A 6in. Reflecting Astronomical Telescope

Hicks

1'3

PRACTICAL MECHANICS

MAY 1959

CONTENTS

You must get one of these new 3 sizes cartons for your tool-box.

A NEW Rawlplug Pack

3 ASSORTED SIZES GAUGES & LENGTHS

Look out for this new pack coming into the Rawlplug dealers shops now. The three most popular sizes of Rawlplugs Nos. 8, 10 and 12 in three convenient lengths are packed in this handy window carton. 50 household screw fixings for only 2/3. Note the novel Rawlplug and Screw gauge incorporated in the lid to make it easy for you to select the right screw for the Rawlplug you wish to use.

DUROFIX

HANDY TUBE **1/-**

Clear, sticky, quick drying all British adhesive

Larger tubes, 1/6d. The ideal all-purpose adhesive for instant repairs to crockery, glass, china, wood, metal, plastic and the thousand and one things handled by the hobbies enthusiast. Instant drying, waterproof, heatproof and insulating. Durofix is grand for electrical, sports and leather goods because it dries hard and non-tacky. **½-lb. tins 2/9 1-lb. tins 10/6**

1/-

Real Wood in Putty Form. In dexterous fingers surprising things can be done with Rawlplug PLASTIC WOOD. Models can be made and coloured intricate mouldings rebuilt, splits in wood made good and, what is more it will stick firmly to any non greasy surface—metal, glass, vulcanite, plastic, earthenware, etc. Can be cut planed and sanded to glass smooth finish. Colours :—Natural, Oak, Mahogany, Walnut. **¼-lb. tins 2/3 ½-lb. tins 3/9 1-lb. tins 6/6**

1/-

Animal glue of tremendous strength. This popular ready to use DUROGLUE is the handyman's friend. It can be used for that immediate need and replaced in the toolbox for another day. It is strong, reliable and for woodwork an ever ready aid to fixing and repairs. It is also suitable for many other materials but not for those washed in hot water. **½-lb. tins 2/6 1-lb. tins 4/9**

$10\frac{1}{2}$D

For quick easy repairs to Metalware. This scientific preparation in paste form can be applied in a few seconds and dries in a few minutes. Metal utensils in the house, garage or garden can be put into good condition again by the intelligent use of Rawlplug PLASTIC METAL without heat or soldering iron. Not suitable for wireless or electrical connections.

Rawlplug Tool Sets

4 in 1 7/9

For the craftsman and advanced handyman these tool sets are a boon. The Four-in-One enables four drills (8a, 10a, 12a, 14) to be used in the No. 14 holder. In a handy box it costs 7/9 and in a strong roll-up wallet 9/6.

POPULAR TOOL 1/8

A very cheap, sturdy tool for making holes for No. 8 Rawlplugs. Turn the tool as you tap it with a light hammer to make clean, round holes in masonry. It is a very handy tool for simple household fixing jobs.

8 in 1 15/6

The Universal Eight-in-One has an improved Knurled holder and takes eight drills Nos. 6/14 to 20/14. In a handy box it costs 15/6 and in a strong roll-up wallet 17/9.

Each Metalide drill is packed with an instruction leaflet in a strong plastic wallet with transparent window.

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REGISTERED TRADE MARK

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Here is a cheap reliable masonry drill for the household handyman. Four sizes are made for use in a hand brace or suitable electric drill. Just what you need for that occasional domestic fixing job.

No. 8 (3/16")	No. 10 (7/32")	No. 12 (1/4")	No. 14 (9/32")
Green Wallet	Blue Wallet	Brown Wallet	Grey Wallet
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The most efficient, precision made, long lasting masonry drill is the Rawlplug DURIUM (with the free re-sharpening service). We strongly advise this drill for continuous drilling (such as industrial operation) 13 Sizes for drilling right through walls. Prices are from 9/6 each. For drilling glass use the special DURIUM GLASS DRILL. Made in nine sizes from ⅛" to ½" at 6/6 to 10/6 each. Free Re-sharpening Voucher with each drill.

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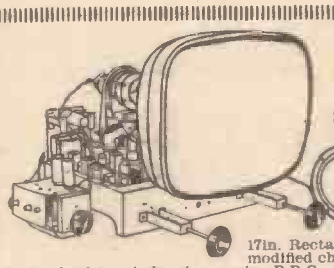
RAWLPLUGS WALL PLUGS



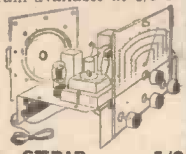
17in. T.V. CHASSIS, TUBE & SPEAKER

16 Gns.

17in. Rectangular Tube on modified chassis. Supplied as single channel chassis covering B.B.C., channels 1-5, or, incorporating Turret Tuner, which can be added as an extra, at our special price to chassis purchasers of 50/- giving choice of any 2 channels (B.B.C. & I.T.A.). Extra channels can be supplied at 7/6 each. Chassis size 12 x 14½ x 11in. less valves. Similar chassis are used by well known companies because of their stability and reliability. With Tube & Speaker (less valves) **16 guineas**. Complete and working with valves and Turret Tuner **24 guineas**. 12 months' guarantee on the Tubes. 3 months' guarantee on the valves and chassis. Ins., carr. (incl. Tube) 25/-.

POPULAR 12in. PLESSEY T.V. CHASSIS 39/6

This is a real bargain for anyone wanting to make up their own T.V. at a very low cost. I.F's 10.5-14 Mc/s. Simply adapted for a 12 Channel Turret Tuner and can be modified to take a larger Tube. A chassis in one unit. Untested. Less valves, tube, speaker & scanning coils. (All can be supplied as extras.) Circuit diagram available at 3/6 or free with order. Carr. & ins. 10/6.



SUPER CHASSIS 99/6

5 valve superhet chassis including 8in. P.M. Speaker and valves. Four control knobs (tone, volume, tuning, w/change switch) Four w/bands with position for gram p.u. and extension speaker. A.C. Ins., carr. 5/6.

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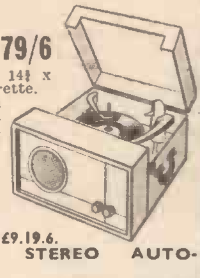
Output stage PEN45. O.P. trans. choke. Smoothed H.T. 325 volt at 250 m.a., 4 v. at 5 amp., 6.3 v. at 5 amp., 4 v. at 5 amp. centre tapped. Valve base for rectifier. Octal or 4 pin. Output is taken from standard plugs. Less valves. Ins., carr. 5/6.

GANG CONDENSERS 1/9

Salvage guaranteed. Standard size two gang .0003 and .0005. All tested and guaranteed. P. & P. 1/3.

RECORD PLAYER CABINET R.P.3. 79/6



A delightful-looking cabinet 14½ x 17½ x 8½in. in 2 tone leatherette. Will take a B.S.R. Monarch 4-speed autochanger and 6½in. round speaker. Carr. & Ins. 4/6.

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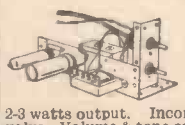

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12 months guarantee.

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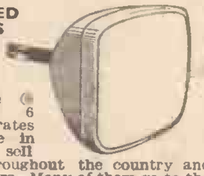

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12 months guarantee.

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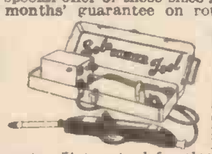
9in., 10in., 14in., 15in. & 16in. ROUND TUBES. Our special offer of these sizes £5. 12in. T.V. Tubes £6. Three months' guarantee on round tubes. Ins., carr. 15/6.



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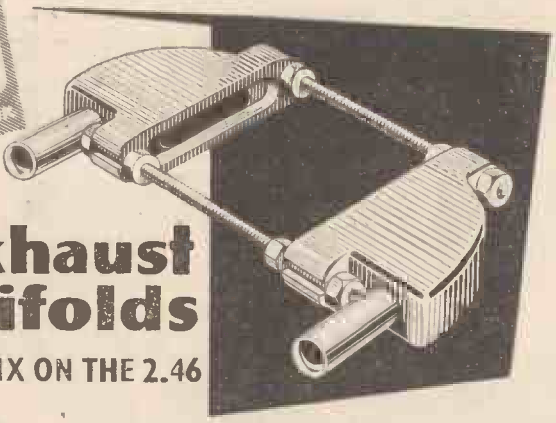
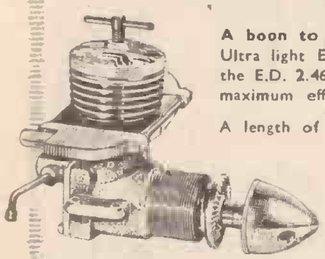


Exhaust Manifolds

EASY TO FIX ON THE 2.46



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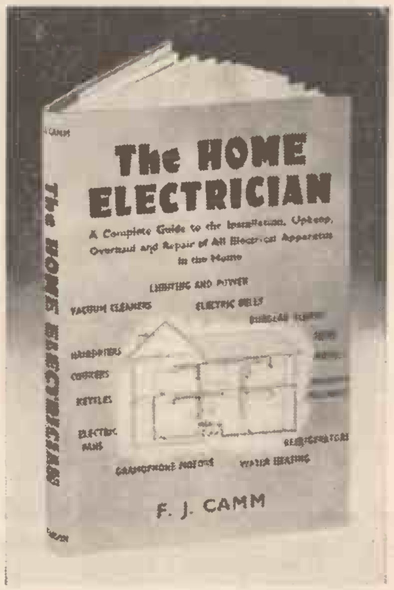

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Most of the troubles which occur in the home are of an elementary nature, and no great experience or technical knowledge is required to put them right. Here is a complete guide for the non-technical householder, publication of which has been prompted by the increasing use of electricity and electrical labour-saving devices in the home.

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MAY, 1959

Vol. XXVI No. 303

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CONTENTS:

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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 AMATEUR ASTRONOMER

AS our readers are well aware a very large number of queries indeed is answered every month by the PRACTICAL MECHANICS panel of experts, covering a diversity of subjects. Recently, when this query service was being reviewed it was noticed that by far the largest number of questions asked by our readers related to amateur astronomical telescope construction and the allied subject of obtaining the best results from these instruments. An analysis of these readers' queries indicated that there was a great need for an article describing in detail the building of a cheap, simple-to-construct, yet efficient and versatile telescope for the amateur and it is to fulfil this need that the series of articles which starts in this issue has been prepared.

The many types of telescope which can be used for astronomical observation were all considered and it was decided that undoubtedly the best type of telescope for use in this country by amateurs and the most suitable for home construction is a 6in. reflecting model. Readers write to us from time to time asking for details of higher magnification telescopes, but without realising that to use such an instrument a very large and solid mounting would be necessary, bearing in mind that even minute vibrations in the telescope will be magnified in the eyepiece perhaps a hundred times, according to the power of the eyepiece in use. It is possible for the amateur to construct such a mounting satisfactorily, but difficulties increase directly in relation to the power of the telescope.

Another point when considering what size of telescope to employ is that larger telescopes are far more sensitive to atmospheric conditions. When these are in a disturbed state, varying refraction is caused by different air densities and viewing is poor. Under these conditions a small telescope will perform as well as a large one, but when conditions are perfect the larger instrument comes into its own. This is one of the factors considered when siting a large observatory and there are comparatively few places in the world where the air is really suitable.

For our readers then, who will have to mount their telescope in their back gardens, whether they live near to an industrial town or not, the 6in. reflector is the best compromise. It is not so large that the constructor will run into insuperable difficulty in mounting, yet it is large enough to enable him to undertake a wide range of astronomical observation, and retain, at the same time, many of the desirable features of the smaller type of telescope.

In addition to complete constructional details, this series will contain instructions for making two types of mounting. One is shown in this month's instalment, but there will also be details of a dipod portable mount. Care, adjustment and use of the telescope will also be discussed.

A REGISTER OF HISTORIC AIRCRAFT

REPRESENTATIVES of Government Departments and other public bodies met recently at the Royal Aeronautical Society under the chairmanship of Mr. Peter G. Masefield, M.A., F.R.Ae.S., President-Elect of the Royal Aeronautical Society. At this meeting it was agreed, as a first step towards the ultimate goal of a National Aeronautical Museum, to compile a register of historic aircraft. This will mean that the location and state of preservation of all the historic aircraft in Britain will be known and steps can be taken to prevent their being destroyed.

There must be a large number of old aeroplanes and aero engines still in the country that are unknown to those preparing the Register and the Royal Aeronautical Society is appealing to owners of historic relics or those who know where they are to be found to send the information to Mr. A. S. C. Lumsden, Secretary of the Committee, Royal Aeronautical Society, 4 Hamilton Place, London, W.1, so that they may be included in the Register.

The June, 1959, issue will be published on May 29th. Order it now!

A Six-inch Belt Sander

Strong, Rigid, Simple and Cheap to Make

By James Roll

(*Left.*)—*An artist's impression of the sander in use.*

A DISTINCT advantage of the belt sander over its disc counterpart is the fact that it will deal efficiently with wide and long surfaces, finishing them "with the grain." The disc sander, as is well known, leaves those objectionable circular marks which ruin a fine finish. For work to be painted this does not matter much, but if the wood is to be polished or left in the raw, then the surface must be gone over laboriously by hand to eliminate the circular scratch marks.

This model is large enough to cover almost any class of work the small workshop is likely to encounter: the sanding surface is 6in. wide and 16in. long. No parts of the machine are higher than the working table and it is therefore possible to accommodate all widths of wood. Similarly, if the fence is removed, any length of material within working limits can be sanded efficiently and quickly. Another advantage of this type of sander is that inside curved work can be finished by passing it over the rear drum. It can be made for less than £3.

The frame is made almost entirely of angle-iron; the drums are crown face aluminium pulleys, mounted on steel shafts, running in Picador loco plummer blocks; the table top and baseboard are of plywood; and the belt is a cloth-backed garnet paper grade 80 and measures 42in. × 6in.

The Framework

Fig. 1 gives two views of the assembled framework and, together with Fig. 2, shows the essentials of its construction. In most cases parts can be fastened together either with nuts and bolts or with bolts alone threaded into the second member. The box-like end pieces which will contain the adjustable plummer blocks, however, must be tapped and the bolts filed off flush on the inside: also, the bolts connecting the top angle-irons with the flat steel distance pieces must be countersunk in order that the plywood top may lie perfectly flat. Other bolts may be R/H or C/S according to taste.

The two steel blocks 1¼in. × 1¼in. × ¾in. accommodate two of the loco plummer blocks as shown in Fig. 3 and should be drilled and tapped ⅜in. Whitworth before being fixed to the angle-iron by means of two ½in. × 4 B.A. bolts. These loco plummer blocks are a Picador product of most compact design and are extremely useful for installation in difficult places; they are obtainable "male" or "female" and the male—used in this case—incorporates a fixed ⅜in. bolt 1in. long.

The "boxes" at the other end of the top angle-irons which carry the adjustable plummer blocks, as shown in Fig. 4, do not quite tally with each other; this is occasioned by the fact that the endless sanding belt has to be easily removable and it is necessary, therefore, to shape one box accordingly. The unshaped one is built up from two additional 1½in. lengths of 1½in. angle-iron as clearly shown in Figs. 1 and 2: note that the hole carrying the plummer block bolt is drilled to clear it in this case, not threaded as was the steel block. Fig. 4 shows that the plummer block is free to move along inside the box when the outside flynut is turned—this accomplishes the necessary tensioning and tracking movement. The shaped box varies in that it has no fixed front plate and the front edge is rounded to a 3in. dia. segment. The front plate is a 1in. width of 1½in. angle-iron from the top of which about 1in. has been sawn off; this has a ⅜in. clearance hole, too, and acts in the same way as the other except that when the flynut is removed from the plummer block bolt, the plate can be removed also, thus giving adequate clearance for the endless belt.

With the framework assembled as in Fig. 2 and with the plummer blocks in position, the whole can be mounted on a ½in. plywood base, approximately 21in. × 10½in., by means of three bolts passing through holes in the 2in. angle-iron and firmly secured with locknuts. This completes the framework, except that while the front top length of angle-iron is quite

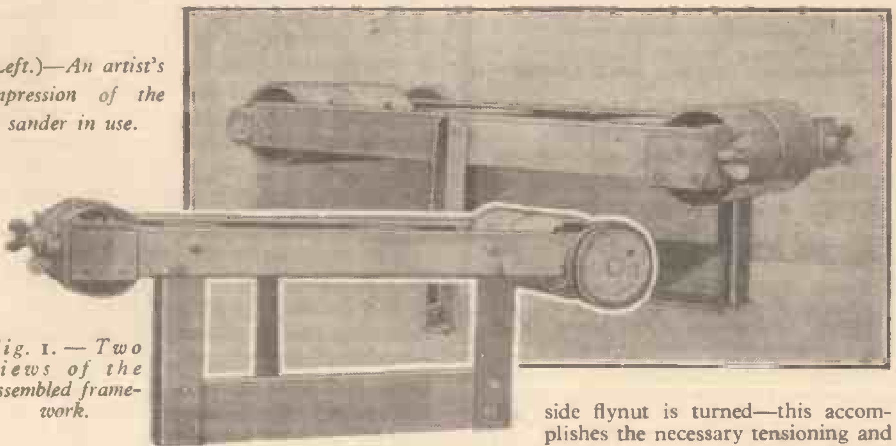


Fig. 1.—Two views of the assembled framework.

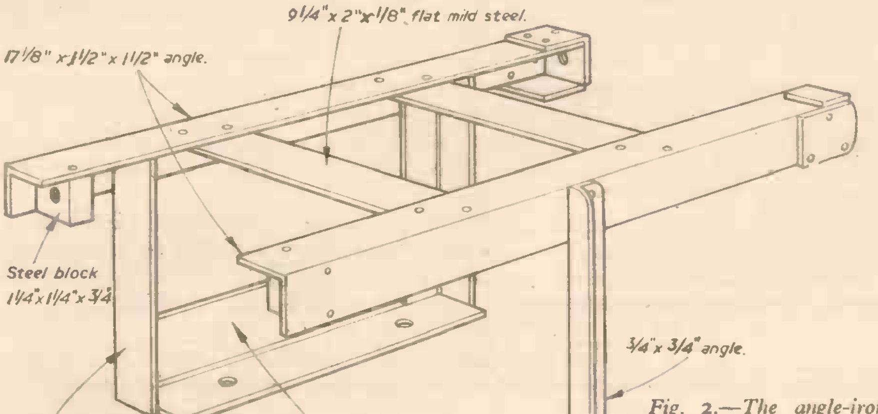


Fig. 2.—The angle-iron framework on which the machine is built up.

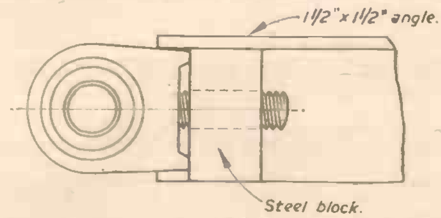


Fig. 3.—Fitting of plummer blocks at fixed (pulley) end.

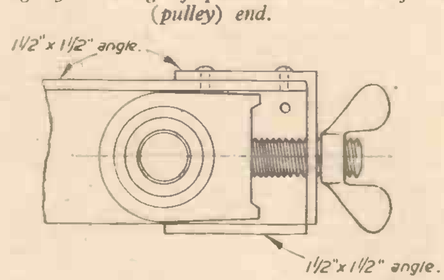


Fig. 4.—Fitting plummer blocks at adjustable end.

rigid it is, nevertheless, unsupported by direct contact with the baseboard because of the need to keep the space clear for the easy removal of the sanding belt. To furnish a "quick release" support of some kind, a 6½in. length of ¾in. angle-iron is fastened to the centre top with a bolt and nut and spring washer in such a way that it can be swung upwards away from the baseboard to which it is merely fixed by a R/H woodscrew. It is, therefore, the work of a moment to remove this screw, swivel the bar upwards parallel with the top, and thus give clearance for changing or replacing the belt.

The Drums

The ideal drum is, of course, one 3in. dia. and 6in. long; this, however, is difficult to obtain unless made up specially. Messrs. S. & G. Sergent of Costessey, Norwich, may be in a position to supply these flat-faced pulleys, but delivery would be from seven to 21 days. This excessive width in proportion to the diameter is not a stock size even in crown face pulleys, and for this reason the author has used two 3in. pulleys on one shaft and found them to work extremely well and to give no trouble whatever in tracking.

Half-inch shafting is adequate for this machine so the four crown face pulleys and the four plummer blocks should be bought with this bore. For the front, or fixed, end two collars and a driving pulley will also be required, and Fig. 5 shows how this end is assembled. Correct operating speed will be obtained by using a 1,425 r.p.m. motor having a 3in. "V" pulley driving a similar sized pulley on the machine, i.e., the velocity of the sanding belt should be in the region of 1,100 feet per minute. While a ¼ h.p. motor will work the machine, a ⅓ to ½ h.p. is necessary if heavy work is to be undertaken.

Assembly of the adjustable end differs only in that there is no pulley to be fixed, and the shaft must be of an *exact* length as will ride inside the two "boxes" without creating side pressure but at the same time not permitting any side-to-side motion. When tightening the drums on the spindles be sure they are as close together as possible so that, virtually, they form *one* drum 6in. wide.

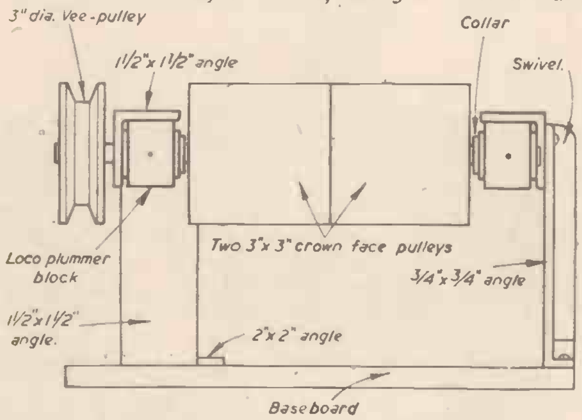


Fig. 5.—Pulley-end view of machine without table top.

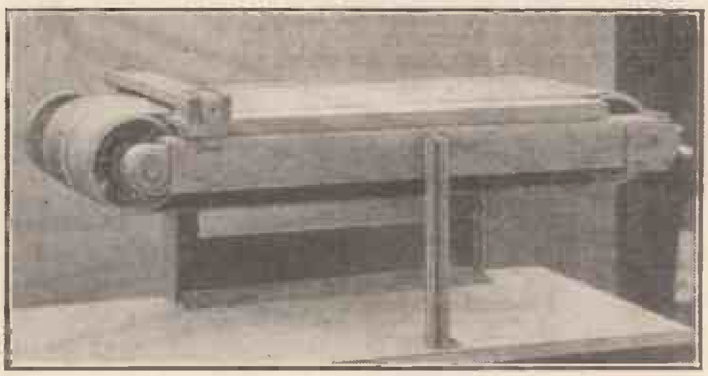


Fig. 6.—The completed machine.

Completion and Operation

By temporarily passing the sanding belt over the drums and tensioning it (not too tightly), the necessary thickness of the table top can be ascertained. It should be ⅝in., but when finally fixing it may have to be slightly reduced by planing or increased by means of packing. It should be just, and only just, below the underside of the belt. When running but not actually being used, the belt should skim along the top of the table only just avoiding contact; the moment the slightest pressure is applied, the table should bear it—not the belt.

The top is 14¼in. long × 9½in. wide and is fastened to the angle-iron top bars by C/S bolts threaded into them. The ends of the top will have to be cut back at an angle where they threaten contact with the drums; they should be as close to them as is practicable to ensure that at no point can pressure be applied to any part of the belt not supported either by the table top or the drums.

The belt should be fitted correctly in relation to the splice in it, i.e., the beginning of the splice should be on the immediate underside and be first to come in contact with the drums. Some belts are marked "Run this way."

Tensioning must not be excessive although any tendency to "flap" must be avoided. Over-tensioning can quickly cause trouble apart from imposing an unnecessary load on the bearings. Rotation is away from the worker, i.e., from the adjustable end of the machine towards the fixed, or pulley end.

Being satisfied that the above points have received attention and that all is in order, the motor may be switched on, but be prepared to switch off very quickly. If the machine is not tracking perfectly—and it will be pure chance if it is—the belt will begin to run rapidly to one side or the other and, if allowed to contact the angle-iron sides, will shred and may even tear if tracking is particularly bad. Faulty tracking can be remedied by turning the flynut on the end to which the belt is running in a clockwise direction. Once the belt is running more or less evenly, final adjustment can be made within fine limits.

Fig. 6 shows the completed machine and it will be noticed that at the pulley end a fence has been introduced. This is removable at will and consists of a length of hardwood 1in. × ¼in. raised at its two ends by 1in. × 1in. × ¼in. blocks of hardwood. The gap thus formed permits the belt to run unhindered under the fence. At each end of the fence are fitted short metal lugs which engage in metal slots screwed to the edge of the table top. In this way the fence is rigid when in use, is removed in a second, and leaves no protuberances above table top level to interfere with lengthy or wide work.

BOOKS Received

Practical Metrology, by K. J. Hume, B.Sc., M.I.Mech.E., M.I.Prod.E., and G. H. Sharp. Volume 3. 87 pages. Price 10s. 6d. net. Published by Macdonald & Co. (Publishers) Ltd.

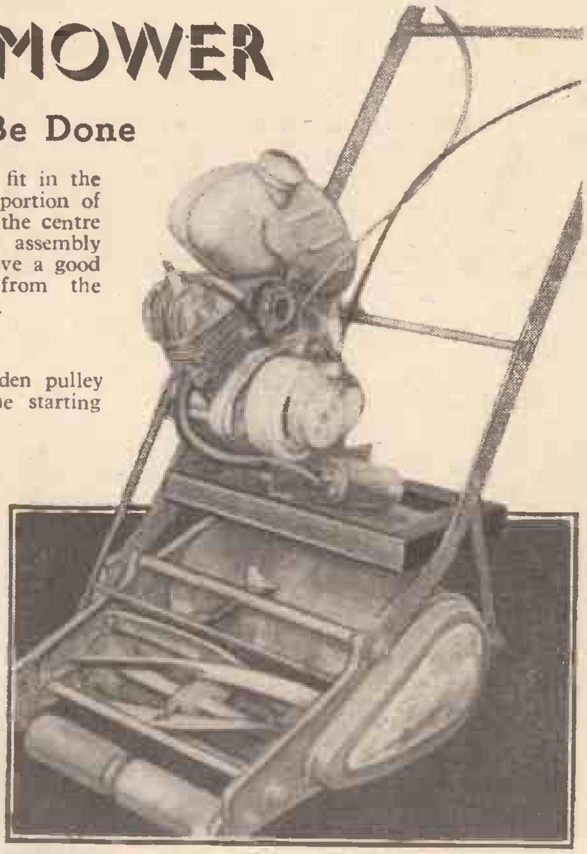
THIS book is being published in four volumes and this, the third, provides collections of laboratory experiments in metrology with instructions for their performance, recording and the assessment of results. All the experiments described correspond to actual examples encountered in industrial metrology work. Some of the experiments detailed in volume three are: Measuring an angular plate gauge, the effective diameter of a ring screw gauge, and the included angle of a taper plug gauge; setting and calibrating an engineer's block level; calibrating a dial gauge, a dividing head or table and a divided circle; comparing two slip gauges and the lengths of two end gauges; testing a straight edge and the flatness of a surface plate; and checking the involute profile of a spur gear. There are 41 line illustrations and many tables.

Clever Hands, by Richard Slade. 62 pages. Price 10s. 6d. net. Published by Faber and Faber.

THIS is a book of arts and crafts for boys and girls. It covers a wide range of interests and is clearly written with photographs illustrating the work and a brief summary of the method used set out at the end of each chapter. The contents include simple weaving, plaster casting, papier mâché, making glove puppets, modelling with wire, printing photographs, etc. The book also contains 21 half tones and three drawings.

POWER YOUR LAWNMOWER

G. R. Gilbert Explains How It Can Be Done



THIS conversion makes use of a 32cc. "Cyclemaster" unit and a Qualcast "Panther" mower. The measurements given are for this combination, no doubt they could be altered to suit a different mower.

The main work consists of making a new clutch shaft, an extension to the cutting blade shaft, and a suitable method of mounting the motor in the lawnmower frame.

The New Clutch Shaft

This is necessary because the original shaft does not extend far enough out from the casing and carries a sprocket.

Remove the engine unit from the wheel, take off the cover and the flywheel. If the flywheel is off any length of time, remember to load it up with iron (hammer head, nuts, spanners, etc.) to keep in the magnetism. Remove the screws holding the two halves of the chain casing and open it up. This exposes the clutch unit and its driving chain. By undoing the 5/16in. nut in the centre of the clutch, and careful use of a hammer and drift, the clutch shaft can be tapped out.

The new shaft is shown in Fig. 1. (This also shows the extension for the cutting blade shaft, which can be made at the same time and separated after as indicated.) It is a piece of mild steel, ½in. dia., reduced to 5/16in. and tapped B.S.F. The keyway was cut out by hand in the following manner Mark out its position from the original and along the line drill a series of closely spaced 3/32in. holes, remove the remaining metal with a slim cold chisel and clean up with a warding file. Make a key from ⅛in. mild steel a good tap fit in the keyway, clean up the projecting portion of the key to make it a snug fit in the centre part of the clutch. Fit the assembly together again and you should have a good power-takeoff shaft projecting from the right-hand side of the power unit.

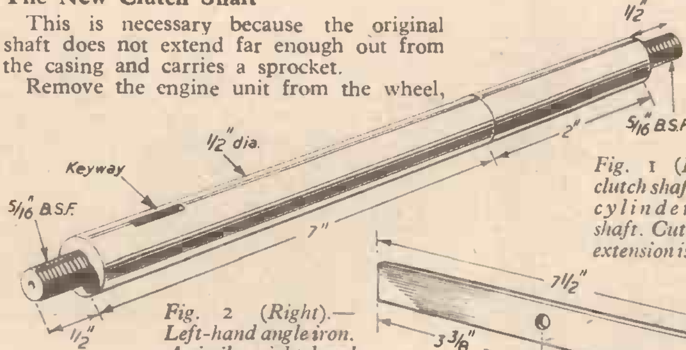


Fig. 1 (Left).—New clutch shaft and cutting cylinder extension shaft. Cutting cylinder extension is on the right.

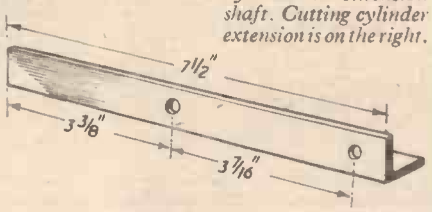


Fig. 2 (Right).—Left-hand angle iron. A similar right-hand angle iron must be cut.

The Starting Pulley

This is a simple 3in. dia. wooden pulley ½in. wide, with a groove for the starting cord and a notch cut into its edge to stop the cord slipping. This notch is cut so that the cord will pull out when the engine starts, bearing in mind that it rotates anti-clockwise, see Fig. 5. The pulley is fixed to the face of the flywheel by two 2B.A. screws in the holes originally intended for the extracting tool. (Some flywheels have three or four holes, however, mark the position from the flywheel.)

Fig. 4 (Above and left).—Two views of the motorised lawnmower, showing modified flywheel, clutch shaft, cutting cylinder shaft and pulleys.

Engine Mounting

To mount the engine it is necessary to provide flat "feet" for the unit. Two pieces of angle iron cut and drilled as in Fig. 2, provide these feet. Remove the two screws holding the chaincase halves together at the bottom and drill ¼in. holes right through, bolt on the feet with ¼in. B.S.F. bolts, sandwiching the chaincase.

Angle-iron Frame

The frame which fits into the lawnmower is simply a rectangular frame, made up from angle iron with mitred and welded corners (see Fig. 3). This frame is then bolted into the mower with ¼in. B.S.F. nuts and bolts passing through the side members of the mower handles. The position of the frame is not critical, but should be kept as low as possible and horizontal in both planes.

Cutting Blade Shaft Extension

Remove the cover plate on the right-hand side of the machine and carefully mark the centre of the shaft. Drill and tap 5/16in. B.S.F. to a depth of ½in. Screw in the extension piece (Fig. 1) tightly. The tendency is for the extension to screw tighter in with the action of mowing. Fit on to this shaft a 2½in. dia. Vee pulley.

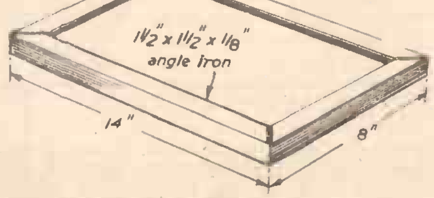


Fig. 3.—1½in. × 1½in. × ⅛in. angle iron frame.

Fitting

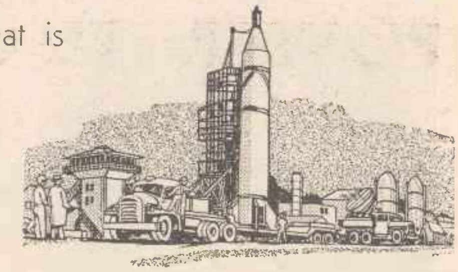
Now lift the engine-clutch unit up on to the frame and carefully align the shaft. Mark its position and drill and bolt down with ¼in. bolts. Fit a 1¼in. dia. pulley on this shaft and connect to the cutting blade shaft with a suitable Vee belt. (A 32in. belt was used on the original.)

Shorten clutch and throttle cables and fix

(Concluded on page 368).

V. A. Firsoff, M.A., F.R.A.S., Examines What is Known and What is Conjectured About Venus and Discusses the Possibility of

A VENUS PROBE



BOTH the Russian "Lunik" and the American "Pioneer IV" are now circling the Sun on their own, the first bodies ever to have left the sphere of the Earth's gravitational bondage. This is without doubt a remarkable achievement, although the navigational accuracy of the trajectories of these vehicles, if considered as being primarily intended for the exploration of the Moon, may leave something to be desired. The next attempt will most probably be to put a satellite into an orbit round the Moon and this will require more accurate control.

The international space race, however, has already a more ambitious target in view and both competing governments have announced their intention of sending a rocket to Venus.

The Journey

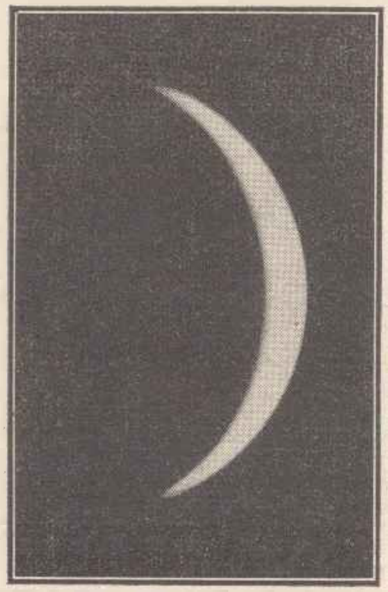
Beyond the Moon, this is the nearest heavenly body (apart from some tiny asteroids occasionally approaching the Earth), as at its closest possible approach Venus is only 24 million miles away as against 34½ million miles for Mars. Distance, however, is not the only decisive factor in space flight and the closest approach is indeed irrelevant inasmuch as the most economical interplanetary orbit is a grazing ellipse which touches the orbits of the two planets on the diametrically opposite sides of the Sun and so at their maximum separation, assuming that the orbits are circular, which is pretty nearly true in the case of the Earth and Venus. Thus, if a rocket is fired to Venus it must be so timed as to reach the farthest point of the orbit of Venus as seen from the Earth when Venus is there. Such configurations are comparatively rare and the next one will occur in June this year.

It is, then, in June that we may expect the Venus rocket or rockets to be launched.

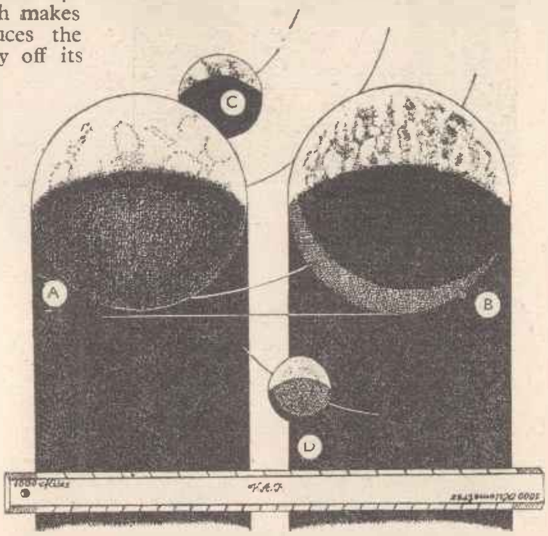
To reach Venus a rocket will need 146 days, as against 259 for Mars, which makes Venus an easier target and reduces the chances of the rocket straying badly off its course. (Based on circular and coplanar orbits these figures are approximate.) The velocity of escape will free the missle from the Earth's attraction, but it will still be moving in an orbit substantially coincident with that of the Earth. In order to drop to the orbit of Venus, the missile will have to have its orbital speed reduced by 1.55 m.p.s., and, conversely, for rising to the orbit of Mars 1.8 m.p.s. must be added to its speed. This, too, makes the Venus trip somewhat easier, though in either case less than 2 m.p.s. is needed over and above the requirements of the Moon flight, which is well within the bounds of the present practical ability of man. More important than the fraction of a mile per second by which the Venus trip is cheaper than the Mars trip is the consideration of the comparatively powerful gravitational field of Venus.

Size of Venus

Venus is much larger and nearly eight times heavier than Mars. Its mass is only 18 per cent. short of that of the Earth, so that the two planets have almost identical gravitational fields and the "capture cross-section" of Venus is about 200,000 miles. A rocket coming within 100,000 miles of Venus can still be put into a satellite orbit round it at a comparatively small cost in energy. But even if the would-be satellite does not stay in its orbit and only swings round Venus something important may be learned about this mysterious world.



Venus photographed in blue light with the world's largest telescope (courtesy of the Mt. Wilson and Palomar Observatories). The photograph shows no surface detail, possibly owing to over-exposure.



The diameters of Venus (A) and the Earth (B) projected as straight shadows on to the scale below. The real dimensions of Mercury (C) and the Moon (D) are likewise shown for comparison. Note the "ashen light" on the dark hemisphere of Venus and the effects of mutual illumination of the Earth and the Moon.

For, although Venus is our next-door neighbour, our information about it is singularly scanty. Hypotheses are not lacking, but facts are few, which makes the situation all the more intriguing as Venus is an almost exact replica of the Earth. The diameters of the two planets differ by less than 300 miles and, as stated, their masses are almost identical. A hypothetical Venusian could feel quite at home on the Earth, provided that the remaining conditions were equally similar.

Venusian Atmosphere

Unlike the nearly airless Moon and the somewhat thinly atmosphered Mars, Venus has plenty of air, which is so full of cloud that there is some doubt if we can ever see any of the planet's solid surface. This is indeed one of the reasons why we know so little about it; another reason is that Venus and the Earth meet with Venus between us and the Sun and thus more or less thoroughly invisible, except for a ring of sunlight shining through its atmosphere, whereas Mars at its closest approach is at full phase.

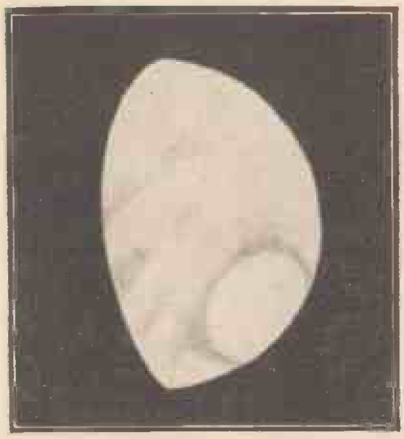
However, to return to the air of Venus, its composition is somewhat startling. Carbon dioxide is organically a most important gas; plants cannot exist without it. Yet our vegetable kingdom gets on cheerfully on a meagre allowance of this gas amounting to 0.03 per cent. of the total atmosphere. On Venus there is enough of carbon dioxide above the visible cloud layer to make up about a third of our total air ocean. There is also some nitrogen there, as it is present in the spectrum of the auroral night-glow of the sky of Venus, occasionally visible as the so-called "ashen light," which shows the dark side of Venus rather like "the old Moon in the new Moon's arms." This spectrum was first obtained in 1954 by the Russian astronomer N. A. Kozyrev, who has recently hit the headlines with his observation of a volcanic eruption on the Moon.

No trace, however, of either water vapour or oxygen has been found to date in the spectra of Venus.

The absence of water vapour need cause no surprise. For, according to the recent measurements of the heat radiated by Venus (W. M. Sinton), the temperature at its cloud level is −38° F and at so low a temperature the amount of water vapour in the air would be too small to be spectroscopically detectable. Oxygen, on the other hand, if present in quantity, ought to show both in the absorption spectrum of the day hemisphere and in the emission spectrum of the "ashen light"—and it does not.

The Clouds

From this it has been inferred, rather hastily perhaps, that there could be no life on Venus and the clouds we see *must* have some exotic composition consisting, according to Professor Wildt, of polymerized formaldehyde (a kind of commercial plastic material); according to Dr. Dauvillier, of France, of ammonium nitrite (with some water); to Dr. Öpik, of the Armagh Observatory, of tiny polished grains of white



Observational drawings by the author, made using a 6½ in. reflector and a set of colour and polarising filters. March 10th, 1956, 200X A white circular area near the pole is clearly shown.

quartz sand; to Mr. Fred Hoyle, of Cambridge, of oil; and to Dr. G. P. Kuiper, of Leyden and Yerkes, of carbon suboxide. You can take your choice! Drs. Whipple and Menzel, of Harvard, and the present writer, on the other hand, incline to the view that the clouds are—surprisingly enough—water, and in fact small water droplets can and do subsist without freezing at −38° F and less at the tops of our cumulus clouds.

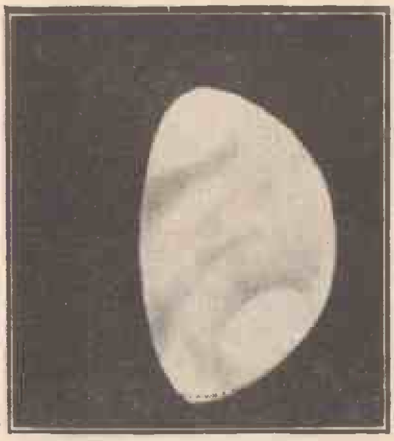
Drs. Whipple and Menzel believe, for certain reasons, that Venus may be a wholly oceanic planet, without any dry land at all; but I think it more probable that it has both land and sea, much as our Earth does, and occasionally something suspiciously like snow caps has been observed near the putative poles of Venus, notably by myself with the help of a green filter and by some other British observers. See drawings on this page.

It is, indeed, not impossible that conditions on Venus do not differ very much from those on the Earth, after all.

Magnetic Field

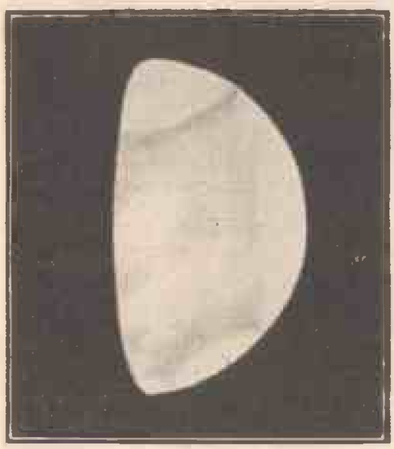
It is known that Venus is a strongly magnetic body, although the exact strength of its field, provisionally estimated at five times that of the Earth's, is in doubt (this could be established by a Venus probe). Now oxygen, in all its forms, is the most strongly attracted of all gases by a magnet, so that if the magnetic field of Venus is sufficiently powerful, oxygen may be wholly imprisoned in its lower atmosphere. Conversely, carbon dioxide is repelled by a magnet, albeit somewhat weakly, and it also has the property of energetically absorbing the invisible heat rays, which causes it to heat up to a higher temperature than other gases will have in the same conditions. Thus in the strong sunshine of Venus, which is a third nearer the Sun than is the Earth, carbon dioxide may have been sorted out into the stratosphere. We have a somewhat similar situation on the Earth, where ozone, which is even heavier than carbon dioxide, greedily absorbs the invisible ultra-violet rays and stays high up in the stratosphere.

I have developed these ideas, as well as examined the problem of the ground temperature of Venus quite recently. Making some plausible assumptions about the amount of sunshine transmitted and absorbed by the clouds of Venus and using the terrestrial meteorological methods, I have obtained a surface temperature only a few degrees higher than the mean annual temperature of the Earth. It may be some-



March 13th, 1956. 200X.

March 24th, 1956. 300X. Polar area and atmospheric belts shown.



March 27th, 1956. 350X. The polar area has moved to the limb consistently with the change of the spatial configuration of the Earth and Venus.

" Ashen Light " as seen through a green filter and a " Pola " screen. 300X.

April 3rd, 1956. 350X. Polar area at the cusp.

what less, or it may be a little more, but there is nothing to substantiate the high temperatures previously ascribed to the surface of Venus. The already-mentioned Russian astronomer Kozyrev thinks that the globe of Venus is swathed in perpetual twilight and a kind of eternal spring, with an even temperature of +86° F, which does not vary as between day and night, summer and winter.

The inclination of the polar axis of Venus has been determined by Dr. Kuiper at 32°, which is nearly 5° more than the Earth's and would give proportionately sharper seasons, though they would also be shorter, as the year of Venus is only 225 of our days.

Venusian Day

Owing to the lack of clear surface detail, the length of the Venusian day remains in doubt. Since, however, the clouds of Venus show a clear banded structure, due to rotation, when viewed through a blue or violet filter, the planet must be turning about its axis fairly rapidly, and Dr. Kraus, of the Ohio State University, has inferred from the fluctuation in the radio " noise " from Venus (caused by atmospheric electricity) a period of 22 hours and 17 minutes.

If this is correct Venus would indeed be very similar to the Earth, but even if it is not it is very likely that at least some kind of life exists on the " Earth's Twin."

A transmitter-satellite put into an orbit round Venus might not answer all these queries, but it could discover a good deal—the strength of the magnetic field, the intensity of the radiation belt, perhaps attempt a radar survey of the globe beneath the clouds and give us a rough idea of the distribution of land and sea upon it. It could obtain air-free spectrograms of Venus and shed some further light on the composition of the Venusian air.

We can but wait and see.

The Cymbals, Tambourine, Castanets, and Triangle

Part 5.—F. Hook Describes Their Construction

Fig. 1.—The completed tambourine, triangle and cymbals.

OTHER essential instruments in the percussion section of the orchestra are the tambourine, triangle, cymbals and castanets, and these will now be described (see Fig. 1).

The tambourine may be constructed around the former used for the shell of the side drum, described in the April issue, i.e., it is 9in. in diameter. The shell is of ¼in. or 5/16in. plywood. The strip is 2¼in. wide when finished and is bevelled off for the overlap joint as described for the drums. A narrow fixing hoop for the parchment head is required to be made to slip over the main shell and this can, in fact, be bent around this shell and glued up, taking the precaution of placing a piece of paper between the shell and the hoop when gluing up. The hoop should be ⅜in. wide when finished.

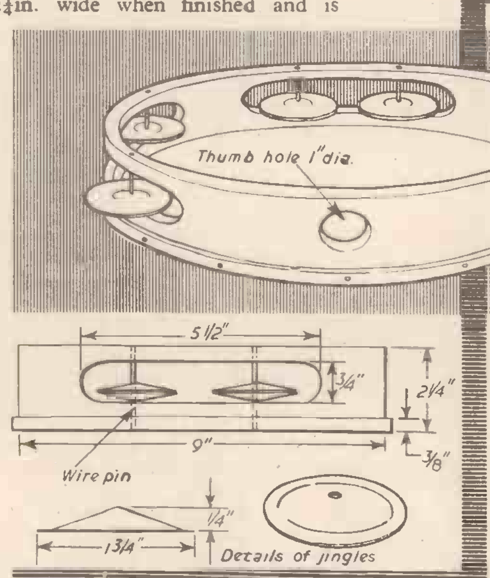
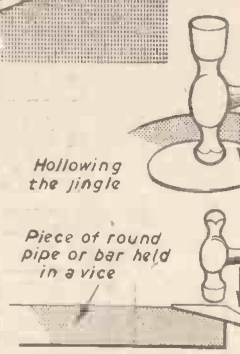


Fig. 2.—Details of the tambourine.



When the shell is glued three slots have to be cut to take the jingles. The overall length of the slots is 5½in. and ¾in. wide. The best way to take out the slots is to drill a ¾in. dia. hole at each end with a centre bit and hand brace and then to saw out the intervening piece with a bow saw or fret saw. A thumb hole 1in. dia. is required as shown in Fig. 2.

The jingles, of which a dozen are required for each instrument, are hollowed out from some thin brass sheet of about 20 gauge thickness. If required, these may be made of thin tin plate sheet instead.

The method of hollowing is to carve out a shallow circular depression in the end grain of a block of wood. The metal should be 2in. dia. to start with before hollowing with the round pene of a small engineer-type hammer.

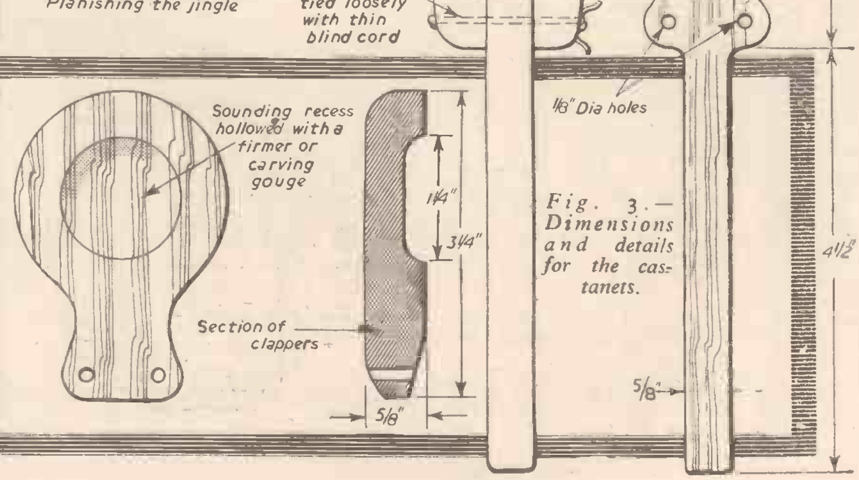



Fig. 3.—Dimensions and details for the castanets.

When the hollowing has been completed the jingle may be planished on an odd piece of $\frac{3}{4}$in. round bar held firmly in the vice.

Finally, from the centre punch mark the circumference is again scribed with the dividers and cleaned up with a fine file. The centre hole is then drilled $\frac{1}{8}$in. dia.

The jingles are mounted in pairs with the hollow sides together by means of a thin piece of wire passing from the edge of the shell through the jingles into the opposite side of the slot.

The parchment is of 10in. diameter. To mount it, first soak in water. Then place it over the top of the shell and press evenly down over the shell. Fit the narrow hoop over the parchment and ease down, pulling the parchment as taut as possible. Tack the hoop in place with some small brass pins, spacing at about 1in. intervals. When the parchment is dry it will shrink quite tightly and any edges showing below the hoop may be trimmed off with a sharp knife.

In humid weather conditions the parchment will become slack and it is then best to hold the instrument in a warm place for a time before playing starts, in order to tighten up the skin.

Constructing the Castanets

This instrument can be made from almost any hardwood. The dimensions are shown in Fig. 3. First of all make the centre sounding board and handle. The two hollowed side pieces can then be marked out from this piece against which they fit when in use.

The two side pieces are hollowed to about two-thirds of their thickness with a carving gouge or firmer gouge. Holes $\frac{1}{8}$in. dia. are drilled in the three pieces, through which is passed a piece of thin blind-cord which is knotted on one side.

The instrument may be stained black and polished with French polish or clear cellulose to imitate ebony from which the instruments were originally made.

The Triangle

The triangle is one of the simplest of the percussion instruments to make. It is formed from a 12in. length of bright mild steel or silver steel of $\frac{1}{4}$in. diameter. This piece of rod may be bent to the triangular shape in a cold state but, of course, it will be easier if the metal is heated to a bright red heat at the two points of bending.

The holder for the triangle is a piece of mild steel $4\frac{1}{2}$in. $\times$ $\frac{1}{2}$in. $\times$ $\frac{1}{8}$in. One end of it may be flattened out to take the two small holes through which the length of gut string is threaded to support the triangle.

A beater is required, made from a 6in. length of $\frac{1}{4}$in. dia. mild steel. Full constructional details of the triangle are shown in Fig. 4.

How to Make a Pair of Cymbals

Cymbals may be made in varying diameters, but for use with the instruments already described a diameter of 7in. will be adequate.

Two circular pieces of 22 gauge brass will be required. These must be thoroughly annealed first of all. From the centre, a circle of $2\frac{1}{4}$in. is drawn with a pair of dividers to mark the centre depression.

This centre depression is hammered out in a depression hollowed in the end of a block of wood. Use the ball pene end of an engineer's hammer working out from the centre.

The hollowing process will draw in the outer flange sufficiently to be ready to planish it to the shape shown in Fig. 5. For this planishing process work from the centre dome outwards to the edge of the cymbal. Finally, from the extreme edge inwards for about $\frac{1}{4}$in. the cymbal is hammered flat to provide surface of impact when the two cymbals are struck together.

The cymbals may then be cleaned in an acid dip or by other polishing processes and finally given a coat of clear cellulose.

Handles are made from strips of soft leather, passed through the 5/16in. dia. hole drilled in the centre, and knotted on the inside.

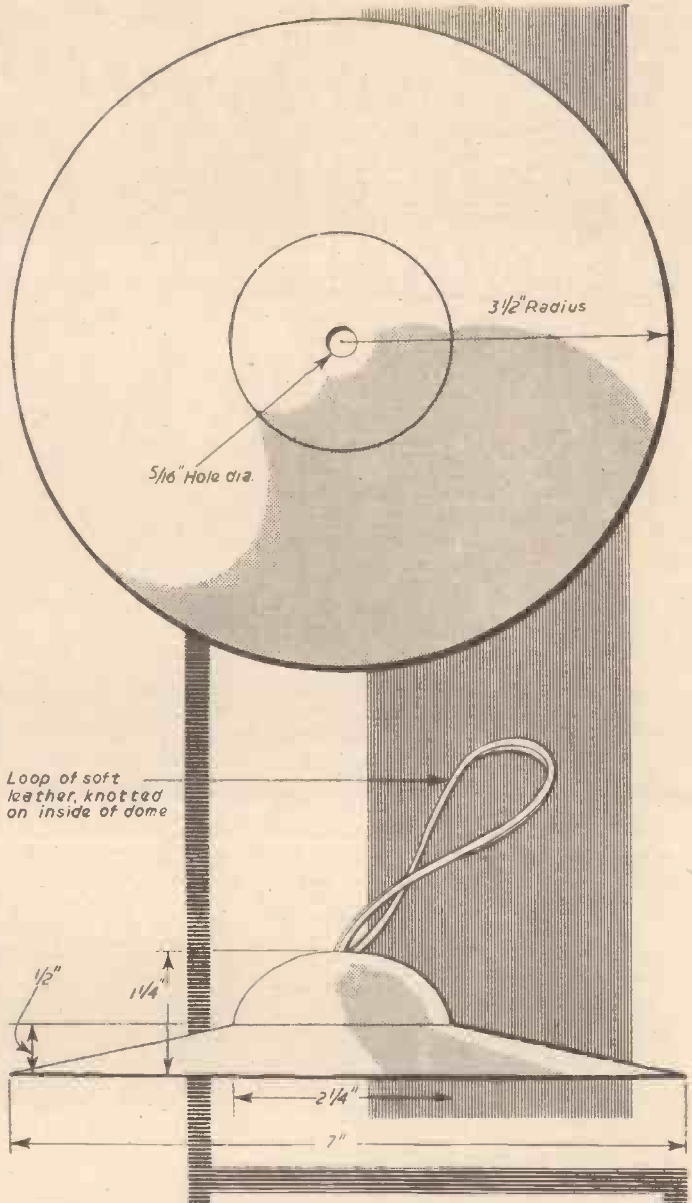


Fig. 5.—The cymbal dimensions.

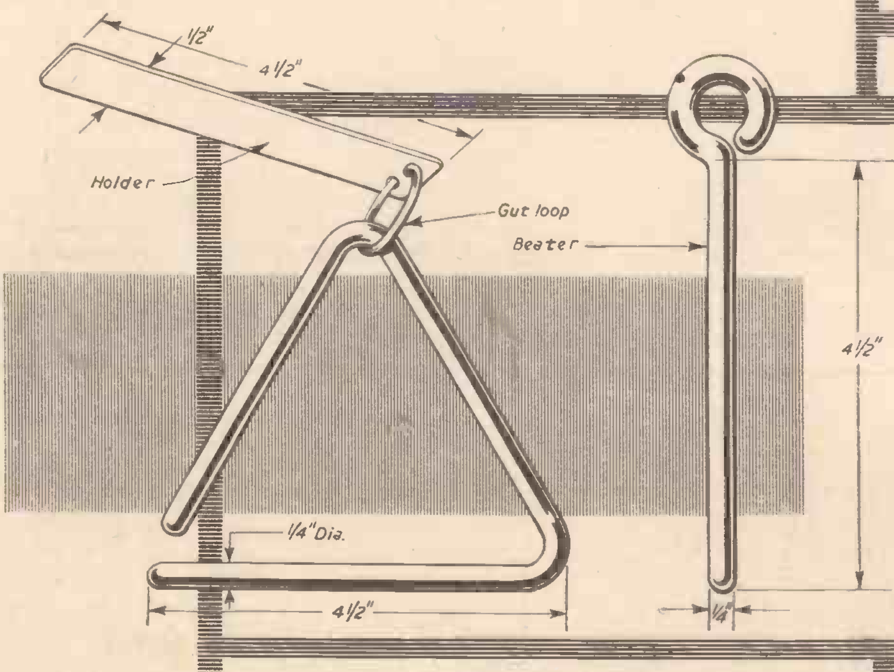


Fig. 4.—The triangle.

Control Tower "Flying" Models

How to Install Electric Motors in Kit-built Models and Fly Them on a Control Tower

By Norman Swallow

THE general outline of the method of flying "solid" aeroplane models can be seen from the photograph, Fig. 1. The model has a small electric motor mounted in the fuselage and a propeller fitted. It is then positioned by one of its wing tips on the end of an arm, pivoted near one end and balanced by means of a weight. Power is supplied to the tiny motor by means of a $4\frac{1}{2}$v. battery, the leads being carried via the arm. The propeller rotates at a very high rate and will provide enough power to enable the plane to take off, fly, dive, taxi and stop at given positions.

The Model

Any lightweight plastic or balsa wood model can be used, either built up from a do-it-yourself kit or purchased already complete, but make certain that there is sufficient space in the fuselage nose to accommodate one of the tiny Japanese-made motors, of the type which are available from most toy shops, model stores, etc. Suitable models or kits of parts are also available from toy shops, multiple walk-round stores, etc.

With some models it may be necessary to clear a larger space in the fuselage, but with others, the motor will have to be packed round with modelling clay or some similar substance. The method of fitting the motor in the model illustrated, which is a Republic P47N Thunderbolt supplied by The Electric Model Aircraft Co., 11, Dryden Chambers, London, W.1, is to fit the wings, but not to cement the two halves of the fuselage together. Mould the modelling clay round

Fig. 1 (Above).—A general outline of the method used. Other models of similar size and materials can be used including a helicopter which has been successfully flown by the author.

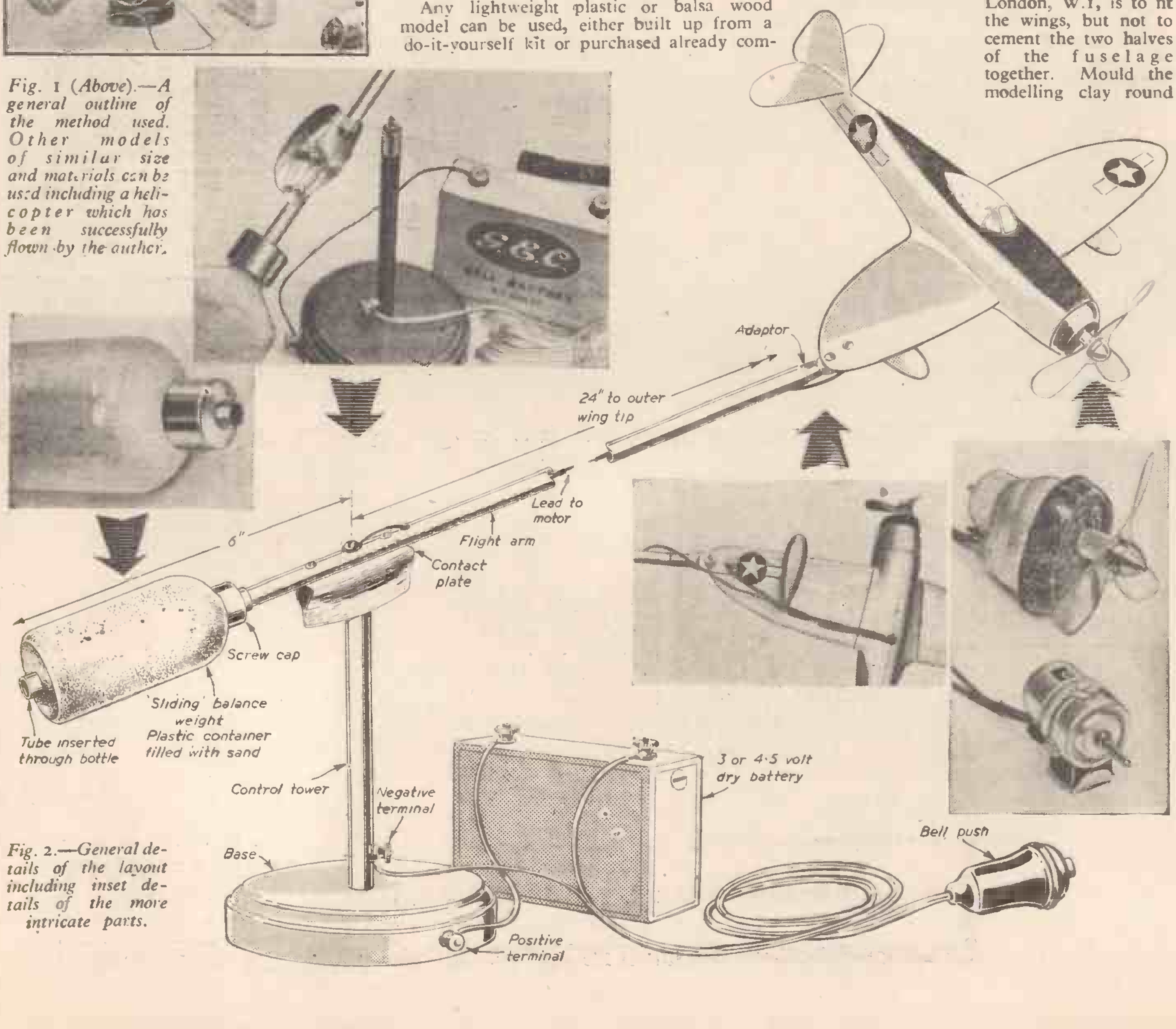


Fig. 2.—General details of the layout including inset details of the more intricate parts.

the motor and press the two halves of the fuselage round it until it is tightly held. Make sure that there is not modelling clay on the motor bearings. Bring the two leads out through a small hole in the bottom of the fuselage and then cement the whole plane together.

Before fitting the front plastic cowl of the plane and the propeller, drill a large clearance hole in the cowl for the motor spindle. The hole could well be ⅜in. dia. Place the cowl over the motor spindle, which should be projecting ¼in. out of the fuselage and cement into position. Press the propeller on to the motor spindle very tightly, making sure that it cannot spin off; these little motors rev at very high speeds.

Attaching Plane to Control Arm

This is achieved by means of the adaptor, shown in Fig. 2. Make this from a 2in. length of aluminium alloy tube. Mark the halfway point on the length and squeeze one half flat in the vice. In the flattened half drill two clearance holes for 5 B.A. bolts and using this as a pattern mark the positions for two similar holes on the starboard wingtip (starboard is the right side, facing forward). Drill these holes also 5 B.A. clearance and bolt the adaptor on to the wingtip. Finally, complete the model by painting as per the maker's instructions and affix the transfers.

The control arm is made from tubing of the same diameter as the adaptor and the two are fixed together by means of a short length of ¼in. dia. tubing used as a dowel inside both (see Fig. 2). This system is also used half way along the control arm. When flying, a piece of adhesive tape provides additional security, and the joint can be quickly disconnected at any time to change from one model to another. Each model has its own adaptor permanently fitted.

Connect one of the motor leads to one of the adaptor bolts on the wingtip. The other motor lead is extended and run through the centre of the control arm.

The control arm is 2ft. long and 6in. from the end farthest from the model, three holes are drilled. Two are for 5 B.A. bolts and nuts and the centre one for a 5 B.A. radio terminal, as shown in Fig. 3. This must be insulated from the control arm by means of tubing and washers.

A piece of tinplate, approximately 3in. × 2in., is cut, the corners trimmed off and bent up, as shown in Fig. 2. Electrical contact is made between the point of the control tower and the terminal nut in the arm, to which the lead passing through the control arm is attached. The sides of the piece of tinplate provide the other contact as they brush the sides of the control tower.

The Balance Weight

A polythene bottle with a metal screw cap is required for this. A hole, which is a push fit on the control arm, is drilled in the centre of the cap and the base of the bottle. A length of brass tubing with an inside diameter which is a slide fit over the control arm is pushed through both these holes; the polythene bottle is then filled with sand. There are two methods of adjusting the weight, i.e., by increasing or decreasing the quantity of sand inside it or by sliding the bottle, by means of the interior brass tube, up and down the control arm.

The Control Tower

There are several ways in which this could be constructed, but one suggested method is shown in Fig. 2. A piece of brass tubing is mounted in the centre of a heavy round wooden base, as shown. A plug of polythene is fitted in the top of the tube and a bolt mounted in it, as shown. The tip of the bolt is tapered with a file to make the mounting point for the control arm (see Fig. 2). A wire is mounted under the head of this bolt and taken to a terminal point on the side of the wooden base, while another terminal is mounted in the side of the tube. Wires from these two terminals are taken to the battery. One of these leads is made quite long and broken by a push-type switch. The electrical circuit can be seen in Fig. 3.

Setting Up

Balance the control arm by means of the terminal nut on the screw point on top of the control tower and bend in the sides of the contact plate until they make a strong rubbing contact with sides of the control tower. Pay attention to these two points of contact at all times to ensure that there is always a good electrical connection. A little petroleum jelly on the contacts from time to time will improve the electrical contact.

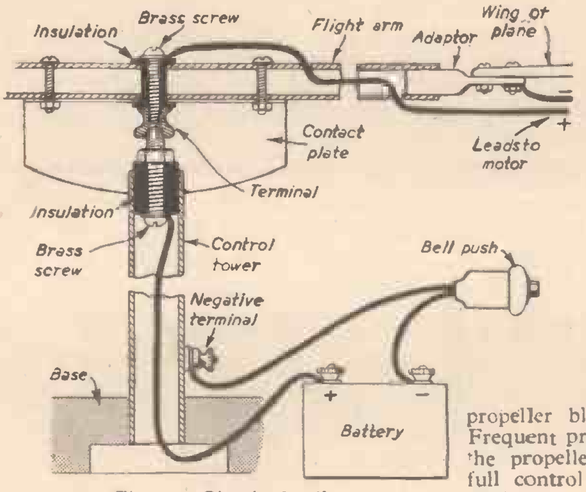
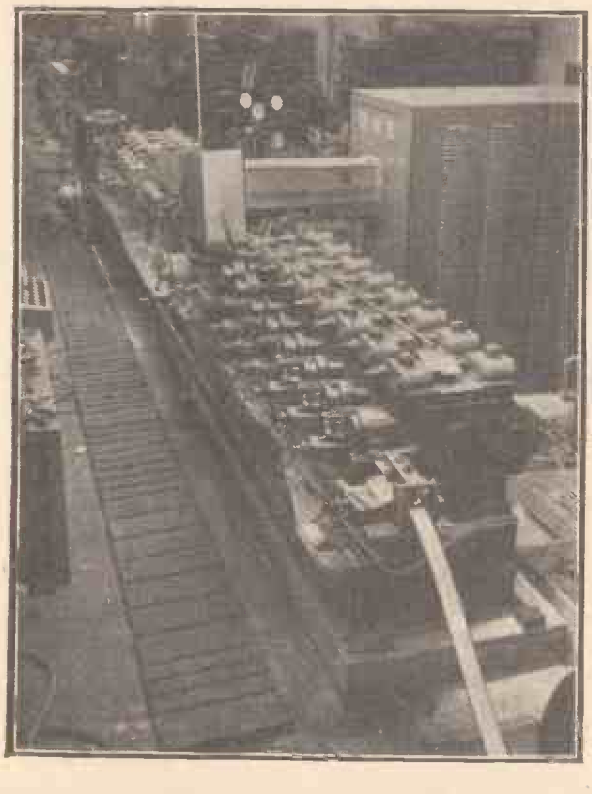


Fig. 3.—Circuit details.

Balancing the Model

As mentioned earlier, this is done by adjusting the contents and position of the balance weight. It should be adjusted so that the plane just touches down on the table, i.e., it is slightly heavier than the weight.

Now try the model in action by pressing the push switch. If the plane tends to move backwards, reverse the connections to the battery. Experiment gradually and get the feel of handling the model. Further adjustments may be necessary to the set of the propeller blades or to the balance weight. Frequent practice in controlling the speed of the propeller will eventually give the user full control of take-off, flying, diving and landing.



New Aluminium Tube Welding Process

UNTIL this year aluminium tubes in the U.K., unlike steel, were only available either as seamless ones (after extrusion and subsequent drawing processes) or split tubes roll formed from strip. The oxide barrier of aluminium had so far prevented high speed welding of strip into tube. The problem has, however, been solved by an American firm, using a new process known as Thermatool, they produced equipment capable of welding at speeds in excess of 200 f.p.m. A British firm, Elm Engineering Limited, of Aylesbury, Bucks, has recently acquired one of these high-frequency welding machines as shown in the photograph. Speeds of up to 400 f.p.m. are obtained and thus the cost of manufacture has been reduced and the resulting saving passed on to the user.

(left) The thermatool welding machinery.

The method of production is as follows: aluminium strip to various specifications and gauges is passed through several stages of rolls until it becomes an almost closed circle. Two contact shoes are used to transmit high frequency current (450,000 cycles per second) along either side of the almost closed seam of the tube. Heating of the aluminium occurs only on the edges of the strip and when these are forced together by two pressure rollers a forged type weld results.

Since the layer of plastic metal is only a few thousandths of an inch thick the crystal structure of almost all of the parent metal is unaffected since most of the metal which has been heated is forced out into the scarf, which on the outside of the tube is subsequently removed during straightening operations.

Independent laboratory tests on the tubes have shown by micro-analysis that the weld point is truly homogeneous and the tubes may be formed, shaped, pierced, polished and even anodised.

Sizes range from ½in. to 1½in. o.d. in wall thicknesses from 14-22 gauge to British Standard Specifications and others.

A COMPACT 2"x2" SLIDE PROJECTOR

Construction of this Smart and Efficient Piece of Photographic Equipment is Described by

J. C. RALPH.

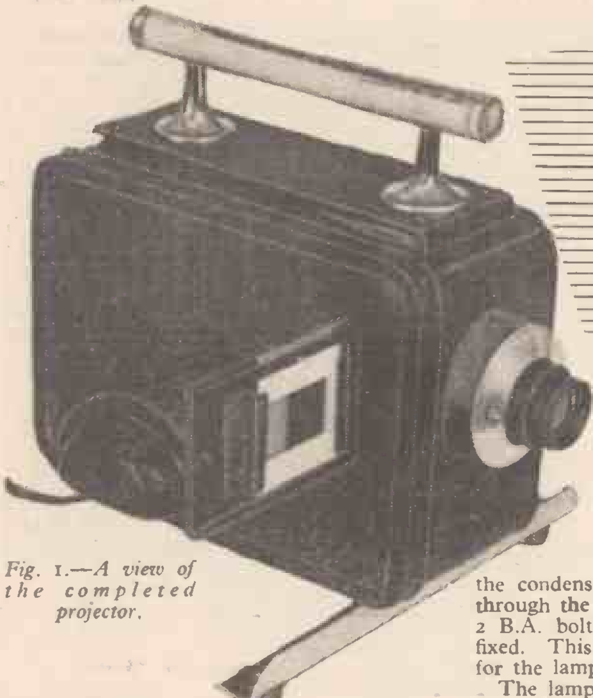


Fig. 1.—A view of the completed projector.

THE design of this 150-watt projector, as can be seen from Figs. 1 and 2, is simple but provides a perfectly satisfactory means of enjoying your slides. Most of the parts are made from sheet metal. The design should be of particular interest to photographers possessing their own enlarger with a 2in. focal length lens of f4.5 aperture or wider. The projector is, in fact, designed to use a 2in. f4.5 anastigmatic enlarging lens.

To make this projector, less the lens, will cost approximately £2 10s.

The Main Body

This consists of a steel lunch box with several cut outs provided for cooling air. The cut outs are made by drilling a series of ⅛in. diameter holes close together around the required shape and filing the edges level. Particular care is necessary when cutting out the slots for the slide carrier; they must be in the correct position with respect to the lens and must be in line with one another. All the holes for air cooling are left with flaps bent inwards to form light traps.

The main cooling ducts at the sides are made by fixing metal drawer handles over cut outs, as shown in Figs. 1 and 3. The cooling air passes up through the body and out of the top which is cut back along almost the whole length. Light spill is prevented by fixing a thin metal plate about ½in. from the top, covering the cut out but still allowing the hot air to escape around the sides.

Lens Housing

The front of the projector, through which the lens housing protrudes, is reinforced with a piece of ⅜in. thick wood. The housing itself is formed from tinplate by wrapping it around the lens mount and soldering it to form a metal tube in which the mount slides. The actual lens mount is made from an aluminium can which previously contained a pressurised hair spray. The hole in which the base of the spraying nozzle was fitted is enlarged to take the lens barrel. The actual fixing of the lens to the sliding mount will depend on the type of lens used. On the original, the flange which is used on the enlarger is bolted inside the mount with 6 B.A. screws, these pass through holes in the tapered front (see Fig. 3).

The base of the body is reinforced by a thin plate which also forms the platform for the condenser mount. Holes are drilled up through the bottom of the case for the three 2 B.A. bolts on which a fibre rectangle is fixed. This fibre rectangle forms the mount for the lamp, concave mirror and heat filter.

The lamp and mirror may then be moved vertically or horizontally and locked in the position which gives even illumination when aligning the optical system.

The condenser mount is made from tinplate cut from a cocoa tin or some other similar tin, the metal being wrapped around the condensers and soldered to form a good fit.

A spacer is made to fit between the condensers, which are held in the mount by small tags bent over the edge of them.

The mirror holder, which may usually be purchased with the mirror, is mounted in a slotted bracket made of 18 G. aluminium or brass. Vertical positioning is then obtained

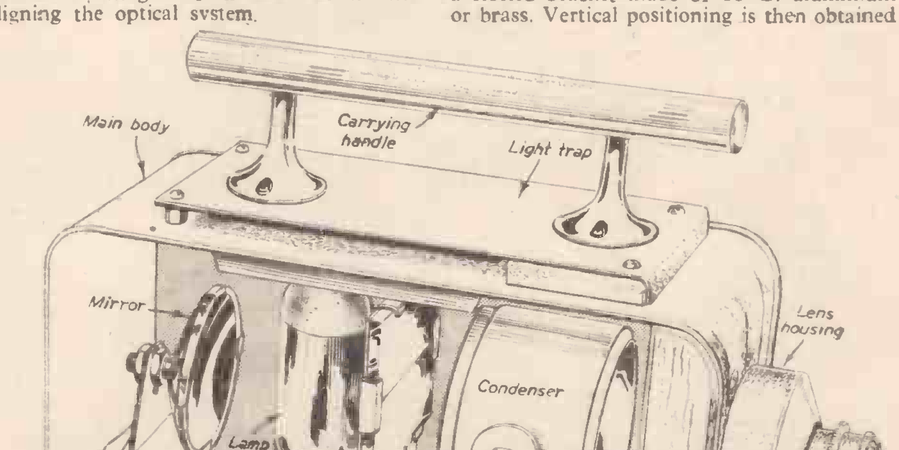


Fig. 2.—A view of the projector with lid removed showing general arrangement. The slide carrier is also shown.

by sliding in the slot and horizontal alignment by movement of the locking nuts on the holder bolt.

The heat filter, which consists of two 1in. × 2in. strips of infra-red absorbing glass, must be free to expand in its mount. The material used to make the mirror mount may also be utilised for the filter mount.

Slide Carrier

The back of the slide carrier is made from a piece of 16 G. aluminium with a small lip bent on the bottom to form the slide rest. Four 1½in. long strips of tinplate are bent to a Z-section and mounted on to the back with 10 B.A. countersunk screws to form guides.

Very thin piano wire is used to form steady springs in the guides. Two 10 B.A. screws are mounted in slots as stops for the carrier. They are aligned when the projector is finally assembled.

The projector stands on three legs, the two at the front are, on the original, fixed to a detachable piece of polished stainless steel angle. The single rear leg utilises an electric plug earth terminal about 5/16in. dia., which is adjustable by locking it at the required position on its mounting screw.

Finish

All parts which are fitted inside the projector are given two coats of matt black paint. The outside was finished in black crackle paint and baked for two hours in a gas oven at regulo "4" as per manufacturer's instructions. The resulting finish, which is quite easy to achieve, is attractive and very hard wearing. Various colours of crackle paint are produced and it is usually obtainable at radio spares stockists and some good paint retailers.

When assembling the projector, position the condenser lens as close to the slide carrier as possible and in line with the projection lens.

As a rough guide to the position of the lamp with respect to the condensers, take the focal length of *one* condenser lens. Place lamp at this distance from the rear face of the condensers with the element on the optical centre. With this arrangement and without the mirror fitted adjust the lamp position until even illumination is obtained and fix the lamp holder in this position. Now fit the mirror at approximately twice its focal length from the lamp element and adjust it to give even illumination. When carrying out these adjustments a blank slide should be focused on a screen placed at normal viewing distance, say, 7ft.

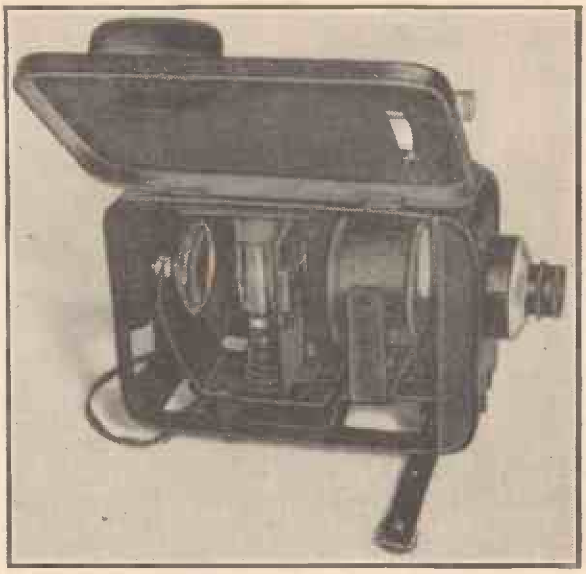


Fig. 5.—(Right) Interior arrangement of the projector.

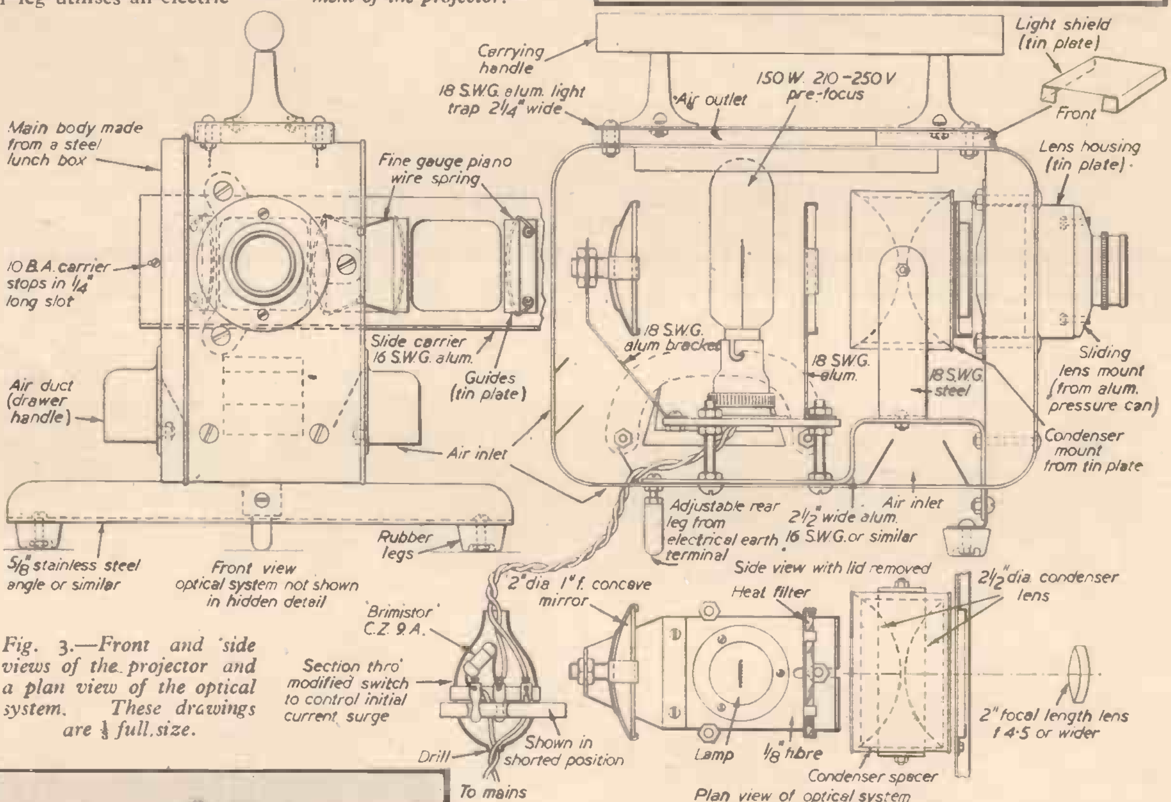


Fig. 3.—Front and side views of the projector and a plan view of the optical system. These drawings are ⅓ full size.

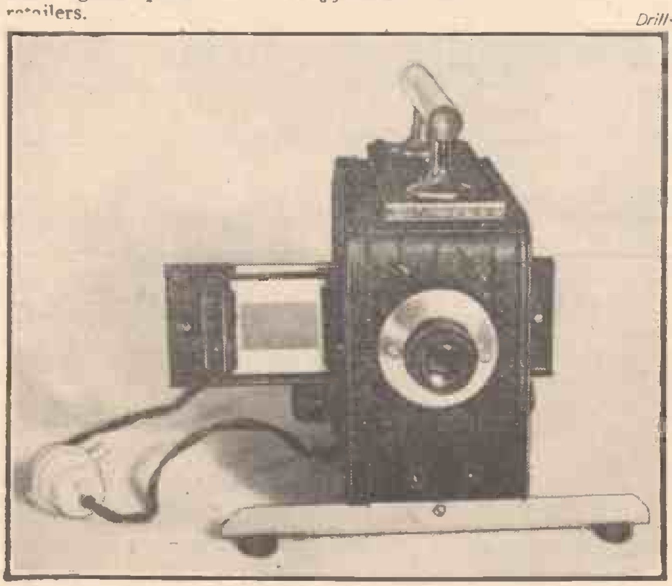


Fig. 4.—A front view of the completed projector.

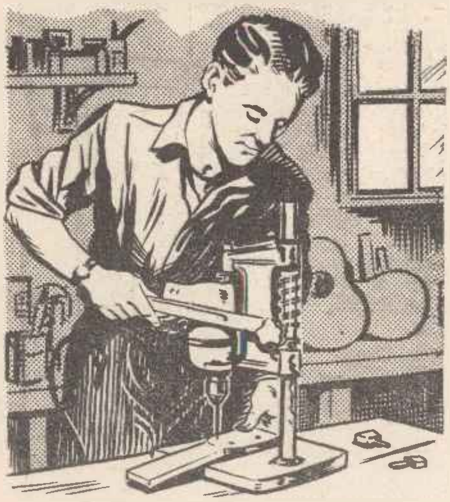
Figs. 4 and 5 are two further views of the completed projector.

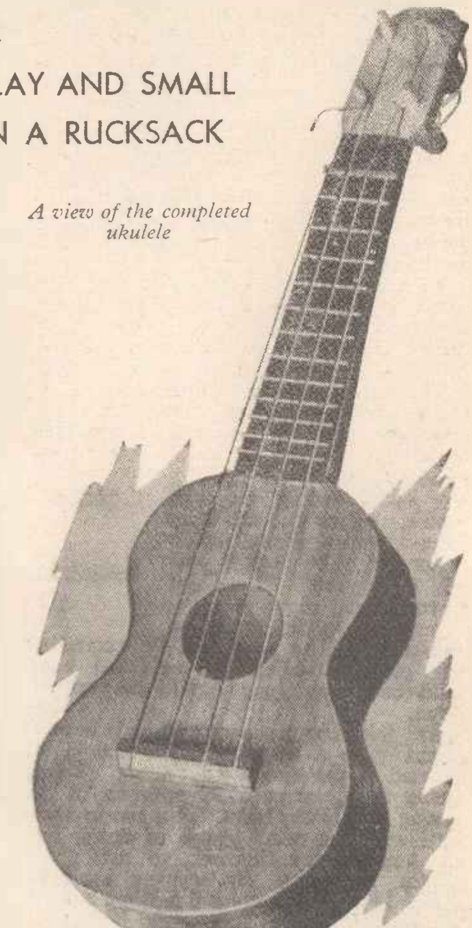
On the original an electric switch was modified to incorporate an anti current surge device. Before the projector is switched on a "Brimistor" type CZ 9A is in series with the lamp and after a warming-up period of six or seven seconds it is shorted out of the circuit to give full illumination and to ensure a longer life for the "Brimistor."

Make Your Own Ukulele

By A. B. ORR

SIMPLE TO MAKE AND TO PLAY AND SMALL ENOUGH TO BE CARRIED IN A RUCKSACK





A view of the completed ukulele

THE body is made from two pieces of ⅛in. mahogany plywood and a length of 1/16in. plain plywood. Start by scaling up the drawing in Fig. 1, making the squares 2in. × 2in. Using carbon paper, transfer the outline to one of the body panels. Now pin the two panels together with drawing pins. These should be pressed through where the sound hole and bridge will be located so that the final finish will not be marred with the holes. The pins will not protrude through the lower panel and should only hold the panels together lightly while they are being cut to shape. When this is done cut carefully around the outline using a fret saw. Smooth down any divergences from the line with sandpaper, ensuring that the edges are kept at right-angles to the face of the wood to give a good gluing surface for the sides.

The centre of the sound hole should be marked on the top panel 3¼in. from the top. Describe a 2in. dia. circle about this centre and cut out with the fret saw. The edges of the sound hole should be tapered slightly.

The position of the end blocks should now be marked on the inside of the lower panel. Note that the lower block is rounded to the shape of the body. After marking centre lines on the end blocks, position them on the centre line of the body and glue in place. The lower panel and end blocks should now be put to one side to dry.

CUTTING LIST

Body: 2 pieces ⅛in. mahogany plywood 10in. × 7½in.; 1 piece 1/16in. plywood 2ft. 9in. × 3½in.; 2 blocks, deal, 2½in. × 2in. × ⅝in.

Neck: 1 block (see text) 1ft. × 2in. × 2in.

Bridge: 1 piece mahogany 3in. × ½in. × ½in. Length of fret wire, 2ft. 3in.

Pegs: 8in. × 5/16in. dowel; 1 piece mahogany 4in. × ⅝in. × ⅝in.

Nut: Small piece of bone or plastic.

Fret wire, pegs, etc., can be bought in any music shop.

A word about glues here. Any good glue can be used, those of the resin and hardener type being particularly suitable, due to their space-filling properties. If this type is used, care should be taken not to splash acid on the surfaces that are to be polished later, as there is a risk of marring the finish.

Once the end blocks are dry, the sound board (top panel) should be positioned and glued. Take particular care to do this accurately so that no difficulty will arise when it comes to adding the sides. If a carpenter's square is laid on the top panel, its blade should line up exactly with the lower panel at any point.

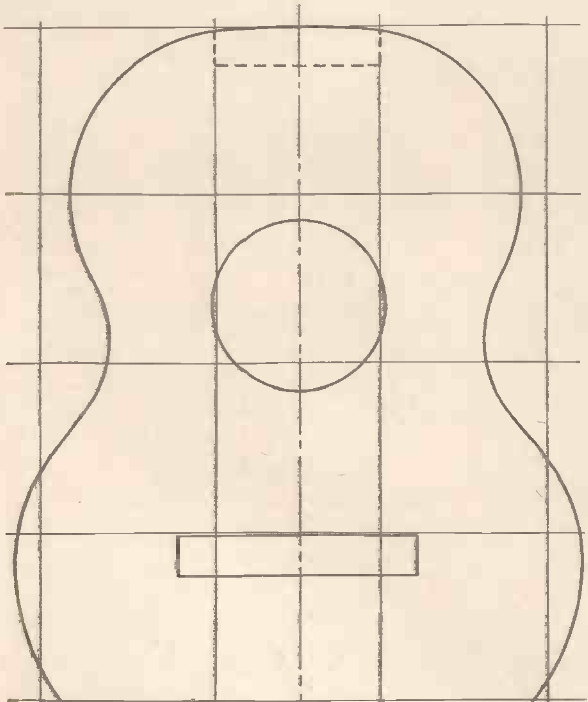


Fig. 1.—Body shape.

Sides

Fig. 2 shows the various stages of fitting the sides. First of all mark a vertical on the 1/16in. plywood at the half-way mark. Glue and pin the sidepiece to the end block, lining up the verticals (stage 1). When the glue is dry bend up one side, and, after gluing, lash in position using two pencils as shown (stage 2). Make sure that a really close fit is obtained before letting this stage dry. If any difficulty arises in bending the plywood to the body shape, the 1/16in. plywood should be held in the steam from a boiling kettle. Next bend the top section round the body shape and pin and glue to the top block. Before the glue dries, trim the side to the centre line of the top block.

Repeat the process for the second side, trimming the end to lie flush on the top block, making a neat join (stage 4).

When the sides are absolutely dry they should be trimmed flush with the body panels.

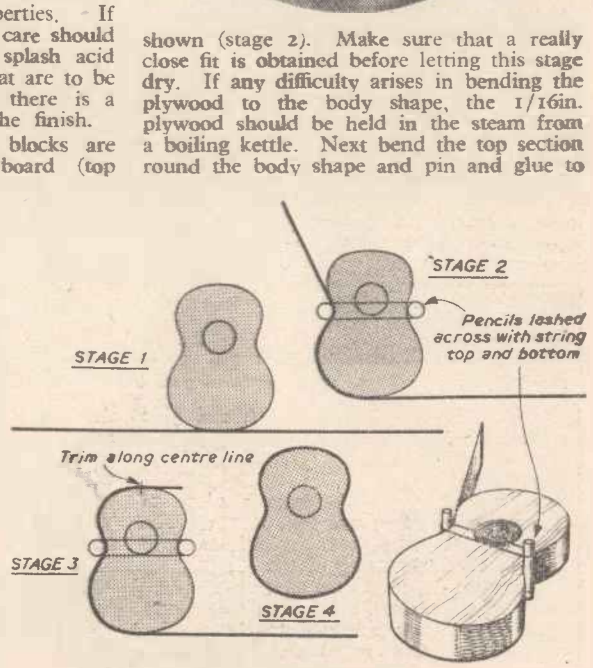


Fig. 2.—Four stages in fitting the sides.

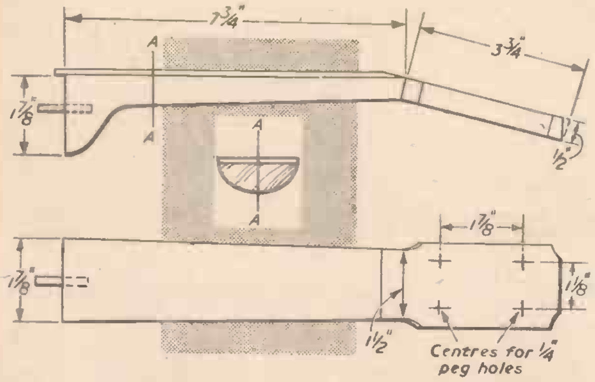


Fig. 3.—Neck dimension.

The Neck

In the original instrument the neck was made from lime but any straight-grained and knot-free wood can be used. Mark off the block from the measurements given in Fig. 3. After cutting out one profile, replace the cut-away piece while the second profile is cut out. The neck is now "in the square." It remains to round and shape it using a rasp and varying grades of sandpaper. The head can be carved or left plain according to individual taste. Drill the four ¼in. peg holes in the positions given.

The joint between neck and body is reinforced with a dowel. This should be inserted in the shoulder as shown. Before gluing it in, ascertain the position of the mating hole in the body. This can be done by inserting a small length of dowel into the hole in the shoulder, so that about 1/16in. protrudes. By pressing the neck to the body in the correct position a mark will be made on the body where the mating hole will be located. Drill this hole in the body, carefully position the neck and glue in place.

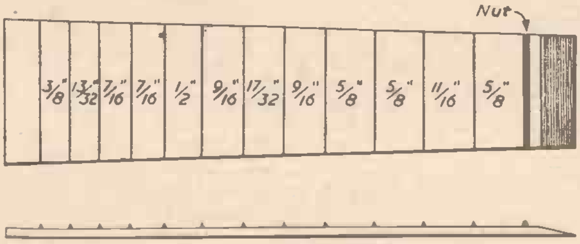


Fig. 4.—Finger board.

Fingerboard

This should be made from a piece of ⅛in. mahogany measuring 8in. × 2in. The success or failure of the finished instrument depends on the accuracy of the work at this stage. Great care should be taken that the measurements are adhered to and that the frets are parallel.

Lay the piece of mahogany along the neck and mark out the outline of the neck on it with a pencil. Do not forget to allow for an overhang of about 1/10in. to cover the join between neck and body. Before cutting around the outline, accurately mark off the fret positions from the dimensions given in Fig. 4. When these have been marked off and checked for accuracy the board can be cut to shape. Do not try to get dead accurate fit at this stage but leave about 1/16in. all round so that the fingerboard can be sanded flush with the neck when it is permanently in place. Using a tenon saw, cut along the fret marks to a depth of about 1/16in. to take the fret wire. The board can now be secured to the neck. This can be done by gluing or using countersunk screws. Perhaps the last method is best as the board can be removed if any fault comes to light later on. Once in position it should be sanded flush with the neck. The top end is bevelled so that it is level with the face of the head. The fret wires should now be cut to length and fitted as a tight force fit in the slots.

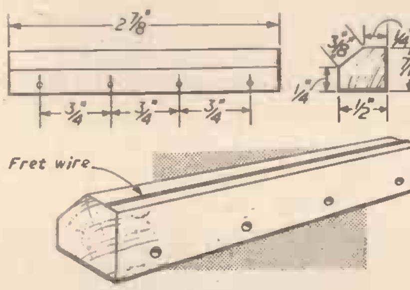


Fig. 5.—Details of the bridge.

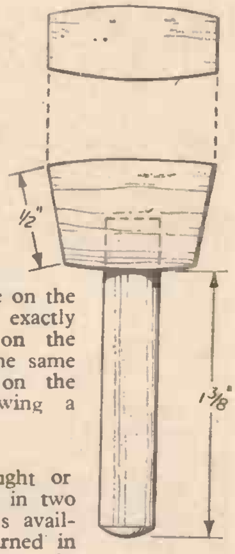


Fig. 6.—Details and dimensions for constructing the pegs from mahogany.

The Bridge

This is made from a piece of mahogany. Fig. 5 gives the measurements. It should be accurately located and glued to the soundboard. The distance between the nut and the fret wire on the bridge should be exactly 12¾in. The fret on the bridge is fitted in the same way as the frets on the fingerboard, by sawing a slot.

The Pegs

These can be bought or can be simply made in two pieces. If a lathe is available they can be turned in one piece, but for those who do not possess a lathe and wish to make their own, the following method can be used.

Shape the heads as shown in Figs. 6 and 7 from mahogany and then drill each one to take 5/16in. dowel. The dowel is glued into the head and then tapered slightly to make a tight fit in the pegholes. Small holes should be drilled in the dowel to take the strings.

The Nut

This is made from a piece of bone or plastic, notched to take the four strings. It can either be glued in place or held by the tension of the strings.

Finishing

The instrument should be sanded to a smooth finish using fine sandpaper. A good grain filler should then be applied until all pores are filled and the wood is silky. The original was then polished with a friction polish until a deep shiny skin was formed. If desired the instrument can be painted, in which case the underside of the neck and the sides should be painted black, the remainder being left natural, polished wood.

The "Uke" is now ready for stringing, tuning and playing. There are many good tutors on the market and it should not be long before proficiency is gained in playing this very simple and pleasant instrument shown completed in the heading and in Fig. 8.

If sufficient care is taken during every stage of construction and attention paid to detail, it will be difficult to distinguish the completed ukelele from a commercial model. Do not rush the construction of this instrument and always give the glue ample time to dry.

Readers may also be interested in the design for a somewhat larger steel stringed ukelele which is included in the "Practical Mechanics" How-To-Make-It Book. This book also contains a design for a Spanish Hawaiian guitar. It is obtainable for 13s. 9d. post free from these offices.

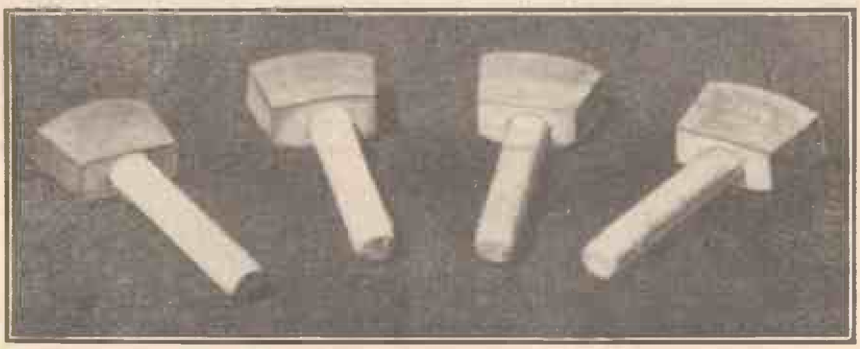


Fig. 7.—Examples of home-made pegs.

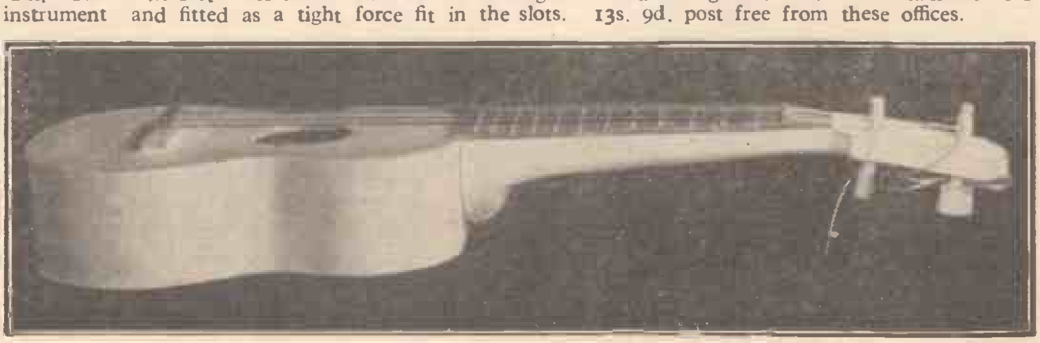


Fig. 8.—A further view of the completed ukulele.

A Single-seater Kayak

In This Second Article F. Hook Continues Constructional Details

carefully to the correct length and saw off the surplus material. Replace in position and screw to the stern piece. Remember that the keelson stands above the frames at the edges and that later these edges are planed away to be in line with the bottom sides of the frames and meeting in a V down the centre of the keelson.

When everything fits snugly, remove the keelson and, after gluing the points of contact with the frames, stem and stern pieces, screw together again. Use brass screws throughout. The construction should now appear as in Fig. 12.

Making the Frames

SET out to full size the outlines of the pair of smaller frames and the large centre frame. Figs. 8 and 9. The smaller frames could be made from some $\frac{3}{8}$in. thickness plywood in which case they would need no reinforcing pieces secured around their edges. In the case described they were made from 4 mm. plywood as used for the skin of the boat. The edges are reinforced with pieces of $1\frac{3}{4}$in. $\times$ $\frac{3}{4}$in. timber glued and nailed on. These pieces could be thinner, say, $\frac{1}{2}$ in. or $\frac{3}{8}$in.

When the glue is dry the frames can have the notches cut to take the chine, sheer strips and keelson (Fig. 10).

The pieces for the centre frame can be sawn and placed in their relative positions on the full-scale drawing. The joints are made by gluing and nailing on pieces of 4 mm. plywood as indicated in Fig. 9. These pieces are secured on both sides of the joints.

The next stage is to fit the frames in place on the main member. Their positions are shown in Fig. 11 and they are held in position by pieces of $1\frac{3}{4}$in. $\times$ $1\frac{3}{4}$in. screwed vertically to the form and main member. Make sure that the centre lines of the frames are vertical and in alignment along the centre line of the keelson (see Fig. 12).

Fitting the Keelson

With the frames in place secure one end of the keelson in position on the stem and temporarily screw it in place. Then lower the keelson into place in the notches in the frames and along to the stern. Mark

Fitting the Chine and Sheer Strips

Before attempting to fit these strips, work the approximate chamfer on the front edges of the stem and stern pieces (Fig. 13). The

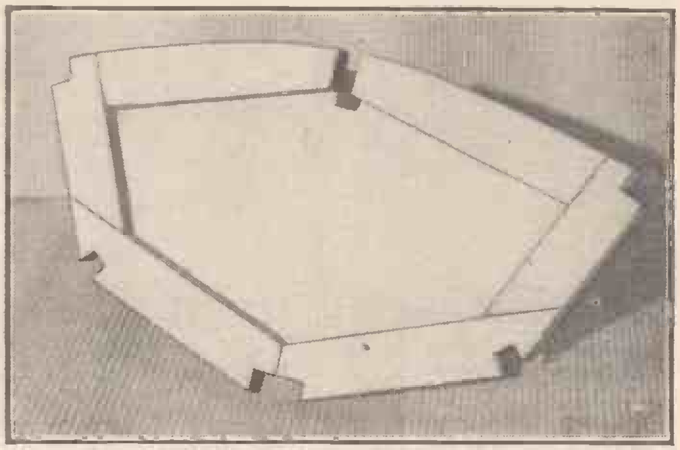


Fig. 10.—*A smaller frame completed.*

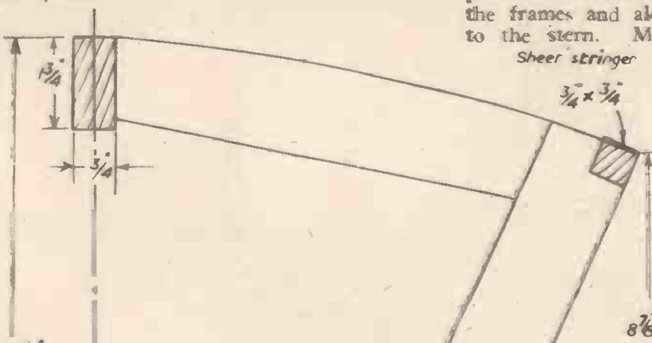


Fig. 8.—Half plan of fore and aft frames.

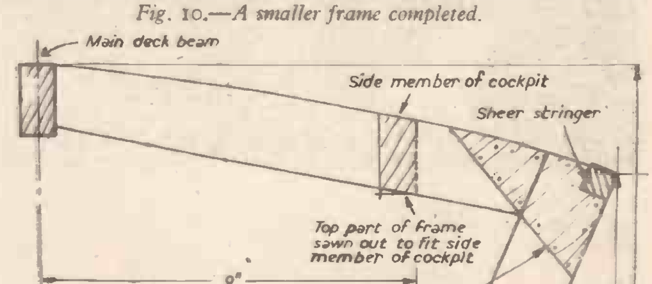


Fig. 9.—Dimensions of the centre frame.

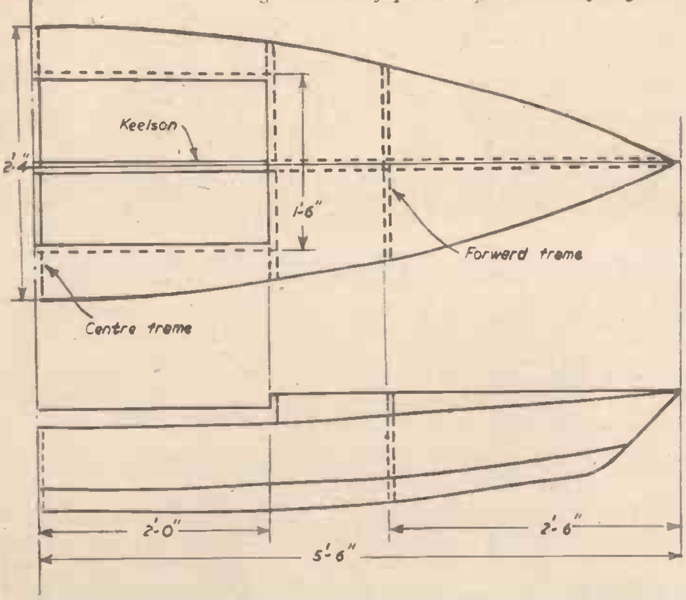


Fig. 11.—Half plan and elevation of kayak.

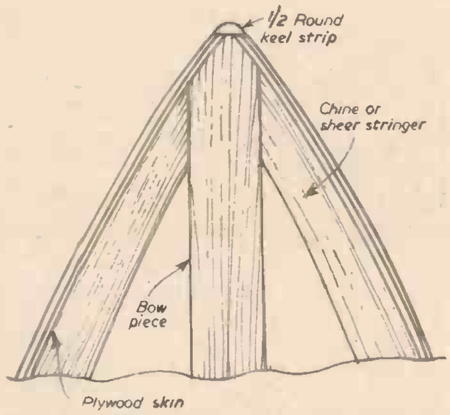


Fig. 15.—Showing how the chine and sheer strips meet the chamfer on the bow piece.

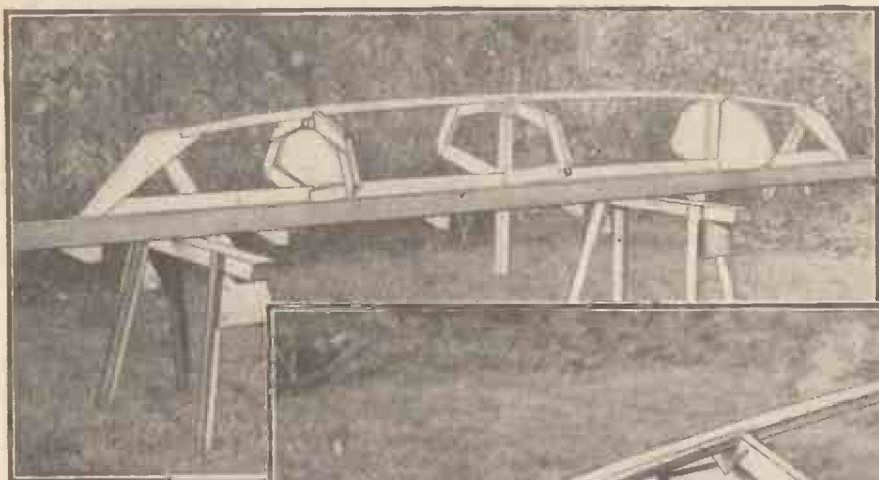


Fig. 12 (Above).—Frames in place and keelson fitted.

Fig. 13 (Right).—A chamfer is worked on the bow and stern post before adding the chine and sheer strips.

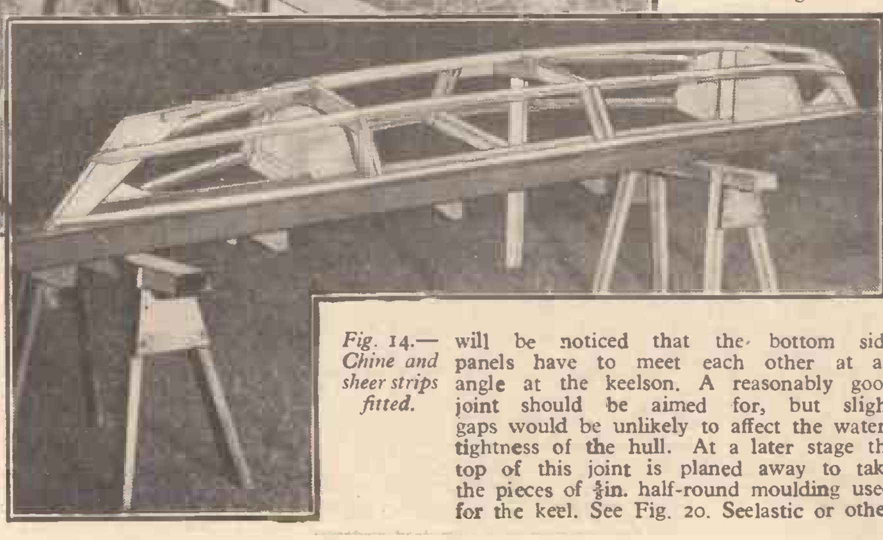


Fig. 14.—Chine and sheer strips fitted.

strips are placed in the notches of the frames and drawn around to the stem and stern in turn. If care is taken, there is no need to steam or wet these pieces in order to get them to the curvature required. With the strip held with G cramps at the frames, the ends can be sawn obliquely to fit against the stem and stern (Figs. 14 and 15). Screw the strips in position with some $1\frac{1}{4}$in. × No. 6 brass screws, the heads of which are well countersunk.

Preparing to Fit the Bottom Side Panels

Before the bottom side panels can be fitted work must be done in fairing off the chine strips and keelson and a constructor is seen doing this in Fig. 17. Most useful for this task is the Surform or Stanley type of file or plane in addition to an ordinary metal smoothing plane.

A problem for the builder of plywood craft is how to join the plywood top side to the bottom side. Amidships the top side overlaps the bottom side at a little over a right angle. Towards the bow the angle becomes very much greater so that the plywood has to be planed down to a long slope at the joint. To meet this difficulty designers sometimes make a notch in the edges of the panels, as shown in Fig. 16, 2ft. or 3ft. from the bow and stern, so that the lap joint turns into a butt joint. Whilst this is a fairly easy task for the experienced woodworker the beginner is recommended to follow the procedure shown in the design given, which is both simple and effective.

As the fairing proceeds it will be found that the top side of the chine strip has to be severely planed away towards the bow and stern (Fig. 18). This means there will be little material into which to nail the top side panels. Therefore, an extra strip of $\frac{3}{4}$in. × $\frac{3}{4}$in. wood is glued and screwed on to the underside of the chine strip between the frame and the bow and stern pieces.

Frequently test across the keelson and stem and stern pieces to the chine strip to see that the surfaces to which the plywood is fixed are in the same plane.

The surfaces on the chine and sheer strips to which the top sides have to be secured may, at this stage, be roughly faired down.

Setting Out the Bottom Side Panels

The easiest method of getting the shapes of the plywood panels is to use a large sheet of paper to make a pattern, as shown in Fig. 19. Odd rolls of wallpaper are useful for this purpose. Pin the sheet in place on the kayak and rub a finger around the outline required on the keelson and stringer. Cut out along the crease thus made.

From Fig. 20 it will be noticed that the bottom side panels have to meet each other at an angle at the keelson. A reasonably good joint should be aimed for, but slight gaps would be unlikely to affect the water-tightness of the hull. At a later stage the top of this joint is planed away to take the pieces of $\frac{3}{8}$in. half-round moulding used for the keel. See Fig. 20. Seelastic or other

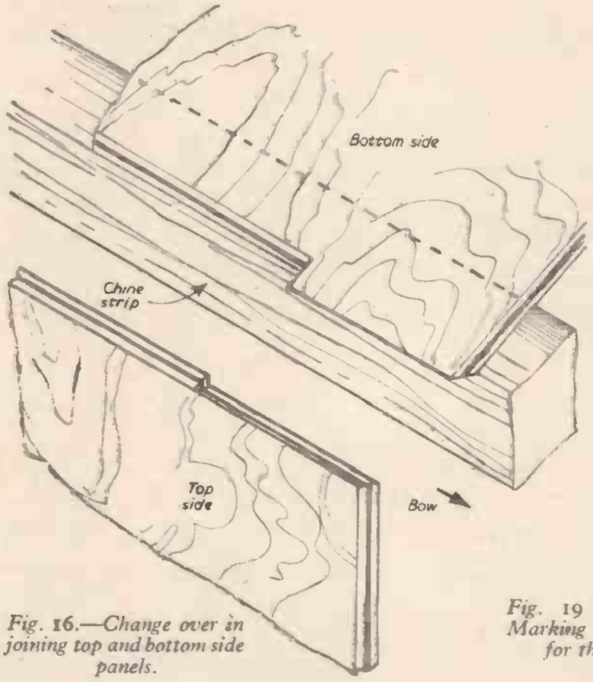


Fig. 16.—Change over in joining top and bottom side panels.

jointing compound is used under the keel so that any gap in the joint between the panels will be filled.

When the panels have been cut out for the bottom sides, one may be placed in position and held by cramps. Some difficulty may be experienced in bending round the plywood at the bow. To make this task easier soak the first 2ft. of the panel in hot water for a short time to render it more flexible and then quickly replace in position and cramp down until the water has dried out. Do not try to glue the panel until the timber is dry.

Apply glue to the points of contact of the panel at the centre frame, the chine, keelson, stem piece and forward frame. Apply the hardener to the plywood panel. Cramp the panel in place. When everything is in the correct position, start nailling with some $\frac{3}{4}$in. flat-headed brass escutcheon pins. Space the nails about 2in. at first and then fill in later at 1in. intervals. At the points of greatest strain it is helpful to use one or two $\frac{3}{4}$in. × No. 2 brass countersunk head screws as these will not draw out slightly which might well happen with the nails alone.

When the glue is dry, slight inaccuracies along the keelson edge of the panel may be removed with a small bull-nosed plane or rebate plane. Check that the panel laps over only half the thickness of the centre frame and plane away the extra amount if necessary.

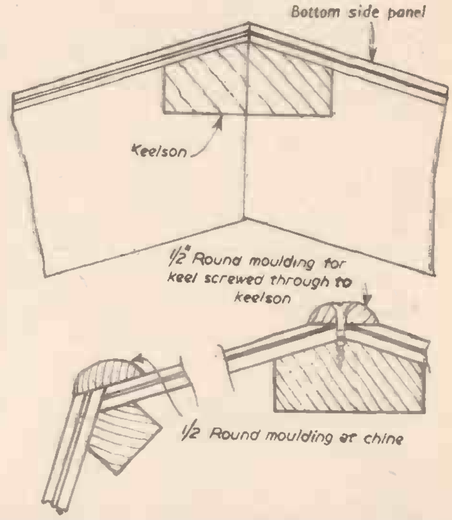


Fig. 20 (Right).—Joining the panels.

Fig. 19 (Right).—Marking out panels for the skin.

Fig. 18 (Below).—The additional piece screwed to the chine strip at bow and stern.

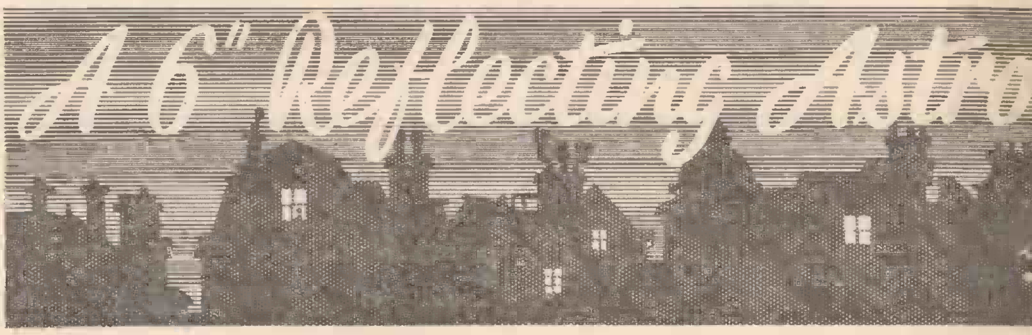
Fig. 17 (Below).—Fairing off ready for fixing the plywood skin.

Before fixing the three remaining panels it is as well to fair off the edge of this first panel at the chine stringer so that the builder is better prepared for the task on the other three. From Fig. 20, it will be observed that the plywood has to be filed away to a very oblique angle towards the bow. Many of the nails will be found to be in the way. They must be punched down because they would catch in the teeth of the file and be dragged sideways in the plywood. When doing this fairing, frequently sight along the edge of the chine to see that a nice even curve is maintained against which the top side panel will eventually rest.

Fixing the Top Sides

When the trimming up of the bottom side edges at the chine has been completed and tested across to the sheer strips with a straightedge, start fixing the top side panels. It is not necessary to damp these panels as there is little twist in them. The shape of the panels is arrived at in a similar manner to those of the bottom sides.

(To be concluded)



Designed for Use in the Back Garden and Costing Ab

THE telescope proposed in this article is capable of taking a high power and it has great light grasp. The design is simple yet robust. The instrument may be made for a sum close to £20.

The construction of the optical parts is not described for there is a wealth of literature on the subject. Two references will suffice.

Amateur Telescope Making—Book One—by A. G. Ingalls. Scientific American Inc. 1948. PRACTICAL MECHANICS, January and February issues 1958.

The enthusiast who wishes to grind his own mirror and optical flat should be encouraged to proceed. It must be fully realised, however, that it is most unlikely that one would produce a perfect set of optical parts at the first attempt.

It may well be prudent to purchase at the outset a mirror, optical flat and eyepiece from

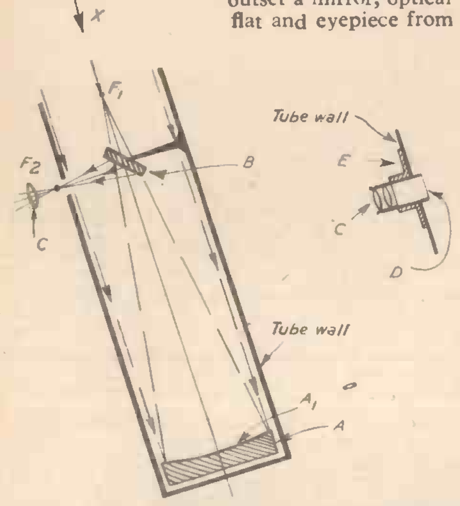


Fig. 1.—The optical system of the Newtonian reflecting telescope.

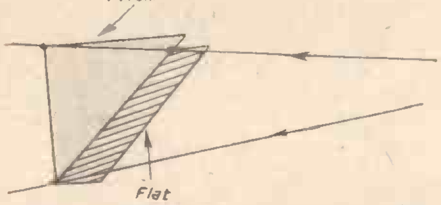


Fig. 2.—Comparison of prism and flat mirror.

a reputable maker. To save expense it is easy to obtain all these components from *amateur* optical workers. The names of these are well known to the amateur astronomical associations and more detailed information may be obtained by sending a stamped-addressed envelope to this office.

The optical system of this reflecting telescope is shown in Fig. 1. The system was devised by Sir Isaac Newton. The mirror at A has a top reflecting surface A_1 of parabloidal figure. It is able to gather light from the heavens and bring it to a focus; the prime focus F_1. In order that the image so formed can be examined the rays are intercepted by an optical flat (or prism) B which turns the rays to the side of the tube. The flat mirror is placed within the convergent beam before it comes to a focus and reflects the light so that the image is formed at F_2. Obviously the flat mirror B reduces the light gathering power of the telescope but there is no way of avoiding this. The smaller the central obstruction in relation to the aperture the better within reason. If the diameter of the small mirror is near one-sixth of the aperture of the telescope the image is scarcely affected at all and only one-thirty-sixth (less than 3 per cent.) of the light is lost. In this design we will make the flat of 1 3/10in. dia. when viewed from X.

(In truth the flat mirror, being tilted at 45 deg. to the axis of the tube, is elliptical in form.)

The eyepiece is positioned at C in a tube D called the adaptor which slides easily in a flanged piece E fastened to the tube wall.

A prism may be used in place of the flat mirror. To intercept the same cone of rays a prism must have a larger size than a corresponding flat mirror. This is shown in Fig 2. In the matter of light reflection and transmission efficiency the prism and flat are equal. If the entrance and exit faces of the prism are fluoride coated it may transmit nearly 10 per cent. more light than the flat reflects. With the modern aluminised surface used on the flat, which enables it to be cleaned (it was not possible to clean a silver-coated flat), the writer prefers the flat mirror.

To begin with then, obtain the following optical components.

Item in Fig. 1.

A. Six-inch aluminised mirror of focal length 48in. (f8), costing £9 (approx.).

B. Flat mirror, aluminised, 1.3in. dia. when viewed from X, Fig. 1. This will cost about £1.

C. An eyepiece of 1in. focal length, a Ramsden or an Orthoscopic, costing about £3. (A Huyghenian eyepiece is useless with an f8 mirror.)

The Ramsden eyepiece comprises two simple plano-convex lenses at a distance apart equal to half the sum of the two focal lengths.

An Orthoscopic eyepiece consists of a triple cemented combination and a simple plano-convex eye lens. The eyepiece is free from chromatic or spherical aberrations. The field of view is 40 deg.

With the optical components safely purchased take great care of the top-surfaced mirrors. The more money you are prepared

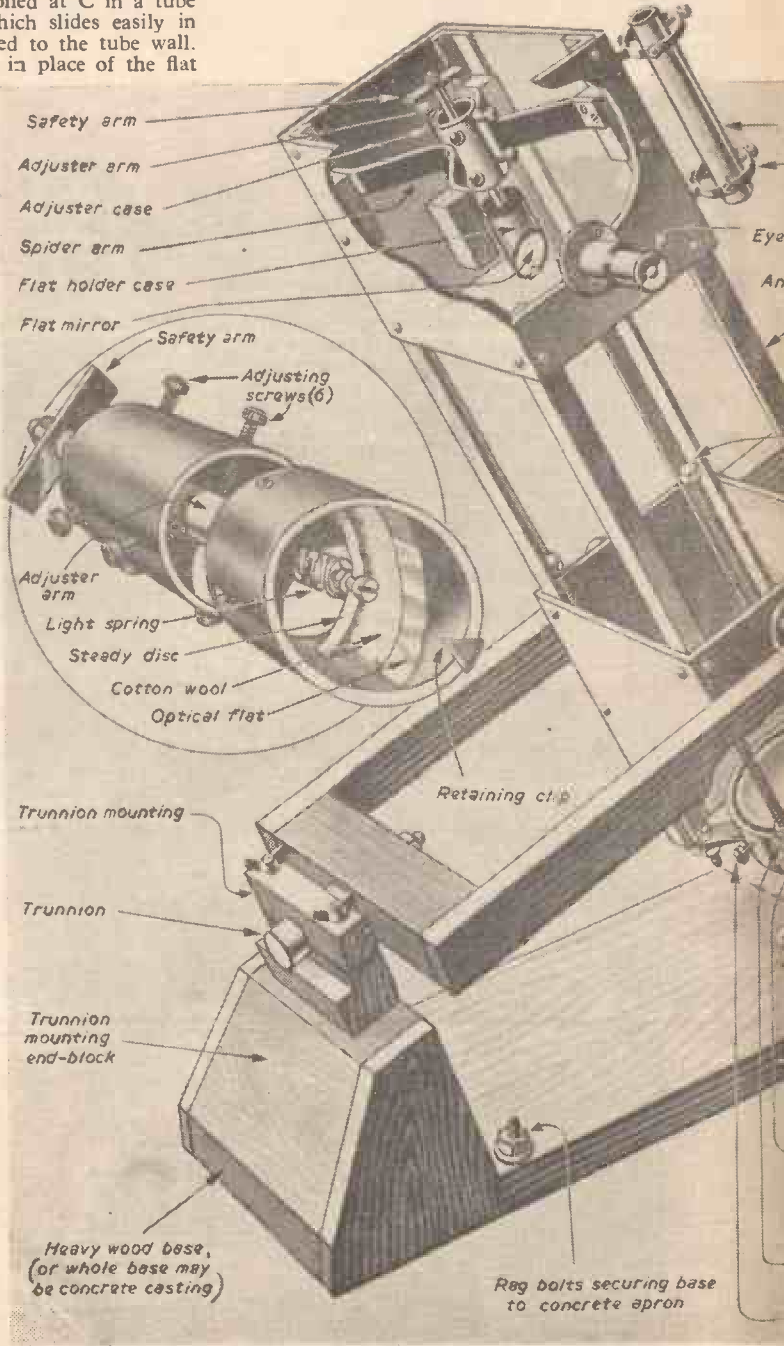
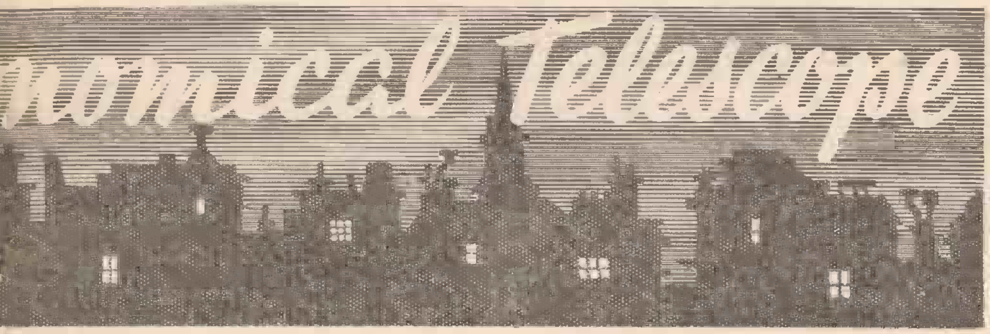


Fig. 3.—Layout of one construction for the telescope in a cradle mounting. Readers as the angle between cradle and base must

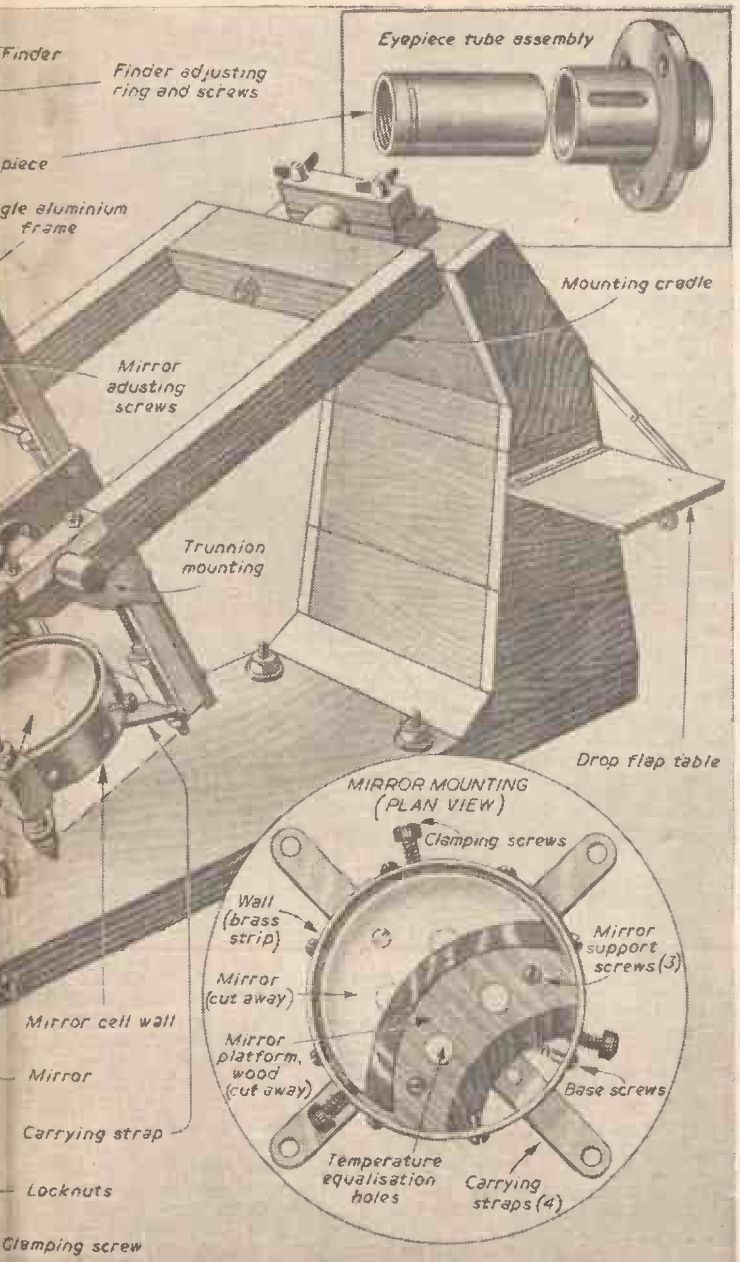


out £20 to Build By FRANK W. COUSINS, A.M.I.E.E., A.C.I.P.A., F.R.A.S.

to spend the more lavish can be the tube and the mounting. £5 should be ample for the materials needed to make the following items:

1. Mirror cell and supports.
2. Mirror cap.
3. Flat holder and spider.
4. Cap for flat.
5. Simple wooden tube or cardboard cylinder.
6. Sellers mounting.

£10 would be needed to construct items 1, 2, 3 and 4 with a superior tube 7 made from duralumin angle and placed within a cradle mounting 8. Both of these designs are now presented in detail. The standard items are taken first.



are advised to await full details before commencing construction of the mounting equal the geographical latitude of the site.

1.—Mirror Cell and Supports

The mirror needs to fit in a special cell. The construction is clearly seen in Figs. 3, 4 and 5. A circular platform of wood with temperature equalisation holes is provided with a brass side wall, clamping screws, mirror supports and carrying straps of brass or mild steel.

In Fig. 5 the mirror is shown seated within the cell. The mirror is best supported at the back on three points 120 deg. apart at distances from the centre equal to two-thirds of the radius of the mirror. Nothing more elaborate than this is required for mirrors up to and including 12in. aperture, provided that the thickness is not less than $\frac{1}{8}$ of the aperture. It will not do simply to lay a mirror (except a very small and very thick one) on a more or less flat surface, because the back of the mirror will touch this surface at a few points only and these points may be so placed that the mirror flexes and distorts.

The supports can be most satisfactorily provided by using dome-headed simple brass screws.

The mirror must not be clamped by the clamping screws otherwise its accurate figure will be distorted. Turn the clamping screws into abutment with the mirror and then *back* half a turn, there must be a slight clearance to avoid all risk of pressure.

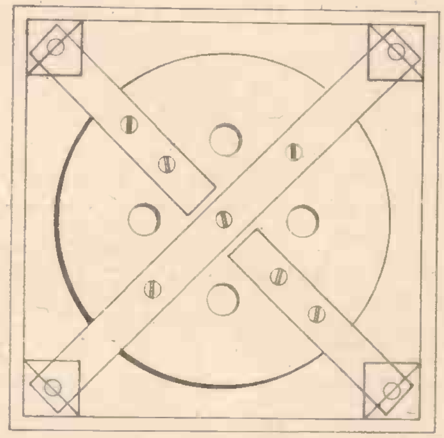


Fig. 4.—Underside of mirror cell in a square tube.

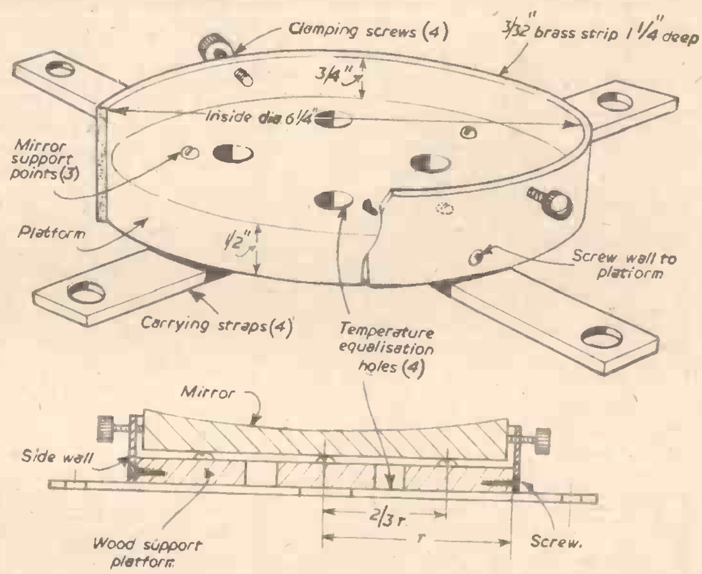


Fig. 5.—Perspective view of mirror cell and sectional view with mirror in position.

The carrying straps, as their name suggests, carry the entire mirror and mirror cell, they are used in combination with suitable nuts and bolts on the tube to "square" the mirror during the final adjustment of the optical components. This is described in detail later. The full dimensions of the mirror cell and the geometry of the various members can be seen in Figs. 3, 4 and 5.

2.—The Mirror Cap

This is a simple cover for the important top surface of the mirror. A tin lid cover is most serviceable and the inside may be lined with a good quality piece of silk over blotting paper. A handle on the lid cover enables the operator to remove the cap

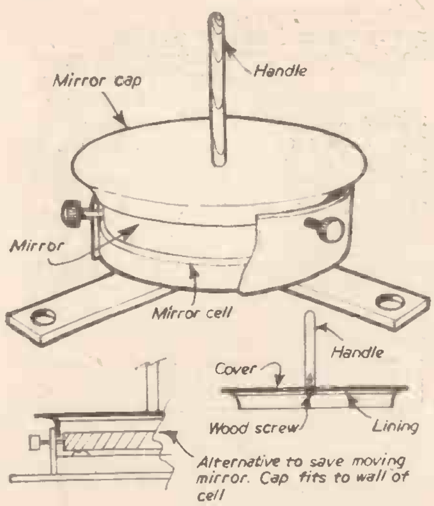


Fig. 6.—Details of the mirror cap.

readily during actual observing conditions. The complete cap is shown in Fig. 6.

3.—The Optical Flat Holder and the Spider

The general arrangement of the flat holder and the spider is shown in Fig. 7, made up in a tube of square section. The arrangement can just as readily be placed in a cylindrical tube. A plan view of the disposition of the spider arms for both types of tube is shown.

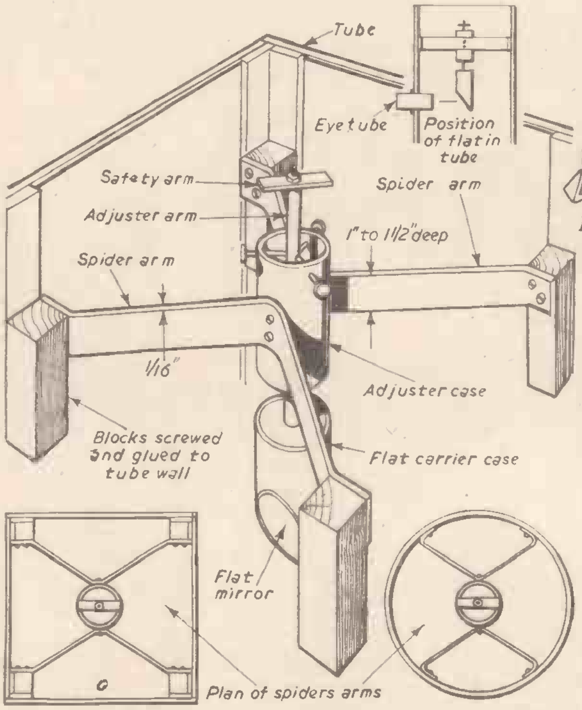


Fig. 7.—Holding and adjusting the optical flat holder.

From a careful study of Fig. 7 it will be seen that there are three main components.

a. The spider arms.
b. The flat holder.
c. The adjuster.

The spider arms must be rigid—it is best to make them in the V form as shown. Keep the thickness of the brass strip to 1/16in. and feel free to make the depth of the arms no less than 1in.

The flat holder comprises a case of brass made from tube of 1.3in. inside dia. cut at one end to an angle of 45 deg. An abutment member is soldered into place to stop the diagonal mirror from falling out. Cotton wool and a steady disc of wood or plastic loaded by a *delicate* spring keep the mirror in position. The end disc acts as a reaction member, it is screwed to the case wall and carries an adjuster arm of brass which is screwed at both ends. The adjuster arm is locked tightly to the end disc at one end while the other is fitted with a safety arm. The safety arm—as can be seen from the arrangement of the optical parts in Figs. 1 and 7—prevents the flat with its case and adjuster arm slipping down the telescope tube on to the main mirror's surface.

The adjuster comprises a case and a bar. The case held by the spider arms has two sets of three clamping screws spaced apart

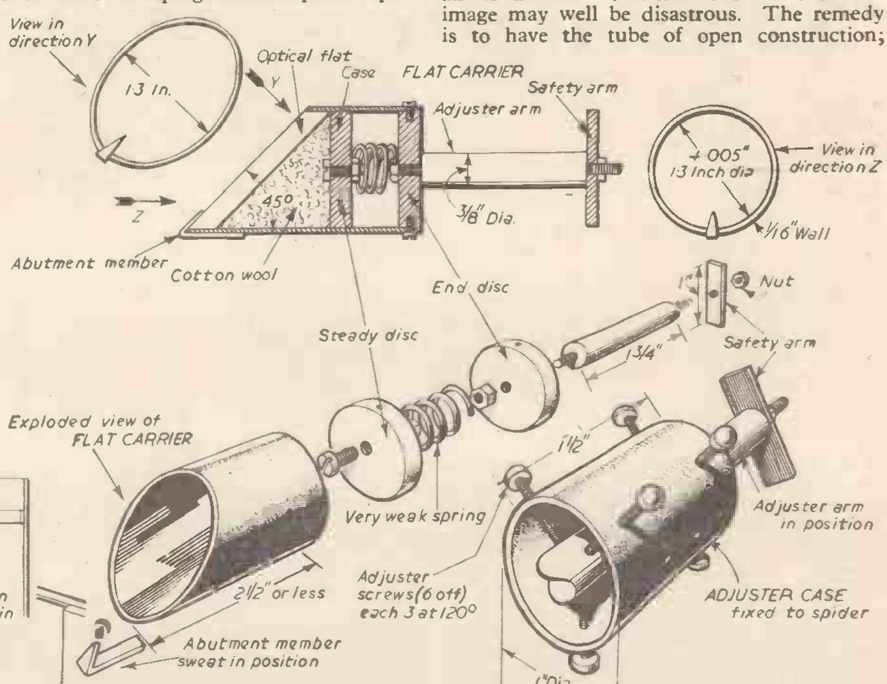


Fig. 8.—Details of the optical flat holder and the adjuster case.

axially round the tube—a distance of 1in. Movement of the clamping screws provides a delicate adjustment for the angle of tilt of the diagonal mirror in relation to the axis of the telescope tube. A reasonable length of adjuster arm permits the flat mirror and its case to be moved axially of the tube. Details of the *main* dimensions can be obtained from Fig. 8. Many of these dimensions are not critical and are left to the discretion of the maker. It must be made clear that the flat diagonal mirror must not be subjected to pressure otherwise its accurately figured flat surface will be distorted and the perfection of the optical system vitiated. There should be a slight clearance all round the edge of the flat mirror and the case of the flat carrier.

4.—Cap for Flat

The cap for the flat is most easily made from a cardboard roll cut at 45 deg. A cardboard end face with a lining of fine leather or silk is glued to the cylindrical wall and a retaining screw fitted. The inner surface of the cap should be a very *free* fit over the case of the diagonal mirror so that the cap can be easily removed once the retaining screw is freed, this ensures that the adjustment of the telescope is not upset each time the cap is taken off for observing the heavens. Construction is shown in Fig. 9.

5.—A Simple Tube

An open tube of square section despite its lack of aesthetic appeal is highly satisfactory. In a reflector the light has to traverse the full length of the tube before reaching the mirror, and then return along the tube which is necessarily open at its upper end. The air inside the tube is usually warmer than that outside to a slight degree and it tends to stream upward to be displaced by incoming cooler air. The result is a confluence of streams with currents of air of different densities—the effect on the image may well be disastrous. The remedy is to have the tube of open construction;

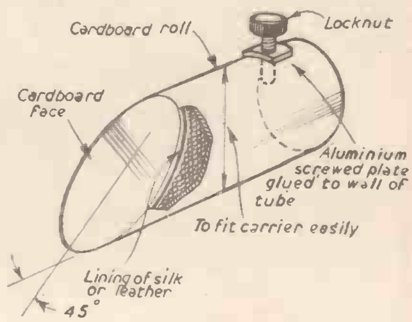


Fig. 9.—Details of cap for optical flat.

some experts even advise a fan for blowing the air through the tube. In the square tube the corners provide a path for the air away from the mirror position.

For those who like a cylindrical tube it is possible for a few shillings to obtain a long cardboard roll of some 6in. dia. (or a little over this size) from furniture stores which sell linoleum. These tubes are the central portion of large rolls of linoleum. The cardboard tube should be given a coating of high quality varnish on the outside and a coating of *matt* black paint on the inside. All fixings by bolts to the wall of the tube should carry *washers of a large diameter* so that the bolts when tightened do not tear through the tube wall. Obtain a tube of length 4ft. 6in. or over. Further instructions will be given in part 2.

(To be continued)

MOUNTING the figures is shown in detail in Fig. 7 and is a simple procedure except that it must be noted that the blocks to which they are attached must be planed on their face sides two degrees out of square, and the screws fastening the riding block to the endless belt must not be more than $\frac{3}{4}$in. apart in order that the belt may negotiate the curve of the running wheels without undue strain. If the two fixing screws are too far apart the heads will eventually work their way through the belt.

Undoubtedly the finest material for the

A Miniature Rifle Range

Part 2.—This Concluding Article Deals with Mounting the Targets and Making a Protective Screen, etc.

By JAMESON ERROLL

endless belt is ordinary flat machine belting which can be easily obtained. It is, perhaps, a bit expensive in initial outlay, but it is lasting and its surface is specially treated with a non-slip preparation. It should be $1\frac{3}{4}$in. wide or, since 2in. might be easier to buy, the running wheels could be slightly over 2in. to allow a small clearance. When this model was made a number of long, secondhand Army valise straps were used, the underside being well resined. They were joined flush by being sewn strongly to thin strips of leather extending about 3in. each side of the joins; better still, make necessary joins with proper machine-belt fasteners.

The hinges are 2in. in length—as are the lower blocks—and should be about $\frac{3}{4}$in. or $\frac{7}{8}$in. wide. The intervals at which the figures are placed will naturally depend upon the number available, but have too many rather than too few, particularly if four or more guns may be firing at the same time. If there is a marksman on the job he will pick them off pretty rapidly and leave none erect for the slower or less accurate aimers. It is also good practice to alternate between large and small figures. Note that at regular and frequent intervals the top part of the belt—holding the figures in view—will require to be supported since weight and movement will cause a certain amount of sagging; any form of wooden reel will do, screwed into the framework with long screws, and the type of bobbin used for copper wire for wireless coils is admirable (see Fig. 1 in last month's issue).

Another essential is four or more strips of iron 1in. $\times$ $\frac{1}{8}$in. bent in such a manner that they will, as the figures approach the idler wheel from the underside, lever them to an upright position. They should be attached to the idler at regular intervals and then bent slightly outwards so that they engage both tall and short figures in such a manner as to push them gently into an upright position. Once they have fallen forward, with a tilt towards the firing point by reason of the canted edge of their wooden support, they will remain in position along the endless belt unless hit by a pellet.

Targets

If targets are preferred to figures or are essential for competitions, the type which wind out and back again for examination can be fixed in the mechanism shown in Fig. 8. It will be seen that the actual target holder is controlled by an endless wire passing over two wheels and kept horizontal by two tracker wires. They are built up on $\frac{3}{4}$in. or 1in. angle-iron to which are attached two "Terry" clips to hold the target. A central tube—shown in detail in Fig. 9—keeps them vertical, and a grub-screw passing through the angle-iron and the top wall of the tube locks the endless wire so that the target travels backwards and forwards.

The endless wire should be stranded for flexibility but the tracker wires can be single strand. These latter are fixed to the front of the protective screen with screw eyes and wire strainers, and to any suitable surface at the firing point end. The endless wire runs on two grooved wheels, spring-loaded at the butts' end, that at the firing point being fitted with a handle.

Fig. 10 gives full details of this mechanism at the firing point end except that the tracker wires are not shown. A strong upright bracket carries a horizontal bracket on which the 4in. wheel is mounted by means of a $\frac{3}{8}$in. or $\frac{1}{2}$in. bolt, washers and locknuts. Fig. 11 furnishes a perspective view of the corresponding wheel mechanism at the far end of the range—the butts. Here the wheel is mounted on a "U" bracket, one end of which is attached to a strong spring, anchored by a bolt and fly-nut to a bracket at such a distance from the spring that it has to be pulled quite hard before it can be fixed; this, of course, when the endless belt is in position. The axle of the wheel rests on two riding bars supported by brackets so that free action may be given to the spring. Note that the farther screw-eye should have a fairly long shank so that the fly-nut can extend the spring even farther than is possible by hand. The grooves in both wheels should not be too smooth in order to furnish the maximum grip to the endless wire; they can well be made in soft wood into which the stretched wire will bite.

The Protective Screen

The sheet material used depends entirely upon the class of gun, and these can vary immensely. Some airguns have remark-

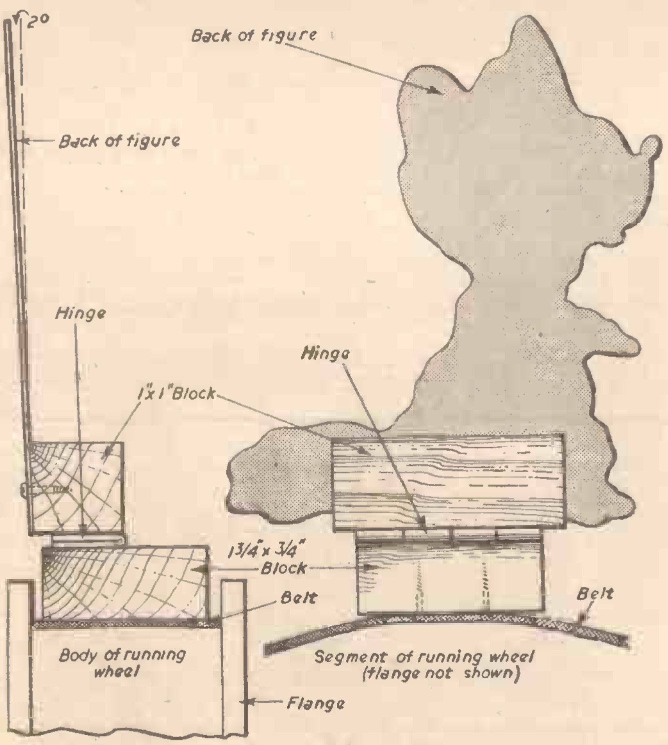


Fig. 7.—Fitting the figures on to the belt.

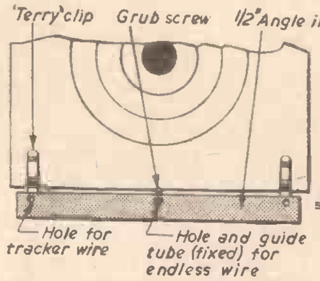


Fig. 8.—Front and side views of the target holder.

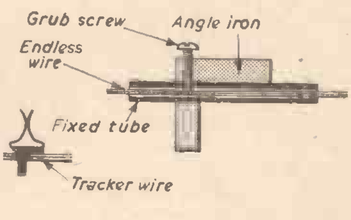


Fig. 9.—An enlarged view of the section running through the angle iron.

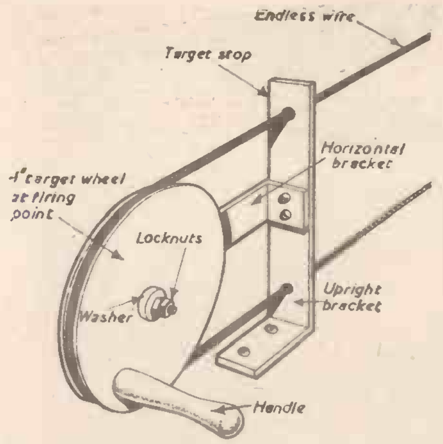


Fig. 10.—The target mechanism at firing point.

able penetrating power, and if any of the more powerful guns be used it will be necessary for the protective screen to be of mild steel about 16 G. which is .064in. thick, i.e., approximately 1/16in. It is, perhaps, best to experiment with the type of gun to be used. It may be found, for example, that with a lighter type of gun and at a distance of, say, 20 yards, 22 G. sheet iron might stop the slugs which are, in the main, of rather soft metal which "spreads" on impact. It is a point that can only be decided by the individual responsible for erecting the range, but it is most advisable to spend a little extra money and be on the safe side. The background also has to be considered. If the range be an indoor one, a brick wall will be more than adequate; if out-door, as at garden fêtes, etc., then a site should be chosen, if possible, that rules out the need for any but a natural background of built up earth such as a bank, or dead ground over which people cannot pass or from which they can be excluded. This is not so formidable as it sounds for it must be remembered that the flight of the bullet is limited and, after its effective range, begins to fall pretty rapidly and lose its "punch."

But whatever material be used, it is framed up in sections of portable size on 3in. × 3in. or 2in. × 2in. timbers according to its weight. The sections can be lap-jointed or mortised and tenoned and, apart from weight, their size should be controlled by storage space available. A few large sections are naturally to be preferred to many small ones. Where the sections butt one against another, horizontally or vertically, they should be bolted together with ½in. bolts furnished with flynuts for easy erection and dismantling. Side stays of 3in. × 2in. or 4in. × 2in. will be required in order to keep the screen vertical and—most important—to resist wind pressure. These should be bolted to the framework at the top by means of suitably bent iron brackets, and pegged into the ground in a similar manner to the motor box; they should have a slope of from 60 deg. to 45 deg.

Lighting

Artificial lighting will be required only if the range is erected indoors. In this case, avoid glare; illuminate the figures well from the front or sides, give the background medium and evenly distributed lighting, and furnish only sufficient overhead lighting at the firing point as will serve to make loading and handling practicable.

The Firing Point

No instructions have been given about fixing up the firing point since so much depends on circumstances and material available. At galas and fêtes the public is easy to please and does not expect too much, whereas on a professional range they may demand that the "counter" be at elbow-rest height. The club running its own little show might well get away with a trestle table or two. It is worth noting, too, that from the "standing shoulder" there will be a greater number of near misses and, consequently, figures will remain in view for longer periods. But there must be a barrier of some kind, not only for laying the guns on when at rest but for the keeping of distance and as a preventative against the jay-walker moving forward when others are firing.

Decoration, too, should be given careful thought. If a proper firing point can be erected with flags and streamers to attract, so much the better.

Safety Precautions

Certain rules must be laid down for the benefit of those assistants at the firing point. Loaded guns must always be pointed rangewards. Obstructions and red flags should prevent and warn the public not to attempt to walk at the back of the range (if this is possible); the assistant at the rear of the range must give due warning if he intends to make any adjustment to the figures or, for any other reason, finds it necessary to leave the cover of the protective screen. When this warning is given, the assistants at the firing point must insist that *all* guns are laid on the counter.

It is also advisable, and in some places obligatory, to notify the police that the erection of a range is intended. They are a very helpful body and by no means obstructive. The question of licences should also receive attention. Much will depend on local conditions and the probable public attendance.

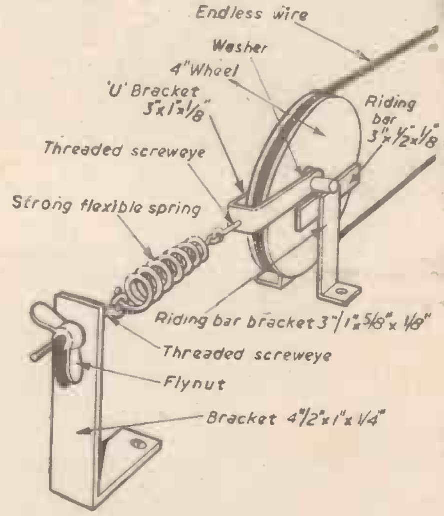


Fig. 11.—Details of target mechanism at far end of the range.

Portable Nuclear Reactor

AMERICAN scientists have recently suggested using a portable nuclear reactor for killing and preventing the reproduction of such parasites as nematodes, fungi and insects and to prevent the germination of weed seeds on agricultural land. It was stated that as the reactor would be used in relatively unpopulated areas, shielding could be cut to the minimum. As a result of this the reactor would be of much simpler design than stationary ones. Radio-activity in the soil would be too short-lived to prove a hazard to the soil or the crops grown in it.

Stair Climbing Truck

INDUSTRIAL TRUCKS LIMITED, of Essex Road, London, W.3, have recently produced a hand truck which will climb stairs. The all-aluminium "Stepmaster" of riveted construction is fitted with 8in. dia. cushioned wheels and a unique retractable double track, which can be lowered into a step-climbing position by the simple movement of a lever catch. The truck can be used in the normal manner when retracted.

Sub-zero Steel Treatment

IMPROVEMENT of the physical characteristics of most steels has been shown resulting from sub-zero treatment. Changes in grain structure resulting from the use of these temperatures have been demonstrated by means of photomicrographs. In some cases temperatures of −120 deg. F have resulted in an increase of 12 to 15 points in Rockwell C hardness.

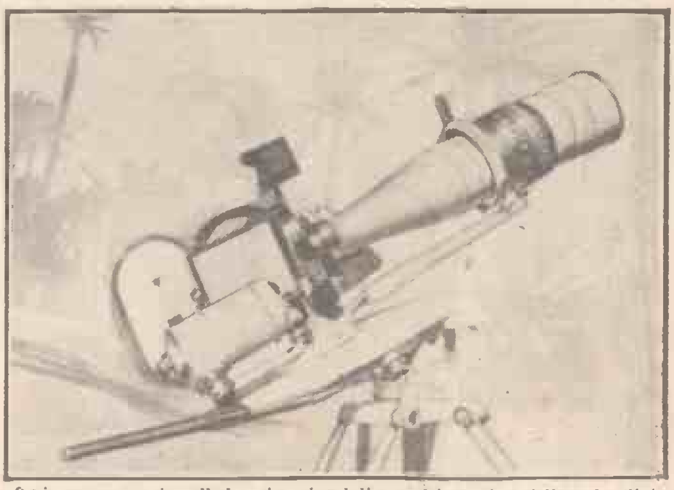
Photo-castings

AN American photographer working with an investment foundry has developed a process using conventional photographic methods to produce a master pattern mould. From this production wax patterns can be made which in turn are used to make investment moulds in which metal can be cast. Exact and minute detail can be reproduced and the process is described as adding texture and depth to the two-dimensional photographs to produce three-dimensional replicas.

Photo Electric Advances

NEW uses for photo-electric equipment include the installation to warn traffic of a low bridge. Interruption of the beam by an object wider than 6in. and travelling at over 40 m.p.h. operates stop lights and a warning Klaxon.

In train washing equipment photo-electric cells can be used to introduce a time delay to allow for the space between coaches.



This apparatus is called a cine-theodolite and is used to follow the flight of experimental French rockets launched in the Sahara.

Navigation from the Stars

Explained and Illustrated By R. N. Hadden

THE best friends of the navigator are the stars. They act as signposts of such accuracy that a ship's position can be determined to within less than half a mile.

First of all it is necessary to clarify a few of the basic ideas which need to be known before navigation can be understood. To begin with a method of dividing the surface of the world must be agreed upon, so that an exact position can be found. To do this draw two lots of imaginary lines as shown in Fig. 1. The lines parallel to the equator are called lines of latitude, and the lines running from the North to the South Pole, lines of longitude.

If it is imagined that the earth is cut in two, as shown in Fig. 2, it will be seen that the lines of latitude are divided into degrees by the angle at the earth's centre. Thus the North Pole is latitude 90 North and the equator is 0. Similarly the lines of longitude are divided up into degrees, the line that runs through Greenwich being taken as longitude 0 (see Fig. 3). From this it can be seen that any point on the earth's surface can be fixed by giving the latitude and longitude. Thus the city of Philadelphia is 40 North 76 West.

Now look at the position of the earth in relation to the stars, and ignoring the sun for the time being. The first thing to realise is the immense distance that the stars are away from the earth. If the earth is considered as a 1in. ball, then the nearest fixed star is 40,000 miles away! From this it can be seen that the annual movement of the earth around the sun does not affect the relative positions of the earth and stars. Also the movements of the various stars are so small in comparison with the distances themselves that they cannot be seen from the earth. Thus from the point of view of navigation the earth can be considered to be the centre of the universe, with the stars surrounding it on the inside of a huge fixed sphere. Inside this sphere the earth rotates on its axis. This is shown in Fig. 4.

Like the earth the huge celestial sphere can be divided up, though in this case the divisions are not called longitude and latitude. Directly over the earth's poles there are the celestial poles, and opposite the earth's equator there is the celestial equator. Also there is a point on the celestial equator from which measurements are taken, this is called the first point of Aries and is shown (♈) in Fig. 4. This point is actually the position of the sun on the 21st of March, and is used in all measurements of the positions of the stars.

Take, for example, a star on the celestial sphere as (A) in Fig. 4. Its position can be given as so many degrees to the right of the first point of Aries, this being known as the right ascension, and so many degrees north or south of the celestial equator, this being known as declination. So then by giving two figures we are able to give the exact position of any star on the celestial sphere. Now draw a line from the star to the centre of the earth, and where this line cuts the surface of the earth call it (a).

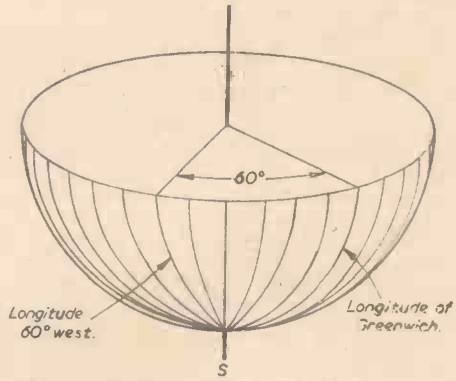


Fig. 3.—The lines of longitude are divided up into degrees, the line that runs through Greenwich is taken as longitude 0.

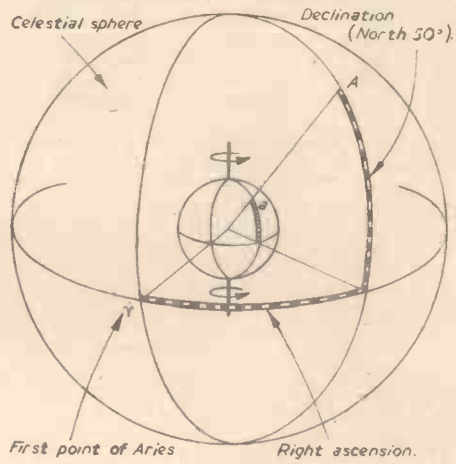


Fig. 4.—The celestial sphere with the earth as the centre of the universe surrounded by the stars.

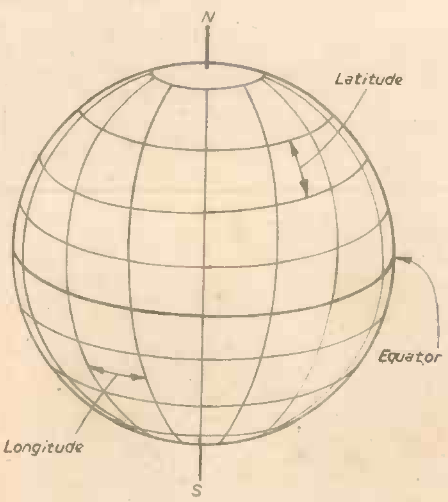


Fig. 1.—The surface of the earth is divided up, thus enabling the navigator to describe his position.

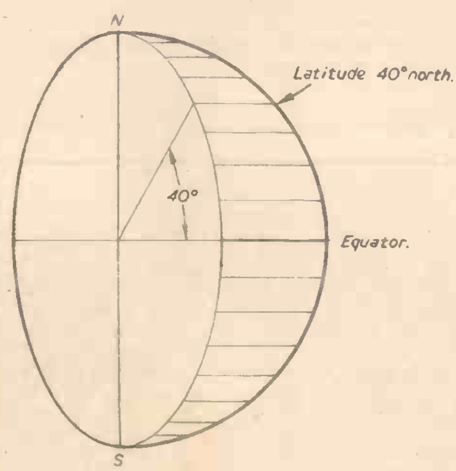


Fig. 2.—The lines of latitude are named after the angle they make at the centre of the earth.

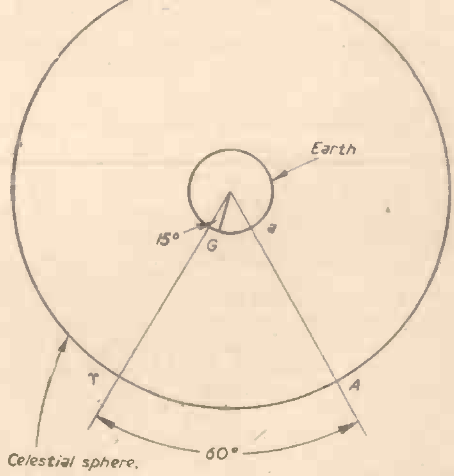


Fig. 5.—The view obtained looking down from the north celestial pole, on to the earth.

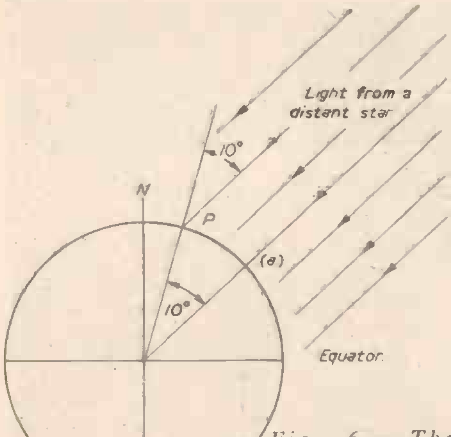


Fig. 6.—The position when the navigator is taking a sight on a star which is not directly overhead.

In other words, a man standing on the earth at the point (a) will be directly under the star (A). However, as the earth is rotating all the time the man standing at (a) will only remain under the star for a few moments, though 24 hours later he will again be in the same position. In the same way the longitude of Greenwich will come under the first point of Aries for an instant every rotation of the earth, or every 24 hours.

Fig. 5 shows what a man would see looking down on the earth from the north celestial pole, assuming that it is one hour after the longitude of Greenwich has passed under the first point of Aries. In other words, as the earth turns through 360 deg. in 24 hours the angle made between the first point of Aries and the longitude of Greenwich will be 1/24 of 360 or 15 deg. Also assume that the right ascension of the star (A) is known, say, 60 deg. From this it is obvious that the angle between the longitude of Greenwich and the longitude of the person at (a) is 60 − 15 or 45 deg. In other words the longitude of the person at (a) is 45 deg. east of Greenwich. If the declination of the star is also known, say, it is 50 deg., it follows that this is equal to the latitude of the person at (a). This is made clear in Fig. 4. Thus in the case chosen the exact position of the person at (a) is 45 deg. East, 50 deg. North, and from a map it will be seen that this is in Russia near Stalingrad.

It may be asked how it is known what values to give to the right ascension and declination of a star. The answer to this is that the figures are compiled by observations and are tabled in the Nautical Almanac which is issued each year. Obviously figures cannot be issued for all stars, so only those that are most easily identified by navigators are given.

From the foregoing it can be seen that it is quite easy to find your position if a known star is directly overhead. But what happens if, as in the majority of cases, the star is not directly overhead? Fig. 6 shows this position, the light from the star falls on the earth in parallel rays, due to the fact that it is so far away. The point directly underneath the star is still (a) but the navigator is now at (P). To him the star seems to make an angle of, say, 10 deg. with the vertical.

Now if the star makes an angle of 10 deg. with the vertical, at the point where the navigator is standing, then it follows that the angle made at the centre of the earth between the point (a) and the point (P) is also 10 deg. This can be seen from Fig. 6. But as the circumference of the earth is equal to 21,600 nautical miles (7 nautical miles equal 8 statute miles) the distance of the navigator at (P) from the point directly under the star (a) must be equal to 21,600 × 10/360 or 600 nautical miles. In other words, if a star's bearing is 10 deg. from the vertical it means that the navigator is 600 miles away from the point directly underneath the star. Similarly 1 deg. equals 60 miles, and 1 minute equals 1 mile. This relationship is very important.

Now the navigator knows that he is 600 miles away from the point on the earth directly underneath the star, and he also knows the exact geographical position of the star. So he can draw a circle on his map, of 600 miles radius, with the geographical position of the star as the centre, and know that he is somewhere on the circle. He can find what part of the circle he is on by taking sights of another star, and drawing another circle; where the circles cross this will be his exact position. Fig. 7 shows this clearly, the navigator is in the Atlantic south of Ireland, and he has just taken sights on two stars, one is 600 miles away and the other 300 miles. His position is where the two circles intersect. If he wants to check this position he can take sight of a third star.

So far only navigation from the stars has been dealt with, but, in fact, it is much more usual to navigate from the sun. The only real difference is that whereas the stars are fixed on the celestial sphere the sun moves around it in a definite path. This path is shown in Fig. 8. It can be seen that the sun moves around the celestial sphere at an angle of 23½ deg. to the celestial equator, making one complete revolution every year. It will also be seen that the sun crosses the celestial equator at the first point of Aries once every year. This happens on March 21. Thus from the point of view of navigation the sun may be used in the same way as a star, except that its right ascension and declination vary from day to day. However these variations are tabled in the Nautical Almanac and so no difficulties arise. When

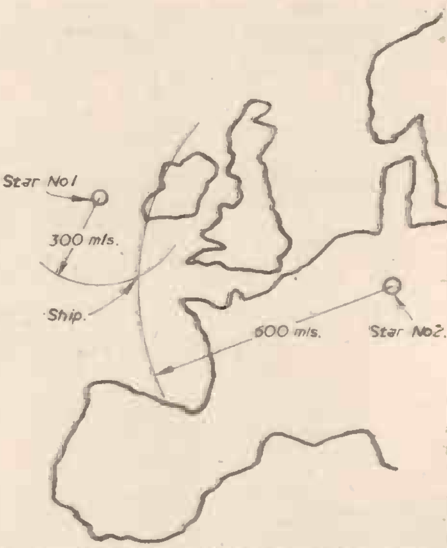


Fig. 7.—When taking his position from two stars, the navigator's position is where the circles cut.

navigating from the sun it is not possible to take a second bearing from another star, so the usual practice is to take one sight at noon and one sight about 4 p.m. This gives the two intersecting circles as in the case of the stars.

This then is the basic theory of navigation. The tools of the trade are a sextant, which is really a device to measure the angle, or altitude, of a star, and chronometer. The chronometer is really a very accurate clock, for by knowing the exact time, and with the help of the Nautical Almanac, it is possible to say how many hours have elapsed since the longitude of Greenwich passed under the first point of Aries.

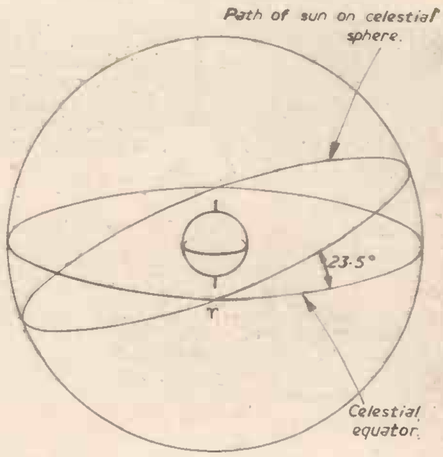


Fig. 8.—The apparent path of the sun in the celestial sphere, one revolution being completed in a year.

PUZZLE CORNER

1.—Motoring Problem

A MOTORIST sets out on a journey and covers half the distance at an average speed of 30 m.p.h. How fast must he travel for the rest of the journey if he is to do the whole trip at an average speed of 60 m.p.h.?

2.—Averages

A MOTORIST drove her car over a triangular route, from town A to town B: from town B to town C, and from town C back to town A. Each of the three stages was of equal distance in point of miles, but owing to various obstructions between town A and town B, her average speed was quite low. She was able to go three times as fast on her next stage between town B and town C. Between town C and town A she went twice as fast again (i.e., six times her slowest speed). In fact, she went faster than an express train. Her average speed for the whole journey was only 30 m.p.h. What were the three speeds?

3.—Misfits

WHICH is the worst misfit, a square peg in a round hole or a round peg in a square hole?

Answers

1.—It cannot be done! If he made the whole trip at 60 m.p.h. it would take the same time as half the journey at 30 m.p.h. The motorist had already used this time.

2.—Town A to town B at 15 m.p.h.; town B to town C at 45 m.p.h.; town C to town A at 90 m.p.h.

3.—A round peg in a square hole is the lesser of the two evils as it occupies 78.54 per cent. of the square space. The square peg in the round hole occupies only 63.66 per cent. of the space and is thus more wasteful. You can show this by drawing a sketch.

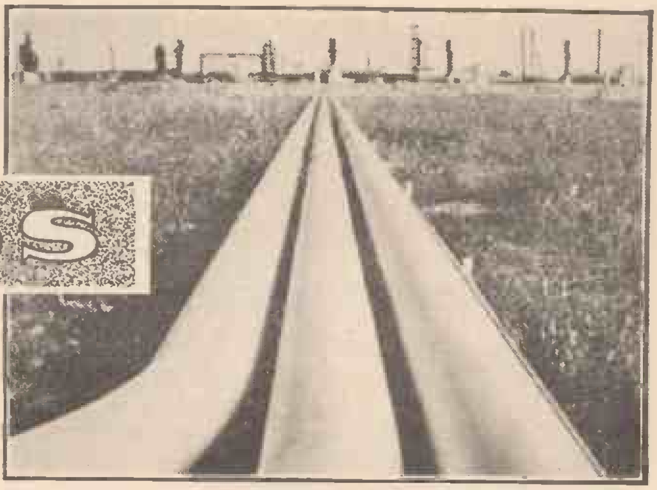
Readers might like to submit their own puzzles for inclusion in this section. We will pay 10s. 6d. for those published.

Pipelines

An Examination of Their Position in the Modern World

TO-DAY more than 300,000 miles of pipeline are helping to carry crude oil. Oil is usually found in remote places, and pipelines are essential for transporting it across difficult terrain from production areas to the coast. In carrying oil from the producing country to the consumer country, a substantial short cut can often be provided, as with the 1,068 miles 30/31 inch "Tapline" (Trans-Arabian pipeline) from the Persian Gulf to the Mediterranean, which cuts 3,000 miles off the tanker voyage. Finally, there may be the journey from the refinery or production area to consumption areas within the same country.

In the Middle East, the major source of oil supplies for Western Europe, more than a quarter of the total output is moved overland by pipelines such as "Tapline" and the 556 miles of 30/32 inch line between Kikuk, in Iraq, and Banias on the Syrian coast.



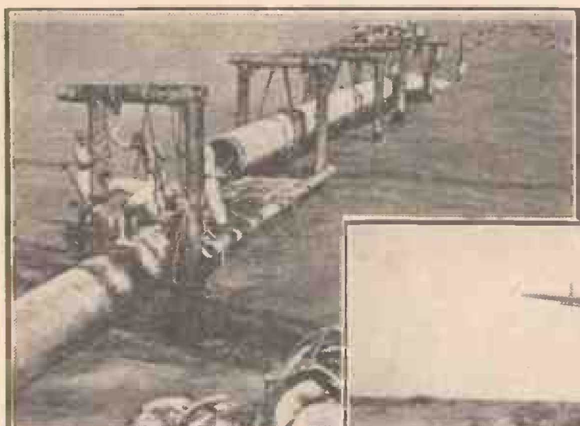
A pattern of pipelines at the Shell-Berre Refinery, France.

In transporting large quantities over long distances through a period of years, the pipeline has proved the most economical method, provided it is used to capacity. However, a considerable amount of capital is tied up—the pipeline is always full of what it is transporting—and this constitutes, as it were, a permanent store of oil, gas or products whose values cannot be realised until the line is taken out of operation.

Then and Now

The Assyrians, Egyptians and Greeks used pipes of stone and clay to carry water, and the Chinese transported natural gas through bamboo pipes. Lead pipes were found in the ruins of Pompeii. Modern oil pipelines are in direct succession from these early ventures.

To-day a variety of petroleum products can be delivered at high pressure to different terminals in a continuous flow, separated from each other by very small quantities of overlapping products known as "contamination plugs." Gravitometers react to the specific gravity of a required batch as it comes through, and electrical control apparatus is then brought into operation to switch it to its appropriate tank or location. Radio-active tracers can also be used to identify the different products.



(Above) Part of a 150 mile long pipeline being laid across the Gulf of Coro, Venezuela, on its journey linking the oil fields of Lake Maracaibo with a refinery at Cardon, on the Paraguana peninsula.

(Below). An oil company's four-seater plane making its low-flying weekly inspection of the Palmarejo-Cardon pipeline in Venezuela to search for possible leaks. Constant vigilance is necessary to ensure that regular deliveries of oil and oil products are not delayed through mishaps.

Remote control of pipeline operations is becoming more and more important, the Ozark Pipeline System in the U.S.A. being perhaps the most advanced example. Control of the flow of crude oil, checks on pressure along the line, switching of products, etc., can all be handled from a main control station through electric cables or even by high frequency radio. The time is approaching when the entire operation of a pipeline may be controlled automatically.

Laying the Lines

The costs of laying pipelines are always high. "Tapline" cost £80,000 a mile, and the Kirkuk-Banias line £75,000 a mile.

The steel pipeline of to-day is usually laid in sections 30 to 40ft. long, these lengths being "strung" along the route and subsequently welded together. To avoid dangerous contraction or expansion as a result of fluctuations in temperature, a certain amount of slack is left in the line.

Protecting the Lines

The normal life of a pipeline kept in good repair is about 25 years. The main problem is that of keeping it in such repair.

Before being laid, the exterior of the pipe is cleaned and treated to guard against corrosion. If it is to go below ground or under the sea, this protection is provided by coatings of moisture-proof material such as bitumen—itself a petroleum derivative—and wrappings of fibre glass or bitumenised felt. Inhibiting agents such as cement and synthetic resin-based linings are used to safeguard against internal corrosion, and promising experiments are now being carried out on the application of polythene—another petroleum-based product—as a lining material.

In the oilfields, the inside of a pipeline is often cleaned by a scraper known as a "go-devil," which, carried along by the oil flow, whirls its arms round to remove deposit from the sides of the pipe. Rust is cleared by the daily introduction of small quantities of a special solution which will also act as a preventative by coating the inside with a molecular skin.

Low-flying aircraft on major pipelines and patrols of "beat-walkers" on very short lines keep a continual watch for discoloured ground and dying vegetation indicating leakages, which are more common in older lines where screw joints were used than in modern electrically welded pipes.

Underwater Lines

Among the most fruitful recent developments has been the tapping of oil resources beneath the sea. Lines have been laid and are still being laid in the Gulf of Mexico, where drilling and production platforms operate in some cases more than 60 miles from the shore.

Much of the oil from Lake Maracaibo, in Venezuela, travels by pipeline partly under water and partly over land to the terminal at Palmarejo. In the U.S.A. pipes from the natural gas wells in Lake Pontchartrain, New Orleans, supply gas to the boilers of Shell's Norco Refinery.

Projected Pipelines

Existing pipeline systems are all likely to be extended as demands increase. The 34-mile, 16in. line from Boscan field in Venezuela, crossing the neck of Lake Maracaibo to the new Puerto Miranda terminal, will soon be completed. Fresh pipelines will be needed for the development of new, promising oil areas such as those in the Sahara Desert and Nigeria. Lines are under construction or being planned in British Columbia, Chile, South Africa, Indonesia, France and Germany.

In Great Britain a Bill is being laid before Parliament for permission to link London Airport with a fuel storage depot at Walton-on-Thames, eight miles away, and gas obtained from oil will soon be piped to the North Thames Gas Board from the refinery at Shell Haven, in Essex.

Oil is the bloodstream of our modern economy, and pipelines are the arteries.

For Use with the Projector in this Issue :—

A 4ft. Square Projection Screen

By C. J. Ralph

THE screen material is finely woven Irish linen 48in. wide by 1½ yd. will leave ample to spare for fixing the ends to the top and bottom booms.

The Frame

Commence by cutting all the wood to the correct length, as shown in Fig. 1. Next drill the holes for the clamping screws in the back half only of the top and bottom boom.

equal to twice the linen thickness, this is widened with a saw to provide a push fit for the metal ends on the side members.

If the cut is made just thinner than the metal ends sufficient spring will occur in the booms to provide a good push fit.

The side members may now be assembled with the lower metal insert left slack. Fit them into the booms to complete the frame

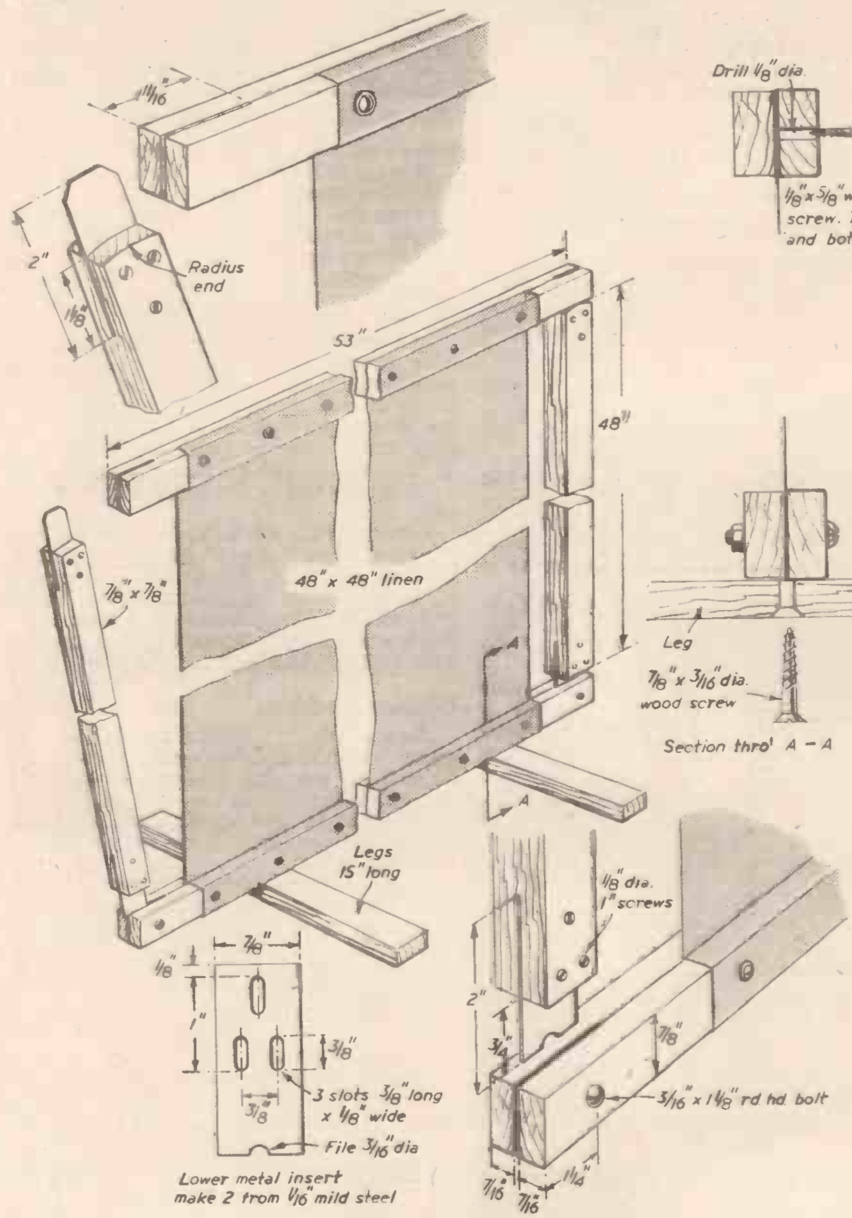


Fig. 1.—Full details and dimensions for construction.

Measure the amount of material required to wrap around the booms as shown in the sketch. Allow for this top and bottom and cut the material to the required size. Carefully wrap the linen around one half boom and screw on the other half to clamp it firmly between. Care should be taken to ensure that the sides of the linen are at right angles to the boom. Next clamp the other end of the linen in a similar manner at the correct distance from the first.

A slot will be left in the ends of the boom and then with the screen tight, mark the position of lower metal locating strip in the side members. The correct degree of tension is then achieved by increasing the effective length of the side members equally 1/16in. at a time until the screen is uniformly tight without too much strain on the booms.

Two 15in. lengths of the boom material are drilled in the centre and screwed on to the lower boom to form swivel legs on which the screen stands when in use.

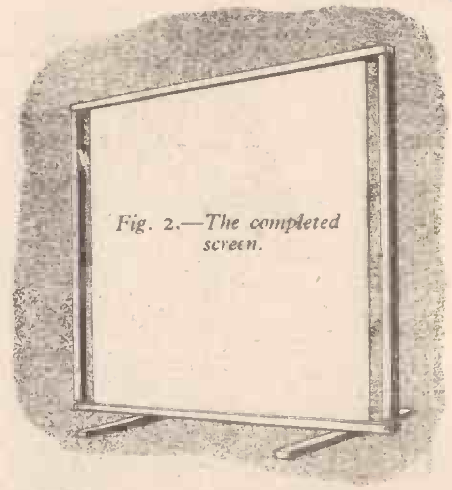


Fig. 2.—The completed screen.

Finishing

The frame of the screen may now be finished in a dark matt stain, say, dark oak.

The final step is to obtain a tin of screen white from a photographic shop and with the screen erected give the front of the linen two coats of this paint.

Allow ample time for each coat to dry, three days for the final coat being about right. After this period the side members may be removed and the screen carefully rolled up and put away until required.

Power Your Lawnmower

(*Concluded from page* 346).

the control levers on the handles of the mower, the throttle on the right-hand side. The motorised mower can be seen in Fig. 4.

Operating the Machine

Pull in clutch lever, turn on petrol, tickle carburettor slightly. Open throttle slightly and wind a few turns of cord on the starting pulley. (The knot on the end of the cord pulls into the notch cut in the pulley.) Pull firmly off, spinning the motor in an anti-clockwise direction, it should start up. Do not flood the carburettor too much or it will be very difficult to start. Opening the throttle gently, gradually engage the clutch.

On small or awkwardly shaped lawns it is probably much simpler to remove the chain between the cutting blades and the roller and just use the power to turn the cutters.

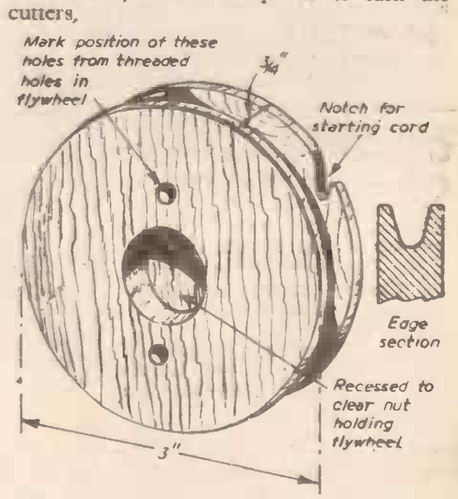


Fig. 5.—Details of the starting pulley.

Having used this mower successfully for some time, and the extension to the shaft being fixed, the author now starts the machine by withdrawing the clutch, pushing the mower forward and engaging the clutch smartly.

Letters to the Editor

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

Mathematical Problem

SIR,—With reference to the problem regarding prime numbers in Puzzle Corner of the March issue, here are some extracts prepared by Plt. Off. Moss of the R.A.F. Technical College, Henlow.

It is interesting to note the words "all odd numbers from a certain point onwards are sums of three odd primes." It would seem that one could test low numbers (e.g., as in the March issue, $35=29+3+3$, $37=29+3+5$, up to, say, P, where P is an odd number) and we are indebted to Vinogradov for the proof that this is true at the opposite end of the scale. Whether the theorem is true for odd numbers between P and C_1 I do not know.

Extract from Hardy and Wright "An Introduction to the Theory of Numbers," 3rd. edition, O.U.P. 1956.

2.8 *Unsolved problems concerning primes.* . . . If $n \geq 9$ is odd, then n is the sum of three odd primes. . . .

Notes on Chapter II

2.8 . . . Vinogradov proved in 1937 that all odd numbers from a certain point onwards are sums of three odd primes. . . .

Quoting from Estermann, "Modern Prime Number Theory" (Cambridge Tracts in Mathematics, No. 41, 1952), the notes continue:

3.1 It was first proved by Vinogradov in 1937 that every odd $n > C_1$ can be represented in the form $p_1+p_2+p_3$, where p_1, p_2, p_3 are prime numbers and C_1, C_2 . . . are suitable (sufficiently large) positive absolute constants.—FLT. LT. G. BENNETT (Henlow).

Source of Inspiration

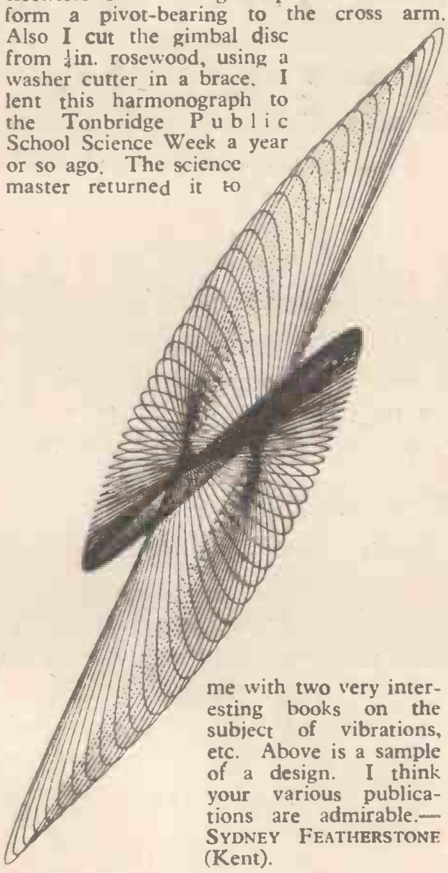
SIR,—I have taken your PRACTICAL MECHANICS magazine for a number of years and I have derived a great deal of pleasure from it. I am an engineer of 30 years standing, both for a living and hobby, and I am the proud owner of a host of worthwhile apparatus, all made with the aid of your journal and its companion "PRACTICALS", these include a radio, radiogram, television, refrigerator, electric washer, spin dryer, etc. I have not kept rigidly to your specifications, by no means, many times I have improved (I think) on your plans, but the germ generally originates in your "PRACTICALS." R. C. BEEVER (Yorks).

Silica Gel

SIR,—It is not correct to say that Silica Gel is either pale pink or vivid blue (letter from N. Don published in March issue). This refers to the indicator grade only. British Standard 2540 covers the requirements for Silica Gel which does not have the indicator added.—J. C. WILLIAMS (Middx).

P. M. Harmonograph

SIR,—You may be interested to know that I made a Harmonograph from your article in the March, 1952, issue. I found the tape hinge unsatisfactory and used scrap electrical brass and gramophone needles to form a pivot-bearing to the cross arm. Also I cut the gimbal disc from ¼in. rosewood, using a washer cutter in a brace. I lent this harmonograph to the Tonbridge Public School Science Week a year or so ago. The science master returned it to me with two very interesting books on the subject of vibrations, etc. Above is a sample of a design. I think your various publications are admirable.—SYDNEY FEATHERSTONE (Kent).



Projector Optics

SIR,—In the February issue of PRACTICAL MECHANICS, Mr. F. Hardy Hammond asks which two of the following lenses he can use to construct a projector for 35 mm. colour slides to obtain a picture 40in. x 30in. at 10ft.

The lenses quoted are:

2 41 mm. diam. 8 cm. focal length.

1 38 mm. diam. 10 cm. focal length.

1 51 mm. diam. 18 cm. focal length.

The following might assist him with his problem. To find the focal length of the lens required to project an image of a predetermined size at a fixed distance it is necessary to divide the distance by the magnification factor.

e.g., 40in. = 101.6 cm. The size of the screen.

35 mm. = 3.5 cm. The size of the slide.

Therefore, 101.6 divided by 3.5 = 29.03.

29.03 would therefore be the magnification factor.

Therefore 10ft. or 305 cm. (the distance) divided by 29.03 would be the focal length required which in this case is 10.5 cm.

To find the focal length of a combination of two lenses the formula is $\frac{FA \times FB}{FA + FB - D}$, where F is Focal length, D is distance. The lenses are called A and B respectively.

So if the first two lenses are taken

$$\frac{8 \times 8}{8 + 8 - D} = \frac{64}{16 - D}$$

which must equal 10.5 c.m.

To meet the specified requirements therefore

$$\frac{64}{16 - D} = 10.5$$

$$\therefore 64 = 168 - 10.5D$$

$$\therefore \frac{104}{10.5} = D \quad 9.9 = D.$$

Therefore, if the two lenses of 8 cm. focal length are placed 9.9 cm. apart, their focal length measured from the centre of the combination will be 10.5 cm. and an image of 35 mm. would be increased to 40in. at a distance of 10ft.

In the same way it can be found that the two lenses of 18 cm. and 10 cm. would have to be spaced 17.2 cm. apart. Thus it can be seen that a combination of any of the lenses can be used though I would favour a combination of the first two of 8 cm. focal length in view of their diameter and compactness compared to the others.—E. M. SUTER (Southern Rhodesia).

A Further Letter on:—
THE MYSTERY OF THE UNIVERSE

SIR,—Mr. J. Waterhouse has apparently proved to himself that matter cannot possibly be created. In his own words (February, 1959, issue) . . . "matter can neither be created nor destroyed. . . ." The reasons for his view are that there is nothing from which to create matter, and that there is nothing to create it with.

Why is there gravitation? Why are there magnetic fields? Why does the universe exist? These questions are very similar to "how does matter originate," and "where does it come from," and they are just as meaningless. Supporters of the continuous origin theory explain that creation is a law of physics, and no one can answer such a question as "why?" We can, by the laws of gravitation, predict an eclipse, and the event will occur. We must not ask why. If we do we are met by the reply that the consequences of the laws of physics agree with observation.

The steady-state theory states that space itself has the property of producing matter, as matter has the property of attraction.

The origin of matter is not yet established as a law but if and when it is, it will be protected from such questions as "where does the matter come from, or go to?" As a theory it is plausible and satisfying. The universe had no beginning and will not end, but the individuals of which it is composed change and evolve with time.—W. R. GRETTON (Nottingham).

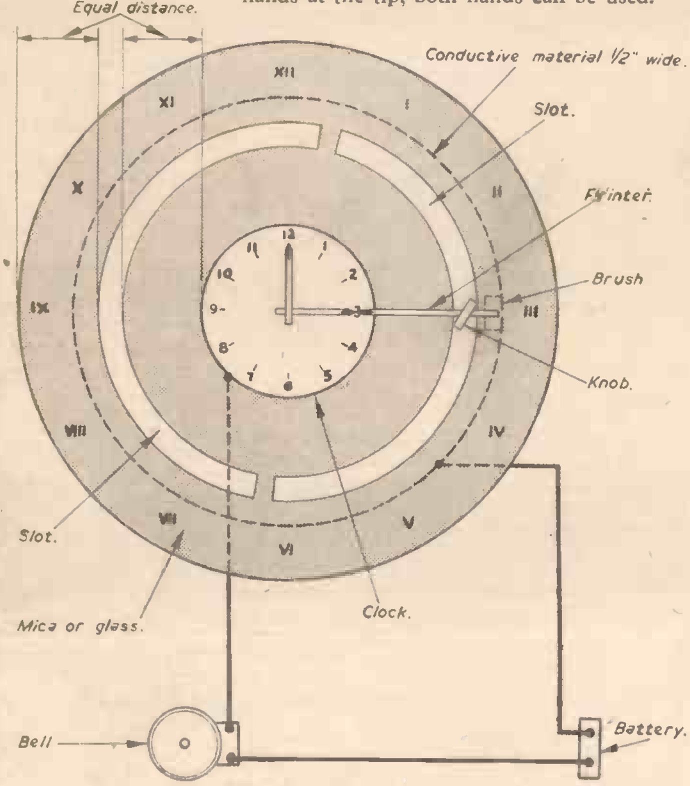
A TIME SIGNAL DEVICE

SIR,—In reply to the request in "Information Sought" in the December issue for details of a device to ring a bell at pre-set times, I suggest the arrangement shown in the sketch below.

The components required are a clock or watch, a bell or buzzer, a battery, a thin sheet of mica, glass or some other non-conductor, 9in. dia.

In the centre of the 9in. disc a hole is cut to suit the diameter of the clock face. Halfway between this central hole and the edge of the disc a circular slot is cut ½in. wide, leaving two small segments in position to keep the disc in one piece. A ½in. wide circle of tinplate or some other conductive material is next cut and cemented into position as shown.

The pointer is fitted to a knob, to enable it to be set at any position in the circular slot, and to a brush to contact the tinplate strip under the mica disc. As many pointers are used as times the bell is required to ring. In this particular alarm, the minute hand of the clock was not used and was twisted out of the way. The pointer should be made from some springy material so that when the hour hand contacts it, it is not jammed but can slowly push past and continue on its way.



Mr. J. P. Scerri's time signal device.

The method of operation will already be obvious. When the hour hand makes contact with the pre-set pointer, the circuit is completed, via the battery bell and a connection to the bezel of the clock. The foregoing describes only the general principles and individuals will probably wish to vary construction.—J. P. SCERRI (Malta).

SIR,—In reply to your request for details of a preset and variable signal device I would suggest you buy a cheap battery-operated clock and assuming it has a metal bezel or dial, use this as positive, and the hands as negative, making sure one is insulated from the other.

(a) Fix a fine springy wire to either of the hands at the tip, both hands can be used.

(b) Locate fine wire or strip on the dial which can probably be held by the bezel and movable to any given time on the dial and as many as you want. You can give separate power through the hands or dial strips to your signal device. I have used this method on a large marble mantel clock as an alarm and it was ideal.—J. MONAGHAN (London, N.W.2).

[We received a number of letters on similar lines to this, but regret that space does not permit the publication of any more correspondence on this subject.]

A Silencer for .22

SIR,—A very effective cheap silencer can be made on the lines of a "straight through" car silencer. I have made a number of the following design and when one gets lost as it invariably does, a replacement can be made in half an hour.

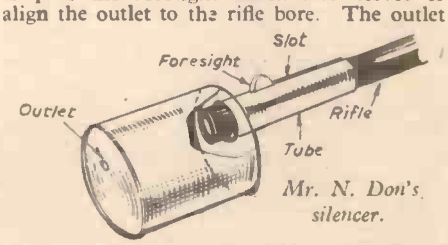
Materials required: 2lb. treacle or similar lever lid tin, 6 to 9 wire saucepan cleaners, 7in. of brass or thin-walled steel tube of suitable bore to be a light push fit over gun barrel.

Construction: Pierce holes centrally through lid and bottom of tin to take tube. Insert tube and allow to project about 1in. either side. Mark where tin and lid touch. Remove tube and drill about 30 ⅛in. holes between marks. The holes are better scattered all round circumference than carefully marked out. Clean up tube and tin. Replace in position without lid, solder to bottom of tin. Pack saucepan cleaners all round tube. Replace lid and solder both lid and tube in place. It will be found that the diameter of the tin obscures the sights, so put in vice and flatten until satisfactory. Give a coat of matt black paint.

The resulting silencer is light in weight, stops crack of rifle and reduces noise very considerably with normal cartridges, but is not so effective with high velocity ones, although it does reduce noise.—P. W. STANLEY (Sussex).

SIR,—In reply to the query by A. Lethbridge in the March issue. I have heard that the following silencer was quite effective. The silencer was made from a tin about 2in. dia. and 3in. long, and is really an expansion chamber for the gases, so the size can be experimented with.

The tube of the tin assembly must be a tight fit over the barrel, slotted at the top to pass the foresight which also serves to align the outlet to the rifle bore. The outlet



Mr. N. Don's silencer.

should be little more than the bullet diameter so that the gases escape slowly.

I would mention that it is possible that a silencer may be illegal, a point which Mr. Lethbridge should first check.—N. DON (Lancs).

Light is Slower than a Snail?

SIR,—It is most interesting to read the letters you have published on light velocity from writers who, like myself, believe that some medium for radiation transmission is essential.

It appears that the erudite are willing to accept experimental negative results as proof of negative, rather than suspect the worth of experiments, as such.

If radiation travels at a fixed velocity, why does it do so unless that velocity is a function of some undulating medium? We think its speed is enormous, but that is only because we ourselves are so microscopically small. Compared to cosmological dimensions and the Universe as a whole, the speed of light is slower than a snail!

So I would also ask the erudite—why is it so slow? If nothingness possesses no inertia, no electrical inductive effect, no attributes, no constants (and as it is "nothing," it cannot possess them), whence arise the constants which determine radiation velocity, about the most constant thing we know?

If we ask ourselves why light takes 100 years or more to slowly travel from one dust particle in space to its nearest neighbour, I am sure we shall get a mental picture, not of "nothingness," but of a very viscous fluid indeed.

Einstein showed that "space" was distorted or modified in the proximity of matter. The bending of light rays near the sun was observed and taken to prove it.

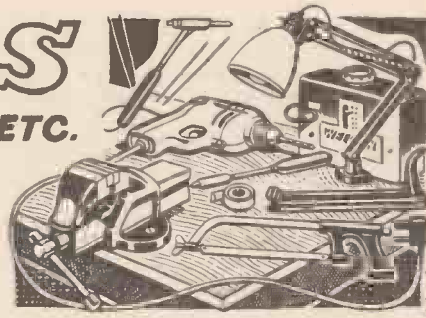
I personally believe that the Michelson-Morley experiment showed a negative result because an "atmosphere" of the cosmic fluid clings to, and moves with, every body in space, through a similar fluid. Thus they could find no evidence of "flow" due to the earth's velocity.

Such an atmosphere, surrounding and moving with the huge mass of the sun, might well produce refraction of passing light-waves, because it is well known that refraction occurs between moving layers of a medium particularly if one such layer is "modified" in any way.

Finally, for many years the erudite assured us that the temperature of space was absolute zero (−273°C.). The Russian rocket recorded 50°F! So what?—F. O. BROWNSON (Beds).

Trade Notes

A REVIEW OF NEW TOOLS, EQUIPMENT ETC.



WOLF POWERED MIXER FOR CONCRETE, ETC.

WOLF ELECTRIC TOOLS LTD. have introduced a rotary mixer for concrete, mortar, seed, compost, fertiliser, etc. It can be powered by the "Safetymaster" or "Quartermaster" home power unit, or alternatively the Wolf OK2c or KG2c industrial $\frac{1}{4}$in. electric drill. Known as the "Rotamix," Set No. 125, it is intended for small-scale mixing for poultry farmers, handymen, smallholders, jobbing builders, etc.

The unit consist of a welded steel frame assembly which incorporates two shafts to which are affixed knurled rubber rollers giving a friction drive to the 24$\frac{1}{2}$in. × 14in. mixing drum. The drive is transmitted from the power unit via a reduction gear-box—the power unit is fitted by means of a quick release wing nut. Capacities are: one bushel for dry-mix materials, $\frac{3}{4}$ cwt. for wet-mix materials. The price is £9 18s. 6d.

There is a mobile conversion pack consisting of wheels, axle, side handles, etc., for those desiring a mobile model, retail price 45s.

The new rotary mixer.

Solid Lubricant

THRED-GARD Solid Lubricant is now available for domestic use. It was originally conceived as a lubricating and high temperature anti-seize compound, for use by the engineering industry, but domestic uses include application to garden shears, garden machinery, pipe threads, cycles, motor cars, oil heating equipment, water taps, cocks and valves, wood screw threads, door locks, latches and rising butt hinges.

Thred-Gard is a highly concentrated compound and need only be used sparingly. It can be applied with a brush, or even a matchstick. It is marketed in 1$\frac{1}{2}$oz. tins selling at 3s. 9d. each. The makers are Crane Packing Ltd., Slough, Bucks.

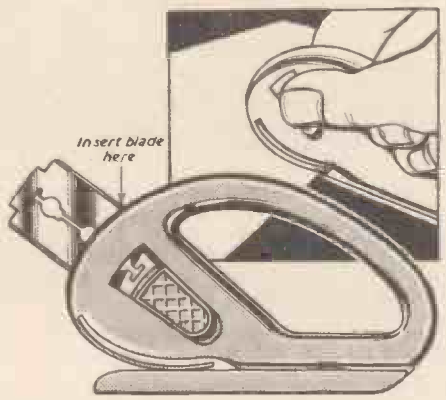
Selecta Rotoform

THE photograph below shows the appearance of this tool which is intended to be used with the Selecta drill or any other popular drill. It is designed to eliminate tedious filing, sinking and rebating and can be used for work on wood, asbestos, hardboard, etc. Its uses include shaping irregular areas, for housing, bevels or straight planing. The price is 14s. 9d. and the makers are Selecta Power Tools Ltd., Hampton Road West, Hanworth, Feltham, Middlesex.

The Selecta Rotoform.

A New Cutter

AS can been seen from the illustration, this novel cutter is essentially a plastic holder for a standard razor blade, allowing paper, card, string or tape, rubberised and plastic sheeting, etc., to be cut easily and safely. The design is such that it can be carried in the pocket or handbag without danger. Blade replacement is quick and simple. The price is 3s. 11d. from shops and stores. The makers are Melody Products (Plastics) Ltd., 57, West Road, Westcliff-on-Sea, Essex.



The "Snippy" cutter.

Casco Contact Adhesive

LEICESTER, LOVELL & CO. LTD., the manufacturers of Casco Synthetic Resin and Casein Glues, have introduced a new adhesive—Casco "Contact." This is a no-pressure/impact adhesive giving an excellent bond between a wide variety of materials (glass, aluminium, leather, P.V.C., wood, cork, cloth, etc.).

Two sizes are available—a small and large tube—each in an appropriately sized pocket container. This is the answer to the mislaid tube. The pocket has a hole already punched in it so that it can be hung up in a handy place in the kitchen, the workshop or the garage. The small size costs 1s. and the large size 1s. 9d. from most ironmongers.

New Formula Humbrol

THIS plastic enamel is completely lead-free, an advantage in connection with children's toys. It is particularly recommended for metal, plastics, cardboard, glass, pottery, wood and plaster models.

The enamel is packed in sizes from miniature plastic capsules to full gallon tins; it will withstand boiling water, petrol and oil and can be used for exterior painting. It covers in one coat.

It may also be used in lieu of colour dopes on flying model aircraft, is lighter in weight, and only takes an hour to dry. New formula Humbrol is proof against model diesel fuel. Not being highly inflammable, it does not need the special fire precautions of cellulose dope.

Six intermixable colours in capsule form cost 1s. 3d. Convenient kits, complete with brush and palettes, cost 3s. and 8s. 11d. A $\frac{1}{2}$oz. seamless tin costs 8d. (gold 1s.). It is available from model stockists, cycle shops and leading hardware stores.

"Surpans" Price Change

THE price of "Surpans" spanners has changed from 19s. 6d. to 22s. for a set of six spanners (prices are now 2s. 4d. to 5s. 8d. each according to size).

New Spraying Machine

MESSRS. DAWSON, McDONALD & DAWSON LTD., Compton Works, Ashbourne, Derbyshire, have produced the Compton D.P.F. spraying machine as general purpose equipment for the workshop, factory, professional decorator and farm. The outfit is supplied complete with $\frac{1}{4}$ h.p. 220/250v. 50-cycle A.C. motor, high efficiency quart capacity spray gun with four interchangeable spray caps, 20ft. air hose and connections, 18ft. 3-core cable, tyre inflator adaptor hose, operating instructions, spare parts list and fibreboard case for £33 19s. 9d. A 2-gallon capacity pressure feed container and parts for converting spraygun to pipe-line type cost £9 12s., and a trolley is available for £4 15s.

The Compton D.P.F. spraying machine.

READERS' SALES AND WANTS

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

PERSONAL

HOLIDAYS

CANOE HOLIDAYS.—Hire a Canoe for your summer holidays. Single and Double types. Brochure, etc., from: E. Barker, Dept. M., Calder Grange, Mytholmroyd, Yorks.

FOR SALE

FLEXIBLE SHAFTS, Grinding Wheels, Ceramic Insulators, Govt. surplus; s.a.e. for list. S. Midgley, Hebden Road, Haworth, Keighley.

ELASTIC, catapult, models, etc., 3/16in. round, 9d. yard, post 3d. C. Blundell, 472, Alcester Road South, Birmingham, 14.

COMPRESSORS FOR SALE.—Twin Piston with tank, 2½ c.f.p.m., £4. Single Cyl., £2. All types Motors. S.A.E. for list. Dept. P.M.9, Wheelhouse, 13, Bell Road, Hounslow. (HOU 3501.)

HOUSE SERVICE METERS, credit and prepayment; available from stock. Universal Electrical, 221, City Road, London, E.C.1.

APPARATUS AND CHEMICALS.—Gigantic price reductions. Save pounds! Special offers; catalogue free Scientific and Technical Supplies (Nottm.), Ltd., 286, Alfred St., Central Nottingham.

GOVERNMENT SURPLUS AND MANUFACTURERS CLEARANCE

VACUUM PUMPS. EDWARDS TYPE 4. As New. £4.10.0. ea.
BALL RACES. ½" x ⅛" bore, ½" x 3/16" bore, ⅜" x ⅛" bore, 1/6 ea., ½" x ⅜" bore, 2/- ea., 2½" x 1" bore, 3/6 ea.
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NIFE CELLS. 1.2 v. 3 amp., 3½" x 2½" x 1" unused. 5/- ea., 48/- doz.
PRISMS. Magnifying, 1 3/16" sq. on adjustable frame, 2 filters, 5/- ea.
I.T.A. AERIALS. New. 3 element, 22/6; 5 element, 27/6; Co-ax. cable, 6d. per yd.; air spaced 9d. per yd.
MAINS POWER PACKS. 250 v. 80 m/amp. or stabilized 150 v. 80 m/amp. with 6.3 v. winding, 30/-.
MORSE KEYS. Small, 2/-; medium 3/-; larger, 3/6. Buzzers, 3/- ea.
TORCH BULBS. Ever Ready. 3.5 v., 16/- per 100, 9/- per 50.
HEADPHONES. Moving iron, low impedance, 6/-; high 9/-; balanced armature, low, 10/-; high 15/-; moving coil, low only, 10/- per pair.
KEY SWITCHES. D.P.C.O. each way, 2/6 ea.
INTERNAL TELEPHONE SYSTEM. 10 line, automatic dial. Complete, £60.0.0.
MICRO SWITCHES. 2/- ea. 20/- per doz.
PROJECTOR BULBS. 110 v. 1,000 w., 20/- ea.
HOPKINSON 3 H.P. 3 phase Elec. motors, ball bearing, £8.10.0.
GERMANIUM CRYSTAL DIODES. 1/- ea. 10/- per doz.
SWITCH PLUGS AND TOPS. 5 amp. 3 pin, metal cased, 5/- ea.
12-24 V.D.C. MOTORS. GEARED. Small and powerful, 4-8 r.p.m., 25/- ea. Works from mains with suitable transformer and rectifier, i.e., 12 v., 16/-; 24 v., 30/- extra.
SOUND POWERED TELEPHONE UNIT. Neon indicator, buzzer, built-in generator, self-contained. Ex-Admiralty. £5.0.0 per pair.
DRILLS. H/S, 9/16" No. 2. M.T.S., 5/- ea.
VENNER SYNCHRONOUS A.C. MOTORS. With gear train, for clocks, models, etc., 12/6 ea.
RUBBER TORCHES. Ex Cinemas, less batteries, 3/6 ea.
ELECTRIC SLOT METERS. Operates 7 days for 2/-, 30/- ea.

HUGGETT'S LIMITED
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"ASTRO TELESCOPE MAKING." Standard Ramsden Push-in Eyepieces, ¼in., ½in., ⅔in., focus, 35/-; s.a.e. list. Object Glasses from 10/6; Eyepieces from 15/6. Newtonian Mirrors, Diagonal Mounts, Focusing Mounts, Tripods, Terrestrial Telescopes and Microscopes. W. Burnet, Grand Sluice, Boston, Lincs.

6IN. PLANING and Rebating Machines, 30in. overall, adjustable cut, heavy ballraces, £6/7/6; also 4½in., 5in. and 8in. Planers at low prices. Combination Woodworking Lathes, heavy-duty ballraced, £11/18/-. Build your own circular saw cheaply. New type Circular Saw Spindles from 37/6, full range for Saws up to 30in. diameter; also Combination Spindles for sawing and planing. All machines fully guaranteed; terms. Send 6d. for lists. Generous terms to trade. Ortan Lathes, Falcon Works, Costessey, Norwich, Dept. P.M.

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CIRCULAR GLASS DISCS for grinding Astronomical Mirrors. Smoothed and edged, per pair with abrasive 80, 180, 280, 320, 400, 600, superfine finisher. Swedish Pitch, Wax, fine Rouge, 6in. x ¾in., £2/15/-; 8in. x 1in., £3/15/-; 8in. x 1½in., £5/15/-, post paid. Money refunded if dissatisfied. H. Gibbs, 75, Portmanmoor Road, Cardiff, S. Wales.

MUFFLE FURNACES, 240v./1 kW., chamber 7in. x 4½in. x 3in., hardening, metallurgy, 2,000°F., 37/6; 8½in. x 4in. x 3in., 43/9. "Paytox." 57, New Road, Rubery, Birmingham.

NODARK OVERLOAD CUT-OUT SWTICH 8/9. This will stop the search for that illusive fuse-wire and the annoyance of repairing the fuse. Accidental crossing of wires or faulty connections will automatically throw the switch of the Nodark cutting the current to the fuses. It now only remains to rectify the fault and switch on the Nodark. 200-250 v. maximum load. 2-5 amps. A fraction of the list price. P. & P. 1/6. **GENERATORS, 1/9.** Less brushes. 24 volts, 3in. x 4in. P. & P. 1/9.
DUKE & CO. (Dept. H.5), 621/3, Romford Road, Manor Park, E.12.
Tel.: ILF. 6001/3.

FINE ART COLOUR PRINTS for miniature picture frames, etc. Sample selection and list, 5/-. S.A.E. for list only. Rushy Meade Studios, School Rd., Blackpool.

HYPODERMIC SYRINGE, 2cc., glass, with 2 needles, only 3/-, post free. Spare Needles 2/6 per dozen. Many uses, oiling, laboratory work, etc. T. E. Dickinson, 12, Bath Street, Liverpool, 22.

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WANTED, Sheet Metal Working Machinery. HarDall Limited, Wingate Road, Luton. (Tel.: Luton 52451-2.)

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PORTABLE POWER TOOLS, new, used, bought, sold, exchanged. terms. Arthur Drysdale & Co. Ltd., 58, Commerce Road, Wood Green, London, N.22. (Bowes Park 7221.)

SET OF 5 WOOD BORING BITS (Black & Decker)
Fit any drill—electric or hand type. Kit in fitted tool case comprises ¼", 5/16", ⅜", 7/16", ½". Bits, ¼" shank, 7/6 plus 1/- carriage. **STOP PRESS.**—New Attachment which enables you to use your drill to cut any shape 4/9 complete.
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Callers welcomed—Prompt Postal Despatch.

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WOODWORKING MACHINES. All cast-iron constructed Complete Saw Benches, 7in., £4/15/-; 8in., £5/10/-; 10in., complete motorised, £30. Planers, 5in., £12; Bowl Turning Heads, £4; with 8in. Saw Tables, £7/10/-. Lathes, £7/10/-; Combination Lathes, £10/10/-. Motors, Pulleys, Belts, etc. 12 months' written and money refunded guarantee. 4d stamp for illustrated booklet. James Inns (Engineers), Marshall St., Nottingham.

SAWBENCHES, 8in. to 30in., from £9; Motorised, £13; Petrol Portable, £44. Planers, Bandsaws, Lathes, Saw Spindle and Planer Assemblies, Logging and Firewood Machines, Chain Saws, Engines, Motors; deferred terms. Send 1/9 for handbook, catalogue and bargain offers. List free. Beverley Products, Sturton-le-Steeple, 47, Notts.

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Single Phase, ⅙ h.p.	1,500 r.p.m.	£7.10.0
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⅓ h.p.	1,500 r.p.m.	£11. 0.0
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Fully guaranteed by makers, approval against cash. Carriage paid mainland. State voltage.
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SPECIAL OFFER.—B.T.H. Electric Motors, ⅓ h.p., 1,425 r.p.m., 230-250v., A.C., single phase, latest type, brand new and fully guaranteed, £8/10/-, carr. paid; approval against cash. Many other sizes at attractive prices. Send for lists. P. Blood & Co., Arch St., Rugeley, Staffs.

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Would you like to build a small Bedside Radio working a Loudspeaker from a flashlamp battery. Transistors can do this. No mains required. Simple to build. Send 8d. stamps for notes on transistors and Price List Components.
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MODEL ELECTRIC MOTORS, amazingly powerful: "Mini Mo," 9/6; "Maxi Mo," 13/6, post free; 4½ to 9v., 1⅜in. x 1⅛in., weight 1½ oz., 4/5,000 r.p.m.; drives boat propellers, 1in. and 1½in.; aeroplane, 5in. and 8in. Model Electric Motors (Dept. P.M.5), "Highland," Alkrington Green, Middleton, Manchester.

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CAN MAKE MONEY FOR YOU
LET US ASSIST YOU PROFESSIONALLY TO SELL YOUR INVENTION.
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SEREN ASTRONOMICAL SUPPLIES
Warehouse Road, Stebbing, Dunmow, Essex.
EQUIPMENT for ASTRONOMERS
Mirrors, eyepieces, focusing mounts, spiders, etc. Do-It-Yourself kits.
S.A.E. for free details.

ASTRONOMICAL TELESCOPES, Grinding Polishing Kits, Mirror Blanks, Aluminised Quartz-coated Optical Flats, etc.; s.a.e. for lists. L. J. Mays & Co., 20, Clover Road, Timperley, Altrincham, Cheshire.

GILMOUR-VALE NEW GAS TORCH,
for town gas.
Better than a blow lamp. Two sizes **25/6** and **19/6**.

Makes silver soldering and small brazing easy. Particulars and ten-page specialist instruction book free, also prices of the materials. 3d. S.A.E.
G. M. VALE & CO., 55, Park Road, Wellingborough, Northants.

HANDICRAFTS

MUSICAL MOVEMENT Spare Parts; all makes. Send broken part for quotation. Gleave & Co., Albemarle Way, E.C.1.

MUSICAL BOX MOVEMENTS
ONLY **13/-** POST FREE.
Kits from 21/- complete with movement. Please send 3d. stamp, or call for new FREE illustrated brochure. Trade supplied.
THE SWISSCROSS Co. (Dept. V), 202, Tulse Hill, London, S.W.2.

MARQUETRY VENEERS, 12 assorted veneers 5/-, post free: send 3d. for list. Frank Coles (Veneers), 76, Rivington Street, E.C.2.

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APPOINTMENTS ARE WAITING in Industry and Commerce for trained men. Special tuition for G.C.E. Also guaranteed coaching for I.Mech.E., I.Prod.E., Soc. of E., Brit.I.R.E., City and Guilds, Management, Secretaryship, etc. Write for free book on your career to: International Correspondence Schools, 71, Kingsway (Dept. 521), London, W.C.2.

"HOW AND WHY" of Radio and Electronics made clear by a new, non-maths, practical way. Postal instruction based on hosts of experiments and equipment building carried out at home. New courses bring enjoyment as well as knowledge of this fascinating subject. Free brochure from: Dept. P.M.12, Radiostructor, 46, Market Place, Reading, Berks.

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WRITE NOW for FREE GUIDE, stating date and type of examination, to the Registrar, (Dept. M.34),
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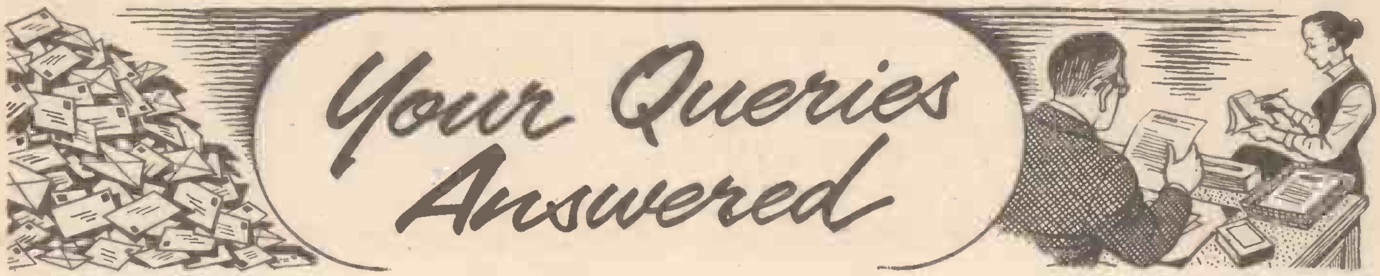
(Continued on next page)



Small Electric Motor Queries

RECENTLY I acquired a 12 v. D.C. shunt motor taking 1.25 amps. and up to 2 amps. on load. This motor ran perfectly off a 12 v. battery but would not start from an A.C. transformer and F.W. rectifier. I also have another shunt motor run from two 12 v. batteries 24/27 v. 2.4 amp. D.C. which behaves in the same way. Please tell me what is required in the rectified A.C. circuits to make the motor(s) run satisfactorily.—R. Raw (Chester).

ASSUMING that the transformer and rectifier are in order it is quite likely that the current and/or voltage output are inadequate, especially if the motors are started by direct-on switching or are started against load. The mean D.C. output of the rectifier on its rated load current may be approximately 75 per cent. of the applied single-phase A.C. voltage, and may be appreciably lower at starting a motor. It would appear that a transformer and rectifier of higher voltage and/or current rating are required, the transformer secondary windings preferably being tapped for voltage control.

Wire for Floor Heating

I AM considering laying a concrete floor in a bungalow of about 700 sq. ft. area. At the same time I would like to heat it electrically by means of insulated heating wire fed through conduit embedded in the concrete and spaced about 1ft. apart. Access to the ends of the conduit would be gained by a covered trap running the length of the bungalow on either side. Floor temperature would be regulated by thermostat to around 65 deg. F. The loading would need to be in the region of 12 kW. Please tell me what kind if wire to use.—J. W. Habgood (Cirencester).

YOU could use Pyrotenax mineral-insulated cable (Pyrotenax Ltd., Hebburn-on-Tyne), or twin lead-sheathed heating cable (Panelec (Great Britain) Ltd., 27, Hatchlands Road, Redhill, Surrey).

Flue Building Materials

PLEASE tell me the correct mixture of sand, lime, cement and fireclay employed in building flues, walls, etc., around Lancashire boilers.—G. Millar (Co. Antrim).

BOILER flues can be built with either fireclay liners or in firebricks set in a mortar composed of Fosalsil Moler cement and sand in accordance with the manufacturer's instructions. The Moler product can be obtained from any good sized builders' merchant and it may be difficult to obtain as it is a foreign product and is stored in comparatively small quantities in this country. It is advisable to use this material rather than mix up a mortar of your own which is uncertain and may not be equal to the job.

Lenses for Terrestrial Telescopes

I WANT to make a terrestrial telescope of 100X or over. I am not interested in coverage but in magnification though not at the expense of definition.

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.

Could you give me the focal lengths and diameters of the lenses required and an address where they may be purchased? What are the approximate minimum dimensions for a 'scope of this power?—P. Heenan (Belfast).

THE focal length of the object glass should be 30in., diameter 2in. to 2½in. It is on the focus that the power mainly depends. The O.G. must be of the highest quality achromatic. The Huyghenian eyepiece should be made up of two lenses, one field lens ¾in. focus × ⅜in. dia. One eye lens ¼in. focus, ¼in. dia., two erectors each ¾in. focus × ⅜in. dia. These last will be placed convexed side towards each other (they are plano-convexed) between the eyepiece and the object glass.

The overall size of the instrument will be about 31½in. × 2⅜in. dia.

Unmounted lenses can, we believe, be purchased from Messrs. Broadhurst, Clarkson and Co., Ltd., "The Telescope House," 63, Farringdon Street, London, E.C.1.

The P.M. Blueprint Service

12FT. ALL-WOOD CANOE. New Series. No. 1, 4s.*
10-WATT MOTOR. New Series. No. 2, 4s.*
COMPRESSED-AIR MODEL AERO ENGINE. New Series. No. 3, 5s. 6d.*
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SYNCHRONOUS ELECTRIC CLOCK. New Series. No. 6, 5s. 6d.*
ELECTRIC DOOR-CHIME. No. 7, 4s.*
ASTRONOMICAL TELESCOPE. New Series. Refractor. Object glass 3in. diam. Magnification x 80. No. 8 (2 sheets), 7s. 6d.*
CANVAS CANOE. New Series. No. 9, 4s.*
DIASCOPE. New Series. No. 10, 4s.*
EPISCOPE. New Series. No. 11, 4s.*
PANTOGRAPH. New Series. No. 12, 2s.*
COMPRESSED-AIR PAINT SPRAYING PLANT. New Series. No. 13, 8s.*
MASTER BATTERY CLOCK.* Blueprints (2 sheets), 4s. Art board dial for above clock, 1s. 6d.
OUTBOARD SPEEDBOAT. 11s. per set of three sheets.
LIGHTWEIGHT MODEL MONOPLANE. Full-size blueprint, 4s.
P.M. TRAILER CARAVAN. Complete set, 11s.
P.M. BATTERY SLAVE CLOCK, 2s. 6d.
P.M. CABIN HIGHWING MONOPLANE. 1s. 6d.*
P.M. TAPE RECORDER.* (2 sheets), 5s. 6d.

The above blueprints are obtainable, post free, from Messrs. George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

*An * denotes constructional details are available free with the blueprints.*

Faulty Circular Saw

I HAVE a 12in. circular saw and find that the ball bearings heat up and there is a cracking sound. I have looked carefully at the ball race and there is no trace of broken balls. Can you suggest what may be wrong?—A. Gardinar (Lurgan).

THE fact that there is a sound coming from the bearings indicates that something is wrong with them. Perhaps the race is badly scored—a fact which is not easily seen by a cursory observation of the race, or the cage may also be worn and broken.

You do not state whether or not you have recently purchased this saw. If it is a recent purchase, we suggest that the wrong bearings are in place and there is a need for the self-aligning type or the double purpose thrust member.

To state precisely how to adjust these bearings without actually seeing the machine is, of course, impossible as there are several methods adopted for this work. We suggest you write to the makers. Request an operator's handbook stressing that you require this to enable you to carry out routine adjustments, or alternatively ask for a brief drawing showing the spindle assembly.

We urge you to contact the makers before proceeding further because we feel that you may experience a bent shaft and perhaps a broken saw while the machine is in action, and this may cause a nasty accident. Unless you can secure the assistance of a millwright to make these adjustments this is the best course to adopt.

Are you satisfied that the details for securing the saw to the spindle are the same as those supplied with the machine? Failure to use these can often lead to excessive vibration and worn bearings.

Lost Wax Process

I AM interested in the small-scale production of castings using the "lost wax" process.

I intend melting the wax pattern out of the plaster mould using an ordinary household gas-oven. But to remove the last vestiges of the wax it is necessary to raise the temperature to about 700 deg. Centigrade for an hour. This will be inconvenient—and expensive.

I am told that an alternative to this second stage is to place the mould in an atmosphere of warm vaporised carbon tetrachloride—which means, presumably, a "de-greaser." Could you give me instructions as to how I can make one of these of, say, about 4 cubic feet capacity? If they are not expensive to purchase I should

also be glad of the name and address of specialist makers. I also imagine that the wax dissolved in the carbon tetrachloride could be recovered by distillation; could this be incorporated in the de-greaser itself?—W. Barrow (Old Portsmouth).

ONLY with extremely complex patterns that form re-entrant pockets in the investment from which wax cannot drain, are you likely to encounter the difficulties that you appear to be envisaging. Moreover, this is the case only under commercial conditions, where the moulds must be processed in closely-packed batches. If you are using an ordinary gas-oven, there seems no reason why you should not change the position of the moulds several times to allow the smaller and deeper parts of the pattern to melt and drain toward the orifice. Some wax will, of course, be absorbed by the plaster, but this could be disposed of by soaking the moulds in benzine or carbon tetrachloride, and allowing the vapour time to dissipate in a well-ventilated place before casting.

If you think it worth while to adopt vapour-phase degreasing, an effective degreaser may be made from an ordinary dustbin with an immersion heater let in, horizontally, near the bottom. The solvent should cover the immersion heater, and a wire-mesh rack or shelf should be fitted an inch or two above the solvent level to take the work. The tank should be operated in a cool place so that vapour rising toward the top can condense on the side walls. It seems unlikely that on your scale of working it will be of any value to distil the solvent to recover the wax; you would do better to use the simple type of tank described. Equipment embodying means of distillation is used commercially and if you think the outlay justified you could get in touch with Messrs. W. Canning and Company, Great Hampton Street, Birmingham, who could no doubt construct an installation suited to your production requirements.

Compressor Operation

RECENTLY I purchased an air compressor giving an output of 2½ C.F.M. 180lb. sq. in. Could you tell me what r.p.m. and what size tank I require to use it for paint spraying? The compressor has two cylinders each having a bore of 1¼in. and 1½in. stroke.—R. Willis (Filton).

WE suggest you operate this compressor in the 550-880 r.p.m. range; the best speed being found by actual practical usage. A speed of 650 r.p.m. will, it is considered, be found most suitable.

If the compressed air demand is fairly constant a receiver need not be greater than the volume of air delivered by the compressor in one minute, but for intermittent work it would be advisable to install a receiver having at least twice this capacity.

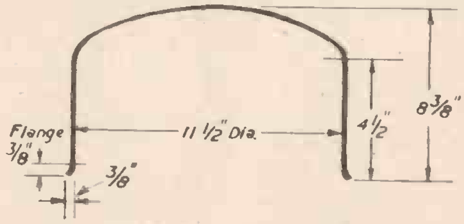
Some authorities quote an air receiver for intermittent work as having a volume of up to three or four times the capacity of the compressor in one minute, i.e., for the compressor in question, a volume of between 5 and 10 cubic feet.

Materials for the Arc and Spot Welders

I AM interested in the two recent designs for arc and spot welders and would like information on where the materials may be obtained.—J. B. (Chatham).

THE principal materials can be obtained from the following firms:—

Stampings: Joseph Sankey and Sons Ltd., Bilston, Staffs. *Wire*: London Electric Wire Co. and Smiths Ltd., Church Road, Leyton, London, E.10. *Leatheroid and Bakelite*: Attwater and Sons Ltd., Hopwood Street Mills, Preston; Mosses and Mitchell Ltd., 60-68, Ironmonger Row, E.C.1. *Angle Iron*: Thos. W. Ward Ltd., Albion Works, Sheffield. *Flexible Cables*: General Electric Co. Ltd., Magnet House, Kingsway, W.C.2. *Brass Rods*: Ross Courteney Ltd., Ashbrook Road, London, N.19. *Copper Strip*: E. and E. Kay Ltd., Queensway, Ponders End, Middlesex.



Dimensions of Perspex dome.

Perspex Dome

HOW can I make a shade or cover in Perspex to the dimensions shown above with a uniform thickness of ⅛in. or 3/16in.?

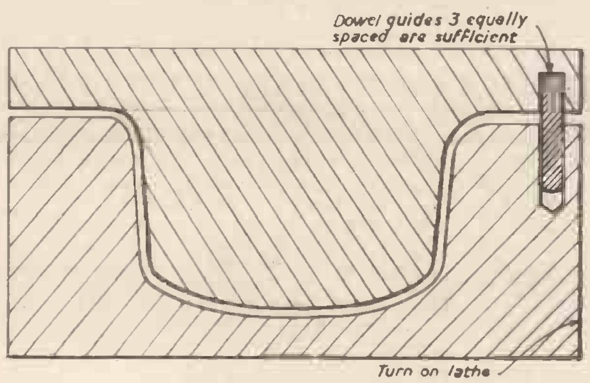
What size sheet of Perspex would I require? How are the large dome-shaped cockpit covers as used on helicopters made?

When blowing and shaping Perspex I understand that such shapes thin out at the top (perhaps even break through) which is something I want to avoid.—J. J. Brady (Dublin).

THE forming of shapes by blowing can be employed only for such shapes as are parts of spheres and would not be suitable for the lamp cover you describe.

It should be possible to make the part by one of the two following methods.

(a) By building up the shape from pieces.



Using a double mould

The vertical portion is formed by wrapping a piece of Perspex 36in. × 4½in. around a suitable former and making an edge to edge joint using Perspex cement. The top is blown to shape and cemented to the vertical part. If true edge to edge surfaces are prepared and the cementing carefully carried out, the joints will be practically invisible.

(b) The second method involves the use of a double mould as shown in the sketch.

The Perspex is thoroughly softened by heating in a flat dish of boiling water to which a little glycerine or common salt has been added (to raise the boiling point) for about a quarter of an hour. It is removed from the bath, wiped carefully with a soft cloth to remove water droplets and then placed between the two halves of the mould. The mould is then closed using much pressure, and held closed with "G" clamps. After 10 minutes the form may be removed from the mould and cooled thoroughly.

When removed from the hot bath, the Perspex must not be at all "springy." Return to the bath if necessary and heat for a further period. In the event of the Perspex hardening before the final shape has been attained, it may be reheated and flattened before trying once more.

For successful results all operations should be carried out quickly once the sheet of Perspex has been removed from the heating bath.

A disc of Perspex 10½in. in radius should be approximately correct for the blank. The mould can be made of wood with all surfaces *highly* polished. This is important as any mark on the wood will be transferred to the Perspex.

Injection Moulding

ASSUMING that it is not possible for an amateur to manufacture simply the type of plastic "pressings" such as are sold for the construction of model cars, planes, etc., could you give me the address of a firm able to undertake small orders? R. N. Laxon (Gt. Yarmouth).

THE model cars and other toys made from plastic materials are not pressings but, for the most part, injection mouldings. In injection moulding the material is heated until it becomes almost fluid and is then forced under extremely high pressure into an accurately machined steel tool, within which it solidifies almost instantaneously.

As these high-pressure injection moulding machines cost several thousand pounds apiece, the business tends to be in the hands of specialist companies, and as a single tool to produce, say, a model motor car is likely to cost between £600 and £2,000, according to the number of individual mouldings made at each injection stroke, very large quantities must be produced to make the process worth while.

Terrestrial Telescope Queries

I HAVE constructed a 40in. Terrestrial telescope with a Huyghenian eyepiece and its definition is good at one to two miles, but farther than that the image becomes hazy, although with the naked eye the view appears to be quite clear at six miles.

What is the likely cause for this and what remedy can be applied. The final image is much magnified but, with this length of focus, very difficult to keep in view and the slightest vibration causes it to disappear.—H. G. Sibcy (Lancs).

THE haze may be normal weather conditions likely at this time of the year. If, however, you mean lack of sharp focus, at infinity, then the distance between objective and the other lens assembly needs to be slightly reduced. You may also need to try varying the spacing between the other lenses, as their exact focal lengths may be a trifle different from that anticipated.

The shift of the image, with movement of the telescope, depends only on the magnification. Alternative assemblies, with the same magnification, would have the same difficulty. A rigid tripod is required for large magnifications, for this reason, and hand-held telescopes can seldom be more than about 16X with convenience.

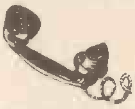
Information Sought

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

Fountain Pen Repair

CAN you please tell me of an adhesive suitable for repairing the broken barrel of a fountain pen?—T. Kearney (Glasgow).

Wilkinsons EST. 1921



Home Intercom

★ Use it Anywhere
★ Installed in Seconds
★ Room to Room
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SET No. 5. TELEPHONE HAND SET as illustrated with sound-powered earpieces and battery operated mouthpiece. Simply connect two instruments with twin flex and a 1½ volt battery in series. "Press to talk" button prevents waste of current whilst not in use. Two instruments with cords and plugs, 25/-, post 2/6.
SET No. 7. Consisting of two P.O. type hand sets as illustrated with press-button in the handle for ringing bell at other end. The instruments are entirely sound-powered and are supplied with two bells and batteries with full instructions for installing. Simply connect with four wires. 75/-, post 3/6. Twin P.V.C. Wire, 3d. per yard. Twin P.V.C. Flex, 4d. per yard, or single P.V.C. in 100 yd. coils at 10/6, post 1/-.
SET No. 9. MODERN DESIGN DESK TELEPHONE with press-button on front for ringing other instruments. Two complete units ready for use—ideal for the office, £8.17.6, post 7/-
S.A.E. for complete list of ten available sets.

METERS GUARANTEED

F.S.D.	Size	Type	Price
50 Microamps	2½in.	MC/FR	70/-
250 ,,	3½in.	MC/FR	55/-
1 Milliamp	2½in.	MC/FR	35/-
5 ,,	2in.	MC/FR	17 6
30 ,,	2½in.	MC/FR	12/6
100 ,,	2½in.	MC/FR	12/6
250 ,,	2½in.	MC/FR	12 6
500 ,,	2in.	MC/FR	25/-
5 Amperes D.C.	2½in.	MI/FR	17 6
5 Amperes	2in.	MC/FS	27.6
15 ,,	2in.	MC/FR	10/6
25 ,, D.C.	2½in.	MI/FR	7/6
30-0-30 ,,	2in.	MC/FR	15/6
50-0-50 ,,	2in.	MC/FS	12/6
20 Volts	2in.	MC/FS	10/6
40 ,,	2in.	MC/FS	10/6
300 ,, A.C.	2½in.	MI/FR	25/-

CROSSPOINTER METER with 2 separate 100 microamp movements. 22/6. Post 2/-.
XPELAIR EXTRACTION FANS. 7½in. blades with baffle outlet. 190 -, carriage 7/6.
ROTARY CONVERTER. Input 12 volts D.C. Output 230 volts A.C. 50 cycles, 135 watts. In fitted case with variable resistance, 0/300 voltmeter, mains switch. The ideal job for television where A.C. mains are not available. Perfect condition. £10, carriage 15/-. Special connectors 5/- per pair
GENERATORS ONLY 12 volt or 24 volt. £8.10.0, carriage 7/6.
10 AMP BATTERY CHARGER. Here is your chance to purchase a brand new unit worth £40 ! For our special price, £17.10.0, carriage 20/-. **Specification:** Input 200/250 volts A.C., 50 cycles. Output 10 amps, 22 volts D.C. Controlled by two 4-position switches for fine and coarse control which enables 6 to 24 volt batts. to be charged. Brand new with 0/12 ammeter. Fused A.C. and D.C.
VARIABLE RESISTANCE 140 ohms 2.4 amps, in ventilated case 10in. x 7in. stud type, 35/-, carriage 7/6.

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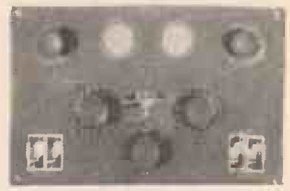

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THE Cyclist

VOL. XXVII MAY, 1959 No. 442

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COMMENTS OF THE MONTH

The Bicycle's Lack of Snob Value

CYCLING is a young man's sport, but why is it? Why do so many of the young riders give up the game in later years? One possible reason is the prevailing opinion these days that if a young man has not reached the position of being able to afford to run a car or at least a motor cycle by the time he is 30, he is a social failure. Why is it then that the man with a car is considered successful while the man who prefers to ride a bicycle is not? It seems that his social position is judged by the transport he uses and, because the bicycle is so cheap to buy and run in comparison with a car or motor cycle, the cycle user must be a poor man. This, of course, is utter nonsense and the whole false position is a result of the modern attitude of "keeping up with the Joneses."

Many office employers have this attitude and manage to indicate to their staff, either directly or indirectly that it is "undesirable" for them to ride bicycles to work, hinting that some loss of face or at least a lowering of their dignity is involved. It is true that office clothing is inclined to lose some of its look of impeccability when the wearer has ridden to work, but provided that spare clothes are kept on the premises and the rider manages to maintain his standard of dress during office hours, some slight disarray on arrival and departure is excusable.

This attitude of some employers may very possibly be directly against their own interests. The health giving factor of the ride to work in the open air and the exercise obtained should not be overlooked. The common cold which causes the loss of so many man hours during the winter is usually caught as a result of travelling on crowded public transport in company with flu-smitten germ-spreading fellow workers. There is no reason why the man who cycles to work, even in the most inclement weather, should catch cold from being exposed to the elements, provided, of course, he is properly protected by suitable clothing against wet and cold.

This attitude of superiority where cycling is concerned is not confined to the employer. In some cases the motorist takes it with him on to the road, but he is not entitled to any preference apart from the normal rules of the road and the Highway Code merely because of the greater size, value and speed of his conveyance! He is merely another road user who has chosen a different type of vehicle. The cyclist, providing he is obeying the rules of the road has at least as much right to consideration as the motorist. In fact, because of his vulnerability, he is entitled to more. His braking power and degree of protection are both less than the motorist's and in addition he has to keep his machine balanced. These things make him—in the same way as a learner driver—entitled to courteous treatment by better equipped road users.

This tendency to look down on the cyclist because of the humbleness of his mount is entirely mistaken. Many men ride a bicycle for the exercise or for the pleasure it gives them and may at the same time own cars themselves. The late F. J. Urry was a fine example of a man who rode a cycle almost until the day he died, in spite of the fact that he held a high position in industry and was a motorist by necessity. He always took his pleasure on a bicycle, rode it to work and maintained that it was entirely due to this that he enjoyed such an active old age. It is a great pity that there are not more men who have the courage of their convictions in the same way as did F. J. Urry. There must be a great number of ex-cyclists who are still enthusiasts at heart, but who are frightened away from active participation by the snobbish attitude of their neighbours and colleagues at work.

There is no loss of dignity involved in riding a bicycle. Early in this century, before the advent of the I.C. engine, cycling was the sport of the wealthy and this was at a time when people were much more conservative than they are now. In view of this fact, it becomes increasingly difficult to understand how the present day attitude came into being. But however it started, the sooner the myth of the bicycle's lack of snob value is exploded the better.

AMERSHAM, BUCKS—with its lovely Town Hall, its old inns and delightful red brick houses.

Young Recruits to Cycle Racing

MOST of the major sports in this country have some form of nursery or other and these are typified by the school cricket and football elevens and college athletic teams. From these, county teams are formed, and, finally national schoolboy elevens can be selected. Up till very recently cycling has had no such nursery training younger members of the sport. Attempts have been made many times in the past to get schools interested in cycle racing but without any large scale success.

In 1957, however, members of the Kentish Wheelers saw a report of the Schoolboys' Championship of New South Wales in the "Australian Cyclist" which had attracted a field of 10,000. Feeling that this pointed the way to the formation of a cycling nursery, the Kentish Wheelers promoted an open event for riders between 14 and 16. This led to other events and at the end of last year an entry of over 150 was received. This year official authorisation has been received to stage an event to decide the championship of London and the Home Counties. If successful this would probably be followed by a National Schoolboys' Championship next year. What the final result of this move could be is open to doubt, but it could, of course lead to a championship event which would eclipse even the Australian Championship which first inspired the organisers.

The Kentish Wheelers have gained many new and useful members through this scheme and if this idea were adopted by other clubs and perhaps eventually by the British Cycling Federation, the flow of new blood would benefit both the sport and pastime of cycling.

An official scheme and racing programme for youngsters organised on a national scale by the B.C.F. would have a better chance of being accepted by education authorities than small club-sponsored private schemes with the result that perhaps cycling could obtain a foothold in the schools athletic programmes. Thus many youngsters who would have perhaps turned to other sports would have their energies and interest diverted at an early and most impressionable age and perhaps become lifelong devotees. How about it B.C.F.?

Lack of Bicycle Fiction

THERE have been a number of books since the inception of cycling on its historical aspect. Some were good, some were bad, but surely it is now time for the publication of a complete history! Many of the earlier books on cycling are now very rare works indeed and an up-to-date book would be of great interest.

Even more rare than books of cycling history are novels with a cycling background. In the earlier days of the pastime, H. G. Wells produced the very popular "Wheels of Chance," and Jerome K. Jerome wrote the witty "Three Men on a Bummel." But what others are there? Surely the sport and pastime provides an unparalleled scope for adventurous writing, with all the roads of the world as a background! It would be interesting to see a list of novels written with cyclists and cycling prominently featured.

TOURING WITH THE Y HA

Table tennis in the Common Room.

Canterbury is one of the largest hostels.

What This Organisation Offers The Cyclist

THERE is a network of youth hostels covering the whole of the British Isles and in every part of these islands it is possible for the cyclist to plan a tour, working out the journey conveniently from hostel to hostel.

The hostels are very varied in type. Some are specially erected buildings of the prefabricated type, some are large houses which have been converted and others are buildings of historic interest belonging to the National Trust. The photographs on this page show hostels which are representative of all three types. The accommodation and facilities afforded by individual hostels vary a great deal, according to the size of the building. Some of the largest may have sleeping accommodation for a hundred hostellers, while others can only provide beds for a dozen or so. Every hostel is thus an individual place. This individuality applies also to the Warden in charge of the hostel. His ability as a manager and his wife's ability as a cook contribute a great deal to the efficient running of the hostel and the enjoyment of the hosteller.

(*Left*) *At breakfast.*

(*Right*) *The historic "City Mill" hostel at Winchester.*

Membership

The Y.H.A. is non-profitmaking and completely non-sectarian. Anyone who is over five years old can join. Juvenile members are those between five and 16; there is a junior membership over 16 and under 21 and a senior membership of 21 and over. There are special provisions for life, family and National Service membership. You can join the organisation by post, sending a stamped, addressed envelope for an enrolment form to the Y.H.A. National Office, St. Albans, Herts.

Facilities

Youth hostellers sleep in dormitories, which vary in size according to the hostel, the overnight fee to members is 3s. or 1s. 6d. for juveniles.

Three course meals can be obtained at many hostels—for breakfast, cereals, a cooked dish and bread and marmalade with tea. Supper is usually soup, a meat course and a sweet, and tea. Lunch packets are available, price 1s. 3d. Supper and breakfast are 2s. 6d. each. In addition to providing meals, hostels have also a members' kitchen, where hostellers may prepare their own food. Here, in addition to stoves, there are utensils, etc., for self cookers' use. A good many hostels carry a store of food for members preparing their own meals. There is always a common room and a store for bicycles.

Sleeping Bags

Blankets, of course, are supplied at hostels with the bed, but members are expected either to carry with them a sheet sleeping bag of an approved type (this isolates the user completely from blankets and pillow) or to hire one from the warden of the hostel, on arrival, for 1s.

Blackboys Youth Hostel.

Book in Advance

Youth hostels are very popular, particularly in the summer months and it is never safe on summer week-ends to journey to a hostel without booking in advance. This is necessary both for accommodation and meals.

Rules

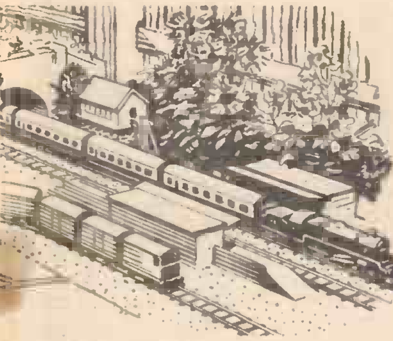
There are, of course, a number of rules which the member of the Y.H.A. is expected to observe, but the majority of these are merely matters of common sense and good manners and are designed to protect the majority of hostellers from being subjected to annoyance from others, as well as to help the warden in his job of running the hostel efficiently.

The bogey that is often "trotted-out" by non-hostelling types, that you are expected to work for your keep, is not strictly true. Every hosteller is expected to do a small chore before leaving, but this is usually nothing worse than a quarter of an hour's washing up, potato peeling or sweeping.

The Handbook

Full details of the Youth Hostels themselves and their amenities are contained in the Y.H.A. Handbook, which is published annually and costs 9d.

The annual subscription is: juvenile members 3s. 6d., junior members 7s. 6d. and senior members 15s. Life membership costs £6 6s. National Servicemen may renew their membership during service without payment.



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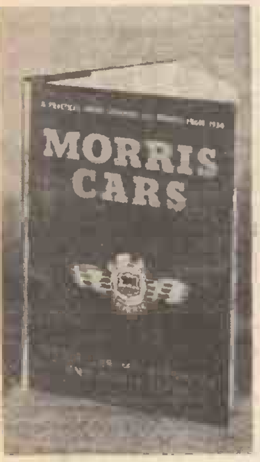

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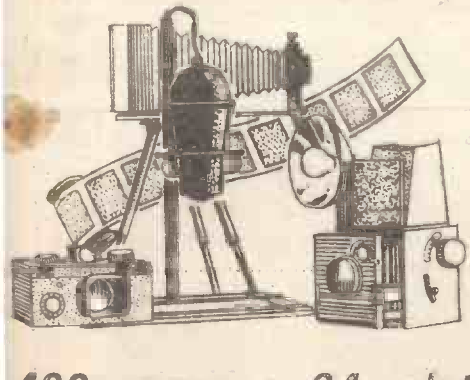

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