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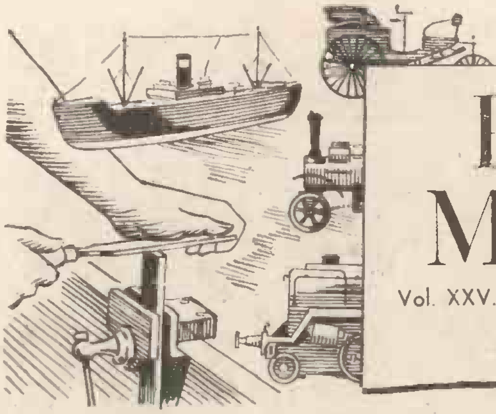
PRACTICAL MECHANICS

EDITOR : F. J. CAMM

JANUARY: 1958

Contents



Practical Mechanics

Vol. XXV. No. 287 JANUARY, 1958
"The Cyclist" and "Home Movies"
are temporarily incorporated

Editorial and Advertisement Offices
"PRACTICAL MECHANICS"
George Newnes, Ltd., Tower House,
Southampton Street, Strand, W.C.2

Phone : Temple Bar 4363
Telegrams : Newnes, Rand, London

SUBSCRIPTION RATES
including postage for one year

Inland - - - - 20s. per annum.
Abroad - - - 18s. 6d. per annum.
Canada - - - - 18s. 6d. per annum.

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CONTRIBUTIONS

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

FAIR COMMENT

THE SECOND SATELLITE

WITHIN a few days of going to press with the last issue, Russia announced to the world that she had launched a second satellite, carrying a passenger in the form of a dog. The satellite contained radio transmitters and various other instruments for research into primary cosmic radiation, temperature, air density, and meteor prevalency. The dog which has since died was housed in a pressurised capsule, with food stocks available, which were fed automatically by special apparatus to the animal. This in itself must have been of intricate design for in zero conditions solids and globules of liquid float freely in space, thus preventing the process of taking food and drink in the usual manner. Certain research apparatus was, of course, attached to the body of the dog, recording its pulse, rate of breathing, blood pressure, etc. The dog lived for a considerable number of days before it expired due to lack of oxygen. The continued use of animals in space experiments where there is practically no chance of the animal surviving will naturally cause distress to animal lovers as it has done in the case of Sputnik 2, and there is likely to be the same controversy as there has always been over vivisection. The outstanding scientific fact of the successful launching of Sputnik 2 is its total weight, reported to be about half a ton. This implies that Russia must now possess an enormously large rocket projection system or new type of propulsive unit the fuel of which Great Britain and other countries are at present unaware.

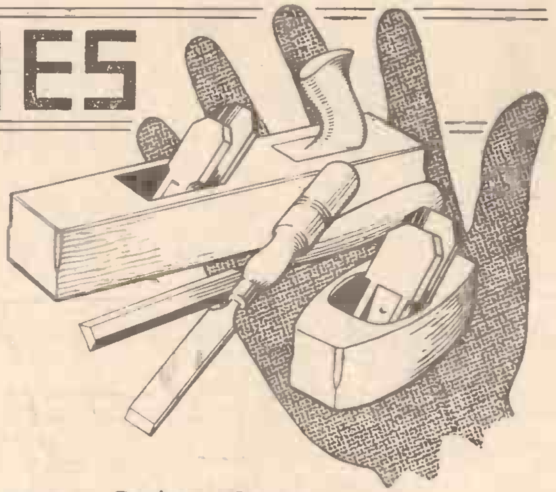
Sputnik 2 has a surface to orbit distance of about 900 miles, and completes one orbital revolution in about 1 hour and 42 minutes. It must, therefore, have a minimum velocity of about 18,000 miles an hour. As it appears to be placed almost completely outside the earth's atmosphere, it is possible for the satellite to continue to circle the earth for many years.

The satellites, however, are but the first step and many more experiments must be conducted during the next few years before human beings will travel in satellites. The journey to the moon, however, must take place during the run of the present century, although it is possible that rockets will land on it long before the human traveller ! It is technically possible for such a rocket containing recording instruments and transmitters to land and provide the information for the design of a space ship.

ABOUT HAMMERS

EVERYONE I imagine owns a hammer, but I wonder if they ever give serious consideration to the importance of correct design ? It is the subject of a 40-page revision of a BSI specification which was first published in 1939 and revised 10 years later. The 14 types of hammer for which quality and dimensions are specified range from the delicate 3½ oz. pin hammer, through engineers' and joiners' hammers, to railway track keying hammers, stone-breakers' hammers and 16lb. sledge hammers. Simple though the hammer is, according to the Royal Society for the Prevention of Accidents, the hammer and chisel are the most dangerous of all hand tools and during the last few years there have been many cases of small particles flying from the faces of hammers causing the loss of sight, damage of arm muscles, severing of arteries and in a recently-reported case, severing of the jugular vein. There have also been several cases of injuries caused by hammer heads flying from loose handles. Those accidents would not have occurred if the users had taken the trouble to examine the hammers regularly, repair damaged faces, and loose handles, or scrap them. In the revised British Standard, the quality of the steel has been improved and a 100 per cent. hardness testing and magnetic crack testing is compulsory, yet even a hammer made strictly to this specification can be made weak by misuse. The new standard is an attempt further to upgrade hammers from the safety-in-use angle.—F. J. C.

CHISELS & PLANES



The Different Types and How They are Used

By W. J. STANNAGE

THERE are, of course, many more types of woodworking chisel than those covered in this article, but the ones mentioned are the most versatile and consequently of interest to the beginner who is thinking of buying chisels and is more than a little overawed at the large selection on view. Fig. 1 depicts four much-used chisels, and with these quite a variety of projects can be undertaken. First is a firmer chisel and, as the name suggests, it is shorter and stronger—in fact firmer—than the longer and thinner bevelled-edge paring chisel. It can be used for quite heavy work and can be struck with the mallet. A point worth making here is that only a mallet should be used and never a hammer, as such treatment would soon fray out the end of the handle.

Next is a bevelled paring chisel which is used chiefly for paring away waste material as is necessary, for example, in the making of a housing joint. Also this type of chisel will be found of great value when carrying out vertical paring.

The third is a sash chisel, or sash mortise chisel. It is used for cutting fine mortises in soft timber or hardwood. In fact, this chisel can be used in many instances in place of the mortise chisel shown last. This tool, which is almost crude when compared with the other chisels, is very strong and is employed for chopping heavy mortises. The design of the tool will resist any tendency to twist in the job and the heavy section material makes it possible to lever out pieces of waste material. The leather washer acts as a shock absorber when the chisel is struck with the mallet.

Thus the work of the four types of chisel is briefly described, and it will be seen that, unless heavy work in the field of chopping mortises is to be undertaken, it is quite possible for the average handyman to make do quite well with the first three mentioned. As to the actual size of the various tools, it is practically impossible to lay down any hard and fast dimensions. However, as a general guide it is suggested that both firmer and paring chisels of about ¾in. should be considered. Other sizes can be added to the kit as required. In the case of the sash chisel the author has found that one of 5/16in. is most useful, and it is suggested that this is purchased in the first instance.

Warning

Because of their sharp edges, which can easily cause nasty gashes in the hands and fingers, chisels must be treated with respect. However, if one golden rule is observed it is practically impossible for one to cut oneself. The rule is simply to keep both hands behind the cutting edge. In fact, if you endeavour to use the chisel with both hands—except, of course, when using the mallet also—you should experience no such injury. If you must steady the work with one hand, then keep that hand behind the chisel.

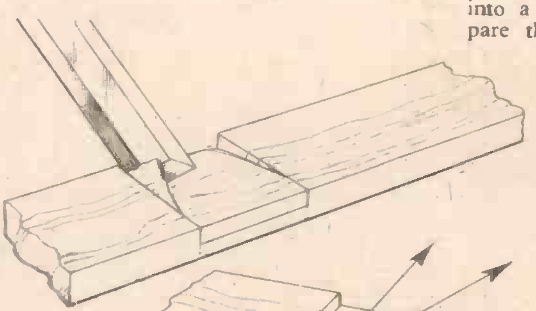


Fig. 2 (Top).—Commencing cutting of groove.

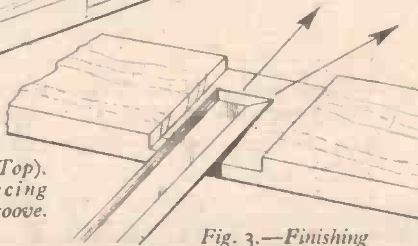


Fig. 3.—Finishing off the groove.

Cutting a Groove

The first step in cutting a groove or notch is shown in Fig. 2. The chisel is not forced into a great depth of timber but used to pare the wood away, commencing at the rear edge in the drawing. When working, this edge is the one nearer the operator. A closer look at the illustration will show that this cutting action is not continued across the wood, but that the cut stops about the centre. The timber is then reversed and the cut commenced again from the untouched edge. These two operations result in both edges being cut away, but the wood being left high at the centre. The next move is to pare this away and finish off the cutting, as seen in Fig. 3.

As well as showing the finishing off of this particular cut this sketch illustrates two other very important points. One has already been mentioned, namely, that both hands should be kept behind the cutting edge of the tool, the other is the direction in which the tool is worked. The two arrows show that as well as being pushed forwards the chisel is also pushed sideways. This results in a cleaner and easier cut, as a simple experiment will soon show.

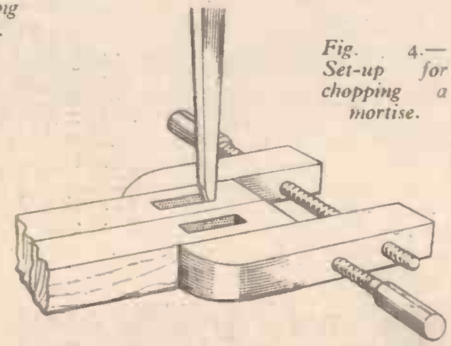


Fig. 4.—Set-up for chopping a mortise.

Mortise Cutting

When chopping mortises which are close to the end of a piece of timber it will often be found that the timber will split in the operation. One method by which this may be overcome is to leave a few spare inches of wood beyond the actual mortise. However, this is not always practical, so the set-up depicted in Fig. 4 can be used. Mortises are usually marked off in pairs and this can be extended to the actual cutting, as can be seen in the sketch. The two pieces

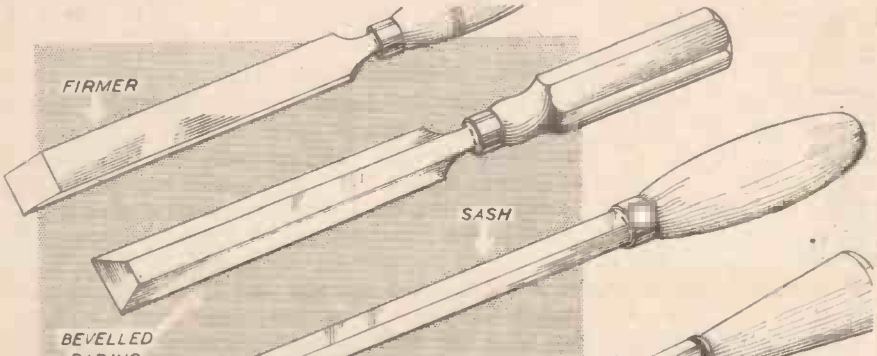


Fig. 1.—Four types of chisel.

are held together with a cramp which gives additional support. Even if spare or additional timber can be left in place until after the mortises have been cut it is still a good plan to use the cramp. It is recommended, too, that a bench cramp also be used to hold the job steady on the bench. Such holding down of the work makes for accurate work with the chisel.

Types of Plane

Another tool which is a "must" if any serious woodwork is to be undertaken is the plane. Like the chisels, there is a wide variety, but again we will consider the more important ones. Fig. 5 depicts the jack plane in use, and this tool is mostly used for rougher work, such as removing saw marks from timber before a finer plane is brought into use. Note the position of the hands in the drawing, as this is important if the plane is to be properly controlled. Another very important point is the applying of pressure as the plane is moved. At the commencement of the stroke a downward pressure is applied to the front of the tool and, as the end of the stroke is almost reached, the downward pressure is changed over to the rear. If this is not observed "dubbing over" will be experienced and this simply means that you will end up with the edges of the timber, where the strokes were commenced and finished, thinner than the timber in the centre of the board.

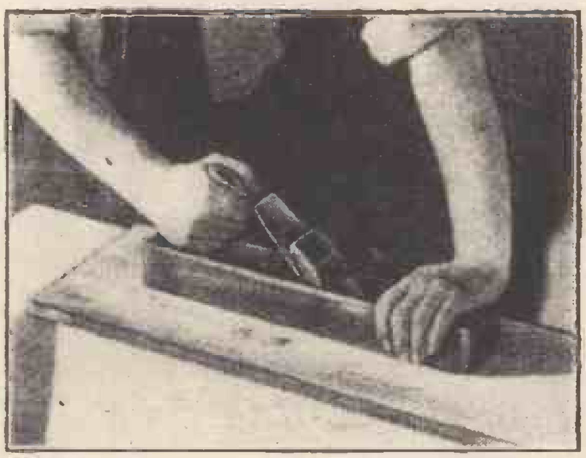


Fig. 5.—Using a jack plane on a flat surface.

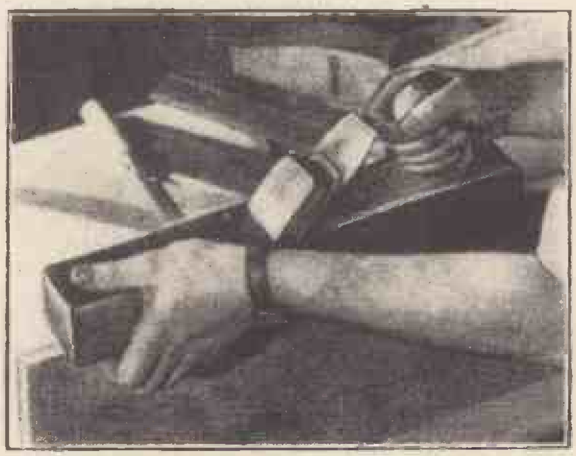


Fig. 6.—Using plane on edge of wood.

Fig. 6 shows how the plane is used on the edge of a piece of timber. The fingers of one hand curl under the plane and the finger tips run along the wood. Thus the fingers form a fence and steady the plane. The plane illustrated is a trying plane, but strictly speaking a jointing plane should be used. However, it will be found that the jointing plane is rather heavy and difficult to use, so, unless very long lengths of timber are to be planed, the smaller trying plane is handier.

Another type of plane not shown because it is very common is the metal smoothing plane. It is widely advertised and needs no introduction. As the name suggests, it is used for smoothing off the timber and bringing it to a fine finish, and would be brought into use following the jack plane.

The reader who is about to purchase a plane will be wondering if he must buy three before he can set to work. This is not strictly necessary. In the first instance timber can now be purchased already planed to the required thickness, consequently the jack plane can be eliminated: for the time being, at any rate. The trying plane can be replaced with a metal smoothing plane at a pinch, so a carefully chosen metal plane can be an all-round tool. A suitable size would be a tool from 16in. to 18in. long and having a cutter in the region of 2⅛in. Such a plane will double for the trying plane and is handy enough for smaller work.

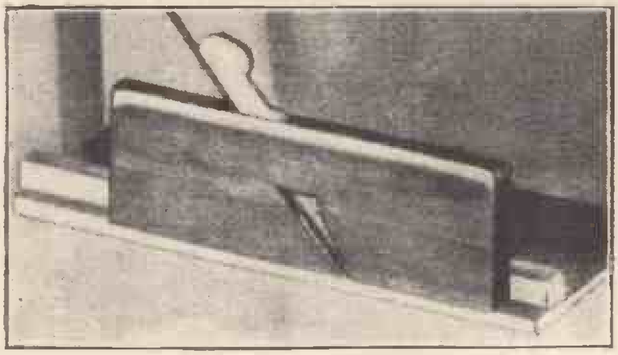


Fig. 7.—Rebate plane.

At some time it will be necessary to add a rebate plane to the tool kit, and a simple form of this is seen in Fig. 7. This type of plane has no fence, so the handyman will find it convenient to use a strip of wood nailed to the job as a guide for the tool. If nail holes will spoil the appearance of the finished job then clamp the fence in place. Of course a more expensive metal plane can be purchased and, besides a fence, this also has a depth gauge.

Another form of the rebate plane which may be of interest is that used for cutting a groove *across* the grain. This tool is fitted with "spurs" which move ahead of the blade and cut the wood, so preventing it from splintering as the blade cuts.

SCIENCE notes

Pill for Radiation Protection

A NEW chemical called AET is being incorporated into a pill which is being developed as a protection against radiation sickness. The chemical has been found to be 100 per cent. effective in mice and in monkeys. Experiment is being extended now to human beings. AET's full name is S2, B-amino-ethyliso-thiuronium-Br-HBr and it is cheap and easy to produce.

New Ocean Flow Below Gulf Stream

MOVING in the opposite direction to the Gulf Stream, this new ocean flow has been discovered off the coast of South Carolina by a combined research unit of British and American scientists. Present ideas of ocean circulation may be entirely changed by this discovery. The device used was British and is called a "Pinger." It is a 9ft. long and 2in. diameter aluminium alloy pipe containing electronic signalling apparatus. The southward moving lower current exists only 18in. from the bottom.

Preventing Water Evaporation Chemically

RESEARCH on this problem is being carried on independently in Australia, South Africa and America. In a 14-week test in Australia a film of cetyl alcohol on the surface of a reservoir saved 200,000,000 gallons of water which would have otherwise been lost by evaporation. In American laboratory experiments a one-molecule thick coating of hexacecanol on the water's surface has eliminated more than two-thirds of evaporation losses.

A Learning Machine

IN America a machine has been developed to allow the modern medical student to test his knowledge in private. A revolving drum is used, on which are printed the question along with mutiple-choice type answers. The right answer button gives a green light and adds to the score, whilst the wrong answer gives a red light and no score.

Colour Photography Put to Work

GEOLOGISTS and minerologists are using aerial colour photography to spot subtle shadings in mineral deposits which are not easily spotted on the ground.

Foresters, too, are gaining information on the health and resources of their timberland by the use, in addition to colour photography, of 3D and infra-red.

Improved Microwave Relay System

THIS new system is capable of handling more than 10,000 telephone conversations or 12 television programmes plus 2,500 telephone conversations. Recent developments such as the silicon rectifier, transistors and ferrite switches are used. The system is being developed by Bell Telephone Laboratories.

Measuring Hardness

A MACHINE has been built by the National Physical Laboratory to calibrate hardness test blocks and so provide a national standard of hardness. The machine is to provide a standard for the Vickers Hardness Scale, but the eventual goal of the research is to provide a standard also for the Rockwell Scale, which is used extensively in industry.

A Coffee Table

Detailed Drawings and Notes on Construction

By "TUBAL CAIN"

THIS table has a Marleyfilm top and shelf. The splayed legs and traditional joints give a very sturdy structure and if carefully made the through dovetails and tenons add considerably to the appearance.

Before commencing work a full-size elevation must be drawn from Fig. 1 so that lengths and angles can be accurately marked.

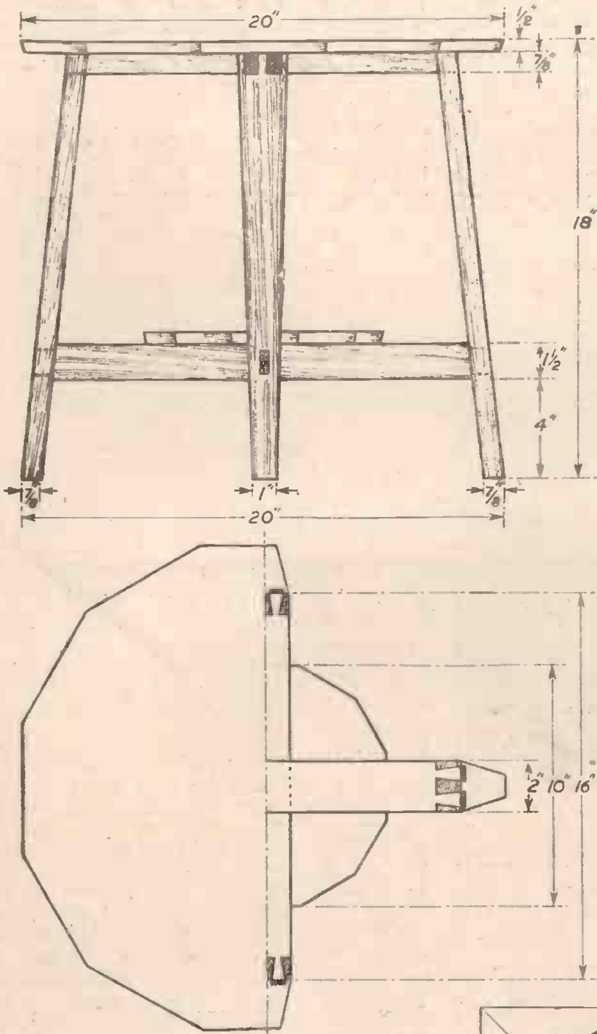


Fig. 1.—Side elevation and plan.

Prepare the wood to size, leaving the legs parallel until all jointing has been completed. Each piece is then marked to length from the drawing and lines marked round with try-square and sliding bevel. The cross-halving joints between the rails are cut in the usual way and the dovetails on the ends of the top rails are then marked and cut (Fig. 2). These are held in position on top of the legs and the sockets marked from them. Cut with dovetail saw, coping saw and chisel. Mark the mortise and tenon joints with a mortise gauge set to a 5/16in. mortise chisel and cut the tenons and mortises. Wedging the tenons adds considerably to the strength of the joint and, if a contrasting wood is used for the wedges, the appearance is also improved. The legs taper from 2in. at the top to 1in. at the bottom and this taper is cut with saw and plane. Clean up the sides of the rails, glue the halving joints together and level off the top and bottom of the rails when the glue has set. Clean up the inside of the legs and glue the whole table together. It may be found easier to glue the mortise and tenon joints with the dovetails in position dry and to glue the top rails when the bottom joints have set. A piece of card cut to the correct angle is useful for checking the frame when assembling. When all glue has set, complete the cleaning up and polish the frame.

The top is a 20in. square of ½in. plywood cut to a twelve-sided shape. First draw the diagonals of the square and draw lines at 30 degrees each side of these lines from the centre to the edges (Fig. 3). Mark the length of these lines on the diagonals and join up the twelve corners thus marked. Saw off most of the waste and finish with a plane. The edges are sloped slightly, this slope can be tested with a sliding bevel. The shelf is cut in the same way from a 10in. square and both pieces are covered with Marleyfilm which is taken over the edges but not underneath, any surplus being cut off level with the underside of the wood. The top and shelf are fixed by screwing up through the rails.

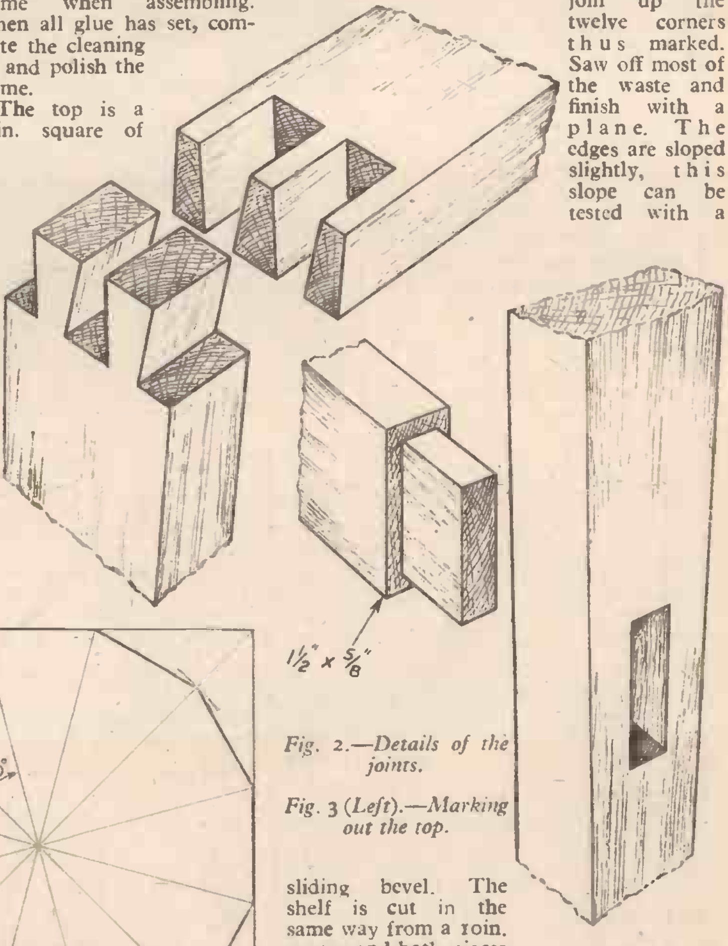


Fig. 2.—Details of the joints.

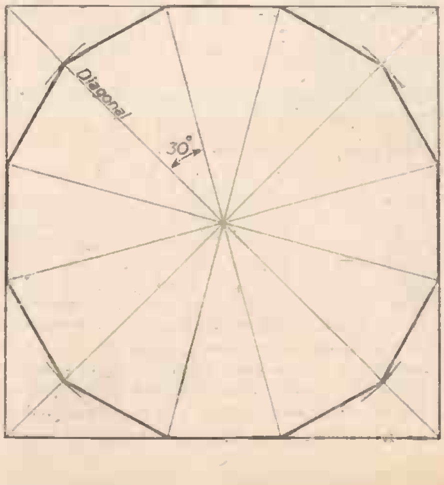
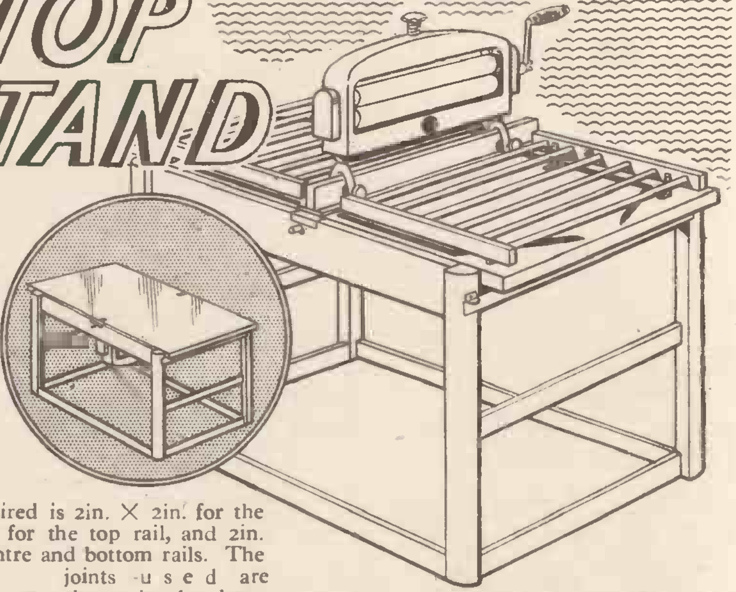


Fig. 3 (Left).—Marking out the top.

A TABLE-TOP WRINGER STAND



W. J. Stannage Tells You How to Make a Space-saving Fitment for the Kitchen

IN the average small kitchen a good deal of space is taken up by the wringer and stand—space that could be used for a small kitchen table. Although the wringer is used only a few times each week it cannot be disposed of, so the author designed a small, sturdy table capable of housing it. As there are several types of wringers it is impossible to give exact measurements for the table, but this design can be quite easily adapted to suit individual requirements.

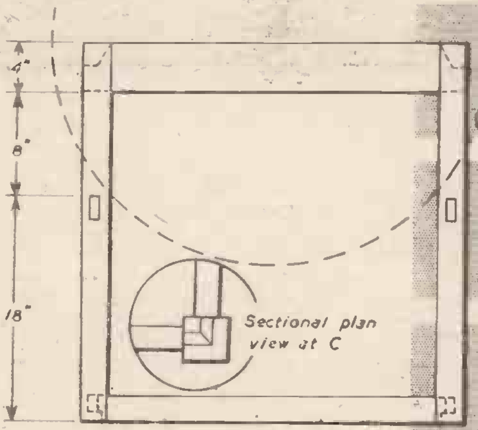


Fig. 1.—View of one side.

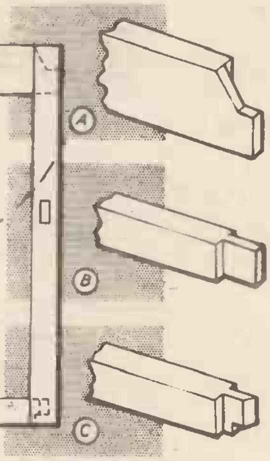


Table Construction

Two sides are required for the table, and a general view of one of these is seen in Fig. 1. The dimensions given are as a guide only, but special attention must be drawn to the centre rails which are mortised to the legs and shown at B in the drawing. These rails must be low enough to allow the wringer to swing out from its normal position below the table top, and the arc of this swing is shown in Fig. 1.

The wood required is 2in. × 2in. for the legs, 4in. × 1in. for the top rail, and 2in. × 1in. for the centre and bottom rails. The joints used are shown in the drawing, and the bare-faced tenon is used to allow the top rail to come flush with the inside of the legs. The joints at B are ordinary mortise and tenon, and at C haunched tenons are used. The outside edges of the legs are rounded off.

Fig. 2 shows a front view of table framework, and it will be seen that two rails are used to join both end pieces together. The measurement between the inside of the legs must be equal to the overall length of the wringer in question, plus 1in.

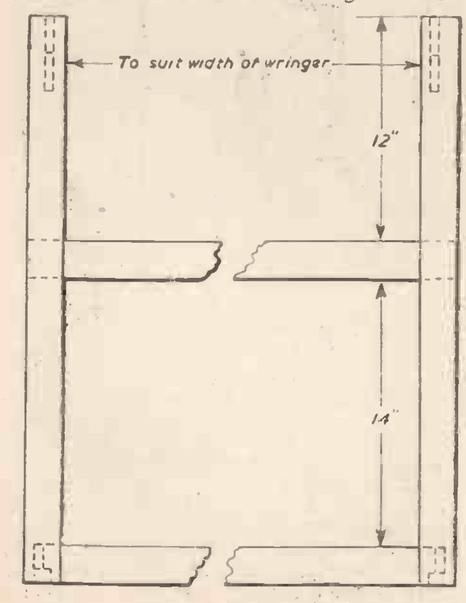


Fig. 2.—Front view.

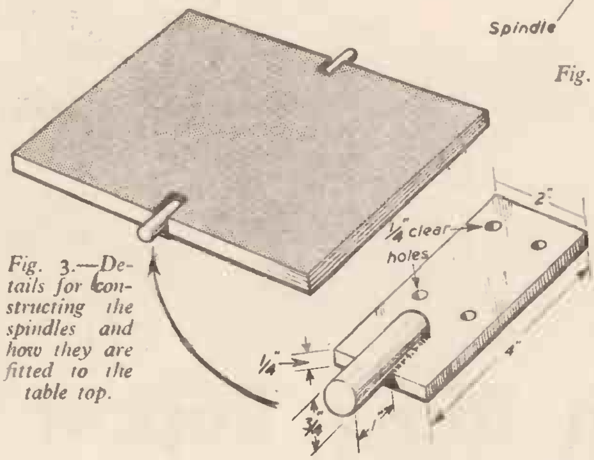


Fig. 3.—Details for constructing the spindles and how they are fitted to the table top.

Swinging Arrangement

The spindles which allow the table top to swing are shown in Fig. 3. These are simply two 2½in. lengths of ¾in. dia. bar welded to plates as shown. The plates are drilled to receive four ¼in. c/sk. Whit. bolts. Two of these fittings are required. The local garage will usually undertake such small welding jobs at a moderate fee.

The spindles are fitted to the centre of the table top as shown. Two cut-outs are made to receive and house the section of the bar which is welded to the plates. Material for the table top is ¾in. plywood of the waterproof type. Holes are drilled in the table top to receive the bolts, and the wood is countersunk on the opposite side from the plates to allow the heads to come flush with the wood. This means that the nuts pull up against the plate.

We now have a "swing top" table, one surface of which is working surface: to the other the wringer is attached, as shown in Fig. 4. Most wringers clamp to the top cross piece of the stand, so a piece of timber similar to the stand top is attached to the table top. It is attached to the same side as the spindle plates, so the ends of the wood must be notched to sit over these plates. Waterproof glue is used to hold the support in place, plus brass wood-screws which pass through from the other side of the top.

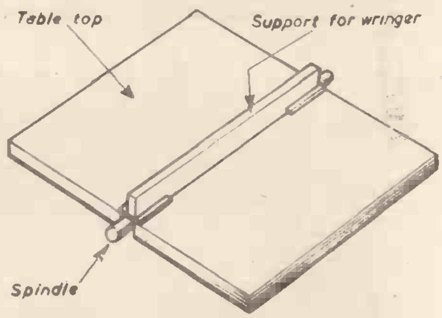


Fig. 4.—The wringer support.

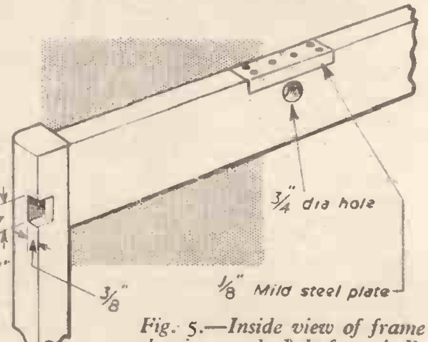


Fig. 5.—Inside view of frame showing notch, hole for spindle and M.S. plate.

Again the wood is countersunk to make the heads flush with the surface.

To receive the spindles two ¾in. holes are drilled in the top rails as shown in Fig. 5. The centre of the hole is ⅞in. from the top of the rail and, to give greater strength, an ⅛in. thick M.S. plate is sunk flush with the rail. This plate is held in position by woodscrews, countersunk as shown.

As also shown in Fig. 5, there is a notch in each leg, and they receive two lengths of 1in. sq. hardwood, which act as supports for the table top. No dimensions are given for the positions of these notches as these are best found by placing the supports under the top and marking off. When the notches are cut, the supports should be a push fit under the top, and if this is not observed the table will not be rigid. Before these notches are cut or marked off, the working surface should be covered with an ⅛in. thick sheet of plastic. It is advisable to fill in around the spindle cut-outs with plastic wood before this is done. When dry, the plastic wood can be sanded flush with the table top, and will prevent water entering under the plastic sheet at this point. The wringer side is fitted with two pieces of plastic fitted close to the wringer support and around the spindle plates.

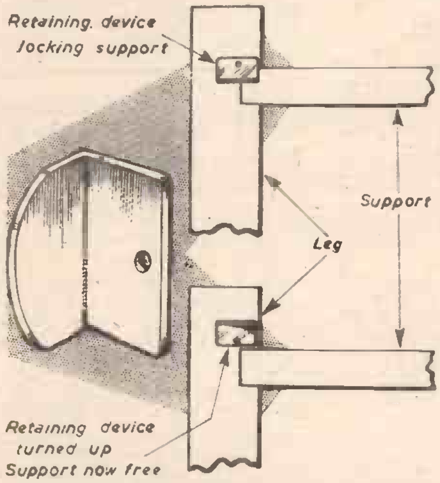


Fig. 6.—Retaining device for supports.

Retaining Device

To make sure that the two supports do not work loose, the retaining device shown in Fig. 6 was devised. The illustration shows the shape which was cut and bent from a piece of sheet iron. It will be noted that the hole is close to the edge, so allowing the device to be turned clear of the supports when they are to be removed. A round-headed wood-screw passes through the hole.

Water from the wringer will, of course, run over the plastic table, so to keep the clothes clear of this, it is necessary to have a rack on each side of the wringer. These racks are made as shown in Fig. 7, and as will be seen, they consist of two side pieces of 1in. × ½in. timber, drilled to receive lengths of ⅜in. dia. dowel rod. They are supported by four brackets cut from sheet iron or aluminium, which are screwed to the side pieces and also the table. It will be noted that these supports are fixed to the inside of the side pieces and also that they are at least 1in. from the front edge. If this measurement is not adhered to, it will be found that the supports are in the way of the wood supports which slide below the table front edge.

To prevent the water flowing over the edges of the table, strips of wood are fixed as shown in Fig. 8. These form sides which direct the water to the narrow outlet at each end. The dimensions of these strips are not important.

Assembly

If the table top is completely assembled it cannot be fitted to the finished frame, so the following method is suggested: The frame is finished and the holes drilled to receive the spindles, also the M.S. plate screwed in place over each hole. Next the table top is cut to size and the spindles fitted temporarily. Now the wringer support can be cut and pilot holes drilled for the screws. The spindles can now be removed, fitted through the holes in which they will turn, and the table top again fitted. Next fix the wringer support in place, use the plastic wood to fill around the spindles and, when dry and sanded, fix the plastic sheet to both sides. When this has been done, the notches for the supporting lengths of hardwood can be marked off and cut.

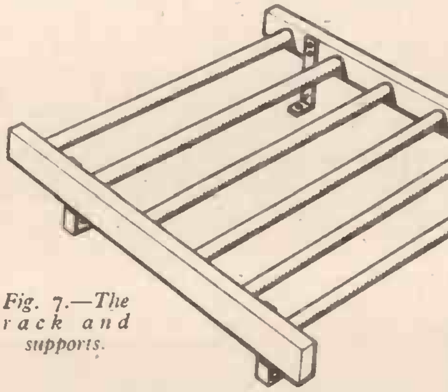


Fig. 7.—The rack and supports.

In operation the table-top stand is simple. The retaining devices are turned upwards, so allowing the supports to be removed.

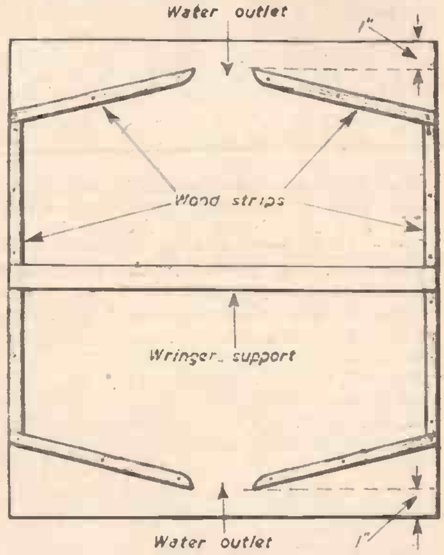


Fig. 8.—Plan view of table showing wood strips.

The table is then turned over, so bringing the wringer to the top. The two supports are replaced and the retaining devices turned down, so securing the supports in place.

When finished with the wringer, the operation is repeated, this time the working surface being brought to the top. The change-over takes less than one minute.

With this design it is assumed that the handle of the wringer is of the folding pattern, and also that it sits in the operating position at such an angle as will allow it to clear the top rail of the table. This point should be carefully considered before work on the design is commenced, but it should be possible to "set" the handle to give the required clearance. If this is not possible it may require a new handle to be constructed. Because of the large number of various wringer designs now on the market it is not practical to comment further on this. In the unlikely event of the handle being of a fixed design it will then be necessary to construct a new handle and knuckle and attach this to the roller spindle. This is, however, a fairly simple job.

Life On Mars Report

New Evidence Based on Spectroscopic Studies

AN American, Dr. W. M. Sinton, of the Lowell Observatory Flagstaff, Arizona, has put forward new evidence of life on Mars.

Spectroscopic studies of the Red Planet were made in 1956 when Mars came close to Earth, and these show that there is matter on Mars absorbing the same wavelengths of radiant energy as some forms of plant life on Earth.

Exactly what this matter is is not known, but Dr. Sinton suggests that it may be bacteria, and in any case it is "organic and regenerative, that is, living and reproducing."

All the previous theories of life on Mars have been based on the dark and light changes which can be observed there. The theory is that these are seasonal changes, deriving their contrasting tones from the recurrence of vegetation. On Mars, as the south polar cap melts, the darkness spreads across the planet's equator to the other hemisphere. This sequence is the opposite to that on Earth, where vegetation regenerates from the equator up and down towards the poles. Dr. Sinton goes on to say that this may be because vegetation on Mars is controlled by variations of moisture in the air, not, as on Earth, by temperature.

Comparison with Lichens

During the 1956 spectroscopic studies, the wavelengths being absorbed by matter on Mars were compared with those recorded for lichens on Earth. The use of the lichen spectrum for comparison does not, however, mean that there are lichens present on Mars, but only that organic molecules are present. Unless these molecules possessed some regenerative power, however, they would be unlikely to remain on the surface of the Red Planet without being covered by dust or being decomposed by the action of ultraviolet rays from the sun.

A Battery Timer-safelight

A Simple and Inexpensive Device

By J. C. LOWDEN

THE motive power of the timer shown in Fig. 1 is a contactor unit, surplus equipment of the United States Army Signal Corps. In its superficial appearance it resembles the familiar 120 size spiral developing tank (see Fig. 2). It is a cylinder of very robust black plastic, measuring 3in. in dia. at the base and 3in. in height.

At the base of the cylinder is a small, internally screwed cover marked "F-S" shields ½in. Within this cylinder are four bright steel contact pins, numbered 1 to 4, and of unequal thicknesses. A small cover marked "F-S" shields an adjusting mechanism. This mechanism has not so far been used, since the dial speed has proved to be accurate.

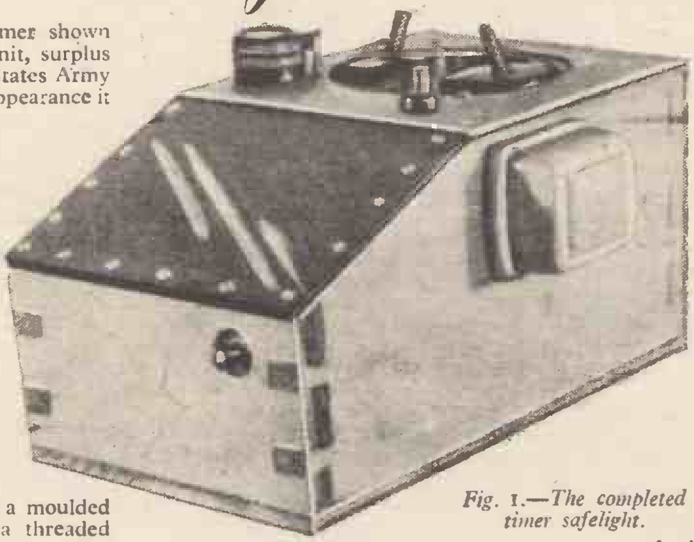


Fig. 1.—The completed timer safelight.

At the head of the cylinder is a moulded four-lug flange. Each lug has a threaded socket of an anti-vibration nature. This socket will take 6 B.A. bolts.

Above the flange, the dial proper is slightly raised, and is 3in. in dia. The most important feature is the timer face. This is 1½in. dia. and it is glass-covered. The single hand is luminous, against a black ground. One quarter of the sweep of the hand is painted on the black ground. When the hand is within this quadrant the contacts are "made."


Fig. 2.—The contactor unit and warning lamp.

The dial ground is marked in quarter minutes. Further calibration is best made with a glossy white enamel or luminous paint, using a fine brush. These calibrations are quite effective if made on the outer surface of the glass. The controls of the contactor are very simple and clearly marked. The mechanism, described as "jewelled" and of 72-hour run, is wound by means of a small milled knob marked "Wind," with direction arrow.

Two switches, moving in opposite planes, and both with luminous caps, control the mechanism. One marked "Clock" gives "Stop" and "Run." The "Stop" is effective at the end of the full minute, just before contact is made. The other switch, marked "Contactor," "In"-"Out," allows the contact to be used or dispensed with at will.

The Contactor, in its excellent original packing, is very light. It costs 9s. 6d. (postage extra) and is supplied by Messrs. Super - Radio, Whitechapel, Liverpool.

The Case

This is of the minimum size, as can be seen in Fig. 3, but may be expanded by a constructor wishing to use a larger safelight screen. The wood used may be of any variety. In the original model the corners are dovetailed, but this jointing is quite optional—a simple glued butt-joint would be quite effective.

The two sides are cut from pieces of softwood 7½in. by 3¾in., shaped as shown in Fig. 4. The ends are from the same thickness, measuring 4½in. × 2¾in. (front) and 4½in. × 3¾in. (rear), as shown in Fig. 5.

The base, lightly pinned to the sides, measures 4½in. × 7½in. × ¼in. thick.

The flat top holding the contactor is a 4½in. square of 3 mm. plywood. In this top is cut an aperture of 3in. dia. to accept the upper surface of the contactor (see Fig. 6). The aperture should be plotted so that the contactor just clears the back wall of the case, allowing the maximum room for the various lights and wiring. The flat top is screwed to the sides of the box.

Four holes, to accept 6 B.A. bolts, are drilled in the flat top. The exact spacing of these holes is, of course, governed by the lugs on the flange. When these holes are drilled the contactor may be bolted to the flat top.

The Warning Light

This is a red panel light, ex/A.M. 5C/1553, supplied by Messrs. Milligan, Harford St., Liverpool, at 6d. plus postage. It is a plastic cylinder ⅜in. dia. × 1½in. long. It accepts standard M.E.S. bulbs. The light is screened by a ruby glass, but has a further green screen on a spring hinge. If this green screen is brought into use the light is reduced to the minutest image of the filament, ideal for use when using fast pan. plates or film in open dishes.

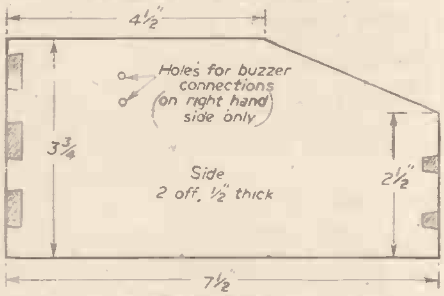


Fig. 4.—Dimensions of one side.

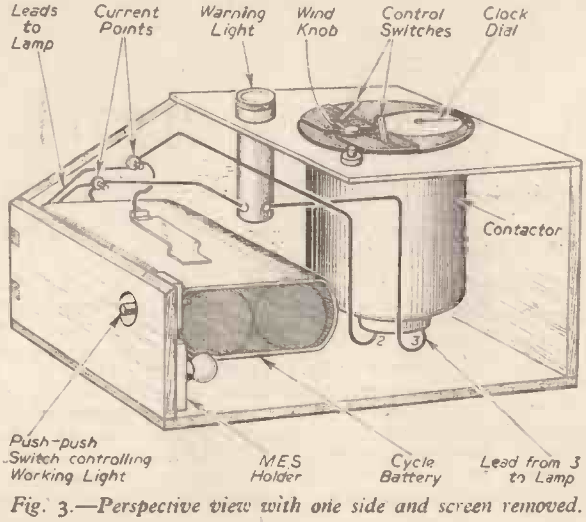


Fig. 3.—Perspective view with one side and screen removed.

The lamp is fixed by drilling a hole ⅜in. in dia. at a convenient point on the flat top. The case is pushed through this hole and secured by use of the spring and circlip fitted. The simple connections are at the base of the lamp case.

The Battery

The battery used is a twin-cell cycle lamp type with two brass contacts. The battery lies on the floor of the box. To facilitate battery changing a fixed current point is made on the inner surface of one side of the case. This is simply a pair of woodscrews, with a small washer on each. Two short leads are screwed under the washers, each terminating in a "bulldog clip." The clips are secured to the battery terminals.

The Working Light

This is wired as shown in Fig. 8. One pair of leads is taken from the current point to a M.E.S. batten holder screwed to the inner surface of the front end of the box. As it is essential that this lamp be under control, a small panel switch is inserted in the circuit. The switch used is a tiny 2 amp. push-push switch sold by Messrs. Milligan at 1s. each. A $\frac{3}{8}$in. hole is drilled in the front end of the case and the switch protrudes through this.

To increase the efficiency of the working light and to cover the battery and wiring, a small reflector of thin sheet aluminium is fitted under the bulb.

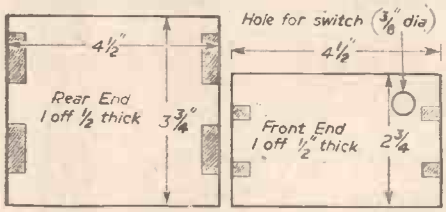


Fig. 5.—Dimensions of the two ends.

The Contactor Wiring

Since no plug to fit the contact pins appears to be available, it is necessary to improvise. Two ½in. lengths of fine brass spiral spring, salvaged from a broken lamp fitting, are soldered to a pair of short flex leads (Fig. 7). The spring sleeves (fine bore tube may also be used) are insulated with cycle valve rubbers. One lead is taken from No. 2 contact to one point of the fixed current point. The other is taken from No. 3 contact to the terminal of the warning light. If the audible warning is not required by the constructor the wiring is now completed by taking a lead from the remaining lamp terminal to the fixed current point, completing the warning light circuit.

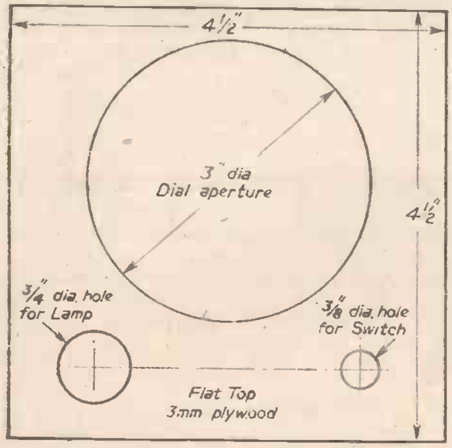


Fig. 6.—Details of the top.

The Audible Warning Device

If it is desired to incorporate an audible warning device in the timer a slight alteration of the main circuit is necessary, as shown in Fig. 7. One lead is taken, as before, from the current point to No. 2 contact. The second lead from the point is taken to one connection of a two-way section of a "chocolate bar" connection. This connection is screwed to a convenient point on the underside of the flat top. A lead is taken from No. 3 contact and paired into the connector. One pair of leads is carried from the opposite end of the connector to the lamp terminals. A further pair of leads from the same is taken through the side of the box. This pair of leads is connected to the terminals of a small buzzer, which is screwed to the outside of the case. Several firms advertise small ex/W.D. buzzers, or they may be bought very cheaply from the toy counters of chain stores where they are sold as dolls' house fittings.

Since the intermittent sound of the buzzer would be irritating if it were not actually required, a switch to control it is inserted into the buzzer circuit, the push protruding through the flat top.

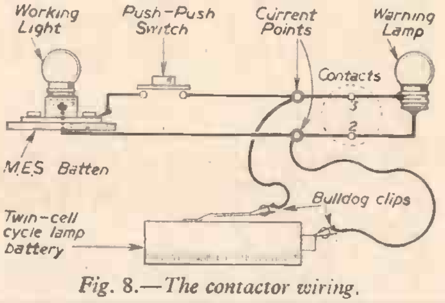


Fig. 8.—The contactor wiring.

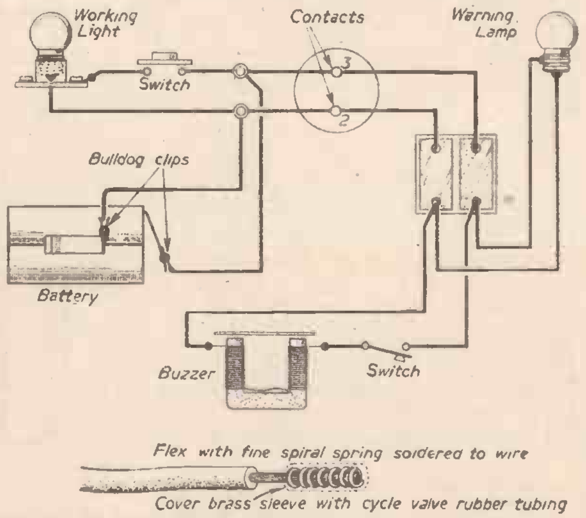


Fig. 7.—The additional wiring for the buzzer and home-made plug details.

The Safelight Screen

In the original model, the safelight screen is a rectangle of No. 400 Ruby Perspex, measuring 4½in. × 3¾in. The upper edge of the Perspex is closely fitted to the flat top, while the remaining edges are screwed to the sides and front of the box.

Many constructors will prefer to use commercial screens. These are sold in a variety of sizes, and the size purchased will more or less govern the size of the case. Fitting such screens should offer little difficulty.

The Timer in Use

The model described is used to time development of plates and cut film. With ortho material the warning light is left uncovered, and the main safelight used with discretion. In processing pan. material the safelight is switched off, and the filter snapped over the warning light to dim it to its merest glow. The buzzer signal is most useful during this work.

During enlarging work the timer rests on the enlarger baseboard, in the light of the beam. There is no vibration problem. Test strips are timed from the dial, and the prints made as decided in the light of these strips. Print development is normally done by inspection in the light of the safelight, but where timed development is desirable the timer is used.

The timer is normally used as a "desk type" light, but it works with the same efficiency when affixed to the wall of the darkroom, or stood upside down or on one end on a shelf.

The case was sandpapered, stained and given a couple of coats of french polish after completion.

PUZZLE CORNER

A Piston Problem

ASSUMING the continuously running mechanism to be perfect and neglecting the possible cushioning effect of oil in the bearings, does the piston in an engine stop at the top of a stroke? One school of thought says that it does not. It is realised that by "stopping" one means for only an infinitesimal part of a second, but another school says that if the piston ever got into this position, i.e., there was a period when there was a dead straight pull, the crank would remain thus a very short period. The objectors to the stopping theory say that the piston reaches the top at a specified point in time, similar to the geometrician's "point," which is assumed to have position but no magnitude. What is your opinion?

The Answer

This is a question which allows of many interpretations. Consider the motion of the piston simply as the extension of the crank and consider the path of the crank as a circle made up of an infinite number of equidistant points. At the moment in question the pull of the piston can be represented by the vertical diameter. The theoretical direction of travel of the crank at this moment is in a horizontal plane, represented by a line drawn tangentially to the circle. The crank then at this moment has no vertical motion; only a horizontal one. It really does stop travelling at the end of each stroke when it changes from a vertical motion to a horizontal motion.

A lot depends on what is meant by stopping at a change of direction. We could regard a circle as a polygon with a vast number of sides; a 30-sided figure would, at a short distance, appear circular. A figure with a trillion sides (drawn, say, within the area of a square foot) to all intents and purposes is a perfect circle, and yet we know in theory it has a trillion sides. Thus the curved line is always changing direction and we could philosophically argue that the direction stops and changes a trillion times. Thus the motion of a crank and piston, though to the human eye appearing a beautifully smooth and continuous circular action, is really an infinite number of jerks around a polygon of a vast number of sides.

Making a Book Rack

An Attractive Design, Including Drawers

By A. E. SMITH

HARDWOOD should be used for this book rack with two drawers under it and it looks especially attractive in oak. The wood for the carcase is all 5¾in. wide and ½in. thick and this is prepared and marked to length. Mark the positions of the mortises and length of the tenons (Fig. 2) and gauge the joints with a mortise gauge set to a ⅜in. mortise chisel. All gauging is done from the front edge of the wood. The ⅛in. projections between the tenons, which fit into corresponding housings in the ends (Fig. 1), prevent the shelves from bending and interfering with the smooth running of the drawers.

Cut the tenons and mortises and cut out the housings with a chisel, finishing them with a router set to the correct depth (⅛in). The appearance is improved if two wedges of a contrasting wood are inserted across each tenon. Two saw cuts are made across each tenon about 3/32in. from top and bottom and the mortises made slightly wider at the outside. The partition is joined to the shelves with housing joints stopped ⅜in. from the front edge. Cut the housings, assemble the carcase, and then cut the partition to fit. The back rail is lap dovetailed into the ends (Fig. 1). Shape the ends and clean up all inside surfaces with smoothing plane and glasspaper. Glue the mortise and tenon joints, cramp up, and insert the wedges. Glue the partition and back rail into position and, when the glue has set, clean up the outside of the carcase.

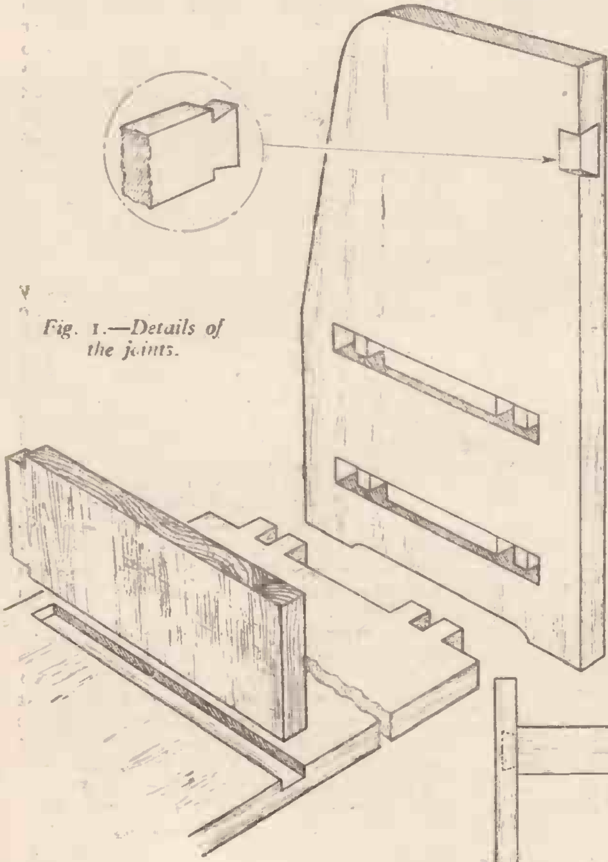


Fig. 1.—Details of the joints.

The drawers can now be made as shown in Figs. 3 and 4. The fronts are planed to ½in. thickness and carefully fitted into the carcase. The sides, 3/16in. thick, are planed to a tight sliding fit into their respective posi-

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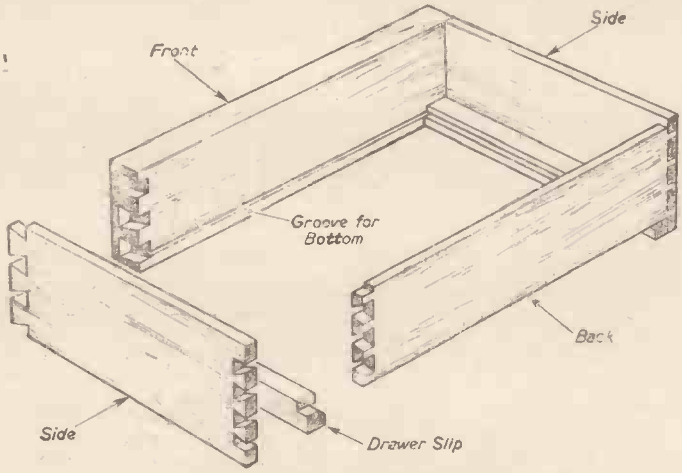


Fig. 3.—Drawer construction.

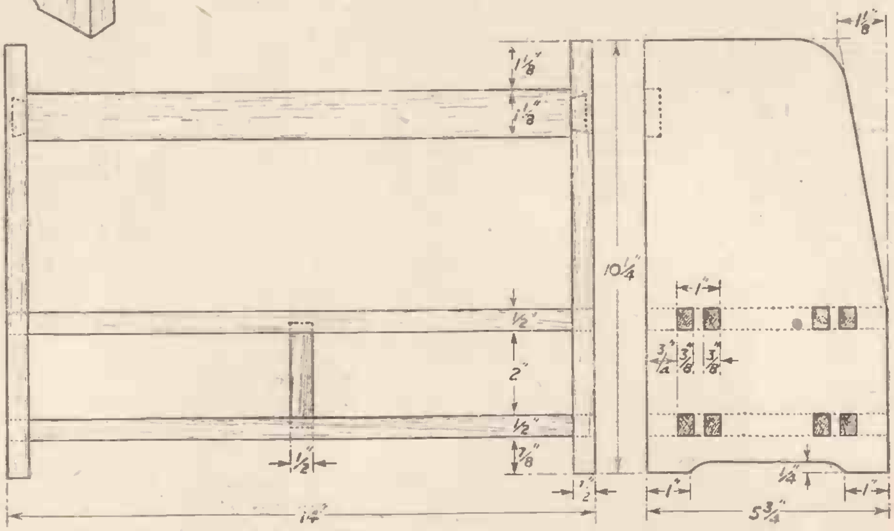


Fig. 2.—General arrangement.

A Dinner Waggon

Details of the Joints and Construction Notes

By A. J. WHITEHOUSE

Fig. 1.—The completed dinner waggon.

THIS dinner waggon is strongly built and has plenty of shelf room, as can be seen in Fig. 1. The shelves are easy to wipe down and the waggon is heavy enough to give stability when negotiating the edges of carpets and other similar obstacles.

The frame can be made from any suitable hardwood, but steamed beech is suggested. The legs are mortised to receive the tenoned rails, haunched tenons being used, and the inside of each rail has a rebate ½in. deep × ¼in. on which the shelves rest so that they are flush with the top of the rails. The joint is shown in detail in Fig. 2 and from Fig. 3 it will be seen that the rails are set in ⅛in. from the outside edge of the legs. This diagram also shows that the ends of the tenons of the side and end rails meet in the mortises in the legs and consequently must be mitred. The top rails are set down 1in. from the top of the legs and the bottom rails up 1¼in. The middle rails can be fixed in any position desired.

"Berite," one of the new heat-resisting plastic surfaced boards, was used for the shelves, and should be ¼in. in thickness. Each shelf must be cut away at the corners to fit round the legs. When the shelves have been fitted into the rebates, strips of wood ⅝in. square are screwed from beneath to the tops, and flush with the edges, of the rails, and these serve both to keep the shelves in position and also to prevent things sliding off the wagon when it is in use. To enable crumbs to be removed easily there is a gap of 1½in. between the strips and the legs. The ends of the strips and the tops of the legs are rounded off.

CUTTING LIST

4 legs ...	...	...	27in. x 1¼in. x 1¼in.
6 side rails	...	...	25¾in. x 1¼in. x ¾in.
6 end rails	...	...	16¾in. x 1¼in. x ¾in.
6 strips	...	...	21in. x ⅝in. x ⅝in.
6 strips	...	...	12in. x ⅝in. x ⅝in.
3 shelves	...	...	25¼in. x 16¼in. x ¼in.
4 castors	...	...	3in. rubber-tyred wheels

All measurements are finished sizes.

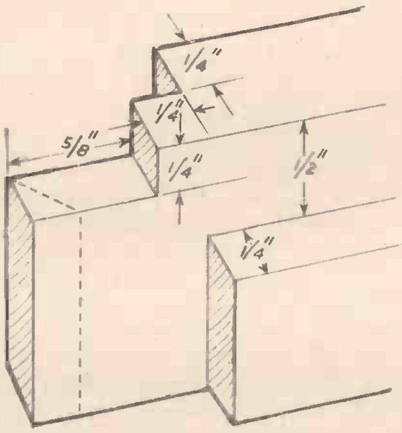


Fig. 2.—Method of jointing.

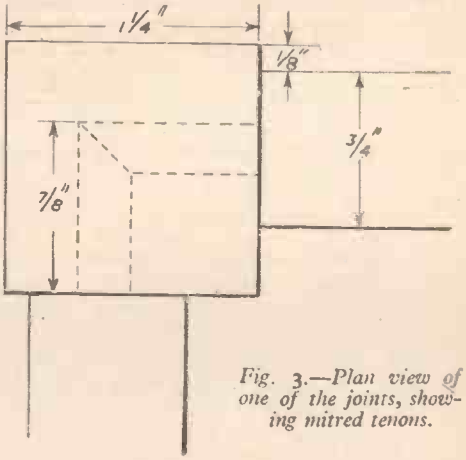


Fig. 3.—Plan view of one of the joints, showing mitred tenons.

The completed waggon is mounted on rubber-tyred spring-loaded 3in. castors.

Finishing of the woodwork can be done to taste, but a quite satisfactory and simple method is to give the wood a coat of clear cellulose lacquer, rub down with fine steel wool, then finish with a good wax polish.

Making a Book Rack *(Concluded from previous page)*

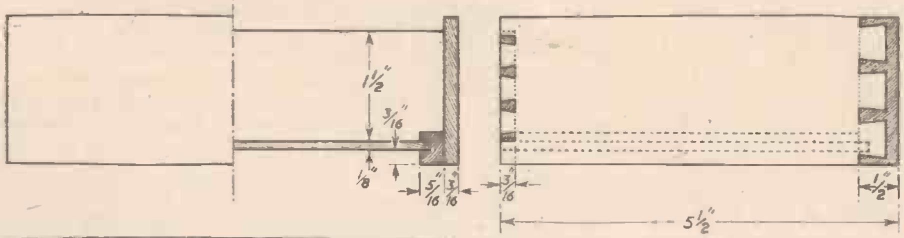


Fig. 4.—Front, side and plan elevations of the drawer.

tions and the back is cut to exact length. Square off the ends of the sides and gauge the depth of the dovetails and sockets with a cutting gauge. When gauging the ends of the front and back, the gauge should be set at a fraction less than the thickness of the sides so that these stand up slightly when the drawers are assembled. Mark and cut the dovetails and from these mark and cut the sockets. Note that the drawer bottom passes under the back. Plough a ⅛in. wide groove inside the drawer fronts 3/16in. from the bottom edge, clean up the inside surface and glue the drawers together. Make the drawer slips, glue into position, insert the bottom, and proceed with the fitting when the glue is set. If the sides are planed down level with the ends of the back and front and a thin shaving taken off the top and bottom, very little further adjustment should be needed to obtain a good fit. A small drawer stop is fitted to the bottom shelf ½in. from the front edge, the drawers pushed right in and the fronts planed level.

Finally, glasspaper and polish the whole job and screw a small knob in the centre of each drawer front.

Building an Outboard Motorboat

A Sturdy All-wood Craft, Ideal for the Week-end

Continued from Page 68 November issue

SHOULD the builder consider the method of constructing the frames described in November a little complicated, an alternative method is to prepare cardboard patterns, made full-size from the drawings, and set the frames up to these. There is, however, the risk of the patterns themselves getting out of true by cockling or bending unless the material is very stout. This method involves a little added labour, but is, of course, simpler.

For this part of the work we shall require 17ft. of 2½in. × 1in. mahogany, planed finished size. This can be purchased in two lengths, each 8ft. 6in., but it would be better to have 2ft. 9in. lengths to allow for split ends. This timber is, of course, for the side members.

For the floor members we shall require 20ft., or two 10ft. lengths, of 2in. × 1in. mahogany (planed sizes).

For fastenings we require 36 brass countersunk head screws, 1¾in. long, No. 8 gauge, but since we shall require more of these later on, it is as well to purchase a gross packet.

The Transom

The transom forms the back of the boat and is made out of mahogany 1in. thick. A piece of this timber 3ft. 3in. long × 16½in. wide and 1in. thick must be obtained and squared up to these dimensions, and is represented in Fig. 13 by the rectangle A B C D. Now all the sides of the transom are curved, but fortunately the radius of the curve is not of vital importance within reasonable limits. Proceed to draw the line E F 1½in. from the bottom edge. This will be the chine line. Next draw the line G H 1in. from the top edge, and the vertical line H I down the exact centre of the plank.

Starting at the point J, where the vertical line cuts the lower horizontal one, mark off half the width of the transom, which will be 19in. (half of the total 38in.) and mark the point L. Similarly mark off the other half, marking the point M, then the line L M will represent the total width of the transom at this point, which, of course, is 38in.

Deal in a similar manner with the line G H, working from the point K outwards in two half-breadths of 15¼in., marking the extremities N and O respectively, as shown.

The Curved Bottom

You can now proceed to pencil in lightly the curved bottom, proceeding from the point I outwards to L and M, taking care to get each side the same and a gentle regular curve.

It is a good plan to do one side first, then make a paper template from tracing paper, and transfer it to the other side. Deal in a similar manner with the top curve which, it will be noted, is flatter in the centre and falls off quickly at the ends.

The side curves are similarly marked out after marking a point P and Q on each line N L O M, at its centre, and drawing a line 1in. long at right angles to them extending outwards; the ends of these lines represent the points through which the curve will pass.

If a template is used (which for these curves is strongly advised), only one side need be so measured.

When you are quite satisfied that the curves are regular, pencil them in distinctly, and saw round them, thus producing your transom. The edges may then be planed up true and smooth.

The transom is, however, by no means finished, for we must provide some means of housing the ends of all the seam battens, chines and gunwales without cutting into and

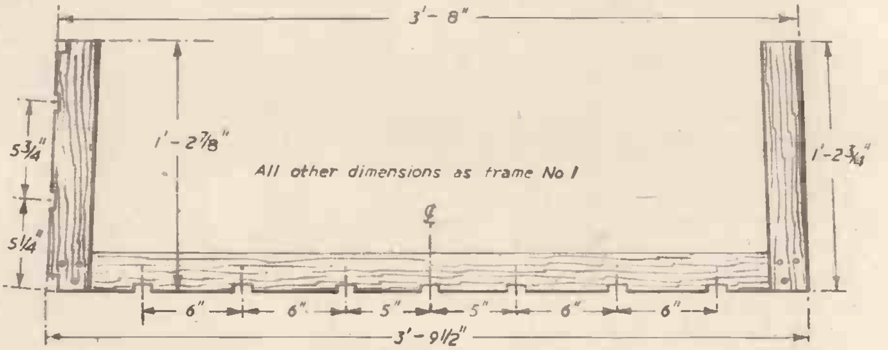


Fig. 11.—Dimensions of frame No. 5.

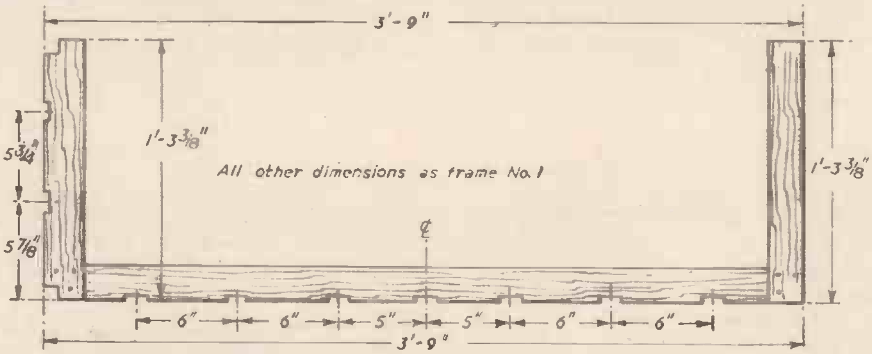


Fig. 10.—Dimensions of frame No. 4.

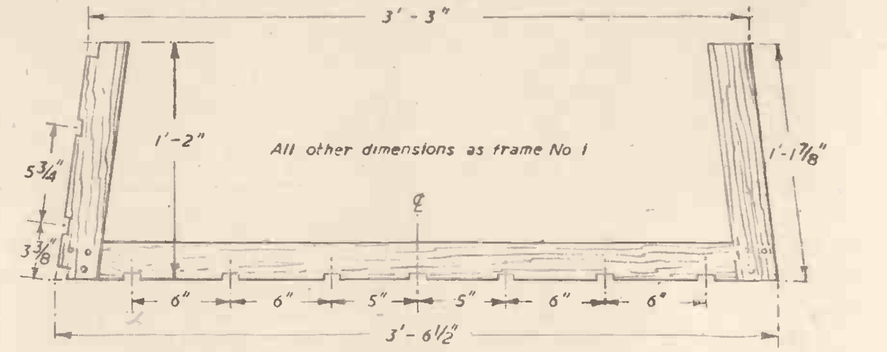


Fig. 12.—Dimensions of frame No. 6.

weakening the transom itself. This is simply accomplished by framing the inside of the transom with 2½in. × 1in. mahogany, and shaping the outer edges to conform with it. It is then slotted out in accordance with the drawing, Fig. 14, which should make matters quite clear. What we have really done is to incorporate a seventh frame with the transom.

It should be noted that the slotting is only done in the framework and not the transom itself. The framing should be securely screwed to the transom with 1¾in. No. 8 screws as used for the frames.

As shown in the drawing, the side framing is only carried up as far as the line G H which corresponds with the line G H Fig. 13. Apart from housing the rails and battens, this framing greatly strengthens the transom and doubles the thickness of the edges to which the planking end will ultimately be secured. For the framing a further piece of mahogany 2½in. × 1in. × 6ft. long should be used.

from the points C and D, and the post is then sawn down vertically along this line, which will have the effect of splitting the post in two parts lengthwise. Next mark off the line E F which is ¼in. and plane off this corner. Now round off the corners A B when the resulting post will resemble Fig. 17. The other piece cut off is not wanted.

between this point and the roof of the workshop. Fig. 19 should make this quite clear.

The curve taken up by the marked batten is approximately the fore and aft curve or sheet of the bottom of the boat.

If the workshop floor is of wood it is as well to nail the two blocks down to it.

The next operation will be to get the stem

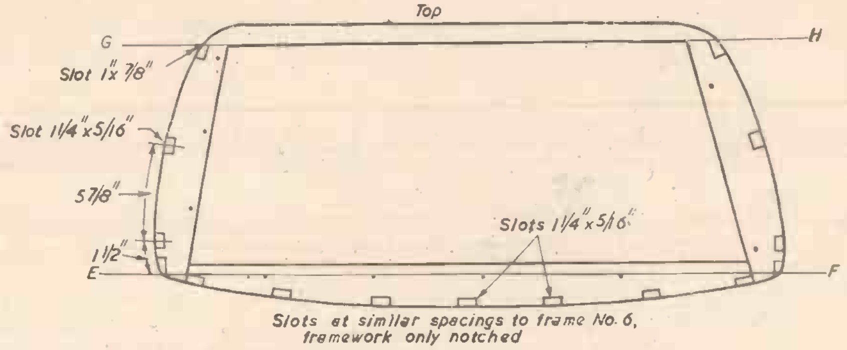


Fig. 14.—The inside of the transom facing forward.

The Stern Post

This is made from 2in. × 2in. oak, and the usual method of construction, and the one employed by professionals is to rabbet the side grooves into the solid piece. This method is likely to be difficult for the amateur boat-builder, and so a deviation is made from standard practice and the stern

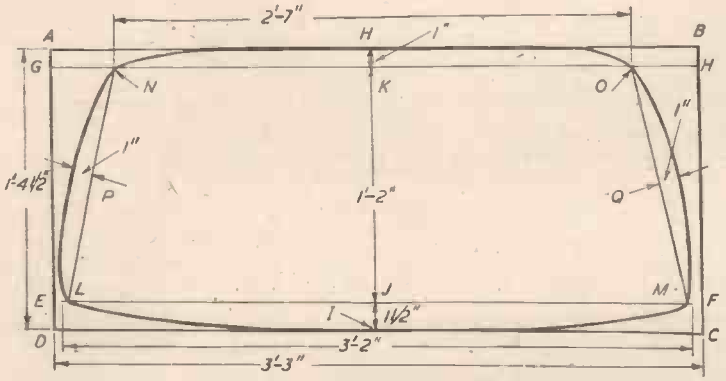


Fig. 13.—Details of the transom.

made in two parts, the second part being put on after assembly.

This method is stronger for this class of boat and allows a better landing for the plank ends.

Obtain a piece of good, straight oak, 2in. × 2in. × 17in. long, and square up the ends and, referring to Fig. 16, proceed as follows:

On the end mark the line A B which joins diagonally opposite corners, then draw C D parallel to it, but ⅛in. distant from it. A line on each side of the timber can be carried down

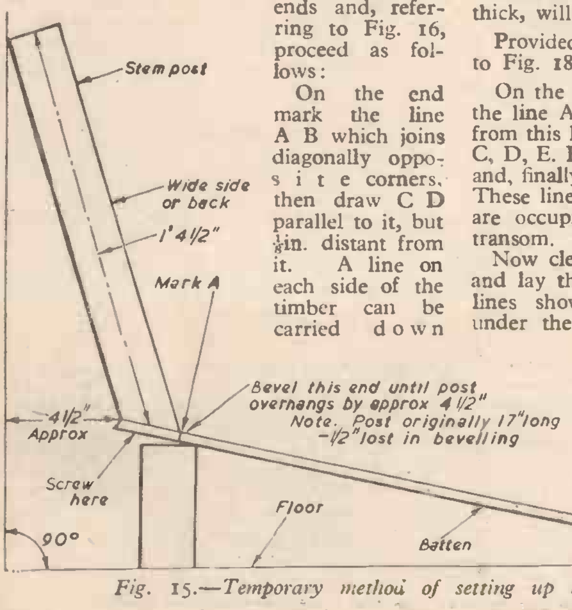


Fig. 15.—Temporary method of setting up the stem post.

The sawing operation is somewhat tricky, and if the builder doubts his ability to cut this straight he can cut clear of the line into the waste part and finally finish off with the plane.

The post will, of course, have to be slotted for the battens, etc., but this will be done after the job has been temporarily set up.

When the frames, transom and stem post are made up, temporarily set them up in order to find other dimensions which can only be accurately obtained in this manner.

Setting Up

For this operation a springy batten of wood will be required; ordinary deal will do, 2in. wide and, say, ⅜in. thick, about 10ft. long. A wooden block about 1ft. long and 5in. wide, about 2in. thick, and another one, 1ft. long, 4in. wide and 2in. thick, will also be required.

Provided with this timber and referring to Fig. 18, proceed as follows:

On the 2in. surface of the batten mark the line A 3in. from the end, then 9½in. from this line B; follow on with the lines C, D, E, F, G, which are spaced 1ft. 6in. and, finally, the line H, which is 1ft. 2in. These lines represent the positions which are occupied by the stern, frames, and transom.

Now clear a space on the workshop floor and lay the batten down face up with the lines showing, and place the 5in. block under the mark A.

Next measure a point on the batten midway between the two blocks and, at this point, with the aid of a stout piece of wood or pole, bend the batten down by wedging the shore

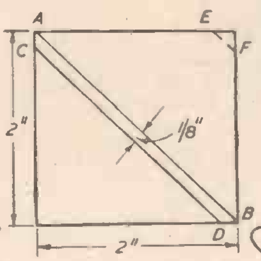
post in position temporarily and, since this does not occupy a vertical position relative to the bottom, it must be suitably shaped. In Fig. 15 it will be seen that the stem leans forward or overhangs, and the extent of this overhanging can be seen by the dimensions given. To thus prepare the post, cut the bottom off at an angle which, when placed on the batten, allows the post to overhang approximately the required amount. This is best done by making the angle slight at first, and then truing it up, increasing the angle by cutting away more wood until it is correct, when it can be temporarily fixed to the batten by means of a screw passed through from underneath. This can be done by either removing the shore or by springing the batten up.

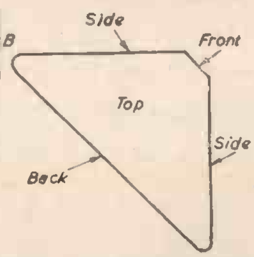
The correct location of the stem post will be when its rear edge is along the line A, the small edge, of course, facing forward.

The transom may now be set up in a similar manner, and it will be noticed that this also overhangs, but not to the same extent as the stem post.

This is, of course, mounted centrally over the mark so that the mark lies in the joint between the transom itself and its framing. The batten must pass under the exact centre of the transom and the centre batten slot will act as a guide here.

In order to obtain the angle for the over-





Figs. 16 and 17. — Method of constructing the stern.

hang, the bottom of the transom must be bevelled with a plane, this bevel being carried right along the bottom from side to side as shown in Fig. 20. The transom may be temporarily secured by a screw in a similar manner to the stem post, but owing to its weight it will have to be supported by further blocks and a strut as shown in Fig. 20.

Fig. 18.—This sketch should be studied when setting up.

Having set up the transom, put the frames in their various positions, No. 1 frame occupying the position B, No. 2 C, and so on.

These can be secured by a single screw passed through the centre of the bottom or floor member of the frame into the batten.

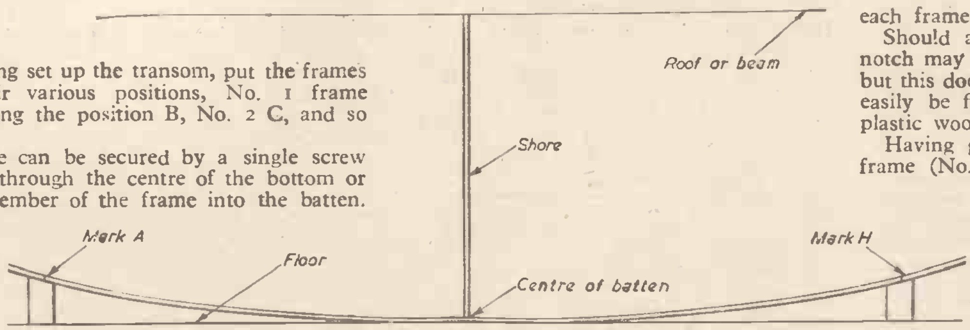


Fig. 19.—The fore and aft curve or sheer of the bottom of the boat.

The hole made does not matter as it will be required later.

Great care must be taken to get the frames central, and here again the central batten slots can be used as a guide.

As an added precaution a piece of 1¼in. × 5/16in. deal batten could be run down the centre of the setting-up batten. The frames would then fit exactly, as the central batten slots would fit over this guide batten. Extra labour is involved, of course, but it ensures that the frames will not only line up correctly but will set firmer on the setting-up batten. The extremities of the bottoms of each frame should be supported on wooden blocks making sure that they are the same height from the floor on each side and square with the setting-up batten.

When all the frames are set up they can be braced together by means of temporary battens run round inside the frame, one on each side at the top and one on each side at the bottom.

These battens may be of 1in. × ½in. deal, and should be lightly tacked with a small nail to each frame.

They are secured to the transoms by tacking them inside the framing in a similar manner to the other frames. At the stem post they are tacked to the bevelled sides.

These battens, together with the supports on transom and stem, further aided by the shore, will hold the complete assembly sufficiently rigid. The complete arrangement is shown in Fig. 21. The blocks however supporting the extremities of the frames and transom are not shown in order to avoid complicating the sketch. It will be noted that the top batten makes a sharp curve upwards from the last frame to the transom. If any difficulty is experienced here, it is not essential to secure the batten at the top of the transom framing since the purpose here is to support it, and a point lower down can, therefore, be chosen.

When all the frames are set up square and vertical, run a batten round the frames on the outside edges. Where the batten touches each frame, it does not do so fairly, but only touches on the corners.

The frames must, therefore, be bevelled to conform with the run of the planking which, at the moment, is represented by the batten.

The frames should be marked where they are to be bevelled and removed one at a time to be dealt with.

During the process of bevelling some of the slots will be reduced in depth, and these must now be deepened to conform with the bevel, that is to say, the slots will also be cut on the bevel.

The transom, too, will have to have its sides bevelled in a similar manner, and the slots adjusted accordingly. The stem post can be slotted later.

Fitting the Chines and Seam Battens

The seam battens are fitted first as these are easier and lighter than the chines or gunwales, and will add rigidity to the structure for the heavier work later on.

The seam battens are made from 1¼in. × 5/16in. mahogany, and four of these will be required, each 11ft. long, planed finished size, also some brass pins or copper tacks, 1in. long.

To fit these battens, square up one end and tack it in the lower batten slot of the transom (this is, of course, the second slot up). Now bend the batten round the frames, tacking it into each frame notch.

Should any error have been made, the notch may have to be cut out a little larger, but this does not matter very much as it can easily be filled in afterwards with a little plastic wood.

Having got the batten tacked to the last frame (No. 1, since you are working from the stern end) bend the batten round until it meets the stem post side, and mark this point on the stem post: this is where it must be slotted to receive the end of the batten.

Deal similarly with the lower batten on the other side, then the two top ones.

Never finish one side completely, always work with battens or planks on alternate sides, building up the two sides together. By working in this manner, strains are kept equal and distortion avoided.

When, however, the second batten is brought round to the stem post see that the distance between it and the lower one is the same as their distances on frame No. 1; also see that the battens on each side of the boat meet exactly opposite each other.

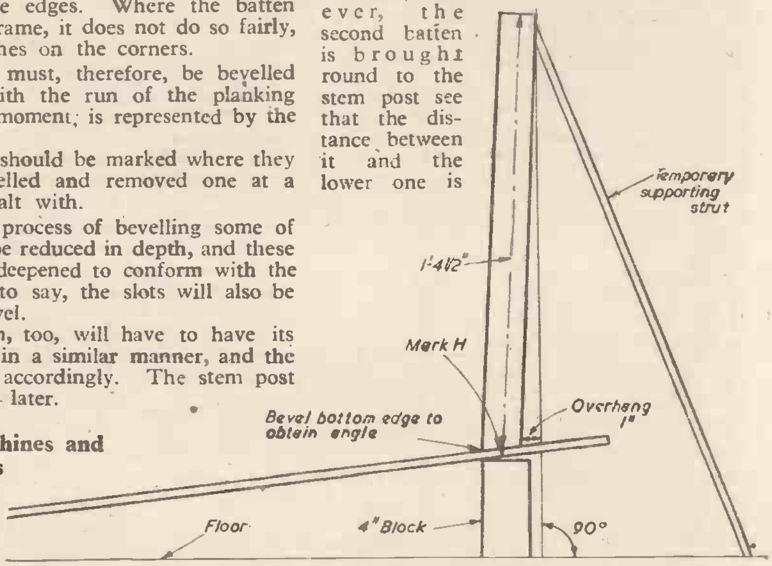


Fig. 20.—Temporary set-up of the transom. Supporting blocks are not shown.

The positions of these battens must be clearly marked on the stem post ready for cutting out in a manner similar to the frames.

(To be continued)

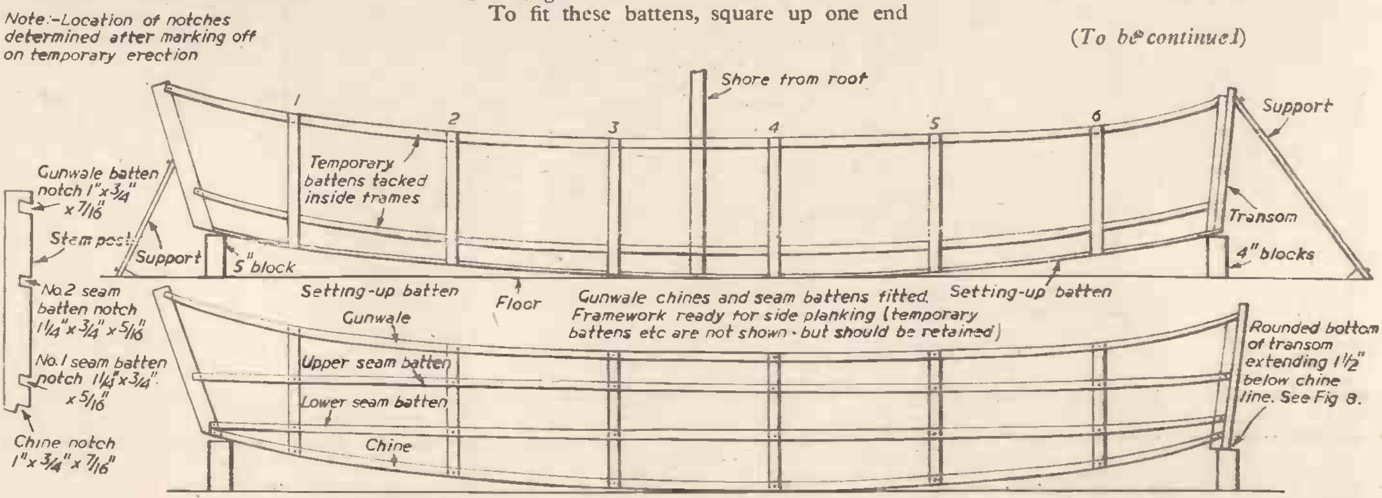


Fig. 21.—The position and details of the various frames and stem post.

Concluded from the December Issue

BUILD YOUR OWN CLUBHOUSE

A Project That Members Can Undertake Themselves

By J. JOHNSTON

THE main structure consists of 3in. × 3in. corner posts, stub tenoned into the top and bottom rails, the latter being half-lapped at the corners. The top and bottom rails are 3in. × 2in. and the intermediate framing 3in. × 1½in. all housed to each other and well nailed. The framing of the front and back is shown in Figs. 9 and 10, and the cross partitions in Fig. 11. Note the 2in. × ¾in. fillets at the corners which provide a neat finish to the matching, as shown in Fig. 14.

The structure is cladded outside with ⅝in. tongued and grooved matching and internally with ½in. similar matching.

The Roof

The rafters are 5in. × 2in. birdsmouthed over the front and back top rails and are spaced out equally as shown dotted in Fig. 4. These support ⅝in. tongued and grooved boarding covered with roofing felt. The construction is clearly shown in Fig. 12.

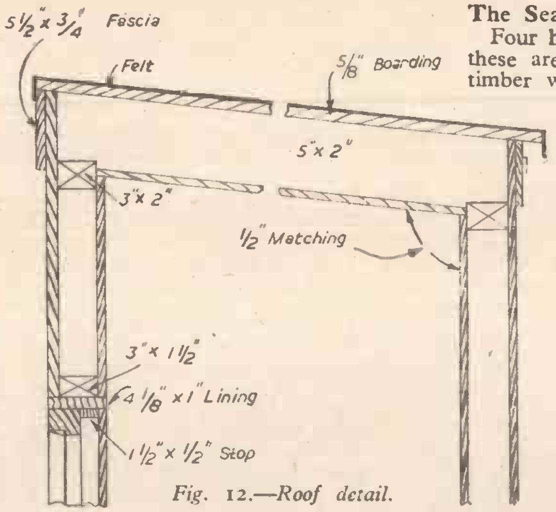


Fig. 12.—Roof detail.

Doors and Windows

The door and window openings can be finished with 1in. planed linings 4⅛in. wide. To these fix 1½in. × ½in. stops to suit doors and window sashes. The window sills are 5in. × 2½in. weathered and checked for the sashes which have 2in. × 1¾in. stiles and top rails and 2½in. × 1¾in. bottom rails. The joints of the sashes can either be tenoned or half lapped and where the sashes meet it will be necessary to rebate the edges of the stiles as shown in Fig. 13. Four pairs of 3in. hinges, two casement stays, two tower bolts and two casement fasteners are all the fittings necessary. Fig. 14 shows the construction of the window opening.

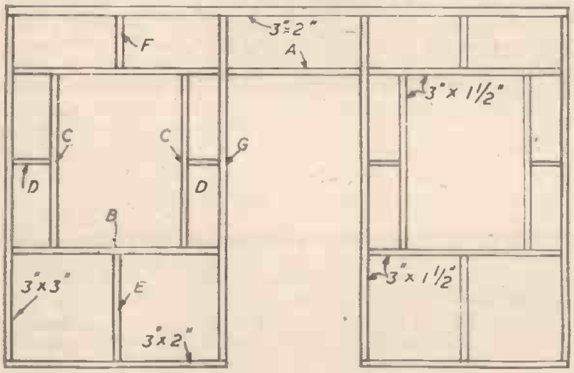


Fig. 9.—Framing of the front.

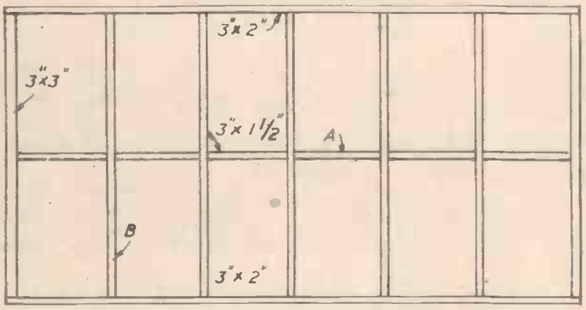


Fig. 10.—Framing of the back.

The front door 1¾in. thick is framed up with mortise and tenoned joints in the usual way. The stiles and top rail are 4½in. × 1¾in. and the bottom and mid rails 8in. × 1in., the frame being filled in with ⅝in. tongued and grooved matching. The other doors are of the ledged and battened type with 4½in. × 1⅛in. top rails and 7in. × 1⅛in. mid and bottom rails covered with ⅝in. tongued and grooved matching. Cut an opening in the matching of the end doors about 8in. × 8in. and fix a piece of perforated zinc to the back of the aperture finishing this off by nailing 1¼in. × ½in. fillets round the four edges of the zinc. If desired, small opening window sashes could be constructed in the outside walls of the W.C.s in place of the ventilators in the doors. Doors and windows could be bought or picked up secondhand which would save a good deal of labour.

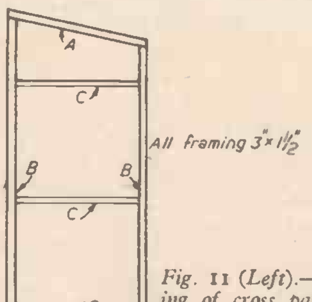


Fig. 11 (Left).—Framing of cross partitions.

The Seat

Four haffits are required for the seat and these are framed up from 2¼in. × 1¼in. timber with half lapped joints. The seat consists of 1in. tongued and grooved flooring nailed to the haffits and fixed at the ends to 2in. × 1¼in. fillets screwed to the matching.

General

Provide hat and coat hooks and paint the structure with two undercoats and one coat of gloss paint outside, and one undercoat and one coat of gloss paint inside. For a cheaper job the outside could be finished with creosote. It is also advisable to treat the bottom runners and the wood plugs with creosote or other wood preservative.

Finally, be sure to get the permission of your Local Authority before starting to build.

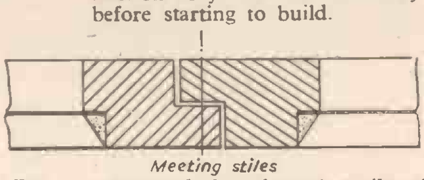


Fig. 13.—Enlarged plan of meeting stiles of windows.

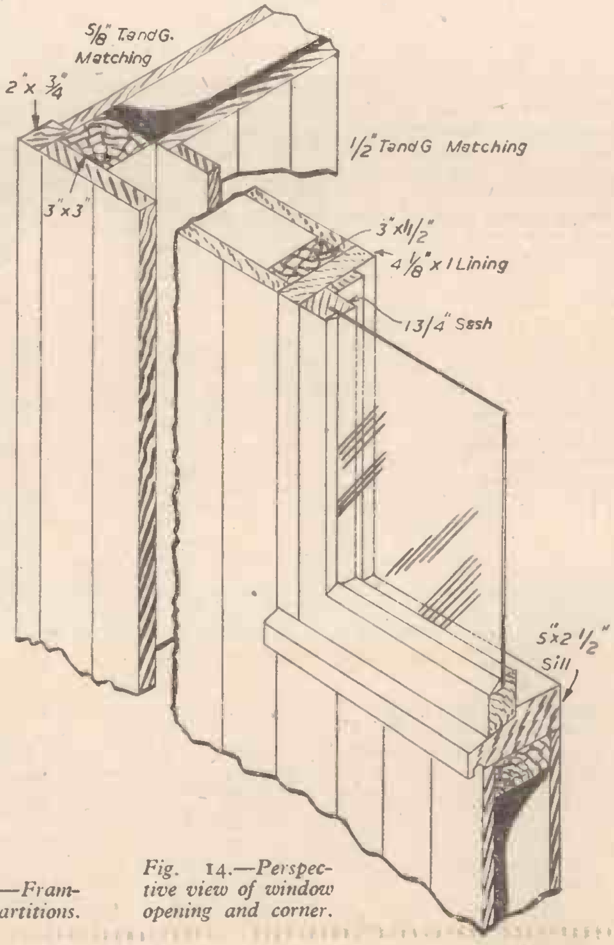


Fig. 14.—Perspective view of window opening and corner.

A 6" TELESCOPE MIRROR

Grinding the Mirror Disc : Testing for Accuracy : Polishing and Figuring

By J. PARKER

THE production of an accurate reflector for an astronomical telescope is a task which falls within the capabilities of the amateur handyman. An efficient mirror can be made at home, the only equipment required being two glass discs and the abrasives, polishing materials and silvering chemicals.

When suitably mounted, the reflector will provide its constructor with hours of interest and pleasure in the observation of the moon, planets, stars and nebulæ.

The Telescope

Fig. 1 shows the arrangements of the optical components of a reflecting telescope ; it will be seen that the concave reflector is situated at the rear end of the tube, and the eyepiece fixed at the side, near the front end of the tube. For the purposes of simplification the eyepiece is depicted as a single lens, although in practice a Huygenian type of eyepiece would be employed which is composed of two plano-convex lenses.

In this sketch the mirror is shown reflecting light from a star or very distant terrestrial object ; this light can be considered as being parallel, and would normally be converged to the mirror's prime focus 'f,' there forming an image of the star or object.

In this position the image could not be conveniently observed, so a prism 'p' is interposed which diverts the focus to a point outside the tube where it can conveniently be inspected by means of the eyepiece 'e.'

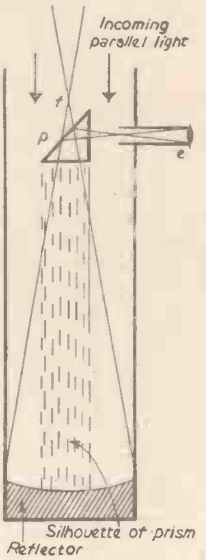


Fig. 1.—Diagram showing the optical components of a reflecting telescope.

It will be appreciated that since the prism lies directly in the path of the oncoming light, a shadow will be cast upon the mirror of an area equal to that of the prism (since the incident light is parallel the shadow can also be considered to be parallel, ignoring diffraction effects). This represents a loss of light, but the loss is negligible when the area of the mirror is large in comparison with the area of the shadow. In the author's telescope the silhouette of the prism was 0.525 sq. in., which is less than 2 per cent. of the area of the 6in. reflector—a negligible amount.

The magnification depends upon the distance of the principal focus from the surface of the mirror and the magnification factor of the eyepiece. The size of the telescope is determined by the diameter and focal length of the reflector—in other words, by its aperture. There are obvious limits to the size of a home-constructed telescope : the focal length should be such that the eyepiece is comfortably placed for the observer's eye when the tube is in a vertical position. A focal length greater than this would make impossible the study of the heavens directly above, unless a much more ambitious mounting were constructed of a type rather beyond the capabilities of the average amateur. In addition, as the size and weight of the telescope increases, the strength and mechanical efficiency of the mounting increases in importance.

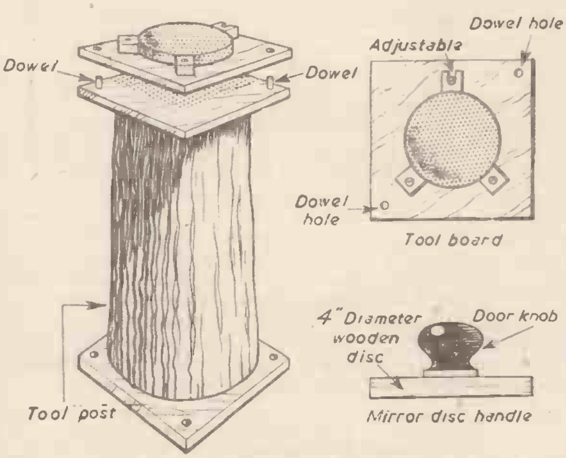


Fig. 2.—Grinding post and details of tool board, mirror disc and handle.

The aperture decided upon by the author was f/10, using a reflector of 6in. diameter and the tube-length a little over 5ft.

Materials

Two glass discs of equal diameter are required, one for the mirror disc and the other to be used as a grinding tool ; these discs should be of a thickness not less than one-eighth of the diameter. A small thickness-to-diameter ratio would be liable to flexure or deformation of the reflecting surface under its own weight, thus causing serious deterioration of image quality. Blanks suitable for mirror discs can be obtained from Chance Bros., Ltd., of Smethwick, either with edges roughly ground to diameter but not guaranteed circular, or with edges machined and square with the main surfaces. Blanks suitable for use as grinding tools are also supplied. These blanks are obtainable with a thickness of one-sixth of the diameter.

The abrasive used is carborundum powder, a good selection of grits being Nos. 70, 90, 120, F, FFF, 400 and 600. These grits are not at all expensive and can be obtained either from local engineers' stores or from the Carborundum Co., Trafford Park, Manchester.

Rouge is required for polishing ; two to three ounces should suffice with care. Jeweller's rouge can be obtained from watchmakers' suppliers and is quite often stocked by chemists.

A small quantity of pitch is required for securing the mirror disc to its holder. The polishing tools are made from pitch with the addition of beeswax.

Preparation

Since the grinding operation will be a lengthy process, it is advisable to take extra care with the preliminaries.

The grinding post is the first and most important item; in this case the indispensable requirement is rigidity—it must either be very heavy or securely anchored. The author's post was a tree trunk which had seen service as a chopping block, this was screwed to the floor and made a stout grinding post. A stout barrel or even a stone bird-bath might be suggested as possible grinding posts. The height should be from 3/4ft., the width of the top and base should not exceed 18in. to permit of a comfortable grinding action whilst walking round the post.

The top board, which carries the glass tool-disc, should fit on dowels so as to be removable when changing over to finer grades of carborundum ; this fitting is shown in Fig. 2.

A shelf or table should be situated conveniently close to the post. This should be cleared and covered with a sheet of newspaper ; on it are placed a dish of clean

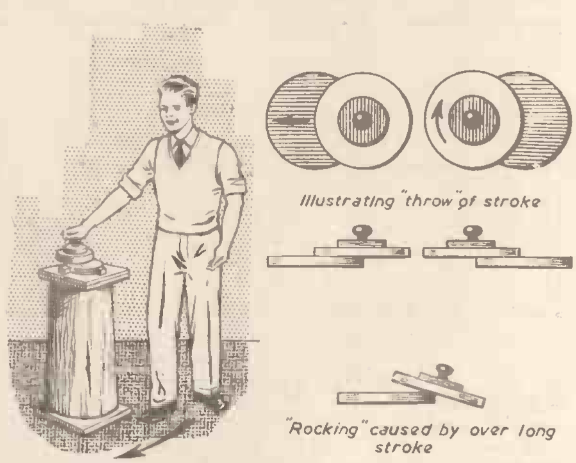


Fig. 3.—The actions used in the grinding operation shown diagrammatically.

water and the tin containing the first grade of carborundum grits. A place should also be provided in which to stand the mirror disc in the intervals between grindings.

Next, a position must be found in which to stand the mirror disc upright when testing for radius of curvature ; there will need to be a clear space of at least 12ft. in front of the mirror ; the necessity for this will be explained when the procedure of testing for radius of curvature is described.

Grinding powders should be kept in tins and clearly labelled ; one grade only should be kept on the shelf near the post at a time.

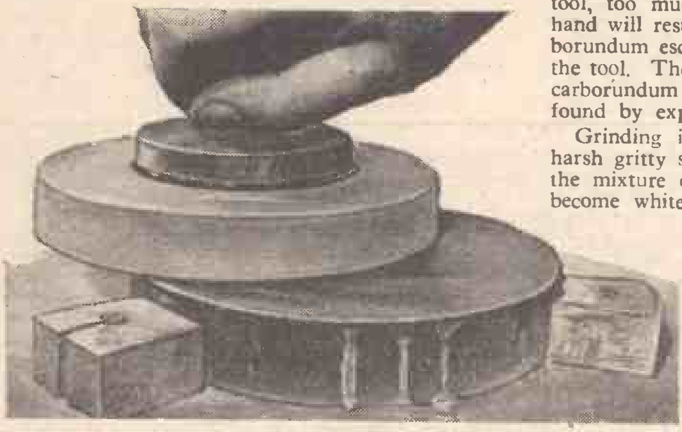


Fig. 4.—An actual mirror being ground.

Grinding

The tool-board (Fig. 2) is placed on its dowels on the tool-post; the dowels should be a snug fit—no movement of the tool can be tolerated when grinding.

The disc selected for use as the tool is placed in position on the tool-board and secured by means of the adjustable edge-piece; a piece of felt placed beneath the tool disc will help to prevent rocking which might be caused by an unevenness in the tool-board.

The whole assembly—tool, tool-board and tool-post should be quite rigid, and incapable of independent movement.

A handle is required for the mirror disc, as shown in Fig. 2. The underside of the 4in. wooden disc, which should be quite dry, is smeared with turpentine, and a little melted pitch poured over it. The holder is then stood aside for a few minutes in an inverted position to allow some of the heat to dissipate. When ready for applying to the glass, the pitch should be warm and sticky, but not too hot.

The mirror disc, which should be gently warmed, is smeared with turpentine and the pitch-coated holder pressed against it, taking extra care to set it as centrally as possible.

When these preliminaries have been completed, the grinding operation can commence. The tool surface is wetted with a medicine dropper full of water and about a teaspoonful of No. 7 carborundum powder applied. The mirror disc is similarly wetted, and laid on to the tool.

The grinding operation is carried out as follows: the mirror disc is stroked backwards across the centre of the tool in the direction directly away from the operator. On the completion of each stroke the mirror is rotated about 20 deg. As the strokes are made the operator walks slowly round the post so that no two strokes follow exactly the same diameter (see Fig. 3).

A rhythmic action should be aimed at, walking round the post at the rate of one step for each complete stroke. After a few journeys round the post this action including the little spin at the end of the stroke will become quite automatic, and the number of steps taken to complete the circuit of the post will become constant.

An actual mirror is shown being ground in Fig. 4.

The throw of the stroke should ideally be equal to the diameter of the tool; care, however, should be taken not to exceed this or the mirror disc will rock at the end of each stroke resulting in chipped tool edges and consequent scratches on the surface of the mirror.

The tool should be kept moist enough to allow of easy passage of the mirror over the tool, too much water on the other hand will result in much of the carborundum escaping over the edge of the tool. The correct proportions of carborundum and water are best found by experiment.

Grinding is continued until the harsh gritty sound has softened and the mixture of grits and water has become white with powdered glass. More carborundum and water are then applied to the tool, and grinding continued.

The rate at which the mirror grinds concave depends upon the pressure applied and the number of strokes, but it is unwise to attempt to speed up the operation by applying undue pressure or increasing the number of strokes per minute. Intimate contact of the mirror and tool should be maintained whilst grinding and this is not practicable at a high speed, which would result in the mirror rocking slightly upon its edge at the end of each stroke. This would result in a turned-up edge which would be very difficult to remove. Too much pressure upon the mirror handle would produce a similar effect.

Two or three hours' grinding will probably be required before the mirror exhibits any appreciable concavity. It will be understood, however, that since the radius of curvature aimed at is 10ft. the amount of depression visible will be quite small.

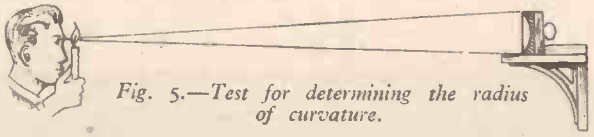


Fig. 5.—Test for determining the radius of curvature.

A straight edge laid across the disc will provide a rough check upon the progress made. After an hour's grinding a small gap will be visible in the centre of the disc. Grinding is continued with 70 carborundum until the gap appears to be a little less than 1/32in. The mirror can then be rinsed clean in preparation for the test to determine the radius of curvature.

Test to Find Radius of Curvature

The radius of the concave surface could be obtained by means of a spherometer, but the optical method combines simplicity with a standard of accuracy which is adequate for this stage of the operation.

The rinsed mirror disc is dipped in water in order to provide a partially reflecting surface. It is then stood upright against a wall or on a shelf at one end of the 12ft. space mentioned earlier, as shown in Fig. 5.

Standing a few feet away from the mirror, a lighted candle is held in such a manner as to cause an image of the flame to appear upon the surface of the wetted disc. The observer now retreats slowly, moving the candle from side to side, and raising or lowering it when necessary to keep the image visible.

At first the image of the flame will follow the movement of the candle; that is to say, as the candle moves from left to right, the image will move from left to right also, and vice versa.

As the distance from the disc is increased, the image will increase in size, and eventually a point will be reached where the image, instead of moving to and fro, will appear and disappear; beyond this point the movement will be reversed, that is to say as the candle moves from left to right the image will move from right to left.

The point at which no lateral movement can be seen can be taken as being the centre of curvature, and is equivalent to double the principal focus. The distance from this point to the disc is measured.

The focus aimed at is 5ft., so the radius of curvature will require to be 10ft.

First tests should show the radius of curvature to be well over this figure; so grinding should be recommenced and continued with occasional intervals for testing until the desired curvature is very nearly attained.

If the test shows that the radius of curvature is too small, the concavity can be reduced by reversing the grinding positions of the mirror and tool discs, the mirror being placed upon the tool-post and the tool-disc stroked across it. When the radius is found to be not more than 6in. more than 10ft., a changeover is made to a finer grade of carborundum.

The mirror disc and its holder are first thoroughly scrubbed so that not a speck of the original 70 grit remains. The tool-disc and its base are removed from the post and similarly scrubbed.

The shelf upon which the tin of 70 carborundum and the dish of water stood is now cleared and the sheet of newspaper replaced with a clean sheet; this is to minimise the risk of coarse grits fouling the finer grinding operations.

The tool on its base is replaced upon the post, and a tin of finer grit and a dish of clean water placed on the shelf. Grinding is now continued with the finer grit.

The coarsely ground surface will require to be worked with the 90 carborundum until all the large grinding pits due to the 70 grit have been smoothed away; a good check can be obtained by occasionally inspecting the surface with a magnifying glass.

Successive grindings with the finer grades of carborundum will produce a surface with a fine, silky texture. Both discs and holders should be thoroughly washed when changing grits, and the water and newspaper changed. Scratches caused by the introduction of foreign grits at this stage can take hours of back-breaking work to remove.

Care should be taken to maintain intimate contact of the ground surfaces when using the finest grade of carborundum; a little soap or glycerine added to the water or good quality talcum powder added to the carborundum powder will lessen the tendency of the surfaces to adhere.

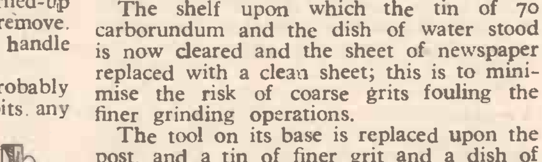


Fig. 6.—The reflection test.

The finer grades of powder will produce an excellent surface with a soft, silky feel; this surface will not be transparent, of course —this condition can only be attained by polishing.

A further simple test is available to prove the readiness of the surface for polishing.

The set-up for this test is depicted in Fig. 6. A distinct white image of the filament should be seen on the surface of the mirror at the 12 deg. angle indicated. If the image is red, the surface is not yet ready for polishing, and fine grinding must be continued until the reflected image is white.

An extra half hour spent at this stage in obtaining a perfect surface will save hours of rouge polishing.

Polishing

Polishing of the finely ground surface is effected by means of a pitch tool charged with rouge. This tool can be made either by running melted pitch over the glass tool *in situ* or by making a hardwood disc the same size as the mirror for use as a base for the pitch. The former method makes a good solid polishing tool, free from the risk of deformation of the base; there is, however, a danger of cracking an expensive glass disc by pouring on the pitch too hot. A hardwood based tool requires to have its pitch surface re-formed before each spell of polishing; that is to say, when it is left overnight the mirror is allowed to rest on it, thus preserving the surface contour and counteracting the effects of warpage.

Polishing and Figuring

For the purpose of polishing and figuring, two pitch tools should be used for optimum results, a hard pitch for polishing and preliminary figuring, and a softer pitch for final smoothing.

The relative properties of these two types of pitch are of the greatest importance. Theoretically, it might appear possible to polish and figure a good reflector simultaneously on one tool, but this would require an impossibly perfect combination of correct hand pressure, carefully calculated staggered strokes and perfectly tempered pitch.

The practical method is to obtain a preliminary polish with a hard pitch tool, using staggered strokes in order to avoid as far as possible tool edge zones; then figuring on a hard tool with facets modified to alter the mirror surface from spheroid to paraboloid, and to correct polishing defects this would be followed by "smoothing" on a softer pitch tool.

The advantages and disadvantages of hard and soft pitch tools might be summarised as follows; hard pitch polishes comparatively rapidly and resists deformation due to hand pressure, on the other hand the hard outer facets tend to produce marked "ring" zones when regular strokes are employed. These zones will be explained more fully when figuring is dealt with.

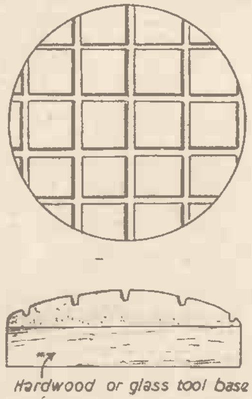


Fig. 7.—Plan and section of the pitch tool used for polishing.

Soft Tools

Soft tools possess the advantage of being easier to mould to the shape of the mirror and also they do not produce edge zones. There are two very serious defects; the outer facets are rapidly deformed by hand pressure, which causes the mirror to polish more rapidly towards the centre, thus causing a central depressed zone which is exceedingly difficult to correct; in addition, soft tools polish very slowly. Pitch as obtained from the chemist is usually too soft to use for polishing, although useful in this condition for securing the mirror to its handle. Polishing pitch should be capable of being fractured easily into small fragments by light blows with a hammer. A newly fractured surface should be just capable of taking a thumbprint, yet not soft enough to be depressed by the thumb.

If the pitch obtained is too soft it can be hardened by boiling, thus evaporating some of its more volatile constituents. If too hard it can be softened by adding a little turpentine.

Sufficient of the prepared pitch to cover the glass tool or hardwood base to a depth of about ¼in. is melted in an old pan together with 1oz. of beeswax. It is then strained through muslin.

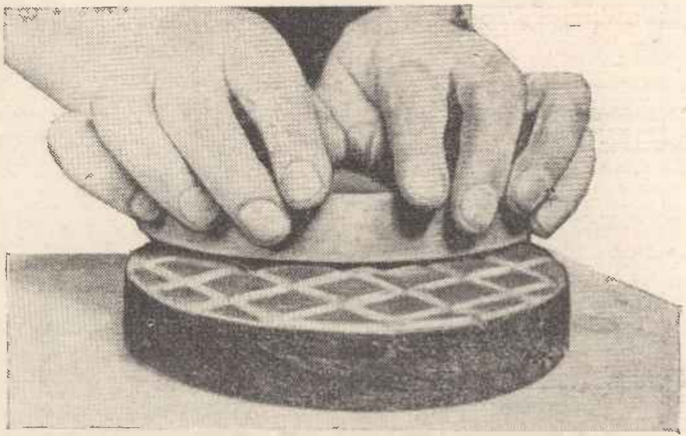


Fig. 8.—Using the pitch polishing tool during the polishing process.

If the glass tool is being used for a base it should be dried and carefully warmed; it is then wiped over with turps.

The pitch is poured over the tool; a band of cardboard or stiff paper wrapped around the disc and secured with string will prevent the pitch from being lost over the edge. Immediately the pitch has set, but whilst it is still quite warm, the cardboard band is removed and the edge of the pitch roughly bevelled with a sharp knife lubricated with a paste of rouge and water.

The mirror disc is smeared with rouge and water and pressed hard on the warm pitch, at the same time moving it backwards and forwards and rotating it in a similar manner to that employed in grinding. This is to form the surface of the pitch convex so that it is a perfect fit for the mirror.

When all-over contact has been obtained between the mirror and the pitch, the mirror is removed and facets cut in the pitch.

The pitch tool is shown in Fig. 7 and it will be seen that it is divided into squares which form a pattern which is slightly off centre; if a square or the corner of a square is exactly in the centre of the disc the remaining squares would form a pattern symmetrically disposed about the centre, and such a tool would tend to produce polishing zones.

Cutting the Facets

The facets are best cut with a sharp knife lubricated with rouge and water; a paraffin-soaked rag should be kept handy for keeping the knife clear of adherent pitch. The channels should be cut about ⅛in. to ¼in. deep.

When the faceting has been completed, the pitch too should be allowed to stand overnight, with the mirror disc, coated with rouge, resting upon it; this is to "iron out" the edges of the facets, which would be raised when cutting the channels.

The mirror disc has its handle removed and the pitch scraped off and cleaned up with paraffin. Greater control of the polishing and figuring operations is possible with the handle removed, and the heat of the hands is equalised over the whole disc—an important consideration to be borne in mind during the figuring operation.

A small quantity of rouge is placed upon the surface of the mirror and a little water added. The mixture, which should be of a creamy consistency, is spread over the surface with the fingertip. The mirror is then placed on the tool and polishing commenced. (See Fig. 8.)

The action is similar to that used for grinding but the strokes are much shorter and should be slightly oval instead of straight backwards and forwards. The strokes should be constantly varied in length to avoid tool edge zones. More weight is applied using both hands and the disc rotated about 20 deg. every two or three strokes.

Polishing must be continued, occasionally renewing the rouge, until the greyish ground surface entirely disappears and becomes transparent. The mirror is then ready for testing and figuring.

(To be concluded)

Convector
FOR THE I

Details of Some
Instructions for M
Model Which is S

By DANIEL BRANN

ELECTRIC convection heaters provide the safest possible means of warming a nursery or sickroom, they are also very useful for the background heating of a hall or sitting-room. The maximum element temperature of the type of heater shown in Fig. 1 is less than 300 deg. C, so that there is little risk of it setting fire to any clothing, etc. Since such heaters rely upon heating the air and not upon direct radiation, it is possible to use a protective cover of quite fine mesh to provide the maximum of safety. Also, no glow is given out to cause frightening shadows on the ceiling of a small child's bedroom—a most important point. All the components required are readily available and for the convenience of readers a parts list is given at the end of this article.

The particular heater shown in Figs. 1 and 2 is intended only for background heating in a child's bedroom and provides either 500 or 1,000 watts output as selected by the switch visible on the right hand side. It is totally enclosed in small mesh expanded aluminium with inner guard plates on the two sides, so that it is as safe as possible from the curiosity of small, prying fingers. The only part of the heater which becomes too hot to touch is the top, but even if this is touched a bad burn is unlikely as the specific heat of the aluminium (and therefore the amount of heat in the metal) is not very high.

Fig. 1 (Left).—A dual 500 / 1,000 watt electric convection heater built for maximum safety in a child's bedroom.

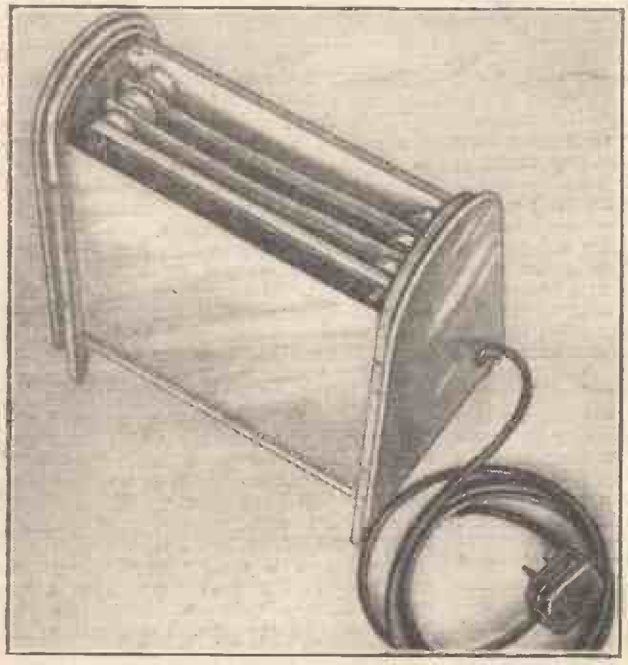


Fig. 2.—The cover removed to show the method of supporting the elements and the inner guard plate which is secured to the back of the square aluminium bar by self-tapping screws.

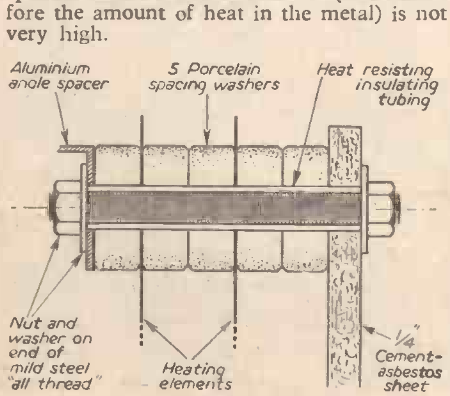


Fig. 3.—The method of mounting the heating elements.

A word now about the general design and construction of electric convection heaters. The heating element consists of a grid of resistance wire wound as the weft thread in an open mesh, with asbestos fibre as the warp. The dimensions of a typical 1,000 watt 230-volt grid would be some 12in. × 9in. × ⅛in. The passage of an electric current through the resistance wire raises the temperature of the grid and hence of the air in its vicinity. This air is then displaced by the relatively cooler air around it, with the result that cool air enters at the bottom of the grid and warm air leaves at the top. Such grids should always be mounted vertically with at least a ½in. gap on either side.

A Limitation

There is little radiation from these elements which leads (in the author's opinion) to one limitation on their use. They are not considered suitable for the main source of heat in a room such as a lounge, since they encourage a draught across the floor, and the warm air tends to stay up in the ceiling. As background heaters in a room in which people are active, or for a sickroom, they are excellent. They also make an excellent clothes airer if fitted in the bottom of a well-ventilated cupboard. However, their use cannot be recommended for a bathroom or similar location where condensation may cause partial short circuits in the element.

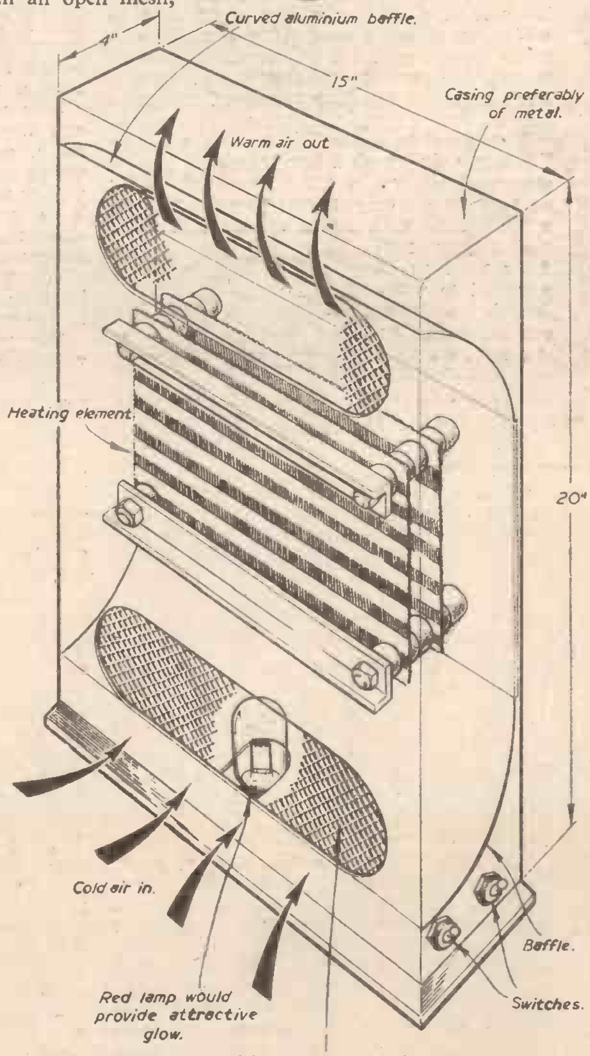
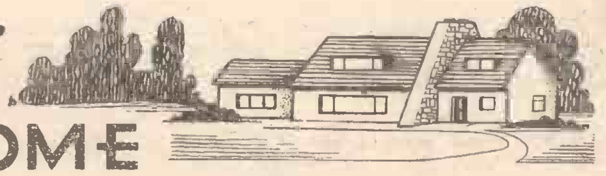


Fig. 4.—Suggested brief details for a convector heater for a hall.

Heaters ... MODERN HOME



...e Attractive Designs and ...aking a Dual 500/1,000 Watt ...afe, Cheap and Easy to Build

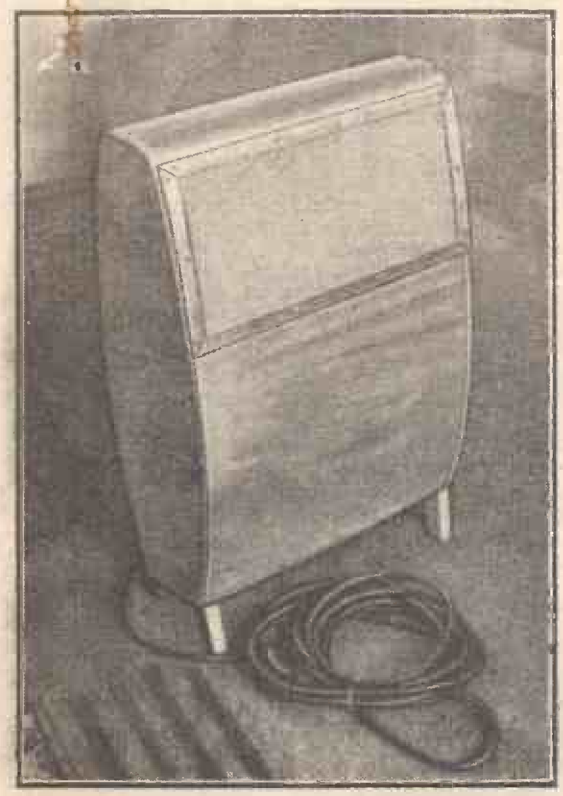


Fig. 5.—A design previously described in July, 1957, PRACTICAL MECHANICS.

Alternative Designs

An attractive heater for a hall could be made as shown in Fig. 6. This might well carry two 1,000 watt elements, each with its own switch control. The elements should be mounted as shown in Fig. 4, with curved aluminium baffles to direct the air flow and keep the top cool. If a red coloured lamp were inserted below the grids, an attractive glow would issue from the apertures, this would also serve as a pilot light to prevent the heater being inadvertently left on.

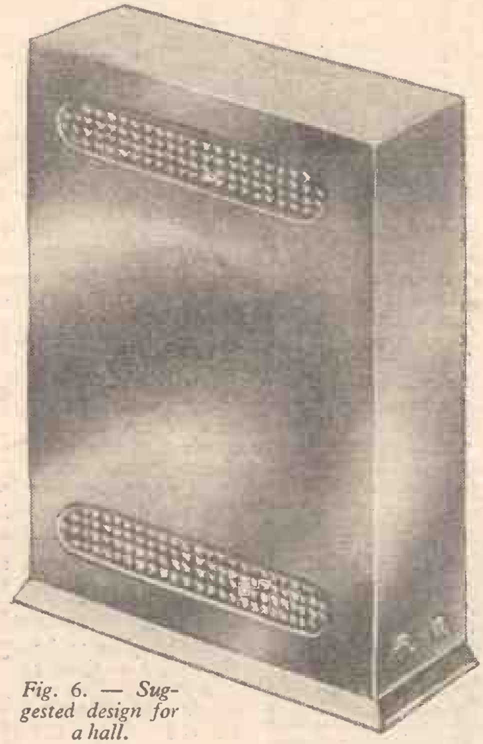


Fig. 6. — Suggested design for a hall.

The sketch, Fig. 4, is not intended to show constructional details, but is merely a suggested design, on which the reader can base his own construction.

Many other designs will suggest themselves to the reader, and another, details of which have been published in a past issue, is shown in Fig. 5. In order to illustrate the method of supporting the elements and the electrical connections the construction of the model shown in Figs. 1 and 2 will now be described.

Construction

Two 500-watt heating elements, each measuring 9in. × 7in., were mounted on aluminised mild steel "all threads" (see parts list), insulated with heat resisting insulating tubing and spaced by porcelain washers as shown in Fig. 3. One end of the assembly was spaced by ⅜in. × ⅜in. aluminium angle bent from 1/16in. aluminum sheet. The other side of the nets was spaced by a cement/asbestos sheet ¼in. thick and 10in. × 8in. overall. The top two corners of this asbestos sheet were cut out to clear the ⅜in. square aluminium bar on the insides of the endplates (see later). The top of the completed assembly is visible in Fig. 2, which shows the appearance of the heater with the cover removed.

The sides were cut from ¼in. aluminum plate and the legs and cover supports were formed by bending and riveting on some ⅜in. square aluminium bar, as shown in Fig. 7.

Short lengths of the same bar at "A" (in Fig. 7) take the self-tapping screws which secure a perforated metal tray, to enclose the bottom of the heater. All riveting was performed with ⅛in. aluminium rivets, carefully countersunk on the outside of the endplates and subsequently filed off flush. Six-inch lengths of ⅜in. × ⅜in. aluminium angle fixed to the insides of the endplates, as in Fig. 7, provide the fixing for the asbestos/cement board carrying the elements. A junction box on the back of the asbestos panel is used to connect the element leads to the switch and mains lead, as shown in Fig. 8. In this way, one element is switched on when the lead is plugged in, the other is brought in as well when the switch is used. Provided that the junction box and leads are kept well behind the asbestos panel and to the bottom, there will be no risk of their being overheated.

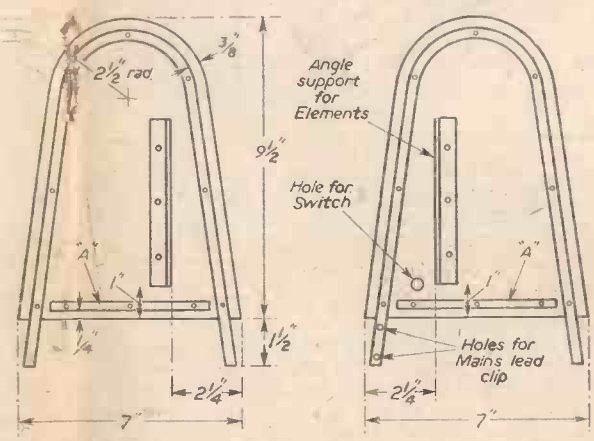


Fig. 7.—Construction of end plates. The ⅜in. square bar is easily bent by hand, then riveted on.

Safety

Three very important points remain, the metal framework *must*, as in all electrical apparatus, be *earthed;* the mains lead should be securely clipped to the leg of the heater so that no strain can come on the connec-

(*Concluded on page 197*)

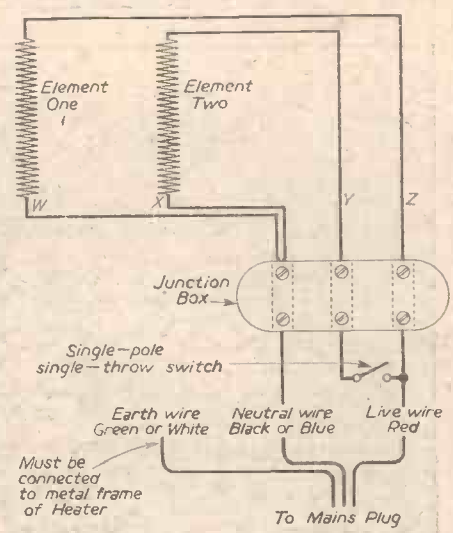


Fig. 8.—Circuit diagram. The leads W, X, Y, Z should be kept short and insulated either with insulating tubing or, preferably, porcelain beads.

PARTS LIST

Prices are bound to vary a little; with this in mind the prices given have been rounded up a little—to be on the safe side!

		£ s. d.
Two 500-watt 230-volt unmounted heating nets	Cressall Mfg. Co., Eclipse Works, Tower St., Birmingham, 19	13 0
One dozen mild steel all threads, ¼in. x 6in.	" " "	3 6
Two dozen porcelain spacing washers, ⅜in. long	" " "	1 0
One foot ¼in. bore heat resisting tubing	" " "	1 0
One piece ¼in. aluminium sheet 12in. x 12in.	Any large tool shop or scrap merchant	12 0
Six feet ⅜in. square aluminium bar (this is the minimum length which can usually be bought)	" " "	6 0
Expanded aluminium sheet (speaker fret)	Any amateur radio shop at about 2/- per sq. ft.	4 0
Switch and lead ...	Any amateur radio shop	10 0
Rivets and odds and ends of angle and nuts	Scrap box	1 0
Porcelain beads ...	Local electrical supplier	1 0
Total cost of heater as illustrated ...	...	£2 12 6

Glass Silvering for the Amateur

Straightforward Practical Details for Carrying Out This Process at Home

IT is very often the case that the amateur mechanic, woodworker or other hobbyist finds himself in need of a piece of mirror glass of special dimensions for the job which he has in hand. At other times, also it may be desired to provide old mirrors with a new coating of silver in order to remedy their defects and to bring them up to their pristine condition, whilst occasionally the experimental worker may wish to silver glass articles of unusual shape, as, for instance, the interior of a glass sphere or the inner sides of a glass vessel of irregular design.

All such requirements can be fulfilled satisfactorily by following the practical glass-silvering instructions which are given in this article. It is true, of course, that mirror glass of all qualities and thicknesses is commercially obtainable, but there is an interest and a fascination in the home production of an article, and particularly to the chemically-minded worker will the technique of amateur glass-silvering make its appeal.

By following the directions given in this article, almost any type of glass can be silvered satisfactorily. The few chemicals required are not expensive and they are obtainable from any local druggist.

Two Important Points

Two factors alone are necessary for the success of home glass silvering. The first lies in the careful making up of the silvering solutions, whilst the second is absolute cleanliness of all vessels, solution and glassware throughout the process. The slightest contamination of the silvering solution with dirt or foreign matter will bring about unsatisfactory results. Hence from beginning to end of the silvering operations the vital necessity of scrupulous cleanliness of everything concerned in the silvering must be well borne in mind.

If possible, it is best to make up the silvering solutions with distilled water and, also, to use distilled water for the final rinsing and washing of the glassware under treatment. Ordinary tap-water or rain-water will of course suffice for the process, but the use of distilled water is in all instances to be recommended.

It is not difficult to obtain an adequate supply of distilled water. Merely boil a kettle of water on a gas stove and allow the steam from the kettle spout to impinge upon a metal vessel filled with cold water. The steam will condense and the water can be collected in a dish or vessel placed under the suspended can, as illustrated in Fig. 1. Needless to say, the sides of the condensing vessel, as well as the receiver of the condensed water, must be scrupulously clean if the distilled water is to be free from contamination.

Removing Old Silvering

If the glass to be silvered has already a deposit of silver on it, as, for example, an old mirror, the old silver deposit must first of all be removed. This can be effected readily by immersing the glass in a 5 per cent. solution of nitric acid in water, the glass being subsequently well washed under a stream of hot water.

Fig. 1 (Left)—A simple method of obtaining distilled water.

The glass for silvering, whether it be perfectly clean and new or whether it constitutes an old mirror glass which has had its silver removed in the nitric acid bath, must first of all be subjected to a chemical cleaning treatment. No matter how clean the glass may appear, this chemical treatment is an absolute necessity, and any attempt to silver the glass without the preliminary treatment will end in failure.

First of all, then, the glass to be silvered is washed in warm water, using a clean, soft rag and a liberal amount of soap. After rinsing, the glass sheet should be transferred immediately to a moderately strong solution of bichromate of potash to which about 1 per cent. of sulphuric acid has been added and allowed to soak therein for about an hour, or, alternatively, to a bath of strong nitric acid.

As the glass sheet lies under either of the above liquids it should be gently "scrubbed" with a wad of cotton wool which is pushed over its surface by means of a glass rod, see Fig. 2.

Finally, the glass sheet is rinsed in plenty of clean water and then immediately transferred to the "silvering dish," which should consist of a perfectly clean shallow dish just large enough to accommodate it. A photographic developing dish, preferably one of the porcelain variety, makes an excellent vessel for this purpose. As it lies in the "silvering dish" the chemically cleaned glass sheet is covered with a layer of water and allowed to remain undisturbed while the silvering solutions are being made up.

Silvering Solutions

Two silvering solutions are necessary. They may, of course, be made up separately beforehand and stored in brown or amber-coloured bottles; they will keep in good condition for a considerable time. They must not, however, be mixed until immediately before their use.

Fig. 2 (Right)—Cleaning glass sheets in nitric acid by means of cotton wool held between glass rods.

Solution A

Silver Nitrate, 4.5 grains or 0.5 gram.
Rochelle Salt, 4.25 grains or 0.7 gram.
Water, 5oz. or 250 ccs.

Solution B

Silver Nitrate, 39 grains or 2.5 grams.
Water, ⅞oz. or 25 ccs.

Solution B, however, needs special treatment to bring it into a sensitive condition. Add to this solution strong ammonia drop by drop. A white precipitate will first form and will rapidly turn brown. The ammonia must be added until this precipitate just dissolves, leaving a clear solution. Hence, it is necessary after each addition of ammonia to shake the vessel containing the solution in order to give the precipitate a good chance to dissolve. After the solution has thus cleared, add to it, also drop by drop, a weak solution of silver nitrate (strength immaterial) until the solution just perceptibly becomes cloudy and darkens. Then dilute the solution with 250 ccs. ($8\frac{1}{2}$oz.) of water and bottle it for use.

Having prepared the two silvering solutions in the manner described and chemically cleaned the glass surface to be silvered, we are now ready to undertake the silvering operation proper.

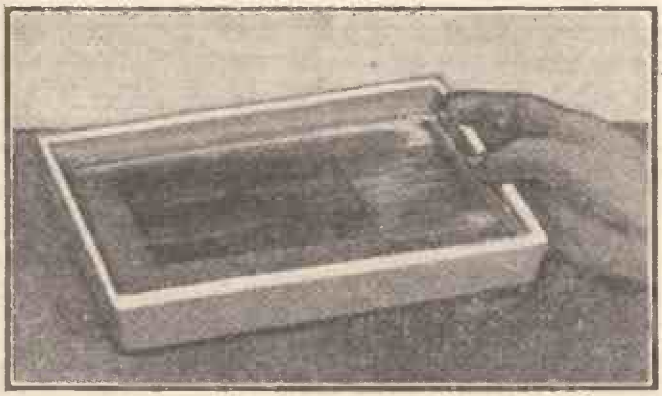


Fig. 3.—The actual silvering being deposited.

Pour off the water from the chemically cleaned glass sheet and pour on to the latter a strong solution of stannous chloride. Allow the latter solution to remain in the dish for about half a minute, then pour it off and finally rinse the glass with several changes of water.

Silvering the Glass

This stannous chloride treatment is not essential to the silvering, but it is one of the secrets of glass-silvering used by the trade. Its advantage is that it gives a very adherent layer of silver on the glass.

The glass sheet after having been finally rinsed with water is allowed to lie, side-to-be-silvered upwards, in the silvering dish. Equal parts of silvering solutions A and B are mixed in a clean glass vessel and immediately poured into the silvering dish. The silvering of the glass will commence instantly. The dish should be rocked gently for five or six minutes in order to prevent particles of the sludge which will form in the mixed solutions from settling upon the silvered surface.

Finally, after the above stated time, the silvering solution is poured away (it is of no further use) and a little clean water is poured into the dish. The silvered glass is given three or four of these rinsing treatments and then removed from the dish and allowed to stand on edge to dry.

A perfectly silvered surface will now be present upon the glass. In order to prevent injury to it, the surface, when dry, should have poured over it a little celluloid or shellac varnish and when hard this varnish layer may be further protected by a thin coat of paint. Thus, completely protected from atmospheric action, the layer of chemically deposited silver will remain bright for many years and will form a perfect reflecting surface, the quality of which can only be marred by any possible surface irregularities in the glass.

Glass Spheres

Naturally enough the silvering method must be modified when dealing with glass spheres and the inside of glass vessels. When these have to be interiorly silvered, the chemical cleaning solution, the stannous chloride solution and the silvering solution are all poured in turn into the vessel and swirled about therein so that the interior sides of the vessel are brought completely into contact with the liquid. Otherwise, of course, the procedure for the interior silvering of a vessel is exactly the same as that for an ordinary sheet of glass.

The scrupulous cleanliness necessary for the success of glass silvering must extend to the hands, or at least to the fingers of the operator. It is best to handle the glass to be silvered as little as possible, but when it does become necessary to handle it by its edges, the fingers should previously have been well scrubbed with soap and water in order to remove all perspiration and grease from them. Dust, of course, must be guarded against at all stages of the silvering operation.

Do not allow the glass sheet to remain in the silvering bath for more than five or six minutes, otherwise it will tarnish. If a heavier deposit of silver is required, this can be built up by pouring a further quantity of the freshly-mixed silvering solutions upon the silvered glass, allowing it to act for another five or six minutes and then applying, if necessary, a still further quantity of the mixed solutions.

If any silver is found deposited upon the front side of the glass this can easily be removed by wiping with a cloth moistened with dilute nitric acid, but not until the silvered side of the mirror has been protected by varnish.

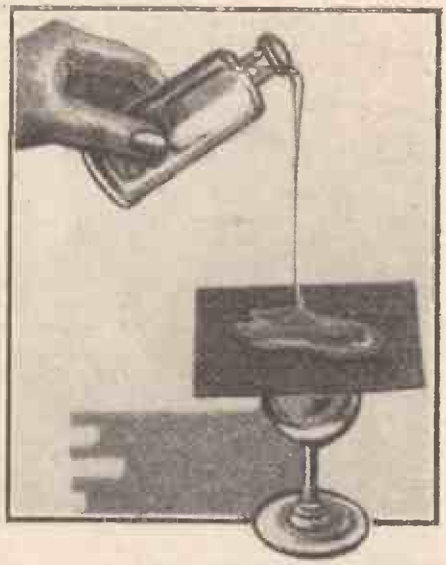


Fig. 4.—Varnishing the back of a mirror.

BOOKS Received

Engineering Mechanics, by Archie Higdon and William B. Styles. 585 pages. 32s. 6d. net. Published by Longmans Green & Co., Ltd.

THIS book is of American origin and deals clearly and concisely with fundamental engineering mechanics, emphasis being placed on the application of basic principles to engineering problems. It is written to help the engineering student to a full understanding of the problems he is likely to encounter, by teaching him to break them down into basic elements rather than solving them by the use of standard formulæ. Sections are included on Basic Concepts; Resultants of Force Systems; Centroids and Centres of Gravity; Equilibrium; Friction; Moments of Inertia; Method of Work; Kinematics—Absolute Motion; Kinematics—Relative Motion; Kinetics—Force, Mass and Acceleration; Kinetics—Work and Energy; Kinetics—Impulse and Momentum, and finally a section on Mechanical Vibrations. 1,200 problems are included and the volume is comprehensively illustrated and indexed.

View from Orbit II, by Antony Avenel. 166 pages. 18s. net. Published by T. Werner Laurie Limited.

THE orbit of the Earth is the third farthest from the sun, and that of the planet Venus is the second farthest, or Orbit II. This is used in the title to suggest a detached, objective viewpoint. The object under scrutiny is, of course, the Earth. A question which is extensively considered is whether the Earth and Man were formed by design or by chance. The author's theory is based on conclusions drawn from many sciences which at first seem conflicting, but which he has welded together. His approach is new and his views disagree with many existing ideas.

The Making of a Moon, by Arthur C. Clarke. 182 pages. 21s. net. Published by Frederick Muller, Ltd.

THE launching of the recent Russian Earth satellite and the American launching which is imminent have brought this subject into the forefront of everyone's mind. This book describes how the idea of artificial satellites first arose and the problems which had to be overcome in their development. The types of information which they can relay back to Earth are discussed and also the uses and possibilities of the larger space stations which will follow as a logical development.

The Practical Electrician's Pocket Book, 1958. 544 pages. 6s. net. Published by "Electrical and Radio Trading."

THIS pocket book (its size is $3\frac{1}{2}$in. × 5in.) contains the whole range of information likely to be required by the practical and professional electrician. It has been brought up to date by the inclusion of chapters on Automation and Ultrasonics. It is illustrated throughout with many diagrams and an index is included.

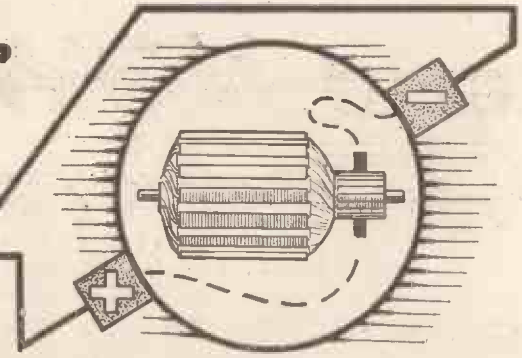
"Manufacturing Processes," by Myron L. Begeman. 610 pages. 64s. net. Published by Chapman & Hall, Ltd.

THIS fourth edition has been completely revised and has additional material included. The book is intended mainly for the student of engineering, but will also be of use as a work of reference to the practising engineer and industrial worker. The author, who has a background which is both academic and professional, is now Professor of Mechanical Engineering at the University of Texas.

Among the new information included in this edition are sections on electroforming, metal coating processes, electro-spark machining, ultrasonic machining, chem-milling, and automation.

A great many illustrations, including both line diagrams and photographs, are used, and a number of tables are included. A comprehensive index completes the volume.

Choosing Electric Motors for the Workshop



By J. GILLETT

Some Points Which the Prospective Purchaser Should Bear in Mind

THE handyman who is fortunate to possess room to establish a small workshop, is often faced with the provision of motive power for the machines he acquires, such as wood or metal turning lathes, sawbenches, etc. For the uninitiated, this is often quite a problem, especially where funds are limited. Much time and money can be spent on motors which are of no use, and which are eventually consigned to the scrap heap.

One of the first considerations is the electricity supply available. Most domestic supplies are standardised on alternating current at a frequency of 50 cycles per second, single phase, the voltage varying between 200/250. There are a few areas still supplied with direct current, where special considerations apply. The more common A.C. supplies will be dealt with first, and the purchase of new motors for use on these. Before setting out to purchase, these essential details should be known.

(1) What size motor is required (horsepower).

(2) What starting characteristics are required. (This will be dealt with more fully.)

(3) What speed the motor is to run at.

(4) Full details of the electricity supply, e.g., 230 volts, 50 cycles, single phase.

(5) What restrictions the local supply authority places on the use of single phase motors.

Size of Motor

This, of course, depends on the size of the machine which it is required to drive, and some examples are given below.

Saw Benches : 4in. blade, 1/6 h.p. ; 6-7in. blade, ¼-⅓ h.p. ; 8in. blade, ½ h.p. ; 10in. blade, 1 h.p. The saw bench in Fig. 4 uses a ½ h.p. motor.

These figures are given as a rough guide and are ample for sawbenches not being continually used day after day.

Wood Lathes: 2in. diameter work ¼ h.p. ; 4in. diameter work, ⅓-½ h.p. (see Fig. 3).

Metal Working Lathes: 3½in. swing, ¼ h.p. ; 4in. swing, ⅓ h.p.

Bench Drills : ¼in. capacity, 1/6-¼ h.p. ; ½in. capacity, ⅓ h.p.

Grinding Wheels : 4in. wheel, 1/6-¼ h.p. ; 6in. wheel, ⅓ h.p.

Starting Characteristics

These are determined by the tool that the motor is to drive, and are dependent on the amount of effort required to start the machine turning. Sawbenches, lathes, drills, etc., require little extra effort on the part of the motor to start them turning, and an ordinary split phase type may be used (Fig. 1). If the starting duty is heavy, such as a motor driving a compressor for paint spraying, a capacitor start motor is advisable. This type of motor may develop as much as three times its rated horsepower at starting, and is thus well equipped to turn a compressor over initially. This type of motor is easily distinguished, as the condenser is usually mounted on the outside of the motor frame, in a cylindrical container. The cost of a capacitor type motor is usually about 30s. more than the ordinary split phase motor in the fractional horse power range. A typical example is shown in Fig. 2.

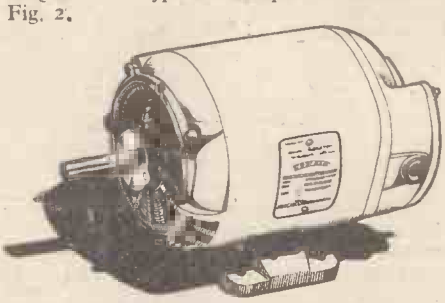


Fig. 1.—A typical single-phase split-phase motor, made by Brook Motors.

Motor Speed

The standard A.C. motor will only run at fixed speed, and apart from a very slight drop in speed when on heavy load, the speed of a motor cannot be varied, and the voltage of the supply will not affect this speed. This fixed speed at which any one motor will run is determined on the actual

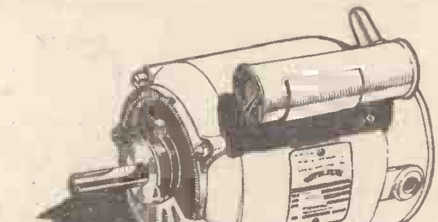


Fig. 2.—A typical single-phase capacitor type, also made by Brook Motors.

winding employed and the frequency of the supply, which is fixed by the supply authority. For normal purposes the two most useful speeds from the workshop point of view are 1,500 r.p.m. and 3,000 r.p.m. These are what are known as the "synchronous" speeds, and are used as a matter of convenience, as no two motors will run at exactly the same speed on load. The actual load speeds will be in the region of 1,420-1,450 and 2,800-2,900 r.p.m. respectively, depending on the efficiency of the motors. Many other speeds below these are available, but these motors are costly. Motors at 3,000 r.p.m. are slightly cheaper than their 1,500 r.p.m. counterparts, and this saving must be offset against any necessary pulley reductions to reduce the speed of the driven shaft if this is much slower.

Small sawbenches and wood-turning lathes normally run at a high speed in the region of 2,000-2,500 r.p.m., and it will be most economical to use a motor running at 3,000 r.p.m. in this case.

Metal-working lathes and drills usually run at much lower speeds, perhaps only in the region 500-1,000 r.p.m., and it will be much more economical to use the slower speed motor running at 1,500 r.p.m. Most grinding wheels run at high speed, and the small bench grinder will require the faster motor.

The size of pulley required for the driven shaft can be easily calculated, using the following formula :—

$$\text{Size of Driven Pulley} = \frac{\text{Dia. Motor Pulley} \times \text{Motor Speed}}{\text{Required Driven Speed}}$$

The Details of the Electricity Supply

The details of the electricity supply, if not known, can be obtained from the local electricity supply authority's office, or from any local firm of electrical contractors.

The size of single phase motor which may be used is restricted in some areas, although this is not likely to affect the domestic user, as the size limit of motors which may be used is usually in the region of 1-1½ h.p. Above this size special starting arrangements have to be made to restrict the current taken on starting to avoid any disturbance in the supply mains. Assuming that the motor you require is smaller than this, the way is clear for you to place an order for the exact machine required.

A typical order for a motor for a small sawbench might be one ⅓ h.p., 220 volts, 50 cycles, single phase, 1,500 r.p.m. "X" motor (specifying the particular manufacturer preferred) of the split phase type. The salesman is then left in no doubt as to what is needed.

Prices vary from different manufacturers, but a motor of the above type would cost in the region of £7 10s. The necessary pulleys and belting may be bought at the same time, and it will be necessary to know the diameter of the driven shaft so that the pulleys may be purchased ready bored to size and fitted without further machining. Full wiring and connection diagrams are included with every new motor, so there will be no difficulty on that score.

Secondhand Motors

It is doubtful whether there is any advantage in the purchase of secondhand electrical machinery, unless conclusive electrical tests prove that there is absolutely no fault to be found with it. Without specialist testing apparatus, the purchaser must take a chance after a thorough examination of the salient details. From the

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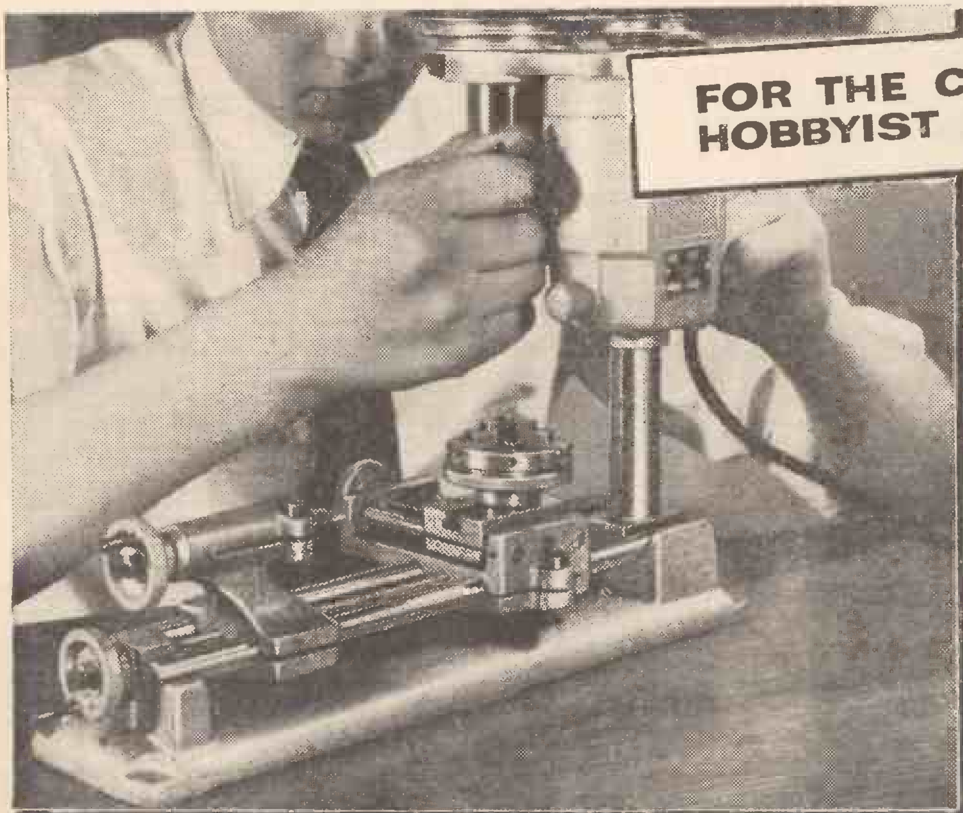

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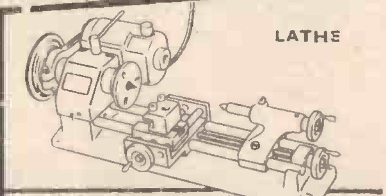

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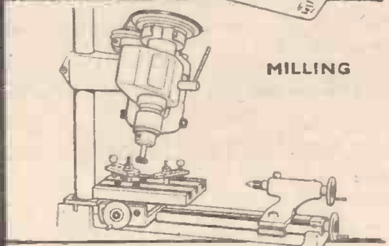

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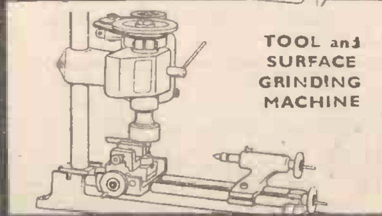

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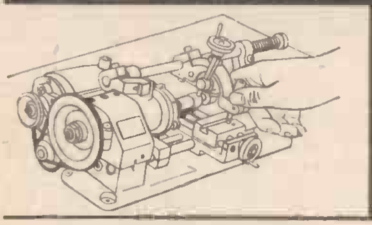

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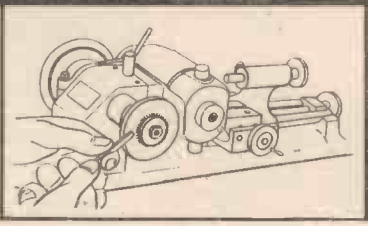

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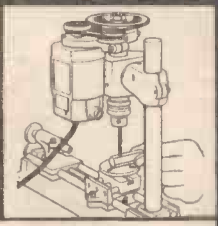

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study of the nameplate, it can be seen whether the motor is suitable or can be adapted for your purpose. A word on the question of voltage is necessary here. A motor of higher voltage than your own mains will run perfectly satisfactorily on the lower voltage, although it will not develop its rated horsepower. Actually the drop in horsepower developed is in direct proportion to the drop in voltage, plus a small amount less because of the efficiency of the motor being less than when run at its rated voltage. This does not work in reverse. Although a motor will run at a higher voltage than that marked on the nameplate it will become hot, the windings will deteriorate and may eventually burn out. With a secondhand machine one cannot be so particular as when buying new, so that a motor may be bought which is rated at a higher voltage than required, bearing in mind the facts pointed out above.

Always be suspicious of motors which have their nameplates missing, and as a general rule do not consider the purchase. Nameplates are very rarely knocked off accidentally, and one can justifiably suspect the worst! Apart from that, none of the vital details is known until the motor is run.

Always insist on seeing the motor running for at least 5 minutes, if possible, on load. At the end of this period feel the frame of the motor for any undue heating. Heat which is localised in one particular spot on the frame of the motor is a worse sign than a general heating, as it points to a short within the motor windings. This will cause the motor to burn out in a short while. Look at the ventilating slots in the motor frame. If they are partially choked with dirt or swarf from any manufacturing process it is a sure sign that the interior is choked in the same way, this meaning that the winding will have been overheated in the past and consequently will have deteriorated, the life of the motor being shortened as a result. Remember that a motor which burns out shortly after purchase is never a bargain at whatever price was paid. The rewinding of single phase motors is a costly business, being often as much as two-thirds of the new price of such a motor.

If, however you are satisfied with a second-hand motor which is offered to you, before taking it away, check with the vendor on the necessary connections to be made when wiring up. There are usually at least 4 terminals on the connection block of a single phase motor, some of which are used as interconnection points for the winding, and not for connection to the mains. A motor incorrectly wired can be damaged to such an extent that costly repairs or replacements are necessary.

The Purchase of Ex-Government Surplus Motors

Many of these are absolutely useless for use on the mains. The majority of them are of the commutator type for low voltages, in the region of 24 volts. Some of these, by virtue of the fact that they have permanent fields, are only suitable for running on the correct voltage D.C. supply, or from a battery. The motors which are suitable for running on A.C. must be used with a mains transformer to reduce the voltage. A word of warning is needed here. These motors, being designed for use on low voltage supplies, are often insufficiently insulated to withstand high voltages to earth, and when being used with a transformer it must be ensured that the transformer is of the double wound type, with an earthed screen between the primary and secondary windings.

There are a large number of ex-Government rotary converters for sale. These are often distinguished by the fact that they have two or more segmented copper commutators, and are designed to convert a low voltage to a high voltage. They will run as motors, but there is the danger that, even though the high voltage windings are not used, the insulation may fail slightly in the armature, with the result that the low voltage circuit has stray high voltages, which may be in the nature of 500 volts or more, impressed on it, with consequent extreme danger to the operator of the machine to which they are connected. This danger could still occur even if the hight voltage winding was severed from the commutator.

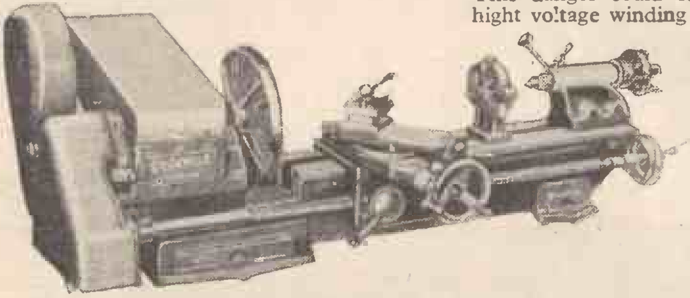


Fig. 3.—A $\frac{1}{2}$ h.p. motor is required to drive this $3\frac{1}{2}$in. centre lathe.

If suitable, these small motors could be used to drive a grinder, say 4in. diameter, and will work very well, as the speed of these motors is very high. Very rarely, however, will these motors develop enough power to drive lathes, saws, etc., and even if they are large enough, a large transformer would have to be purchased, which tends to make the initial financial saving very little.

The small ex-Government repeater motors (A.C. only) are of no use whatsoever. They are usually three-phase, and the horsepower output is minute.

Direct Current Supplies

The householder who is still on this type of supply is not so fortunate, in that the range of motors he has to choose from is restricted.

Although the basic details required are the same as for A.C. motors, the price of D.C. equipment is much more, in the small sizes being often twice as much. Transformers cannot be used to reduce the voltage for use with ex-Government motors. An A.C. motor will not run on D.C., and should a motor be so connected it will burn out almost immediately.

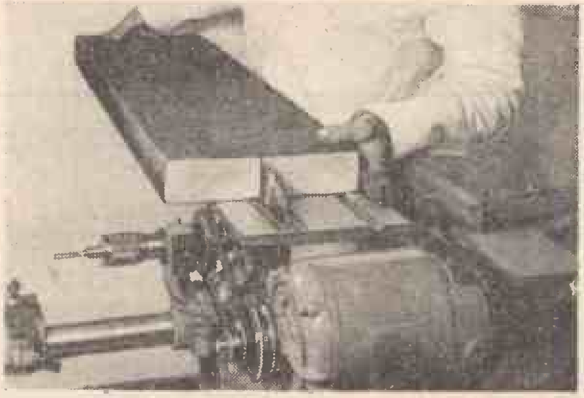


Fig. 4.—The Coronet "Minorette" which used a $\frac{1}{3}$ h.p. double-ended motor.

Wiring and Fuses

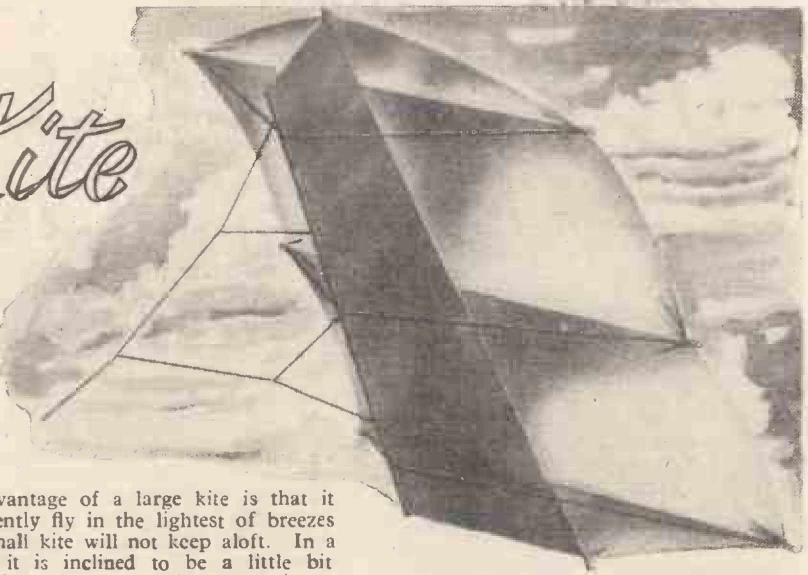
A final word about the wiring for fractional horsepower motors. At the moment of starting, such motors, especially of the split phase types, take a current several times more than the full load current stamped on the nameplate. For instance, a $\frac{1}{2}$-h.p. motor on 220 volts will take approximately 4 amps. when running on load, but when starting may take as much as 20 amps. This will probably cause a 5 amp. fuse to blow, even although this current surge is only for a fraction of a second. Before uprating the fuse, replace it with one of the same capacity, as the original may have deteriorated through age. In any case, the fuse should not be uprated to more than twice the full load current of the motor, both to protect the motor itself and the wiring feeding it. According to the Institute of Electrical Engineer's Regulations, all motors above $\frac{1}{2}$ h.p. should have a "no-volt" protection incorporated in the circuit, which means, in effect, that a proper starter should be used.

Those who have read this article and already have workshop equipment powered by electric motors may find on checking the various points raised that they can improve the efficiency of their workshop and perhaps increase the safety factor.

For the reader, however, who contemplates increasing the scope of his workshop and the purchase of new or secondhand motors, the article should provide some very useful pointers.

JUNIOR SECTION

A Giant Kite



Constructional Details and Dimensions of a Unique Design and a Fine Flyer

By J. WYNER

THE box kite is a fairly good flier, but for its weight-surface area ratio and the number of sticks in its framework it is very inefficient, and this is largely due to the fact that the lifting surfaces all make an angle of 45 deg. to the wind instead of being normal, as they should be. This does not refer to angle of incidence, but to a line drawn through the kite at right angles to the wind. It is, of course, upon this 45 deg. cross angle that the kite depends for its stability. It was therefore proposed to design a perfectly flat kite like the old-fashioned tailed type, but which should be kept rigidly into the wind without needing the weight and drag of a tail; so a central fin, or keel, from top to bottom of the flat surface was added and braced to the outer edges of the kite by means of cords. The result was a form of kite which is shown in flight in the heading sketch.

The advantage of a large kite is that it will frequently fly in the lightest of breezes when a small kite will not keep aloft. In a high wind it is inclined to be a little bit too powerful and unmanageable, except in the hands of a strong man, so it is recommended that this kite be only flown in breezes, or, if the wind is strong, the aid of an older and stronger person be enlisted.

Materials

As regards cost of construction, the expenditure of a few shillings is all that is called for, the most costly item being the kite line. For its making, 8yds. of 36in. wide strong white calico is required; five bamboo sticks, which can be bought from a nurseryman or perhaps at a florist's; 1½yds. of strong white tape, ⅝in. wide; some No. 16 gauge tinned iron wire and about a dozen yards of strong whipcord. It will be noticed that white calico is mentioned for the fabric material. This means, of course, that the kite will be all white, and in the author's opinion this looks better than any colour in the air. If a colour is preferred, a material such as sateen will have to be used.

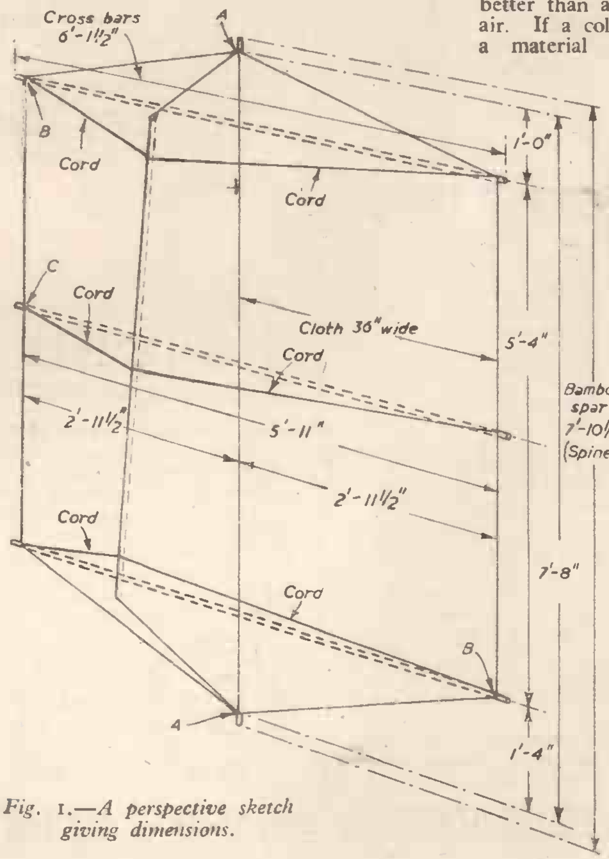


Fig. 1.—A perspective sketch giving dimensions.

Construction and Balance

It will be obvious that success in getting perfect balance of form will depend wholly upon the accuracy with which the cloth is cut out and sewn together, but really the shape is so simple that one cannot go very far wrong. The 36in. wide material will have, of course, two selvedges, and these are not to be cut. The first thing to do will be to cut two pieces for the main surface of the kite, the actual diagonal cuts in both pieces of cloth being made together; this is to say, with the cloth of double thickness. Then, from the remainder, the keel, or fin, should be cut out. It will not matter whether the selvedge of this is placed at the back or whether it wraps around the spar at the edge where the bridle is attached. In any case the cloth should be spread on the floor, or a large table, and lines drawn upon it in pencil to the measurements given in Fig. 1, allowance being made at the top and bottom and at the front for turning in. It should be turned over for an ordinary narrow hem at the top and bottom and at the front edge with a hem large enough for the bamboo spar to be passed down inside it. The back edge of the fin cloth is then sewn between the inner edges of the back cloth, ½in. being

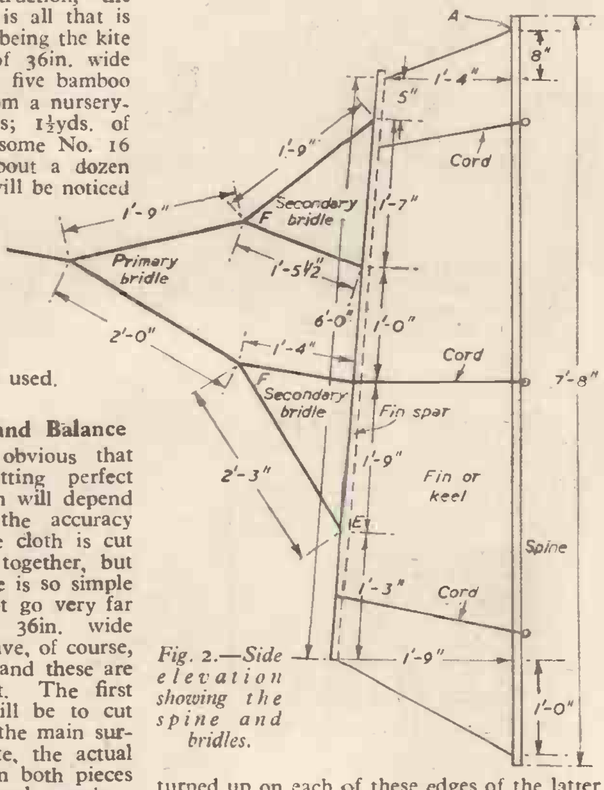


Fig. 2.—Side elevation showing the spine and bridles.

turned up on each of these edges of the latter to receive it.

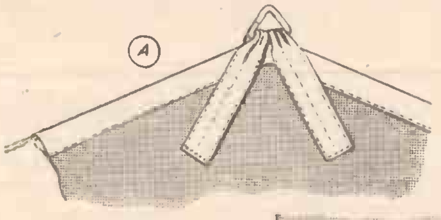
All the measurements required are given in Figs. 1 and 2, including those which the cloth will have after hemming, the width of the hems being added to the measurements in cutting the cloth, and the length of all the bamboo rods. In Fig. 3 are shown details of the construction. Reference letters in capitals against each sketch are repeated in Figs. 1 and 2 to indicate the position on the kite where the detail occurs.

Collapsibility

It is essential, of course, that a kite such as this shall be capable of being taken to pieces in a few minutes, rolled up for carry-

(*Concluded on page 197*)

ing, and similarly re-erected. The simple manner in which this is arranged will be made clear by the details in Fig. 3. At eight points on the main surface triangular rings are fastened. One of these rings is sketched at H. At each end of the four main bamboos, which flatten the kite, wire hooks are fixed as shown at G. These hooks are bent, as shown, the wire passed through holes drilled through the bamboo about $\frac{3}{8}$in.



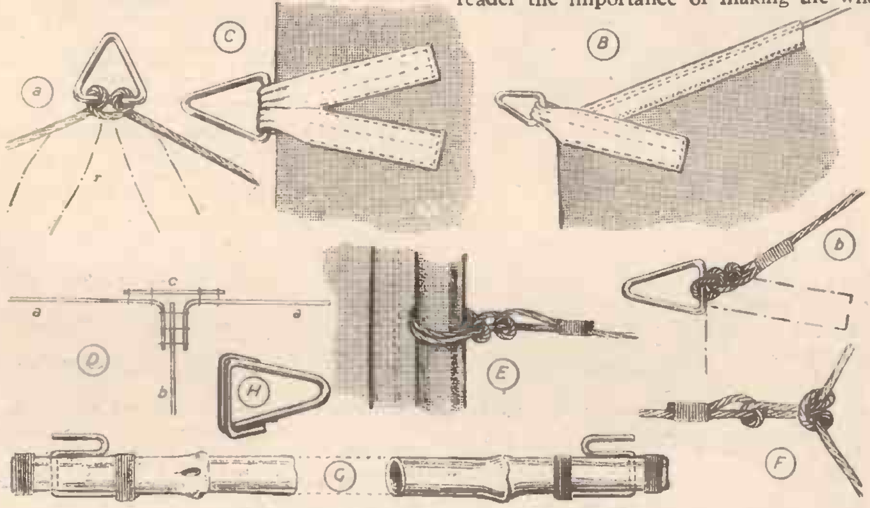


Fig. 3.—*Details of joints, knots and bindings.*

from each end, and bound with either strong thread or fine tinned iron wire such as florists use. If wire is used it should be soldered and if thread it may be beeswaxed.

Dealing with the rest of the details in alphabetical order, A shows the method of attaching the rings at the top and bottom of the kite. Here it will be seen that two tapes are used, each length of tape being passed through the ring and stitched with its ends one on each side of the cloth. Through the hem at the top and bottom a length of whipcord is passed. Below A is another sketch showing the same ring somewhat enlarged. This sketch, a, shows the way in which the cord should be secured to the ring. This cord may either have the hem made over it or may be passed through the hem with a bodkin after making. The cord terminates on each side of the kite at B, where it is secured to the ring with two half-hitches and a seizing. Great care should be taken to secure each of the side rings, B, at exactly the same distance from the centre ring A. The particular knot to be used at the side rings is shown in b, Fig. 3. Here again tape is used, in this case one piece only. C is a sketch showing the ring in the middle of each side. D is a cross section through the three cloths where they unite down the centre of the length of the kite; aa are two side cloths, b the fin, and c is a tape also extending from top to bottom. E shows one of the four attachments of the bridle. A hole is made through the cloth and the cord taken twice around the bamboo spar, then secured with two half-hitches and a seizing.

The object of using two secondary bridles on the fin spar, and a primary attached to the two secondaries, is to distribute the pull of the main cord equally over the whole area of the kite. This object is further achieved by taking from the fin spar additional cords to the ends of the three crossbars, not actually to the bamboos themselves, but to the rings which fit over the hooks in the bamboo. Sketch F shows the attachment of the ends of the primary bridle to the two secondary bridles. Before making these knots (F), it must be decided how to attach and detach the kite line from the main bridle. I suggest that a good plan will be to get two key split-rings, and on one of the rings secure the bridle in the manner shown at a; the kite line is attached to the other ring as at F. It will thus be seen that the line can be attached and detached by opening one of the rings.

Stay Cords Regulate Symmetry

This completes the construction of this kite, and it only remains to impress upon the reader the importance of making the whole of the six stay cords, which are clearly indicated in Fig. 1, and which run from the fin or keel bar to the points B and C, of exactly equal length. If this is not attended to, the main surface will not be perfectly flat, and the kite will not fly well. For instance, suppose that the stay on the left-hand side at the bottom is longer than the right, then there will be a twist upon the surface, and this will cause the kite to turn over in a left-hand direction; similarly, if the bottom left is shorter than the right, the kite will twist over to the right.

Kite Lines

The strength and fitness of any particular cord for use as a kite line is important. Cheap string should not be used, and it is well worth spending more money to obtain some which has the maximum breaking strain coupled with the smallest diameter—not less than 5/64in. and with a breaking strain of at least 60lb. Go to a firm of rope and twine merchants rather than to an ironmonger's shop. The cord should be of such a nature that it will remain hard and smooth and not become ragged and woolly. The length of the cord is purely a question of

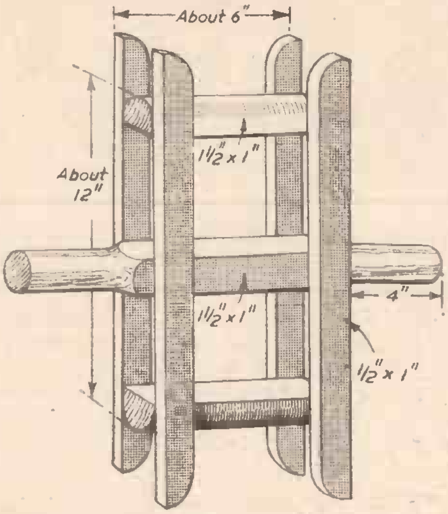


Fig. 4.—*A simple reel for a kite line.*

how high one wishes the kite to be flown, but a quarter of a mile of line is suggested.

Kite Line Reel

Obviously some form of windlass, that is to say, a drum upon a shaft, carried in bearings and with a handle on one side, is the best, but such a windlass would be difficult to make and, furthermore, it ought to be provided with a brake and ratchet and have some means of attaching the whole thing to a fence or post. For kites very much larger than the bigger one described, a windlass would have to be used, but the reader should be able to manage fairly well with the device shown in Fig. 4, which is a form of reel.

The best way to get the big kite aloft will be to get someone to walk away with it in the direction of the wind, trailing it along the ground, whilst you stand and let the line unreel with the winding gear simply running round it in your hands. Then, when the kite is about 100ft. away, get your assistant to raise it to the vertical. It should then take the wind and rise aloft without any running or pulling. When it is well up you can begin to let the handles slip round in your hands.

To get the kite down again do not attempt to pull in the line and turn it over and over on the reel, for this will twist the cord and produce kinks in it, but get your assistant to walk away from you and pull the line down hand over hand. When the tension is thus slackened on the line, you can yourself walk forward and spin the reel in your hands, so taking in the line in exactly the same way as it was paid out.

Convector Heaters for the Modern Home

(*Concluded from page 187*)

tions and the toggle switch used should be of ample rating. For a 500-watt element use a 5-amp switch, and for a 1,000-watt element use a 10-amp switch.

The finished appearance of a home built article is sometimes neglected, but much more satisfaction comes from a job which is attractively finished. This heater was completed by first filing the rivets flush with the outer surfaces of the endplates and then going over the endplates with a rotary wire brush held in an electric drill to roughen the surface and hide the positions of the rivets. Rubbing with scouring powder on a damp cloth then produced a pleasant semi-matt silvery appearance. The cover, formed from a piece of expanded aluminium sheet 21in. × 10in., was secured to the $\frac{3}{8}$in. square side supports by self-tapping screws. This cover is in the natural aluminium colour, but the material is available in a whole range of colours to suit individual choice.

With modern materials and the ready availability and low cost of all the components required there is no limit to the variety of attractive heaters which may be made by the home handyman.

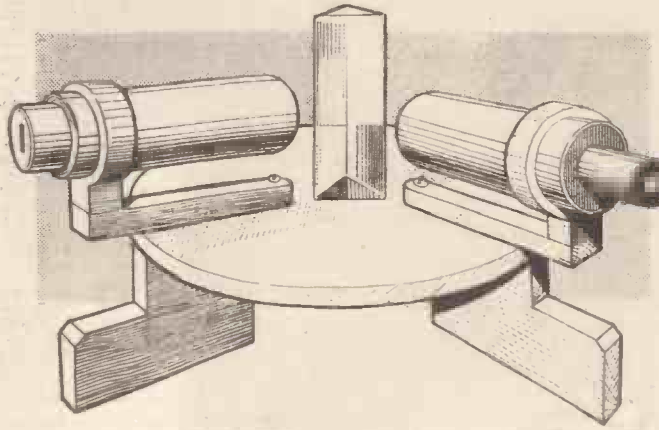
A SPECTROSCOPE

Simple Constructional Details for Making This Fascinating Instrument

By B. C. CONDOR

THE spectroscope described here and shown complete in Fig. 1 may be made at a trifling cost, and will be found a most fascinating and instructive instrument.

Fig. 2 shows the optical system, of which the most important item is the prism. This consists of one of the triangular glass "lustres" to be found on early Victorian vases and chandeliers, and which may be picked up at most antique dealers for a few pence. The lower end will probably have a fancy point. This should be broken off, leaving the plain triangular piece which makes an efficient and inexpensive substitute for a real prism.



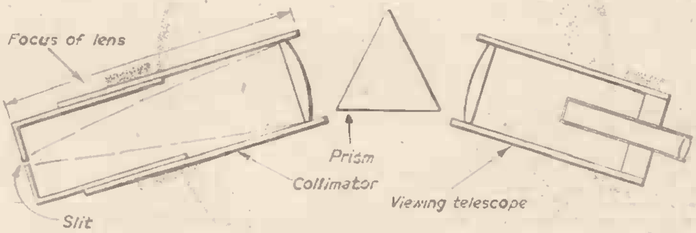


Fig. 1.—The instrument assembled and ready for use.
Fig. 2 (Right)—The optical system.

Construction

Begin the construction by cutting from ½in. wood a circular table 6in. in diameter.

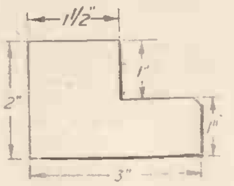


Fig. 3 (Left)—The shape and dimensions of one of the feet.

At the centre of this make a triangular hole which will make the lustre a tight fit. Cut 3 feet from ½in. wood to the measurements given in Fig. 3 and attach them to the table at equi-distant points, using glue and small nails. Then push the lustre into the opening in the centre of the table until the projecting half is 2in. high and exactly perpendicular.

The Collimator

To make the collimator (the left-hand tube in Figs. 1 and 2) you will require a plano-convex lens. This should be about 1in. in diameter, and the object glass from a discarded pair of opera or field glasses will suit perfectly. Measure its focus and make or obtain a cardboard tube 1in. shorter and of a diameter as will admit the lens tightly at one end. Make or obtain another shorter tube which will slide within the first, and close the end of this with a thin cardboard disc in which has been made with a sharp penknife a vertical slit ½in. long. Make sure that the joints in the tube are light-tight; no light must enter except through the slits, which, by means of the sliding tube must be brought to the exact focus of the lens. Details of the tube support and radius arm are given in Fig. 4. The tube support is cut from ½in. wood, the size of the opening corresponding to the size of tube used. It is glued in position at the end of the radius arm which is ¼in. thick, the other end of the arm being attached to the table with a round headed screw. This allows the angle which the collimator makes with the prism to be adjusted.

The Viewing Telescope

The viewing telescope is simply a small telescope for magnifying the image of the spectrum and if a small pocket telescope is available it may be used complete. Failing this one may be made as shown in Fig. 2, using the companion lens to the one used in the collimator. Make the tube the same length as other, but close the end with a disc of ½in. wood in which is cut a hole to admit the draw-tube. This is made of cardboard and contains a small double-convex lens, about ½in. in diameter for an eyepiece. The telescope is attached to the table in exactly the same way as the collimator and this completes the instrument.

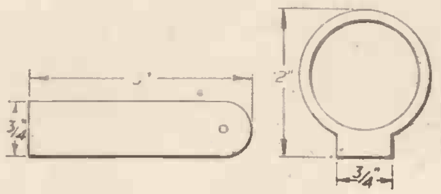


Fig. 4.—Fitting for mounting telescope and collimator.

Viewing

A candle flame in a darkened room is best for this purpose. Place the candle a few inches away from the slit in the collimator—taking care that the slit is vertical—and adjust the instrument by changing the angle of the arms and sliding the collimator and telescope draw-tubes until the clearest image of the spectrum is obtained in the viewing telescope.

Two Problems About Trains

When Trains Meet

THIS is an old chestnut which still catches a number of people. A train leaves Glasgow for London and travels at an average speed of 50 m.p.h. At the same time a train leaves London for Glasgow, and travels at an average speed of 60 m.p.h. When they meet, which train will be the nearer to Glasgow?

A lot depends on the manner in which the puzzle is told. It is obvious that if the trains meet, they will both be exactly the same distance from Glasgow!

This, of course, assumes that the trains are considered as mathematical points. In actual practice, when the engines meet, the tail end of the Glasgow train will be nearer Glasgow. Only when the trains are side by side will their distances from London and Glasgow be equal.

Counting the Trains

ALTHOUGH this is apparently a straightforward arithmetical problem, the solution often evokes some perplexity. A train leaves Eastown for Westown every minute, and similarly, a train leaves Westown for Eastown every minute, the journeys, in every case, taking one hour. A train leaves Eastown at 8 a.m. How many trains coming from Westown does it pass?

The correct answer is 119.

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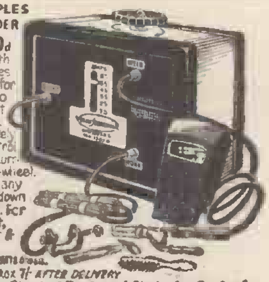

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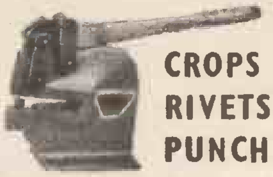

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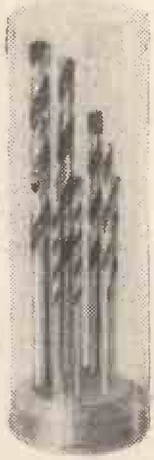

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Letters to the Editor

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

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

Scooter and Cycle Braking

SIR,—May I add my views upon the question of braking appearing in the November issue of the "Cyclist" (page 5)?

The instructions to the Metropolitan Police on this matter seem to be somewhat farcical as, on the whole, they appear to suggest that the cyclist, or "scooterist," can choose his particular portion of the road before using his brakes, according to paragraph 2.

Their idea of maximum braking being applied to the front wheel is cut right through by the emergency instanced in paragraph 3, and by many instances in practice.

It is, also, further stressed in their paragraph 4.

Regarding paragraph 5, as a practical cyclist of many years experience, also from an engineer's point of view, I would say that the suggestion of 75 per cent. and 25 per cent. rear braking is entirely wrong, since the front forks being in the form of a cantilever, a heavy braking effort tends to flex them and puts a heavy stress upon the fork crown.

This gives rise to the well known symptom of "juddering" and violent vibration which, in addition to being uncomfortable, can be really dangerous and I am in agreement with yourself as to the disposition of the braking loads, particularly in the case of emergency braking since, as the rear carries the greater weight, it therefore has the greater braking effect before slipping on any surface.—J. I. GEORGE (Brighton).

The Mantell Incident

SIR,—I am surprised at the theories put forward in an attempt to explain away the most wonderful flying vehicle the world has ever known.

The superb manner of movement and the absolute effortless ease of manœuvrability coupled with trouble-free acceleration is quite obviously indicative of a kind of propulsion which stands in a class of its own—a form of propulsion which will become known as "G" propulsion.

On that fatal day Capt. Mantell was in fact investigating the presence of a "G" propelled plane, which originates from some country on this earth of ours.

The scientist and technician alike are aware of the meaning of "G" force and how it will always remain a hazard to conventional aeronautic practice. The "Flying Saucer" is no more mysterious, in that it utilises "G" force as a powerful propellent, or rather a powerful "pulling force."

The "Saucer" is specially designed and operated so as to reverse the direction of the "G" force which it itself creates.

Just as the technician knows that "G" force is a tremendous drawback to high acceleration, so should he be aware of the overwhelming advantage given when the direction of "G" force is reversed.

It has been said that no human being could live under such terrific acceleration as has been observed in the "Saucer." Such statements are obviously based upon the fact of what would happen were a conventional plane subjected to such acceleration.

By reversing the direction of "G" force, the "Saucer" always has "G" force in the lead, thus when the "Saucer" accelerates with sudden very high speed, the "G" force created does not pass through the machine but is away ahead of the machine acting as a powerful "pulling force."

Of course the real reason why the "Saucer" is not understood is simply because conventional aeronautic technology and "G" propulsion technology are two entirely different fields.

Reversal of direction of "G" force is easy to achieve, and when Whitehall and the Pentagon realise this, they will, in a very short time, be in a position to challenge the "Flying Saucer."—V. A. MILBURN (Sittingbourne).

[*We are sure our readers will wish to comment.*—ED.]

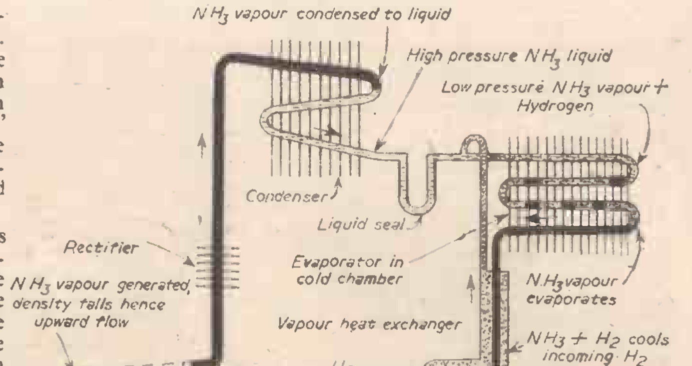
The Paraffin Flame Refrigerator

A Reader Replies to "Information Sought"

SIR,—Your correspondent, G. Lewis, under the heading Paraffin Flame Refrigerator in "Information Sought," refers to the Electrolux Refrigerator which is a patented design, I believe.

I think G. Lewis would find the construction of this type of refrigerator quite difficult, as the whole unit is sealed and the amount of hydrogen must be such that a suitable pressure drop is achieved without causing the liquid seal to break.

The liquid used is ammonia solution (NH_3) and the gas is hydrogen (H_2). The diagram shows the principle of operation.



Mr. W. R. Podmore's refrigerator drawing

Weak NH_3 solution (or water) flows from the generator to the absorber, since level of liquid in the generator is higher than in the absorber. The total pressure to the left of the liquid seal is due to NH_3 only, and the total pressure on right of seal (by Dalton's law of partial pressures) is due to NH_3 and H_2. Thus, in the evaporator, NH_3 is at a low pressure and can pick up heat from a low temperature.

In this case the hydrogen is an inert gas, since it reacts neither with the NH_3 or the water, but merely enables a drop in pressure of NH_3 to be produced. I hope this will answer Mr. Lewis.—W. R. PODMORE (Scunthorpe).

MORE LETTERS ABOUT THE STEAM CAR

SIR,—I have read with interest the many articles and letters on the above subject which raises the question as to whether it is possible to design a steam car capable of competing in road performance and general economy with its internal combustion-engined counterpart, and whether there is a potential market large enough to warrant the production of such a vehicle, not forgetting, of course, the opposition likely to be encountered by the enormous amount of capital already sunk in the production of the modern motor car.

The history of the steam-driven road vehicle dates back for more than a century, but real development appears to have begun about the year 1900, and for a time serious competition to the petrol car was offered by such manufacturers as White, Stanley and Serpollet who, towards the decline of the light "steamer," had evolved small units of 10-20 h.p., equipped with oil-fired semi-flash boilers, condensers, automatic water and steam pressure controls. Those who have had the pleasure of driving some of these vehicles will recall with delight the feeling of smooth, silent power at all speeds when the throttle was opened and will regret that the "steamer" died in its early youth, and wonder on the causes of this decline.

The causes were many and varied. The general public viewed the "steamer" with fear and mistrust, they disliked the idea of sitting in close proximity to a boiler which, so they thought, might blow up at any moment with disastrous results, the annoying delay of anything from 10 to 20 minutes when starting from cold, but the most serious cause appears to have been their exclusion from entering competitive events with their rivals, powered by the I.C.E.

Everyone, I think, will agree that road and track racing, hill climbs, speed and distance records, were largely responsible for the rapid development and popularising of the petrol car and have helped in no small measure in raising the industry to the position it occupies to-day. Had the "steamer" been allowed to compete in open competition and events of this nature, continued research and development would have been assured, and doubtless cold starting and other disadvantages, real and imaginary, would no longer exist.

During the war, when enemy submarines seriously threatened our very existence and we had to resort to inefficient gas producers to help our internal transport, many old "steamers" (goods vehicles) were recalled from semi-retirement and did yeoman service. Unfortunately there were less than 800 on the road in 1939. This small number compared with some 9,000 in 1927 was mainly due to the fact that sufficient incentive for development had ceased at an earlier stage, with the resulting failure to keep up with technological progress.—G. F. BALL (Southampton).

SIR,—Much has been written in your magazine's editorial columns about steam cars and their pros and cons, while Mr. C. A. Oldroyd (June, 1957, issue) has dealt with the idea of a "Com-car," I should like to comment further.

Do you remember the similar gas-plant cars and lorries, the speed of which was comparable to that of snails? Moreover, as the pressure inside the gas-cylinder became low, it markedly affected the speed of the car. Who is going to deal with that problem? Technology is not far enough advanced to deal with this matter successfully.

We should not forget that it is the age of I.C.B.M's and space travel, not forgetting the Russian satellite!

Anything done in reviving these old ideas would be a sheer waste of time—it would be just like reviving triodes and demountable valves.

Why not pay more attention to the advanced idea of indirect propulsion? If we are successful in harnessing fission-energy, the great oceans will become our energy reservoirs. — GANDHARVA RAJ CHANHAN (India).

A Large Ukulele

SIR,—I would like to comment on the article "A Large Ukulele" in the November issue of PRACTICAL MECHANICS.

In my opinion the use of celluloid for frets would soon lead to disappointment since the steel strings would cause rapid wear. Even with conventional fretwire wear *does* take place and can eventually lead to re-fretting . . . so Mr. Powell's suggestion of brass strip as an alternative would be much more satisfactory.

The least troublesome solution of all would be to buy some guitar fretwire, which is specially made for the job, and this is obtainable at about 4s. per yard (in yard lengths, and made of nickel) from The Clifford Essex Music Co., Ltd., 8, New Compton Street, London, W.C.2.—J. POCOCK (Wolverhampton).

Materials for Rubber Masks

SIR,—Re the query from Mr. Eugene B. Chape and your reply in the November, 1957, issue, I suggest he contacts the Dunlop Rubber Company for material needed for rubber masks. I am sure they will advise on the type needed. About three years ago I intended making similar items myself and I suggested metal moulds to them: they told me these were not needed, plaster being suitable. I was offered the rubber in one gallon cans at the time.—E. RUDD (York).

Double Bunk Beds—Wiring Fault

We regret that a wrong reference in Fig. 2, if acted upon would render the wiring of the double bunk beds contrary to I.E.E. Regulations. The reference concerned reads "To two-pin socket fixed to back of headboard." This should be "To two-pin *plug* fixed to back of headboard." As published, the inference is that the mains lead will carry a "live" two-pin plug.

About Lending Your Tools

By OUR LAWYER

MANY a man, among them this present writer, dislikes to lend his fountain pen; many a man, and there is here reason for the reluctance, dislikes to lend his greatly cherished working tools. However, reluctance is often overcome by kindly feeling towards one's neighbours, and we do lend a helping hand—and a helping tool. At times we wished we hadn't: "I lent my plane to my friend," one of our readers writes, "and he returned it in a deplorable state. I am not making a fuss about it, but I should like to know what the law says when borrowed things come back damaged."

Well, the law says a good deal about the liability of a borrower. The question has often arisen; for he is a curmudgeon that will not on occasion help his neighbour out of a jam. You lend though you dislike to lend, and though you know that you run these two risks. You may find the tool much impaired when it comes back, and you may find a difficulty in getting the tool back.

As for the first, unless you can show that the borrower was greatly wanting in care and skill when using the tool you have no remedy at law. The borrower may well think that he ought to make good the loss you have had; but you cannot compel him to do so. The borrower's liability does not cover a loss from reasonable use, from "wear and tear." We may, indeed, sum up a borrower's obligations in this way: he must care for the thing borrowed as a prudent man would; he must not use it for a purpose other than the one for which you lent it (you lend a book to be read, not to be a receptacle for the borrower's comments; you lend your razor for shaving, not for cutting firewood); he is not to lend it to another; and he must return it at the agreed time or when required.

The other risk, that you will not get back what you lent, is negligible among neighbours; but it does exist. An unfaithful borrower may sell or pawn your property. We speak here, you appreciate, about the loan of things to be themselves returned, a bit the worse for the wear for which you gave your licence, but identifiable still. We are not speaking of a money loan. If—your heart being large and your power to resist importunity small—you replenish the empty pocket of a borrower like Sir John Falstaff, you are likely to whistle for your money. You certainly cannot require a return of the very pound note you handed over; that has speedily found a new owner. The borrower is indebted to you for the amount you lent, not for the coins or notes.

In one respect the position of the chattel you lend, the book or the tool, is less desperate. The pound note ceases to be yours as soon as it gets into the hand of one that takes it in good faith and for value. Not so the book: you only can divest yourself of its ownership. If the borrower, abusing your trust in him, sells the book to Mr. Jones, you ask Mr. Jones to return it. And he does return it, ruefully reconciling himself to a remote chance of getting from the unfaithful borrower what he paid. We should note, though, that the Limitation Act, 1939, created a new peril for the lender: his ownership goes if he should leave the book or other chattel unclaimed for over six years.

One further point, by no means negligible, is this. You might be held liable for an accident arising from the use of the borrowed tool. You certainly would be if a defect rendered the tool dangerous, and you gave no warning of the defect.

TRADE NOTES

A Review of New Tools, Equipment, etc.

Patay Pumps

THE PN series of rotodynamic hand pumps are manufactured by Patay Pumps & Turbines Limited, Horton Parade, West Drayton, Middlesex. There are two models, the PN10, which is a high head pump (max. dynamic head 120ft.) with a suction lift of 30ft. Maximum discharge is 40 gallons per minute. When pumping water at 190 deg. F., it has a minimum suction lift of 5ft.

The PN15 medium head pump (max. dynamic head 60ft.) is suitable for suction lifts of under 20ft. and has a maximum discharge of 70 gallons per minute. Prices of these two pumps are £25 8s. and £25 12s. 6d. in aluminium alloy, and £32 5s. and £32 10s. in gunmetal.

The "Bullfrog" rotodynamic hand pump is primarily designed as a bilge pump for use at sea, but has many land uses also, such as emptying water from sumps, etc. It is capable of a discharge rate of up to ¾ ton per minute and while not being a general purpose pump is very versatile. The price is £33 10s. in aluminium alloy and £37 12s. 6d. in gunmetal.

One of the PN series of handpumps.

Descriptive leaflets and all further information are available from the makers at the address above.

"Fraxite" Fireback Cement

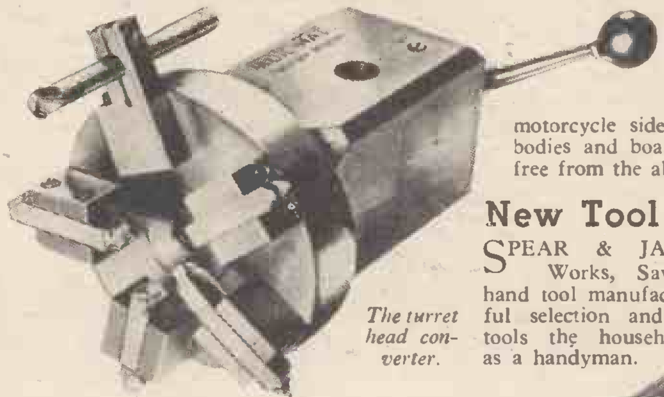
THIS fireback cement is a new addition to the range of refractory cements produced by the Carborundum Company Ltd. Alumina, which is capable of withstanding temperatures of 1,000 deg. C., is one of the ingredients used and Fraxite should, therefore, be more than adequate for use on the domestic grates for which it is designed.

Household grates, stoves, boilers and the fitting of all-night burning grates come within its scope. It will give a permanent rock-hard joint which will be proof against heat, flame and the wear and tear from sharp-edged coal.

The price is 3s. for a 2lb. tin.

New Turret Head Converter

LATHE operators frequently have to carry out several different operations in rapid succession with the minimum loss of time.



The turret head converter.

The new Swiss-designed HSR Automat Turret Head, distributed by Insley Industrial Supply Co. Ltd., 21-22, Poland Street, London, W.1, provides the solution to this problem. It can turn any ordinary centre lathe into a turret lathe. The HSR Automat Turret Head, shown in the photograph, is available in six sizes, selected to make the attachment fit practically all standard lathes in general use. Prices range from £49 10s. to £69.

Simplicity of construction is among the outstanding features; another is ease of operation. With a single level movement, carried out with one hand, a new tool is brought into working position. A further advantage is the ease with which tools are accurately set to centre height by means of a setscrew. The Turret Head is equally suitable for turning, facing and undercutting, since it is mounted on the compound rest and describes all its movements.

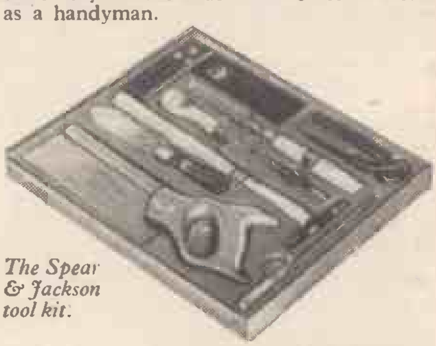
A descriptive leaflet can be obtained from the distributors.

Bondaglass Handbook

FROM Bondaglass, Ltd., 55, South End, Croydon, Surrey, we have received a handbook which describes glass-fibre and its uses for the handyman. In addition to all the useful information given on the material itself, the use of Bondaglass is described for making a draining board, a motorcycle sidecar, a scooter screen, car bodies and boat hulls. It costs 2s. post free from the above address.

New Tool Kit

SPEAR & JACKSON LTD., Aetna Works, Savile Street, Sheffield 4, hand tool manufacturers, have made a careful selection and grouping of just those tools the householder needs to function as a handyman.



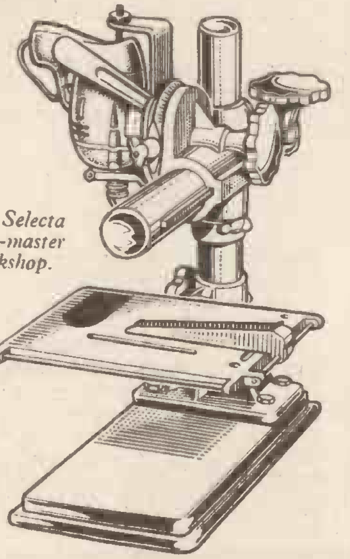
The Spear & Jackson tool kit.

Handyman Kit No. 1 contains claw hammer, cabinet screwdriver, wood chisel, combination pliers, handled file, gimlet, junior hacksaw, cold chisel, paint scraper, spring tape, carpenter's pencil.

Handyman Kit No. 2 contains Pin hammer, tenon saw, wood chisel, tri-square, electrician's screwdriver, pincers, putty knife, bradawl, nail punch.

These kits are priced at 59s. 6d. and 62s. 6d. per set.

Selecta Home-master Workshop

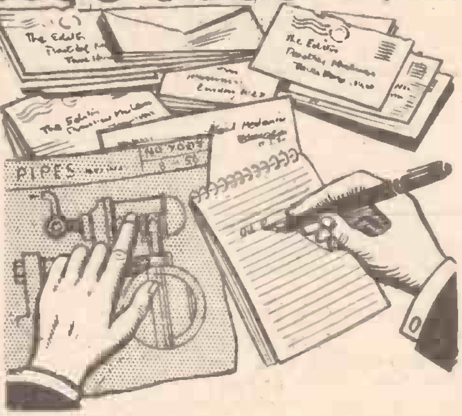


The Selecta Home-master Workshop.

THIS is a combination power tool capable of carrying out a large number of operations for which normally an equally large number of tools would be necessary. The power source can be any of the popular types of ¼in electric drills or alternatively the new specially designed Power Pak HPM 1. This costs £10 9s. 6d. or combined with the basic Selecta home workshop, £24 19s. 6d. The basic unit is capable of the following operations: ripsawing, crosscutting, grooving, scarfing, mitring, undercutting, drilling, routing, grinding and polishing. A large range of attachments is available which will extend the range of the unit. Included are a lathe attachment, flexible drum sanding attachment, jigsawing attachment, box combing attachment, universal spindle moulding attachment, copying former attachment, planing attachment and dovetailing attachment.

The makers are Selecta Power Tools Ltd., 116, Victoria Road, Willesden, London, N.W.10.

Your Queries Answered



Oxidised Copper Bronze Finish

I HAVE an anthracite stove fitted in my caravan, the outer casing of which was oxidised copper-bronze. Unfortunately, water was spilt on it while it was hot and stained the finish, so I cleaned off all the oxidising down to the bare copper. However, immediately the fire was lit it became dull and tarnished and near the fire box there is a patch which is blackish. If the casing must be properly oxidised to keep itself clean and smart, how can this be done?—M. H. J.—(Leighton Buzzard).

THE "oxidising" (it is really a process of sulphuring) of copper is quite a straightforward process. The copper must be rendered perfectly clean and free from lacquer or other protective deposit by careful treatment with fine sandpaper which will leave the metal surface clean and bright. It is then brushed over with a hot solution of one part of sodium sulphide in five parts of water. This treatment will immediately "oxidise" the surface by turning it a dark brown/black and rendering it tarnish-proof. The actual surface coloration of the copper will depend mainly on the concentration of the sulphide solution.

The blackening of the copper caused by the water being spilled on the hot metal was a true oxidisation which, in our opinion, has a better appearance than a sulphurisation. If you want to imitate this appearance again, it will be advisable to have the casting properly blackened and lacquered. This can be done in the polished copper state. It is not necessary for the casting to be bronzed first, but it is usually sulphur-bronzed.

Handling Gold Leaf

WHEN making or repairing gold leaf electroscopes I invariably find the greatest difficulty in fixing the gold leaf itself. I have found that I can shape it with a pair of sharp scissors, but the subsequent attaching of it to the instrument is most difficult. Can you suggest a method?—R. E. C. Davies (Kent).

GOLD leaf for decorative purposes is cut with a special knife. For cutting it is laid on a chamois leather cushion plentifully sprinkled with rouge. When cut to size and shape the leaf is lifted with a gilder's tip—a wide, very thin brush of fine badger hair which is rendered somewhat greasy, for adhesive purposes, by stroking it on the operator's head. This applies, of course, to loose gold leaf. The operation of applying leaf to the electrodes of an electroscope would require a particularly steady hand, but it could be done with a gilder's tip. If a thin film of Japan gold size or oil gold size is used, there is no reason why the leaf must be lifted; if the leaf were moved to the edge of the cushion the electrode could be gently lowered on to the leaf and, owing to the gold size, the electrode would pick up the leaf.

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.

An Episcope

I WISH to make an episcope. Can you assist on the following points?

(1) What is a convenient size for the body? (2) Is there any advantage in the fitting of condensers? (3) Where and at what angle should the mirrors be fitted?

The main use of the instrument will be for the showing of postage stamps, and for this I need critical definition. I should also like to use it for the projection of small photographs not larger than 3½in. by 2½in.—C. F. Garner (Kent).

IF the instrument you wish to make is to be used to project on to a screen pictures and objects, or the images of the latter, then (1) the size of the body will depend upon the maximum size of such pictures or objects. It will also depend to some extent upon the size and focus of the projection lens. If the lens is small and of short focus, then only small objects and pictures can be projected and the whole instrument will be diminutive. So, it will be seen that everything depends upon the lens you are going to use. The ideal lens is one of about 12in. focus working at a full aperture as large as possible.

(2) Condensers cannot be used unless the pictures are transparent, like lantern slides.

(3) If the picture or object to be projected is to be laid upon the bottom of the episcope at right angles to the optical axis of the projecting lens then the mirror will be mounted at an angle of 45 deg. to the bottom and to the axis.

Referring again to the matter of a condenser, the statement above only implies that such an arrangement as is used in magic lanterns is impracticable, but for throwing a concentrated beam of light upon tiny objects, pictures and, particularly, postage stamps, it would be a very great advantage to use a single lens, such as a reading glass, of about 3in. diameter and, say, 12in. or 15in. focus, and let *all* the light from the lamp be brought to a focus on the stamp through this lens.

If the postage stamps could be mounted vertically on a board, such board being either painted black or covered with black velvet, no case to the apparatus would be needed, only the said board, another board or panel carrying the projecting lens, and a metal tube with the reading glass at one end and the lamp at the other. All focusing could be done by moving the several components.

Inscribing on Glass

COULD you please suggest a method of etching calibration lines and numerals on the glass barrel of a hypodermic syringe?—G. F. Poulton (Manchester).

A SIMPLE method of etching numerals and lines on glass is to coat the glass uniformly with, say, a 20 per cent. solution of ordinary shellac in spirit then, after the spirit has evaporated inscribe the lines or figures by means of a fine stylus on the film of shellac left on the glass. The shellac film is then mopped over with dilute hydrofluoric acid and left to stand a few minutes. The hydrofluoric acid attacks the glass potently. It is then flooded off with water and the shellac is removed by a mop immersed in spirit. The inscribed lines are thus engraved in the glass. To render them more prominent they may be filled by means of the hard black wax used by clockmakers for filling dial numerals. This material can be obtained from any dealer in clockmakers' requisites, such as E. Grey & Son, Ltd., 18 and 20, Clerkenwell Road, London, E.C.1. Hydrofluoric acid (dilute) can be obtained conveniently packed in special drip containers from Messrs. Oswald M'Cardell & Co. Ltd., Sudbury Hill, Harrow, Middx.

Preserving Shed Floor and Roof

I HAVE completed building a shed in softwood and the outside will be painted for protection. What is the best method of preserving the underneath of the floor? It will be supported off the ground by bricks to keep an air space underneath. The roof of the shed will be covered in the usual roofing felt. What is necessary to keep this in waterproof trim? I notice that often it is coated with a type of tar, but I would like to paint mine aluminium.—M. H. Jones (Beds).

THE simplest and most straightforward method of preserving the under-surface of the floor which you describe is to give it a good brushing over with hot creosote every twelve months or so. A very effective protective coating would be a solution of one part of zinc naphthenate in five parts of white spirit or solvent naphtha. This material can be obtained from Messrs. Thos. Tyrer & Co. Ltd., Stratford, London, E.15. The preparation is one which is practically colourless and which is non-staining to white woodwork and other light coloured surfaces. For general simplicity and straightforward ease of application there is, however, much to recommend the creosote treatment, particularly if the woodwork is likely to be exposed to the effects of damp and wood-boring beetles. To keep your roofing-felt in good waterproof trim, impregnate it with the solution of zinc naphthtnate above mentioned. Then paint it lightly with ordinary aluminium paint. A final brushing down with the zinc naphthenate solution will complete the treatment as well as conferring on the roof added protection from weather.

Specific Gravity Calculations

PLEASE tell me how to calculate the percentage of water in liquid heavier than water knowing that commercially pure liquid is of spec. grav. 1.26 and with water 1.20?—W. T. F. (Leeds).

THE specific gravity of a mixture of liquids is never the mean of the specific gravities of the ingredients of the mixture. Hence it is not possible to calculate theoretically the specific gravity of a mixture of given proportions of liquids nor, conversely, from a known specific gravity of an aqueous mixture, to calculate the proportion of water in the mixture. Problems such as these are usually overcome, in practice, by reference to Tables of Specific Gravities in which the specific gravities of a long range of specified mixtures of varying compositions are listed. The problem can also be solved by plotting on a graph the specific gravities of a comprehensive range of mixtures and then by referring to this graph when dealing with experimentally-determined specific gravities. There is, however, no comprehensive formula which will enable you to deal with the question on the purely theoretical lines which you indicate.

Perspex Windscreen Repairs

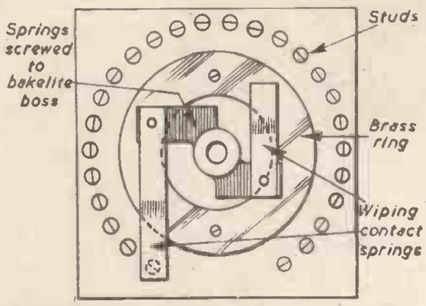
PLEASE tell me how to mend a split in the Perspex windscreen of my motor cycle.—R. R. Menneer (Salisbury).

IN order to mend your Perspex windscreen you will have to make up a thick solution of scrap Perspex. This can readily be done by pouring about 8 parts of trichlorethylene on 2 parts of Perspex clippings contained in a well-stoppered bottle. The mixture is left overnight and well shaken up in the morning. The Perspex will dissolve to a viscid, transparent, rubbery solution which can then be taken up between the finger tips and conveniently pressed into the cracks in the sheet Perspex and then, after drying a little, carefully smoothed off with a small knife blade. You will not get a perfect union by this method, but the crack will be adequately filled in and the appearance of the windscreen much improved.

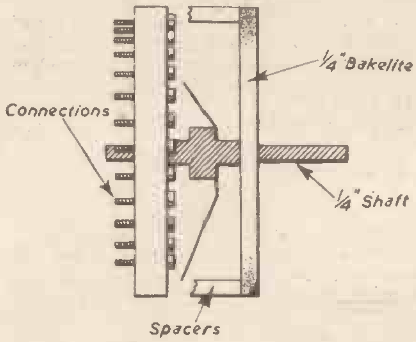
Motorising Sewing Machine—Switch Details

I HAVE read with interest your article in the November issue "Motorising a Sewing Machine" and was particularly intrigued by the foot control which I should like to use to control a small watchmaker's lathe. Please tell me where the geared switch can be obtained. I am fully conversant with the electrical side of the proposition.—W. Ware (Birmingham).

[The switch referred to was removed from ex-Government equipment many years ago and the source is not now known. However, the sketch below gives more details of the switch construction and there is no reason why such a switch could not be made up, using 6B.A. cheese head screws for the studs.]



The two springs are strapped together so that the brass ring is one connection and studs the other



Constructional details of home-made switch.

How Condensation is Formed

WILL you please explain how condensation is formed, i.e., what temperatures and state of atmosphere is necessary for its formation.—L. J. Roper (Glos.).

AIR acts like a sponge towards water-vapour. The less water-vapour which is present in the air, the more the air tends to absorb it and retain it. The warmer the air is the more water-vapour it absorbs. Now, when air is saturated with water-vapour it can hold no more, and it tends to deposit the water-vapour in the form of actual water on any cold surface with which it may come into contact. Hence it is that the warm air of rooms causes cold ceilings and other surfaces to "drip" the moisture absorbed by the warm air condensing itself on the cold surface. It is by this mechanism that the well-known phenomenon of "condensation" is produced.

Caustic Paint Removers and Galvanised Tank

I INTEND using an alkali tank for the purpose of removing old paint and cellulose from various metal articles. I have a galvanised iron tank which will hold approximately 100 gallons. Will you please advise me of the best (or most practical) alkali to use, the method of mixing and the usual proportions?—E. R. Hunnisett (Hastings).

THE best alkaline solution for dealing with old paint and varnish is a solution made by dissolving 1 part of caustic soda in 6-10 parts of water; but this solution or, indeed, any other solution of caustic soda, could not be stored in galvanised containers since the caustic soda would rapidly and powerfully attack and dissolve away the zinc of the galvanising. For all such solutions you would have to use an enamel tank or one made of glass, slate, iron or stainless steel. Tanks of this nature may be obtained in various sizes from Messrs. Wm. Canning & Co. Ltd., Gt. Hampton Street, Birmingham. An alternative supply source would be Messrs. R. Cruickshank Ltd., Camden Street, Birmingham, 1, or Hoklykem Ltd., Hokley Hill, Birmingham.

If it is imperative for you to use galvanised tanks, you will have to employ solutions of common soda (sodium carbonate). which solutions, unlike those of caustic soda, will not attack galvanised coatings.

Stencil Correcting Fluid

CAN you tell me how to make the filler that one uses to blot out mistakes in stencils cut in the typewriter?—A. Gable (Dartford).

THE usual stencil-filling of the type you mention consist merely of blended wax pastes combined with resin and frequently filled with varying amounts of fine, dry powders such as common whiting. They are not easy to make, but the following procedure will give you an indication of their preparation: Dissolve 10 parts of powdered resin in 90 parts of hot turpentine. Melt down together a mixture of about equal parts of ordinary candle wax and common beeswax and dissolve about 30 parts of the resulting mixture in 70 parts of white spirit. Whilst the solution is still liquid, pour into it with continual stirring the solution resin in turpentine in the proportion of 1 part of the resin solution to every 5 or 6 parts of the wax solution. The resulting solution will take the form of a creamy or whitish paste which can be rolled or otherwise pressed into the stencil and readily levelled off thereon. It will be fairly quick drying. If you think that the product could be improved by giving it extra body, heat it up again and stir into it about an equal amount of perfectly dry sieved common whiting. On cooling, the resultant product will have a putty-like consistency.

Information Sought

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

WHAT is the best method to use for recovering spirit that has become contaminated with paint and dyes, etc.?—H. G. RADFORD (Ilford).

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THE Cyclist
Editor : F. J. CAMM

VOL. XXVI JANUARY, 1958 No. 426

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

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WHAT I THINK By F. J. C.

That Russian Bicycle

THE Russians claim to have built the first bicycle in 1801 and they have circulated photographs of the machine, a replica of which now reposes in the Moscow Museum. Comparing this, however, with the original which is in Tagil, there are marked differences. The replica shows a bone shaker, and it appears to be without pedals, whereas the original has pedals. The machine is made of iron, including the rims with a wooden saddle of somewhat large size. As with the Macmillan machine, the saddle supports are also the springs. It has a 25½in. rear wheel, and a 43in. front wheel. Several Russian papers have commented on this and claimed that it was first seen in Moscow in 1801 which was the Coronation Year. We are told that it was built by a workman named Artamonov of Verkhoture, which is in the Ural district. To honour his invention, the Tsar released Artamonov from serfdom. The Russians claim that it was the first machine to use and include a front fork to provide caster or self-centring steering. The Russians, however, are not noted for the accuracy of details, and are not averse to altering history for national propaganda purposes. The machine itself bears too close a resemblance to British machines of a much later date. With British bicycles, facts and dates have been checked and verified by numerous cycling historians and particularly by the late H. H. Griffin, who wrote the classic history of the bicycle.

It seems somewhat strange, in view of the great publicity given to the Centenary of Macmillan's invention, that the Russians, have remained so quiet about it, and, failing more accurate records from the Russians, the world will, I fear, continue to regard Macmillan as the first inventor of the pedal-propelled bicycle. Originally, one Gavin Dalziell, a Scotsman, claimed the credit, but his machine bore a remarkable resemblance to Macmillan's and it was only through the researches of Griffin that the credit was rightfully accorded to Macmillan many years later. Dalziell was compelled to admit the justness of this decision, and it seems impossible to believe that he was unaware of Macmillan's machine. Perhaps a native and natural conceit persuaded him to keep dark about it. He loved to bask in glory, even though he was not entitled to it.

Amalgamation Again!

THE Road Times Trials Council has issued what it calls a statement for the guidance of clubs in rebuttal of the propaganda put out, by the British Cycle Racing Movement, designated as "self-constituted," whatever that may mean. The RTTC is a self-constituted body and so are all the other bodies. This propaganda invited clubs to take action in favour of amalgamation between the NCU, BLRC and the RTTC. They suggest that amalgamation will enhance the status of cycling, effect substantial savings, remove dissention, produce agreed categories, provide one set of rules and give rise to increased international competition which can accrue only from amalgamation. The RTTC opposes this and says, in effect, that an enhanced status can be achieved equally well through a joint committee, under agreement as under amalgamation. This statement is specious and fatuous, and there is nothing in the previous history of such so-called joint committees to support such a belief. Whenever joint committees meet on controversial topics, there is dissention and failure to reach agreement; even if agreement is reached, the agreements are broken when it suits one or more of the parties to do so. Had the RTTC possessed a longer memory, even of recent events with the NCU and the BLRC and itself, it should know that such a scheme could never work. It would be almost impossible to get the three bodies to agree on all subjects. Regarding lower subscription, it says that the structure which can bring this about and yet deal with three major branches of cycling sport has never yet been broadly outlined, much less defined. This statement is meaningless. Obviously, an initial meeting would be necessary to discuss such details with the object of effecting this. What the statement really means is that the RTTC wishes to paddle its own canoe and retain its identity.

"Is it suggested one national council will suffice, although the delegates expert in all three sports are very rare? Is it suggested one national committee will have time to deal with all the affairs of a unified body? If single councils were set up, certain evils would tend to arise. There is waste of time for some whilst the affairs of others are considered. There is the loss of the enthusiasm of the specialist in this particular sport. Apathy results: more frequent meetings to get through the business are likely to be needed. The work of the honorary officials will be increased and it will become even more difficult to find volunteers. It may be necessary to replace honorary workers with paid labour, nationally and locally."

The answer to these questions is that offices have to be taken and a competent secretary appointed with a knowledge of the various branches of the sport and supported by an equally knowledgeable committee. Of course, it is suggested that one national committee will not have the time to deal with the affairs of the unified body. It should not be run on a shoestring from the corner of a kitchen table, like the RTTC for example. Regarding waste of time, it should not be beyond the wit of intelligent people to have a tripartite committee, with a representative on each from the other two. Regarding volunteers, whilst these are always acceptable, there should be adequate paid officials. The point which has been overlooked by the RTTC is that if amity and sportsmanship permeated the committees of the three bodies the need for amalgamation would never have arisen.

"It was long ago proposed and agreed that the existing duplication of certain services should be avoided. The obstacle which has prevented the arrangement has been the constant attempt to secure amalgamation. It is presumed the total cost of a unified body would be recovered by a single subscription scale levied upon everyone. Assuming total costs do not increase, those individuals at present members of all three organisations might benefit, but only at the expense of everyone else."

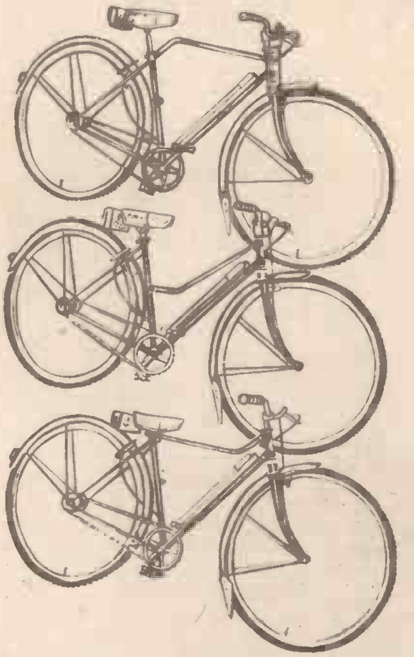
All subscriptions are at present far too low compared with pre-war levels and should at least be doubled. Those who want sport must pay for it.

Whether amalgamation finds favour or not, and it has been mooted several times during the past quarter of a century, is for cyclists themselves to decide. Those opposed to it are so because they still wish to retain their identity, and not submerge it to other bodies. They are in favour of amalgamation if they themselves absorb the others.

Thus, lobbying and jockeying by the various partisans will continue. We do not think that the sporting bodies are likely to win this battle. My own solution is that someone should settle the problem by calling a meeting to finalise the matter under the ultimatum that if agreement is not reached, a new body will be formed. If cyclists analyse the position, they will realise that the opposition to amalgamation comes from but a mere handful. At the present rate of declining memberships, in a few years there will be nothing to amalgamate!

Three Bicycles in One

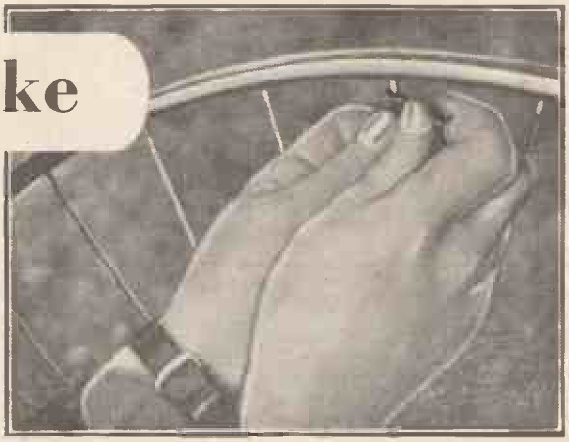
A BRITISH bicycle manufacturer has built a bicycle for young people which by means of a single detachable top tube provides a choice of two different crossbar heights for boys or an open frame model for girls. The whole object of this ingenious invention is to provide a safe bicycle for the youngster to ride while at the same time providing an economical buy for the child's parent, because the bicycle will last



through many years in the life of the growing child and will, in fact, grow with him. The bicycle can be used by the average child from the age of eight or nine, up to well into his or her teens.

Wheel Truing and Spoke Replacement

How to Do It At Home



A SINGLE broken spoke in a cycle wheel is not a serious defect in itself, but it may lead to much more serious trouble. Broken spokes can remain undetected for some time before the weak spot

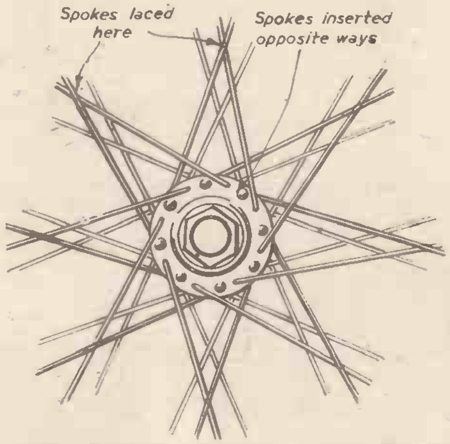


Fig. 1.—The tangent spoked wheel.

in the wheel causes strain on other parts of the wheel, more broken spokes and a wheel seriously buckled. In a tightly laced racing wheel, however, a single broken spoke can throw the rim seriously out of true, and it is not unusual for the lightweight tourist to carry a stock of replacement spokes round with him.

When spokes break, without the machine being involved in an accident, the fracture usually occurs either at the bend by the head of the spoke or at the threaded end where it enters the nipple. If this occurs when out on a ride, the broken end can either be twisted round some of the other spokes to prevent the end striking the forks as the wheel rotates, or the broken end twisted into a handle and the threaded end unscrewed from the nipple.

Make sure, when buying spokes, to replace broken ones, that spokes of the right length are purchased and of the right gauge. Endricks are usually spoked with plain 14 gauge, while lightweight wheels are spoked with double-butted 15/17 gauge. The easiest way to measure the length is to match spokes against existing ones, or if the hubs and rims are standard, the dealer will probably know what spoke length is required. Wheels are almost invariably tangent spoked (see Fig. 1).

To get the spoke in position in the wheel correctly is merely a matter of matching it up with the others. Notice that each spoke is inserted in the hub in the opposite direction to the previous and following ones and that it is laced behind the spoke which it crosses a few inches along its length (see Fig. 1).

Once the replacement spoke is in position, the nipple is screwed on with a screwdriver in the slot in the head and finally tightened by means of a spoke key, several designs of which are available.

Truing the Wheel

In the absence of a proper wheel-building jig, the forks of the cycle can be used to mount the wheel for truing. Lock the wheel in position firmly and spin it, holding the thumb on the brake block to detect sideways eccentricity in the rim. An aid to this is to chalk the brake block so that the chalk marks the rim where it touches the block. This set-up is shown in Fig. 2. When one spoke only is being replaced, it will usually be found that tightening or loosening the new spoke will true the wheel properly. Remember that the wheel must not be trued by tightening spokes only, or part of the wheel may become strained. Spokes on the other side of the wheel must be loosened so that tightening can pull the rim over, unless, of course, the spoke being tightened is already slack.

When the wheel is true, the protruding end of the spoke in the nipple must be filed off flush in the well of the rim. A small three-cornered file is best for this (see Fig. 3).

Fig. 2.—The set-up for wheel truing.

When spokes break on the sprocket side of the rear wheel, it will be found necessary to remove the sprocket before spoke replacement can be made.

Temporary Repairs

When on a long ride, and proper tools are not available, makeshift repairs can often be carried out to enable the ride to be completed. For instance, spokes can be inserted the wrong way round to avoid removing the sprocket and tightened to pull the wheel true. Spokes of the wrong length will often last long enough to get the rider home, and if no file is available to trim the end of a replacement spoke, it can often be padded sufficiently to prevent it from puncturing the inner tube. However temporary the repair, it is unwise to insert spokes in a wheel without removing the tyre and tube. This is often done when the spoke breaks near the head and is unscrewed from the nipple and replaced with a new spoke, by pushing the nipple up into the rim and then screwing it back into position on the thread of a new spoke. The danger, of course, is of adding a puncture to your other troubles.

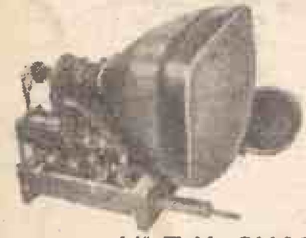
Sometimes when a wheel has sustained a severe knock, the same spoke will break repeatedly, due to the fact that the rim has "sprung," i.e., even after being pulled back into truth by a new spoke, it tends to jump back to the distorted position, breaking the replacement spokes when doing so. This can sometimes be cured by using heavier gauge spokes as replacement, but some riders claim that this is false economy, and the only cure is respoking with a new rim.

If the rim has been so badly buckled as to sustain a definite kink, there is no cure. The rim cannot be trued and the brakes will never be able to function efficiently. A new rim is the only answer here.

"Dishing" the Wheel

When a derailleur gear is fitted, it is necessary to adjust the spoking to bring the rim over the centre of the rear ends of the cycle instead of the centre of the hub. This is done by loosening the spokes on the plain side of the hub and tightening those on the freewheel side by a similar amount. If care is taken to start the adjustments at the valve hole and to ensure that every single spoke on either side is treated exactly the same, there should be no need to re-true the wheel.

Fig. 3.—Filing the spoke ends



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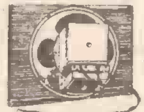

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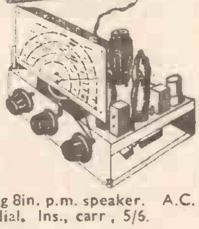

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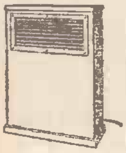

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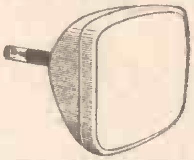

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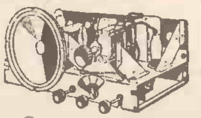

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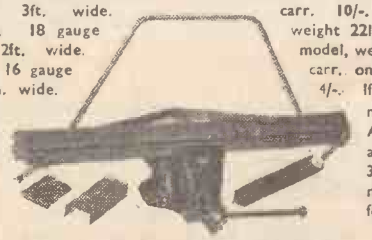

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