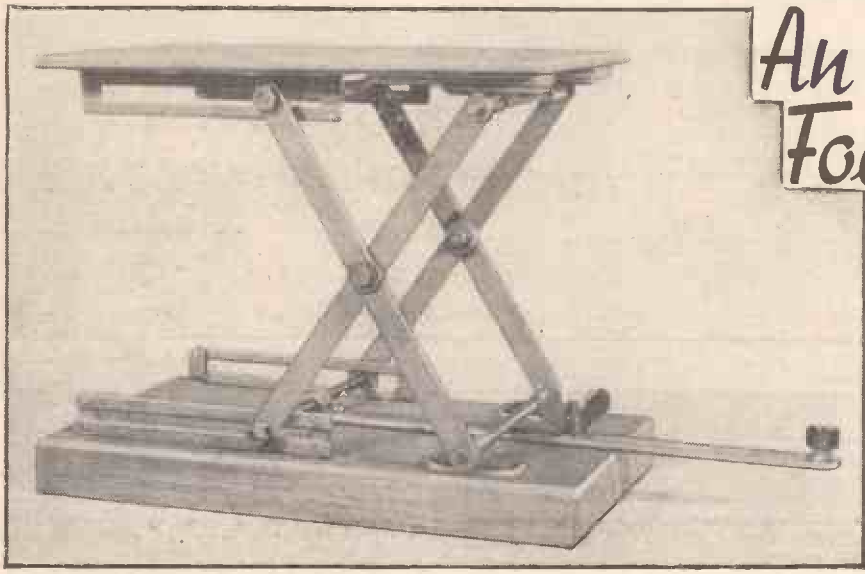


Fig. 1.—The completed focusing stand.

THIS stand was evolved for use when copying or photographing small objects requiring the use of double extension bellows or extension tubes.

It was found that when trying to focus with the bellows almost fully extended, the point of sharpest focus was difficult to determine, as a considerable movement of the lens appeared to make little difference to the sharpness of the image on the focusing screen. If the focusing movement was applied to the object to be photographed, however, very small movements were sufficient to alter the focus enough to provide a large margin either side of "critical," due to the very small depth of field.

The stand in Fig. 1 was built to take advantage of this, the subject to be photographed being laid on a light platform or table, mounted on a heavier base by means of a "lazy tongs" assembly. This enabled the table to be raised and lowered to adjust focus, while remaining exactly horizontal and parallel to both base and the film.

Constructional Details

The movable table is a piece of 3/16in. three-ply for lightness, while the base is a piece of $\frac{3}{4}$in. wood the same size. The metal cross pieces of the lazy-tongs movement are $\frac{1}{8}$in. wide strips of 1/16in. duralumin, as are the guide bars along the edge of the base (Fig. 2). The ends of the cross strips are joined to their opposite numbers on the other side by four 3/16in. steel rods screwed 2 B.A. at the ends, and screwed into the strips with lock nuts outside. The pivot at the cross-over can be either a small nut and bolt or a rivet with a washer between the arms.

The upper and lower rods at one end are free to turn in bearings, each consisting of a short length of tube soldered to a small plate (Fig. 2). The two pairs of plates are screwed to one end of the table and to the base, while the rods at the other end are free to slide between guide bars.

The guide bars are $\frac{1}{4}$in. wide strips of the same material as the crossed arms, riveted by 1/16in. rivets to small angle brackets and spaced apart just sufficiently to allow the rods to slide freely between them with the minimum of play. A washer on the rod between the side arms and the outside of the guide bars makes for smoother working. If necessary, the bearing plates or the guide bar brackets should be packed up with pieces of thin cardboard until the table is perfectly parallel with its base.

To the lower sliding rod is attached the end of a sliding strip by which the table is raised and lowered (Fig. 3). To allow the rod to turn while being drawn along, the fixture to the sliding strip is merely a short strip like the side arms bent round the rod and screwed or riveted to the end of the sliding strip. If the loop is made from a fairly wide piece it will prevent sideways movement of the sliding strip.

Locking Device

The table is locked in any position by

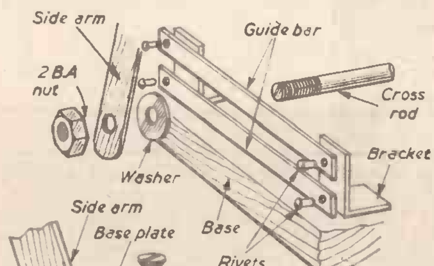


Fig. 2.—The guide bars and bearings for cross rods.

a clamping arrangement on the sliding strip. This strip has a slot cut in it through which protrudes the end of a $\frac{1}{4}$in. Whit. coach-head bolt inserted from underneath. A wing nut on the bolt, when screwed down firmly, grips the strip tightly to the base, retaining it in any position.

Operation

Slack off the wing nut sufficiently to allow the strip to slide freely, and then pull it out to raise the table. Lowering is effected by allowing the strip to slide gently back, which it will do automatically by the weight of the table. A small knob attached to the outer end of the sliding strip will make operations easier.

Dimensions are a matter of personal choice and material available, but in the one illustrated the table and base are both 6in. × 4in. If a thin print larger than this is being copied, for instance, it is a simple

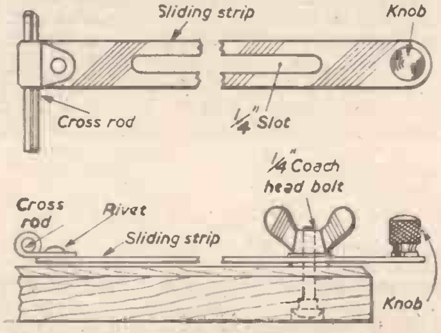


Fig. 3.—The sliding strip.

matter to lay a piece of stiff card on the table first to hold the print flat. The side members are 5in. long, and this length affords an up-and-down movement of some 4in.

The device was designed for use with the tripod standing over it and the camera aimed straight down. The procedure in this case is to place everything in position, raise the table about 2in. and then focus as near as possible to the size of image required by rough adjustments of the tripod. The final focusing is then achieved by raising or lowering the table slightly as required. If a small object such as a coin is being photographed by extreme angle lighting to show up the relief of the design, take care that any adjustment of the focus by movement of the table does not disturb the lighting.

For photographing objects in the vertical plane a small hook can be screwed in one end of the base so that the table can be hung on the wall and the camera and lights placed on a small table in front of it. In this case the object to be photographed will have to be pinned to the table.

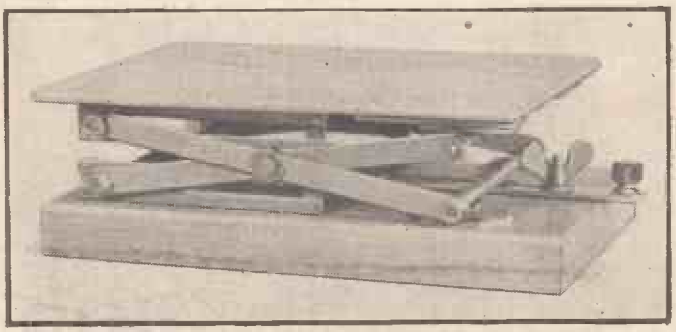


Fig. 4.—The focusing stand in the lowered position.

HOW TO TAKE PORTRAITS

Some Simple Rules to Aid Success

By A. E. Bensusan

Fig. 1.—Effect of a key light and white card reflector.

A CERTAIN amount of equipment is necessary to tackle portrait work, and this subject will be considered first. The selection of a suitable camera is largely a matter of personal preference, but the writer has found those with large viewfinders to be most convenient. Squinting through a minute optical direct vision viewfinder is disconcerting from the points of view both of the photographer and the sitter, whilst it is impossible to see small details at all clearly when they are reduced to such a diminutive scale.

Fig. 2.—A portrait slightly softened with cellophane during printing.

Cameras fitted with large non-optical direct vision finders are quite satisfactory, but the best situation is not reached until cameras with negative-sized focusing screens are considered. Equipment of this type includes single and twin-lens reflexes, hand and stand cameras and studio outfits. With any of these the subject is seen full-sized, while focusing and framing are carried out at the same time. Many photographers prefer to use plates or flat films so that negatives can be developed individually, but careful working with roll films will produce results of perfect quality.

A solid tripod with a wide range of vertical movement is essential and it should be fitted with an equally stout ball and socket or pan and tilt head. This simplifies angular adjustments, during a portraiture session with the minimum of bother. Nothing is more disconcerting than to have to indulge in a major engineering feat every time the camera height or angle requires alteration. A long cable release is a worthy complement to the tripod for camera movement to be entirely eliminated. A long release enables the photographer to operate the shutter from a distant point; a useful facility where nervous sitters are being photographed. A lens hood, to prevent stray light from striking the lens, completes the camera equipment.

Lighting

The choice of lighting apparatus depends upon the amount to be spent. It is unwise to buy a great deal of equipment at the start, and far better to build up as skill is gained in handling the lights. Portable floodlights, which fold away when not in use, can be bought quite cheaply and are ideal for the early stages. Two, or if possible three, will do very well for most portraits other than full length, when at least one more would be needed.

Later an inexpensive 250 or 500 watt spotlight can be obtained, but take care that this is capable of being focused to produce a small beam. Some of the spotlights currently available are little better than an ordinary floodlight, since it is impossible to obtain a finely directed beam from them. Couple the lights with heavy duty cable for the leads are likely to come in for considerable kicking and other misuse while working. If possible, all the lamp leads should run to a portable switch panel with a built-in fuse unit and, from there, a single cable only is required for the mains input.

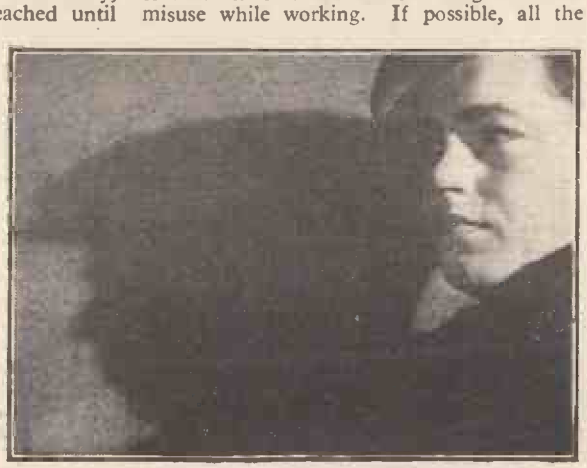


Fig. 4.—An experimental portrait emphasising the shadow.

The taking of portraits is a very pleasant occurrence for most people, and the successful picture can only result from complete collaboration between the sitter and the photographer. The room to be used as a studio should be prepared beforehand, and all necessary equipment and props should be placed near by where they can be reached instantly. For a formal portrait a backless stool can be placed in a convenient position and the subject invited to occupy it when he or she arrives. A short chat often puts a nervous person at ease and, in any case, no sense of urgency should be allowed to intrude and upset the routine.

Fig. 3.—The key light, fill-in light and a light on the background.

Building Up the Lighting

At the appropriate moment the first lamp can be switched on and this should be the main or key light around which the supporting illumination is built up. Then, and only then, is it possible to gain some idea of the effect of the sitter's position and, if this is not entirely satisfactory, suggestions for a movement one way or the other may be made until the desired position has been attained. The key light may now be adjusted for height and angle so that, by itself, it places accent on the features to be emphasised. A sound general rule is that the key light should be placed fairly high to add some weight to the brows, nose and chin. In particular cases, especially when a fairly dramatic effect is required, the key light can be the only source of illumination; the shadows being lightened as appropriate with the aid of white card reflectors (Fig. 1).

A second light can now be switched on and used to add relief to the dark side of the face, adding modelling and a sense of roundness to the picture. The sitter having been placed some distance from a plain wall or other suitable background, the latter will still be quite dark and the facial features may tend to merge into the darkness. Here, the third light becomes useful, for its beam can be directed straight on to the wall, thus having the effect of lifting the head away from the background and adding to the three-dimensional result (Fig. 3).

Using a Spotlight

If a spotlight is available, it can be used to throw a concentrated beam on to the hair, so adding highlights and a feeling of life which would otherwise be difficult to obtain. This light may also be used to throw pattern effects on to the background to add variety to the photographs.

When printing portraits, particularly of the ladies, an unusual soft effect can be obtained by diffusing the image with slightly crumpled cellophane (Fig. 2). The result is quite attractive and is a certain cure for graininess in the negative, as well as smoothing out any minor imperfections in the sitter's complexion.

In portraiture there is considerable scope for experimental work, as Fig. 4 shows. The intention here was to depict a street-corner boy, and this was largely achieved by prominently featuring his shadow, as it might have been thrown by a street lamp.

DEVELOPING A FILM

FOR THE BEGINNER

Using the Time and Temperature Method in a Tank

It is possible to develop a film using dishes, but by far the best method is to use a tank. There are several disadvantages using dishes ; light is necessary which means that only ortho films can be developed by this method, 35mm. films are very awkward and also the method is tiring. All these snags are eliminated when a tank is used.

A typical developing tank is shown in Fig. 1 and this particular one is a universal tank, with an adjustable film spiral which will take 120, 127 or 35mm. size roll-films.

Fig. 1.—A typical universal developing tank.

Tanks are available for 120 films only or for 35mm. films only for the photographer who knows he will only use one size. If there are several cameras in the family, taking different-sized films, the universal tank will be best.

The tank must be loaded in the dark, the film being fed into the spiral groove between the two flanges of the film holder. This is a job which may be found awkward at first, but which becomes easier with practice. It might help to practise once or twice in the light with an old film ; with 120 films the paper must, of course, be detached from the film itself before loading. Once the film is in position in the tank and the lid in place, it can be developed at leisure.

Materials and Equipment

Fig. 2 shows the equipment required, and it includes the tank, a measure, a couple of bottles or old jugs, an ebonite stirring rod, a thermometer and a couple of clothes pegs.

Mix up both the fixer and the developer according to the maker's instructions. The fixer should be acid hypo fixing and this is available from several different firms of chemical manufacturers in small quantities at a reasonable price. If a balance is not available, remember three heaped teaspoonsful weigh 1oz.

There is a large range of developers available, but it is suggested that the beginner will find one of the type available in liquid form easiest to start with. All that is necessary is to dilute it with water. Transfer the two solutions to the bottles or jugs and label them plainly.

Fig. 2.—Equipment required to develop a film.

Developing

When the developer is mixed, use the thermometer to find out its temperature. Consult the instruction leaflet supplied with the developer to find the developing time with the solution at the temperature just noted. An ideal temperature of about 68 deg. F. is often mentioned and the developer may be got to this temperature, either by running the bottle under the cold tap or standing it in hot water (not boiling). When the temperature is correct pour it into the tank through the hole in the lid and note the time. Agitate occasionally by rotating the rod with the knurled top ; about 10 seconds in every minute should be adequate. When developing time has elapsed, pour the developer back into its bottle.

The film must now be washed and this can be done either by standing the tank under the cold water tap and filling and emptying a couple of times or using a jug for the same purpose.

Pour in the fixer and leave it for 10 to 15 minutes, agitating every now and then. When the time has elapsed, open the top, inspect the film without removing it from the spool to see that the emulsion has completely dissolved. Replace the spool and lid and then empty the fixer back into its bottle.

Washing

Remove the lid again and stand the tank under the cold water tap, so that a stream of water runs into the hole in the centre of the film holder and flows out of the pouring lip. Washing should be continued for half an hour and the tank may be emptied completely once or twice to make sure that a complete change of water is effected.

Drying

Finally, remove the film from the tank and hang it up by means of one of the pegs to a cord stretched across a room. The other peg should be clipped to the bottom to prevent the film from curling. Special clips are available for this purpose. It should be hung in a position which is dust free and where no one is likely to walk into it. When the film is dry, cut the negatives apart with a pair of scissors, if the film is 120 size, or into strips of six frames, if it is 35mm.

It is wise, when starting to develop your own films, to choose a particular developer and then stick to it. Also follow the same routine each time. By this means a thorough knowledge of the developer's characteristics is obtained.

Cine and Colour Fortnight

From April 14th to April 26th inclusive Messrs. City Sale and Exchange Ltd. are holding a special Cine and Colour Fortnight. All the latest Cine Equipment is to be demonstrated and new apparatus exhibited by many manufacturers. There will be film shows daily, including exclusive films taken by all makes of 8mm. cameras. One of the main features will be 8mm. sound for the amateur. The 8mm. wide screen will also be demonstrated.

In addition, there will be a colour print exhibition.

Programmes and details are available from City Sale and Exchange Ltd., 93-94, Fleet Street, London, E.C.4.

The Use of Filters

1.—Filters for Correction

WHEN colours are photographed they appear in the print as black and white and varying shades of grey in between. The aim of the photographer is to render these colours in the print as they would be seen by the eye. Colours give an impression of varying shades of brightness, i.e., yellow appears bright, red not so bright, and blue darkest of all. In the print, then, yellow would be white, red a shade of grey and blue approaching black.

Unfortunately for the photographer, film has not yet been perfected to the degree where it will record colours with the same brightness as seen by the eye. This is shown in Fig. 1 where the sensitivity of the eye and the three main types of film to the

The importance of filters when photographing seascapes. A medium yellow filter was used for the top picture.

basic colours is shown diagrammatically. Only the four most common colours are shown, and as can be seen at A, yellow is the brightest, green comes next, this is followed by red, and blue is last.

Film Colour Rendering

It will be noticed that orthochromatic film is totally insensitive to red, and also renders blue far too brightly (B).

Panchromatic red, a type of film which includes most of the high-speed emulsions, gives a truer rendering of colours than ortho; it records red, which ortho does not, but its chief defects are over-sensitivity to this colour, and blue.

So far as accurate colour representation is concerned, correct pan film is the most satisfactory type of all. Red, yellow and green are all recorded with the same degree of brightness as they are seen with the human eye, but it fails with blue, to which it is over-sensitive (see D in Fig. 1).

No type of film will record colours with complete accuracy, and one of the chief uses of filters is to improve the performance of the various types of film. There is a very wide range of filters available, and the colour used will depend upon the type of film in use, the particular type of correction required and the prevailing light conditions.

How a Filter Works

Light is composed of all the colours of the rainbow, as anyone who has seen it split into its component parts by means of a prism will know. Coloured or tinted glass or gelatine, when placed in front of the camera lens, will prevent a light component of a certain colour from reaching the film, or will restrict it, while still admitting the others. A filter will allow the rays of its own colour to pass, but will hold back rays of its opposite colour, as shown in the following table:—

Filter Colour	*Light Admitted*	*Light Rejected*
Yellow	Yellow	Blue
Green	Green	Red and Blue
Red	Red	Green and Blue
Blue	Blue	Yellow

Yellow, when it is considered here, is the mixture of red and green reflected light, not the "pure" yellow which is part of the spectrum.

Before considering the best filters to use with the various types of film it is as well to remember that a filter cannot increase sensitivity to any particular colour, it can only reduce the sensitivity of the others to improve their proportional relationship. Therefore, there is no filter that can make ortho film sensitive to red.

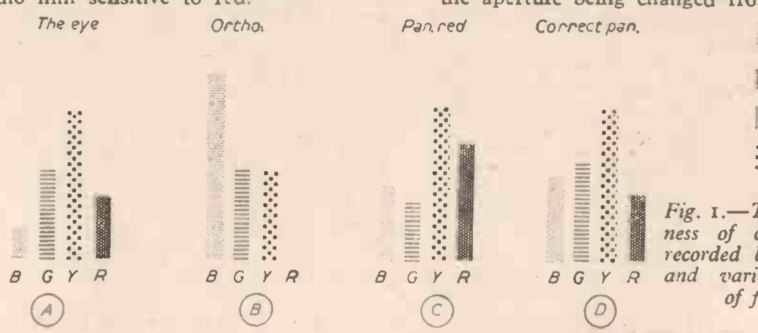


Fig. 1.—The brightness of colours as recorded by the eye and various types of film.

Filters with Ortho Film

The chief failing of ortho film is its over-sensitivity to blue (ignoring its total insensitivity to red, about which we can do nothing), and to correct this a medium yellow filter will be required. A light yellow

filter will provide the same degree of correction in artificial light.

Filters with Pan Red Film

As can be seen in Fig. 1, this film gives rather inaccurate tone values. It is over-sensitive to red and blue and under-sensitive to green. In landscape work, where there is seldom any red to consider, a light yellow filter may be used to reduce the sensitivity to blue.

If it is required to reduce the strength of the red, a blue filter should be used in theory, but as the blue is already over-prominent, this must be combined with yellow to produce a yellow-green filter. A bluish green filter will be required with artificial light.

Filters with Correct Pan Film

Over-sensitivity to blue is the only fault with correct pan film. Red, yellow and green are all more or less correctly recorded. Therefore, the filter chosen to correct this fault will be a yellow one. For most work, a light yellow filter will be adequate, and in many cases no filter at all will be necessary. When working with artificial light (particularly portrait work) a blue-green filter could be used to prevent the lips appearing too dark and otherwise tone down the reproduction of red. but this is not normally necessary.

The Filter Factor

The use of a filter will invariably necessitate an increase in exposure, and this increase will vary according to the type of film with which it is used, and also the lighting (i.e., daylight or artificial). If the filter factor is 2, the exposure must be doubled, which would mean a speed of 1/50th sec. being changed to 1/25th sec., or the aperture being changed from, say, f 11 to f 8. A filter factor of 3 would entail trebling the exposure, 4 quadrupling it, and so on.

Some Uses for Filters

The photographer who requires correct

(*Concluded on page 14*)

A PRINT DRIER AND GLAZER

H. A. Robinson Describes the Apparatus to Help You Obtain That Professional Finish

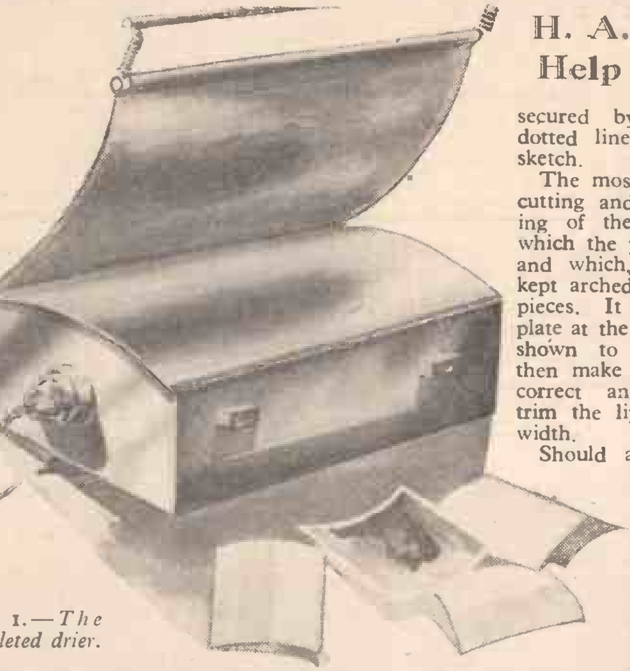


Fig. 1.—The completed drier.

THE drier and glazer shown here is essentially a metal box containing a heater with a stainless steel or chromium plate for the top, upon which the prints are squeegeed. Unlike glass, prints will never stick to plates of this type and when dry they peel off cleanly with a high gloss.

Stainless steel plates are better than chromium, as in time the chromium surface tends to wear away, leaving the base exposed, upon which the prints certainly will stick. Stainless steel is the same material throughout and consequently never loses its surface.

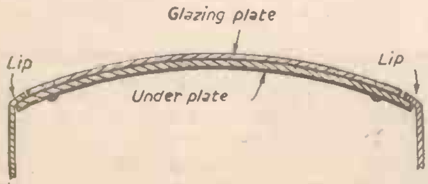


Fig. 2.—Method of fitting the top.

These highly polished plates which are sold for print glazing can be obtained from photographic dealers in various sizes from about 10in. by 14in.

When the wet prints have been placed on the plate and squeegeed, a canvas apron is fixed tightly over the top and left in position till drying is completed: it is important that this apron should be in tight contact with the prints all the time, hence careful fitting is essential. This all-over contact is assisted at the edges by the fact that the glazing plate is fastened to an under plate, thus making the glazing surface flush with the side lips of the box (see Fig. 2).

Constructional Details

The size of the box is dependent upon the size of plate that has been obtained and so dimensions have been omitted here, but these can easily be gauged with the plate to hand to work from.

The box is first cut, as shown in Fig. 3, in thin tinplate, which is obtainable from any tinsmith. The flaps on the ends are for turning over and riveting or bolting to the sides when the box shape has been secured by bending along the dotted lines, as indicated in the sketch.

The most awkward part of this cutting and shaping is the forming of the two side lips under which the plate on its base slides, and which, when in position, is kept arched and tight by the end pieces. It is best to cut the tinplate at the sides wider than shown to start with and then make the bend to the correct angle and finally trim the lip to the desired width.

Should any real trouble be experienced here, the lips can be made as separate strips (Fig. 3), and riveted in position.

To hold the electric bulb socket for the bulb supplying the heat, a circular hole is cut in one of the ends to take a standard collared socket, the main point here being that the bulb must stand out free without actually touching the top plates or bottom of the casing. Two holes are also drilled to take the bolt assembly which holds the apron and three holes are drilled to hold the end of the canvas apron, as shown in Fig. 3.

The bolt assembly is shown at the top of Fig. 4.

Glazing Plate

The stainless steel or chromium plate is fastened by six flat-headed rivets at the extreme edge to the under plate of aluminium which, in its turn, is just big enough to arch over the ends of the box and slip under the lips (Fig. 2). The main point in the fastening of the two plates together is that the rivets must be put in at the extreme edge after holes have been drilled to prevent denting. Soft rivets must be used and should be tapped gently as they are flattened out and finally the top of the rivet appearing on the top surface must be made as flush as possible with the surface compatible with strength. These precautions are necessary so as to lose as little glazing surface as possible. The rivets down one side can be put in on the flat, but the plate should be given the approximate final curve before drilling the further side.

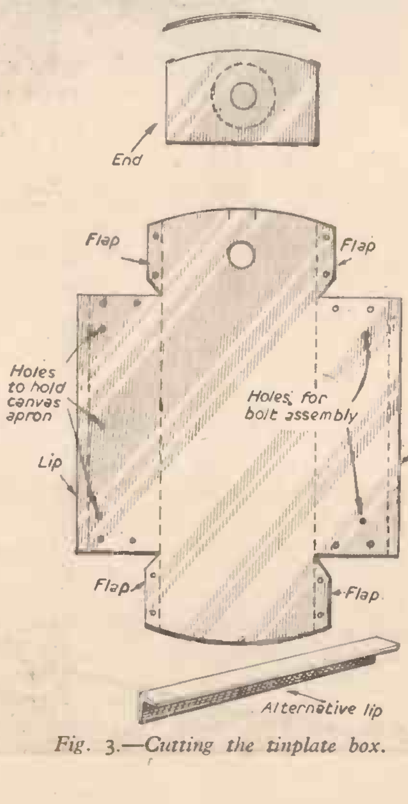


Fig. 3.—Cutting the tinplate box.

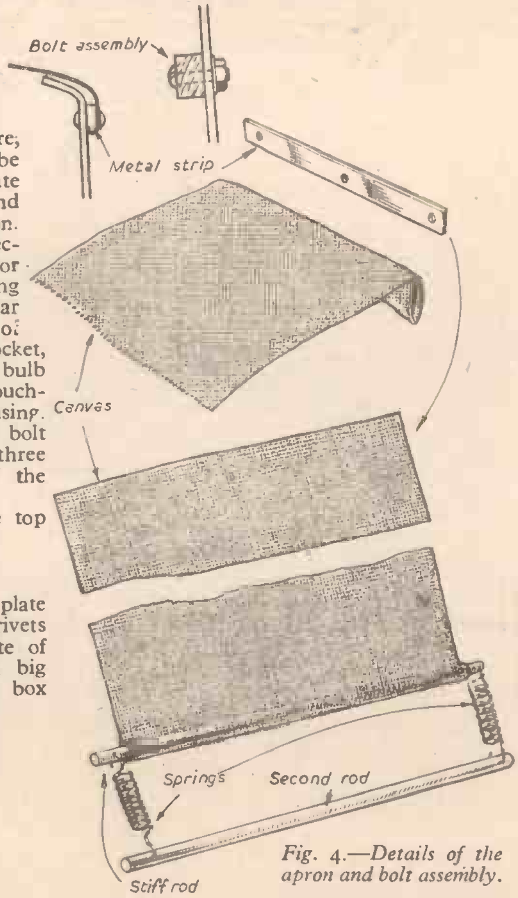


Fig. 4.—Details of the apron and bolt assembly.

Fitting the Apron

This can be made from a strip of fairly stout canvas. At the permanently fastened end it is wrapped once round a strip of metal bored with three holes to agree with those in the casing, to which it is fastened by three small bolts. The further end is folded over and sewn back to form a small channel through which goes a stiff rod (see Fig. 4).

Two short coil springs attach this to the second rod. Everything is arranged so that when pulled over the rod will slip over the small blocks and be under tension. It is best to adjust the length, if not right at first, by undoing the fixed end of the cloth and refitting after wrapping more (or less) canvas round the metal box.

Copying Photographs——

This Article by an Expert Tells You How it is Done

Fig. 3.—An enlarged copy of a small photograph.

THE technique of copying original photographic prints is not a difficult or lengthy affair, and it can be carried out with little more than the average equipment possessed by most photographers. The ability to make, at will, new negatives—where the original ones have been lost or destroyed—is of obvious value.

Close-up Focusing

Assuming, as is generally the case, that the only camera available is a roll-film model, some form of supplementary lens is required to enable the camera to focus accurately at a very much shorter range than that marked on its focusing scale. Supplementary lenses fitted into standard sized spring clip mounts —or specially designed fittings for certain of the more expensive cameras—can be obtained at reasonable cost. Spectacle lenses can also be used and, for extremely short range work, magnifying glasses.

Where no indication of the working distance comes with the lens, it is necessary to ascertain this fact by practical means. In addition, it is essential that the area covered at the particular range is determined. To do this the supplementary lens is attached to the camera lens mount; the shutter is opened to time, with the iris open at the largest aperture and the back of the camera is removed or swung open. A temporary focusing screen is formed by stretching a strip of tracing paper tightly across the film rollers and securing this at both ends with strips of adhesive tape (Fig. 1).

The camera, so equipped, is propped up on a small table, which can be moved nearer or away from a sheet of newspaper suspended against a convenient wall. The newspaper is illuminated adequately, while the image on the focusing screen is surveyed, extraneous light being prevented from striking the screen by the use of a cloth or cardboard screen. Moving the table, and the camera, backwards and forwards soon enables the correct working distance to be established, for this occurs when the image is at its sharpest on the screen. The distance from the front of the lens mount, or any other convenient point, to the newspaper should be measured very accurately and noted down for future reference.

While the equipment is set up, the area covered at this distance can also be determined. By observing the extent of the image on the screen, the boundaries of the view can be measured on the newspaper, in both the horizontal and vertical planes if the format is rectangular. This, again, should be carefully noted for future use. The camera shutter may now be closed, the tracing paper screen removed and the back panel replaced.

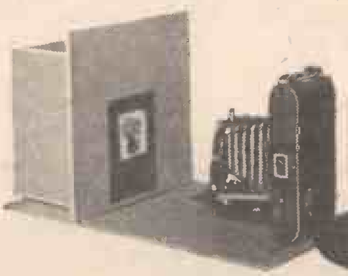


Fig. 2.—The simplest copying arrangement.

Fig. 1.—A temporary focusing screen.

As mentioned earlier, an ordinary hand magnifying glass may be used for extreme close-up work where, for example, the original to be copied is very small. In many cases, a cheap lens, removed from its hand-grip holder, will enable the camera to be brought within 3in. or 4in. of the subject, thus giving an image slightly less than full-size on the negative. While properly corrected supplementary lenses may require the camera iris to be closed down say, half way, the use of a magnifying glass requires the aperture to be as small as possible. In this way only the centre of the magnifying glass is used and distortions are reduced to negligible proportions.

The simplest copying set-up possible is shown in Fig. 2. Here, the subject has been attached to a piece of cardboard supported against a box, while the camera stands on another card bearing two lines; one for the camera and one for the subject. The illumination is provided by a 100 watt pearl bulb in a table lamp with the shade removed. Since the area of the subject is so small, the position of the lamp is not important for there is virtually no change in illumination from one edge of the subject to the other. An enlarged copy of a small photograph is shown in Fig. 3. Here, although the image is quite sharp, the grain structure of the original print is clearly visible in the copy. This gives some idea of the accuracy of the process.

Copying Glossy Prints

For larger subjects, and in particular for copying glossy prints, a slightly more elaborate lighting system is necessary. The aim should be to have the light strike the subject at an angle of approximately 45 deg. to the axis of the camera lens, and so avoid reflections coming off the original right into the lens. The rate of illumination over the required area must also be as consistent as possible, and the lamp may either be switched over to a similar position on the other side half way through the exposure, or two lamps may be used and the length of the exposure cut accordingly.

When two lamps are used they may be balanced by switching both on and holding a pencil perpendicularly from the face of

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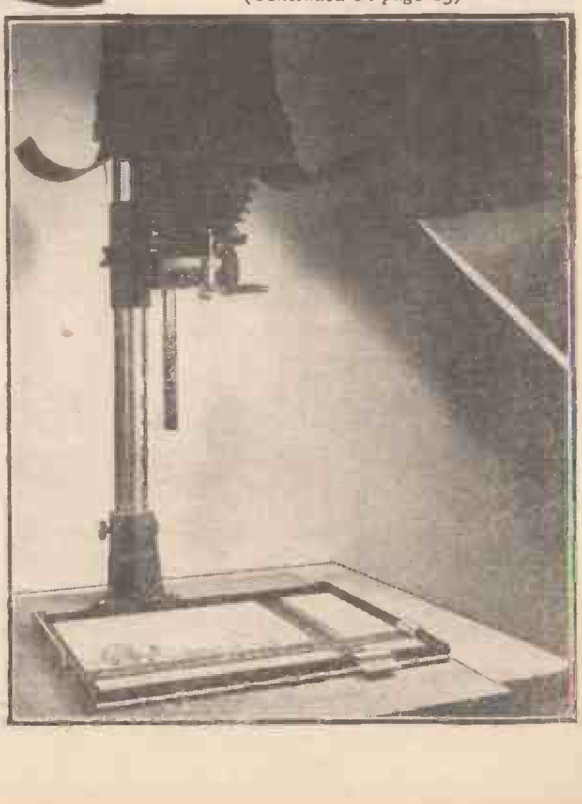


Fig. 4.—(Right) Copying in the enlarger.

An Adjustable Lighting Stand

By C. L. Soman

An Aid to the Portrait Photographer

Fig. 1.—The completed lighting stand.

THE stand is made of wood with metal for the adjustable clamp and reflector. The three pieces forming the stand are cut from a length of 2in. by 1in. timber, planed to shape and sandpapered to a smooth finish. Both joints in the base are straightforward mortise joints, the one forming the "T" shaped base being glued. It is worth while taking some pains over the fit of the upright in its slot in the base, as it is very convenient to be able to pull this out to pack the stand flat for storage or transport. It should fit tightly enough to make sure that there is no risk of the lamp falling out in any position. The stem of the "T" forming the base has a ¼in. hole drilled at the end for use with a stiff wire hook, by which it can be hung from the picture rail or the top of a door. A loop of string could be used.

Protection to polished table-tops or wall paper is afforded by fitting three small rubber feet to the base. Finish on the woodwork is a matter of taste, but if a surface other than plain wood is required it should be remembered that the finish will have to withstand a fair amount of handling.

The wooden upright carries at its top end a metal strip through which passes the clamping screw. This screw is a short length cut off a ⅜in. bolt. Choose a bolt with ½in. or more of plain shank below the head and drill a hole through the plain part of the shank so that one side of the hole almost cuts into the start of the thread. The size of the hole will depend on the rod selected to hold the reflector—about ¼in. dia. is suitable. To start the drill on a rounded surface first file a small flat on the shank, then centre-punch the spot.

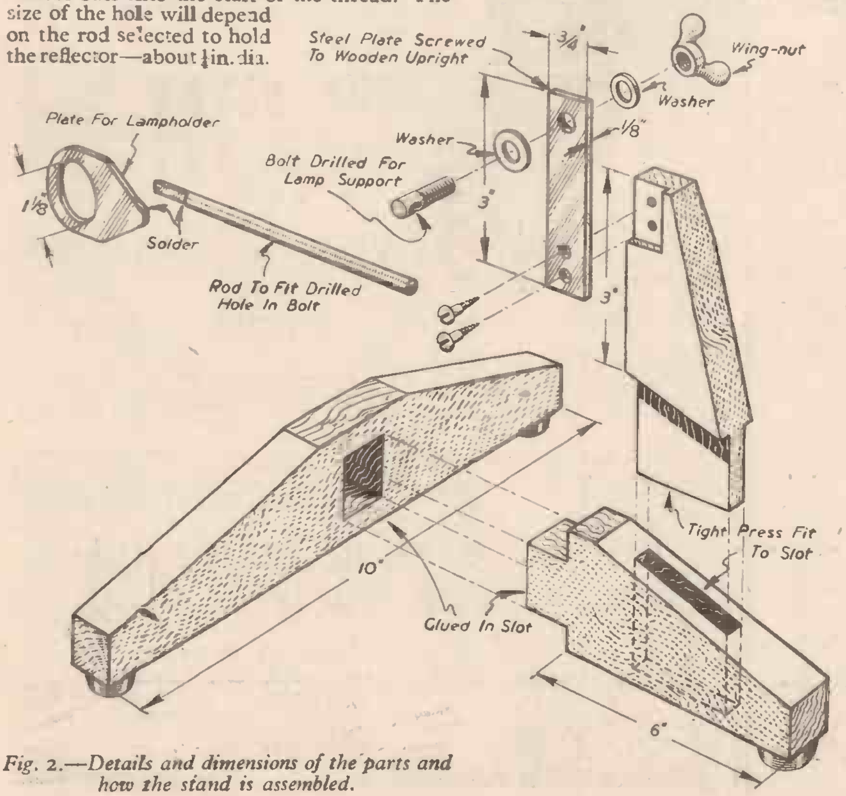


Fig. 2.—Details and dimensions of the parts and how the stand is assembled.

"Sight" the drill through the middle of the shank, keeping the hole as square as possible with the bolt. Cut off the bolt head with any unnecessary part of the shank, and also any excess threaded portion. Procure a wing nut and two washers to fit (Fig. 2). The order of assembly is as shown in Fig. 2.

The rod, ¼in., carries the lampholder on a pear-shaped plate, to which it is soldered. Both this plate and the one on which the clamping bolt is mounted can be either of stout sheet brass or steel, a strip 1½in. wide and about 8in. long being sufficient to make both parts. A generous flat, ½in. long, is filed on the rod where it is to be soldered to the plate to provide a strong joint. The hole in the plate is a bare 1⅛in. dia. to fit the standard lampholder. This plate and the base of the reflector are both clamped under the shade-ring on the lampholder. A thick cardboard washer between the two ensures a snug fit. The base of the reflector, which is held by the lampholder, is merely the bottom of a cocoa tin. This has a spun-over edge, giving it a useful stiffness.

Metal Reflector

This is of sheet zinc. Tinplate could be used, or aluminium—with its advantage of lightness and good surface. However, in this case tinplate was not available, so zinc was chosen for ease of soldering. Fig. 3 shows the reflector laid out in the flat before bending, the dimensions given being suitable for most purposes. It can be bent to form a plain cone if that is preferred to a series of flats. To form the bends cleanly, lay a steel ruler along the lines and press the ruler down heavily with one hand while lifting the metal against the edge with the other. Start the bending by dealing with the left hand one first, working from left to right. This ensures having a flat piece to grasp to be bent up each time, which will be found much easier than trying to bend an already shaped area. The two surfaces at the join—one inside, one outside—are tinned and sweated together. Bend in the bottom tabs, tin their outer surfaces and sweat to the base.

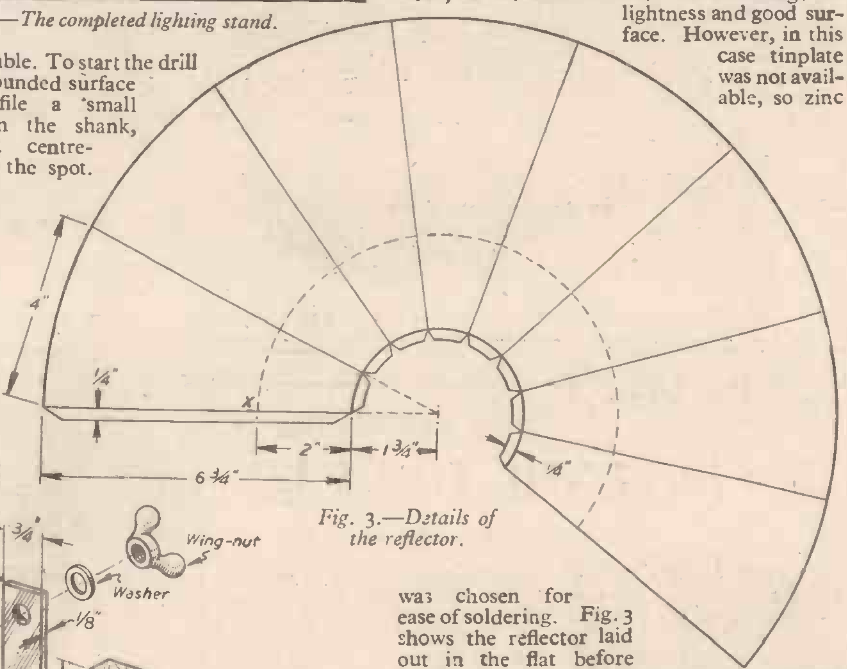


Fig. 3.—Details of the reflector.

A coat of paint inside is desirable to make the most of the light if sheet zinc is used, as this goes very dull after a time, particularly on exposure to the heat of a high-power bulb. Either plain white or aluminium paint is suitable. A coat of black enamel outside adds greatly to the appearance, hiding surface marks or irregularities in soldering.

The only dimension at all fixed is the diameter of the hole in these parts which fit on the lampholder.

Improving the Negative

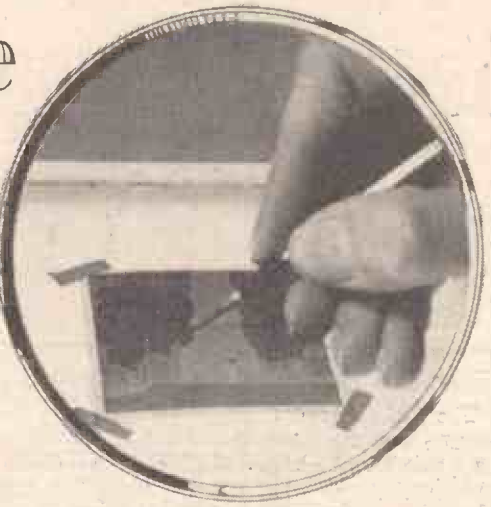


Fig. 3.—Spotting a negative.

By Albert Benson

NO unsatisfactory negative should be thrown away as unusable until some effort at correcting the fault has been made. It should be noted that only faults of a chemical nature can be corrected.

Thin negatives can be caused either by under-exposure or under-development and where a change of paper grade produces no noticeable effect, chemical treatment of the negative must be applied. First, it is important to determine whether the trouble has been caused by short exposure or development time. If the negative has good shadow detail, but lacks contrast, the error is in the development, but where there is little shadow detail and the highlights are rather weak, under-exposure can be held responsible.

The first step in the treatment of the negative is to wash it thoroughly. Where a roll film is concerned, and the negatives have not yet been separated, it should be reloaded into the spiral of the tank to avoid scratching. A well-hardened film can be re-inserted into the tank spiral by holding both in a bowl of water, and sliding the film in as usual. Since the temperature of the washing water is not critical to a hardened emulsion, the tank may be held so that an extension from the cold water tap is wedged into the centre core (Fig. 1). This gives the effect of high-pressure washing.

Fig. 1.—High-pressure washing.

Intensification

An under-exposed negative is difficult to improve, as the shadow detail simply has not been recorded. However, a slight improvement may be gained by carefully controlled intensification. Cut the negative away from the others on the roll, and handle it only with plastic tongs used to grip the clear rebate of the film (Fig. 2). Avoid putting the fingers into chemical solutions, particularly if they are cut or scratched.

Chromium Solution

For very slight intensification of under-exposed negatives, use a chromium solution. Make, or have a chemist make up, a stock solution of potassium bichromate 1oz. 240 grains, concentrated hydrochloric acid $1\frac{1}{4}$oz., and add water to make 20 oz. The liquids are given in fluid measure. For use, add one part of the stock solution to 10 parts of water and immerse the negative until it has bleached right out. Wash well until the stain has disappeared, and redevelop in any non-staining developer.

Uranium Solution

For a rather higher degree of intensification, a uranium solution should be used, but with very great care, for prolonged immersion will cause the contrast to increase rapidly and accentuate the fault. Dissolve 50 grains of uranium nitrate in water to make 5 oz. For the second stock solution, dissolve 50 grains of potassium ferricyanide in water to make 5 oz. Mix four parts of each of the above solutions, and add one part glacial acetic acid, immersing the negative and agitating the dish to ensure even action. Remove the negative when the shadow areas have been tinted a delicate pink shade, and remember that the colour, although not seeming to do so, adds to the printing resistance. Wash briefly and hang up to dry.

The uranium intensifier given above is also suitable for under-developed negatives and, since an increase in contrast is desirable, the treatment may be prolonged until the required density is built up. The washing process, after intensification, should be lengthened so as to remove some of the coloration from the shadow areas. This treatment gives maximum intensification but, regrettably, a slight increase in grain size.

Mercury Intensifier

A useful mercury intensifier for under-developed negatives can be made by dissolving 200 grains each of potassium bromide and mercuric chloride in water to make 20 oz. The negative is bleached in this solution until it is perfectly white, giving constant agitation to the dish. Wash thoroughly and regain the normal colour by soaking in a 10 per cent. solution of sodium sulphite. Should the density of the negative still be too weak, the entire process may be repeated.

Reducing

Over-exposure and over-development are more easily dealt with, as the shadow detail is not lacking. In the former case, identification is by the flat, lifeless nature of the negative, possibly with some loss of contrast. Over-development causes a contrasty negative with dense highlights which will not print through on to the paper.

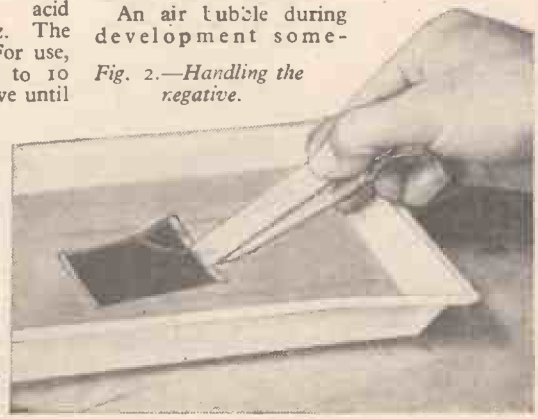
To correct over-exposed negatives, the veil over the shadows must be removed, thus improving the contrast. The best-known formula is Farmer's Reducer, made up in two stock solutions. The first consists of $\frac{3}{4}$oz. of potassium ferricyanide dissolved in water to make 10 oz., and the second is 2 oz. 160 grains sodium thiosulphate (hypo) in water to make 10 oz. Use one part of the first solution with four parts of the second and 27 parts water. Keep a close watch on the reduction process and, when the effect has been achieved, wash well.

Over-development is corrected by a variation of the above process, using 33 grains of potassium ferricyanide in water to make 10 oz., and 2 oz. hypo in water to make 10 oz. Immerse the negatives in the first solution for from one to five minutes, depending upon the result required, then transfer direct to the other solution where the reduction will take place, washing well before drying. This process may be repeated if the initial effect is insufficient.

Spotting a Negative

An air bubble during development sometimes causes a small, clear spot to appear on the negative. The only ways to deal with this trouble are to remove it from the negative or its corresponding black image from the print. Where a large number of prints must be made from the same negative, the former course is the better. Hold the negative, image side up, on a window pane or a special retouching desk and coat it with the special matt varnish available. Then work out the defect with a finely pointed pencil of the appropriate grade (Fig. 3).

Fig. 2.—Handling the negative.



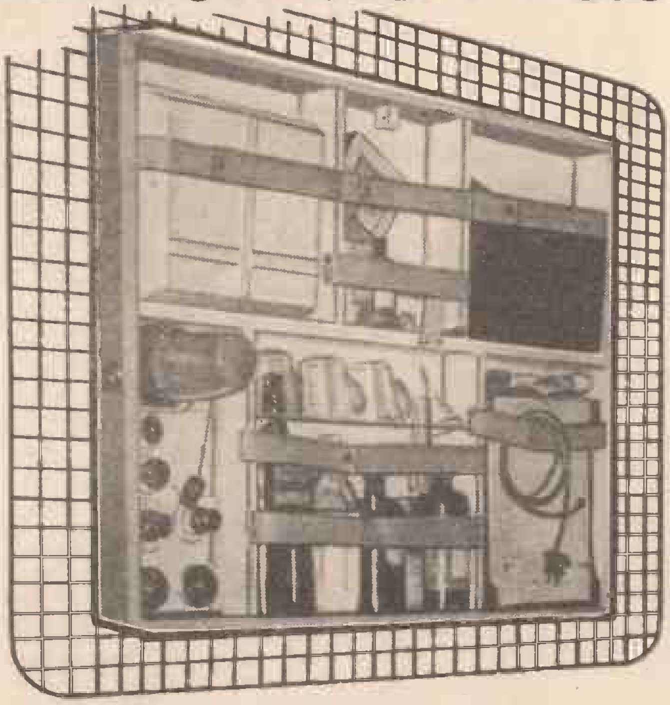
Copying Photographs

(Concluded from page 9)

the subject. Depending upon the type of light source, there should either be no shadows, or they should be of equal length on both sides.

An alternative arrangement, employing the enlarger, is shown in Fig. 4. The original is held in the masking frame, the lamphouse and condensers removed, and a tracing paper screen placed in the negative carrier. The image can then be sharply focused, the lights switched off and the lamphouse replaced. The screen is replaced with a plate or flat film and the aperture around the carrier light-proofed with a black cloth. Any ventilation holes in the lamphouse should also be sealed. The exposure is made by switching on the lights for the required period.

A Solution to the Darkroom Problem



J. B. Knight Describes His Permanent Darkroom Cupboard

MOST amateurs have to make some sort of compromise when arranging somewhere to work, and the amateur photographer is no exception. Assuming the work he does requires no studio, and that once a film is in the tank development can be carried out almost anywhere, he still needs a room for enlarging. This is a headache for most, since although the kitchen or bathroom can usually be made available the tiresome business of setting up presents a second problem, and this is generally because the equipment is stored when not in use anywhere but in the place where it will be used.

My answer is a compromise, everything being in its place, out of sight and in the room ready for use.

The room I use is the kitchen and the only equipment not stored there is the enlarger, printing frame and box of paper, it being the work of a moment to transfer these to the site when ready. The feature of my scheme is the cabinet, which is tailor-made to fit the equipment it houses. It is an advantage to have had some darkroom experience and to have reached a stage where the necessary items can be recognised and superfluous gear discarded, this saves storage space and obviously the less bits and pieces there are to set up, the less time it takes. The cabinet is built around the essentials, as shown in the heading photograph.

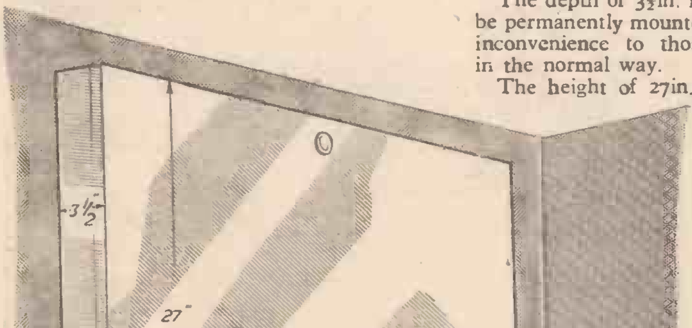


Fig. 1.—Dimensions of the cabinet.

The Switchboard

The first item is a switchboard to which the mains supply is introduced by means of the standard plug and socket as used on movie projectors, power being taken from a convenient wall socket. Provision is made on the board for supplying power to the enlarger, safelamp, print dryer and a further item if necessary. This board and the Paterson safelamp are built in.

The external dimensions of the cabinet are approximately 36in. × 27in. × 3½in., as shown in Fig. 1.

The depth of 3½in. means the cabinet can be permanently mounted on the wall without inconvenience to those using the kitchen in the normal way.

The height of 27in. in my case is maintained to allow the detachable lid to be used as a working surface when placed across the kitchen table which it protects.

The length of 36in., the most easily variable dimension was chosen as the minimum length in which my gear could be contained after taking the other controlled dimensions into consideration.

Although my Paterson 35 mm. tank can be stored within the 3½in. depth, the construction of a kitchen stool is contemplated in which can be housed larger tanks or extra bottles needed for colour work. For black and white work up to 12in. × 10in. the cabinet under discussion is adequate. Shape and dimensions may need to be varied to accommodate the individual worker's equipment.

Cabinet Contents

Apart from the switchboard and safelamp, which together occupy one compartment, the following items are included.

Two 12in. × 10in. dishes, two 8in. × 10in., two each of whole plate, half plate and quarter plate occupying two further compartments and the print dryer cum dishwarmer taking up a fourth.

The remaining accommodation is occupied by the thermometer, glass funnel, three 8oz. measuring jugs, box of "Multigrade" filters, 2oz. measure, print forceps, stirring rod and the bottles of chemicals.

Webbing straps at strategic points prevent the articles from falling from the very narrow shelves when the cover is removed. They are fastened by means of press studs.

Setting Up

Removing the cover and placing it in position on the table, selecting the appropriate dishes and pouring solutions is the work of five minutes. While the developer is warming up the enlarger is fetched and placed on the kitchen half-cabinet. Heavy curtains drawn, safelamp on and the door closed—a further six minutes and printing can begin.

The Use of Filters

(*Concluded from page 7*)

tone renderings and who uses mainly correct pan film, will find the most useful filters are a light yellow and a medium yellow or yellow-green.

A light yellow filter will be found useful for general work at the seaside or with snow scenes, for open air and artificial light portrait work, and perhaps for improving the sky rendering with ortho film.

A medium yellow or yellow-green filter can be used to obtain correct sky tones, particularly in landscapes and over water, for taking portraits against the sky, for sunsets, and for seaside and snow scenes. This filter can also be used with ortho film for portrait work with artificial light.

In general, a light yellow filter is best used with correct pan film in daylight, while medium yellow filters are best with ortho film. Medium yellow filters are used also with pan red film in daylight, but when photographing red, use a yellow-green filter.