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PRACTICAL MECHANICS

EDITOR : F. J. CAMM

JUNE 1958

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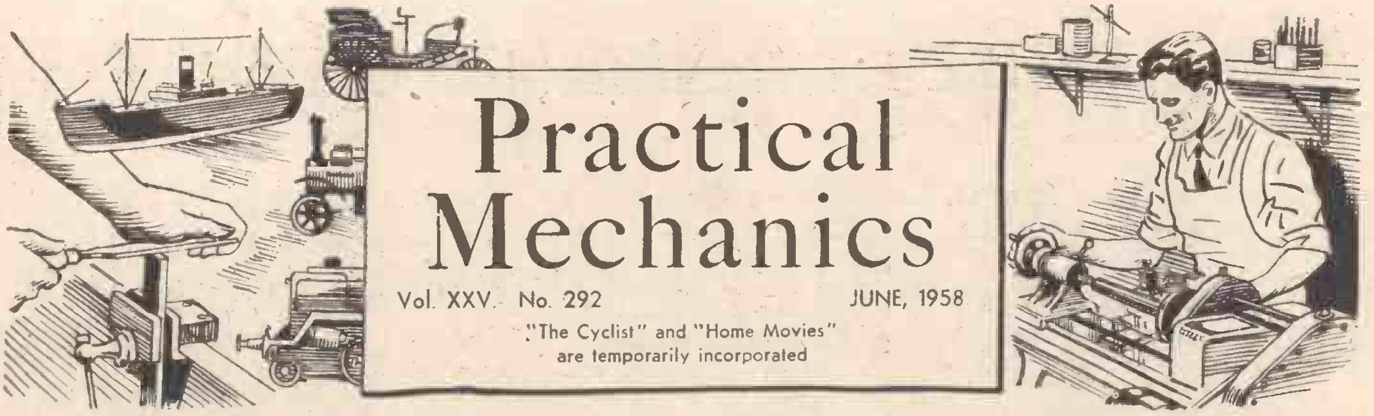
Making a Xylophone



Practical Mechanics

Vol. XXV. No. 292 JUNE, 1958

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

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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

ELECTRONIC RECORDING

THE BBC has just released details of its electronic recording apparatus for recording the vision and sound signals of television programmes for possible repetition at a later date. In America, a system of recording TV programmes on tape was announced about a year ago, but it has not been satisfactory. The BBC apparatus, on the other hand, is entirely practicable and is in use. It is, of course, a vast improvement on the telecine system previously employed. There was an earlier British system of recording TV programmes on wax discs, but it applied only to the old Baird 30-line system now obsolete. It is impossible to record high-definition TV programmes on wax because of the very wide frequency band covered. In the new BBC system three tracks are used, two for vision and one for sound. This is a most important development since it should considerably cheapen the cost of repeat programmes. It is nice to be able to record that once again Great Britain, the pioneer of television, leads the field.

"HE LIT THE LAMP"

UNDER the title of "He Lit the Lamp," Miss Ursula Bloom has written a biography of the late A. M. Low, (Burke, 18/-) whom all knew as the Professor. It is more of an autobiography than a biography, and consists largely of a number of anecdotes and short statements by Low, linked together by comment. Lord Brabazon of Tara gives an introduction. Those of us who knew Low well will agree with Lord Brabazon's comments on this versatile and often-maligned character. Low was a brilliant inventor, he wrote fascinatingly for the non-technical, he was a wit and a most accomplished after-dinner speaker. His interests were very wide. In some ways, he was grasshopper-minded. He would start off in great enthusiasm on a particular project and then drop it like a hot brick for something else. Although he wrote over 48 books he was a failure, at least from the financial point of view. It is true to say that, in scientific circles he was disliked, and as Lord Brabazon says much of this antipathy was due to his use of the title "Professor." He had no right to it. He had never held a chair at a University and when challenged would refer to the fact that he was assistant at the Royal Ordnance College. He was not and never was a professor. As far as I have been able to trace, I can find no record of his being a Doctor of Science either, although he was, undoubtedly, an Associate of the City and Guilds of London Institute. He dressed the part. He wore an odd hat, long hair, coat with astrakhan collar and lapels to lend verisimilitude to his wrongly adopted title of professor. This vain streak in his character led many to suppose that he was a fake, but, in fact, he was a most knowledgeable man on science, mechanics and invention, and could write most entertainingly as readers of this journal will know. He was a charming and kindly man, and it is a thousand pities that in some ways he endeavoured to imitate the quack Joad and the overrated Sir Oliver Lodge. Joad was, undoubtedly, a humbug and Sir Oliver Lodge was a conceited showman who did not achieve very much. Low, had great ability, and there are many important inventions to his credit.

"BEGINNER'S GUIDE TO TELEVISION"

READERS will remember that we published two years ago my "Beginner's Guide to Radio," which, to date, has run through four large editions and is now being produced in Braille for the blind. I have received a large number of requests for a book written in similar elementary style for television enthusiasts. I have written that book and a limited edition will be published on July 17th at 7s. 6d., or 8s. 3d. by post under the above title.—F. J. C.

The July issue will be published on June 27th. Order it NOW!

A SAIL FOR THE P.M. SAILING DINGHY

You Can Make it at Home by Following These Instructions Carefully

By F. HOOK

OF those who have made the PRACTICAL MECHANICS Pram Dinghy, the construction of which was described in our August to November, 1956, issues, and have already enjoyed the pleasure of rowing it, there may be some who would like to try their hand at making the Bermudian sail shown in the original designs.

Everyone is familiar with the beautiful curve of a well-cut sail when filled with wind. This fulness is no accident, but is achieved by cutting the three sides of the sail as convex curves and not as straight lines. When the sail is secured to the mast and boom, which are straight, a fulness in the centre of the sail will be produced.

This sail is made with 3½oz. or 4oz. mildew-proofed Egyptian cotton 36in. wide. Several widths are seamed together. In between these seams false seams are made to give added strength to the sail. All the seams are at right angles to the leech as shown in Fig. 1. The first seam to be made is the one running from the tack to the leech known as the tack seam.

Setting Out

For sail making one must have a floor space of sufficient area so that the shape of the sail may be drawn out in its real size. For such a small sail as described here it is suggested that one could roll back the carpet and set out the sail plan on the floor boards. Failing this, perhaps the co-operation of the caretaker of the local hall could be obtained and the floor there used instead.

Assuming then that a floor space of about 18ft. by 8ft. is available, the three sides of the sail are drawn out on the floor as shown in Fig. 1 by the broken line. First of all draw the luff towards the right-hand side of the space available, exactly 11ft. in length. Then at right angles to this line draw the foot of the sail 5ft. 6in. in length. Finally draw in the leech from head to clew to form a right-angled triangle.

Place the aluminium headboard in place at the head and draw round it as shown.

Setting Out the Fulness

At the points A, B and C on the luff, leech and foot respectively, mark out the distances as shown in Fig. 1. Then through these points draw lines in smooth curves as shown by the help of a light, springy lath such as one might have used for fairing off the frames of the dinghy. These lines will then represent the final shape of the sail.

The sail cloth is 36in. in width usually, and along the entire length of the material three lines must now be drawn with a soft pencil thus dividing the cloth into four equal 9in. strips. Now fold the cloth along one of these lines and make a sharp crease. At a distance of ½in. from the crease, stitch the two thicknesses of cloth

MATERIALS REQUIRED

9 yards of 36in. width 4oz. mildew-proofed sailcloth.
1 headboard.
16 eyelets for luff.
4 eyelets for batten pockets.
2 eyelets for tack and clew.
6 yards ¾in. circumference hemp rope.
Linen thread.
All sailmaking materials and equipment may be obtained from:
Bowker and Budd Ltd., Bosham, Sussex.

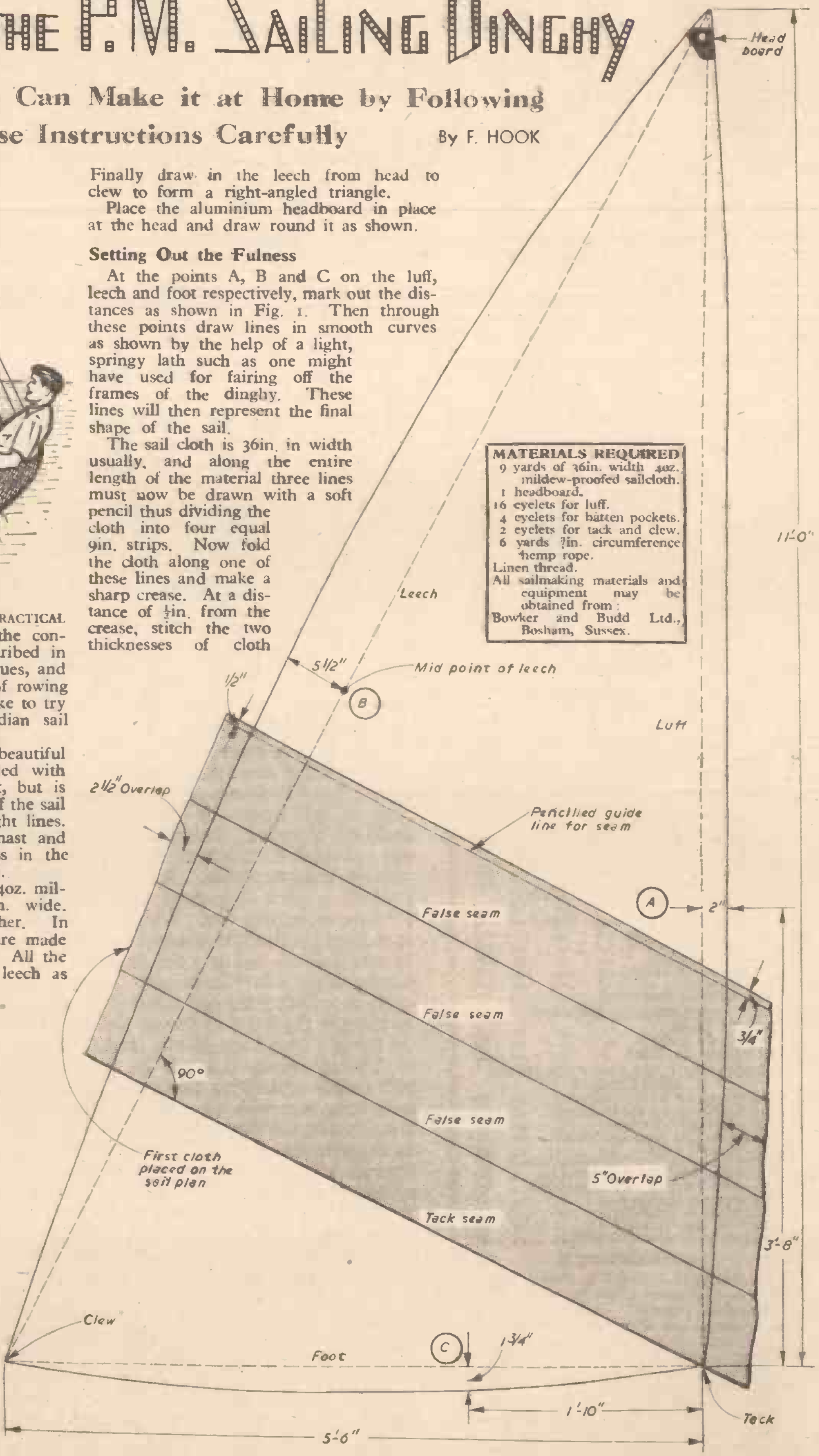


Fig. 1.—Setting out the sail.

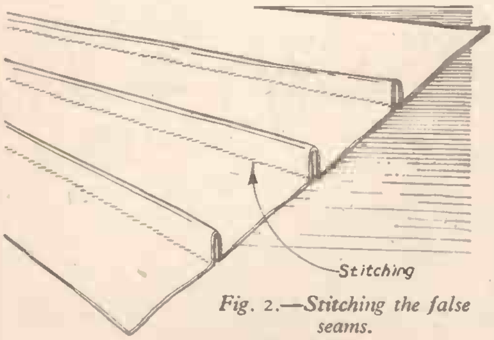


Fig. 2.—Stitching the false seams.

together using linen thread and setting the sewing machine to a long stitch.

Repeat this process with the other two pencil lines. The cloth will then have the appearance as shown in Fig. 2. It is usual to leave these loops standing up as shown for the time being. At a later process they are creased down and stitched. When stitched down they would appear as in Fig. 3.

A sewing machine used by the sailmaker produces a zig-zag stitch. It is unlikely that the reader will have access to such a machine. However, for such a small sail, straight stitching will do quite well.

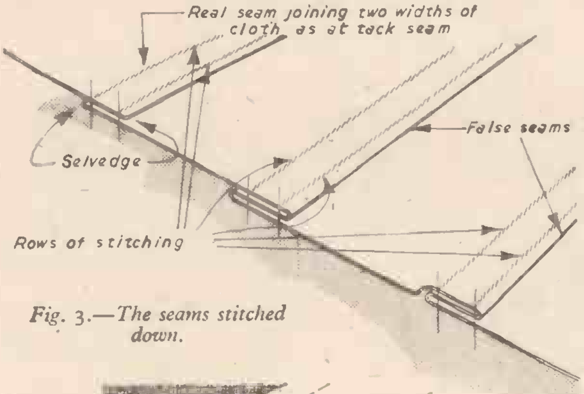


Fig. 3.—The seams stitched down.

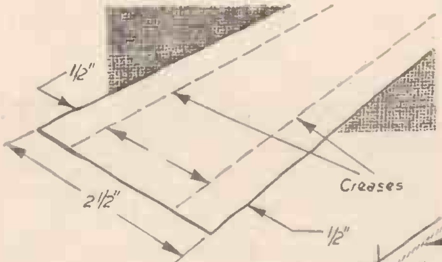


Fig. 4.—Dimensions of luff tabling.

Lay the cloth now on the sail plan with the loops uppermost so that the lower selvedge passes through the tack and cuts the leech at right angles as shown in Fig. 1. The cloth must be adjusted so that an over-lap beyond the actual sail outline can be pencilled in. The overlap on the luff and foot is 5in., and on the leech 2½in. Cut carefully along the line and the piece of cloth thus cut off is held in place on the sail plan with weights or a number of pins.

On the upper edge of the cloth so laid down, pencil in a line ¼in. from the selvedge at the leech and widening to ¾in. at the luff. This line is a guide to the overlap for the seam to the second piece of cloth. This broadening of the seam is to allow for the extra stretch at the tack. A similar broad seam will be required for the lower edge of the first cloth on the tack seam.

Place the sail cloth in position along this line along the top edge of the first cloth and mark off the overlap as before. Cut off the second piece of cloth. Proceed to lay down the other pieces of cloth up to the peak of the sail, but for these remaining pieces a parallel seam of ½in. is required.

Now proceed to lay down the remaining strips of cloth below the tack seam. A sewing guide line is pencilled on the top edges of these pieces and the selvedge will pass under the higher cloths. The tack seam will be a broad seam, being ½in. wide at the leech and ¾in. at the luff.

Carefully go over all the pieces of cloth and ensure that they are all exactly in position, the top selvedge of each piece being under the lower selvedge above, and the correct overlap over the luff, foot and leech have been cut.

When all the cloths are correctly placed, go along every seam and, at a distance of 12in. apart, make short pencil lines across the two pieces of cloth to act as register marks when machining up the seams. The sailmaker calls these "strike-up marks." Finally, fold up the overlaps allowed beyond the shape of the sail and make a sharp crease in the material. The creases may be lightly marked with the soft pencil.

Sewing the Cloths Together

The various pieces of cloth forming the sail are now stitched together on the machine. Lay the two cloths to be sewn in their correct position; selvedge to pencil line and strike up lines registering correctly; stitch along the seam at a distance of ⅛in. from the first selvedge. Turn the cloth over and stitch along at ⅛in. from the other selvedge. Repeat this operation for the other selvedge. Repeat this operation for the other seams. The false seams are now pressed down towards the foot of the sail and stitched down into place as shown in Fig. 3.

Finishing Operations

Now spread out the sail on the floor and go over the creases again on the three sides of the sail. Rectify any slight inaccuracies which might have arisen during the seaming process.

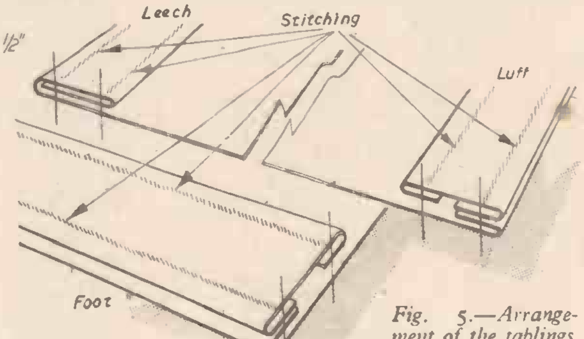


Fig. 5.—Arrangement of the tablings

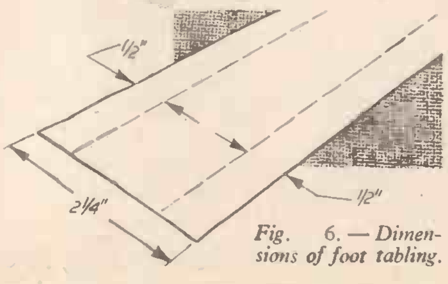


Fig. 6. — Dimensions of foot tabling.

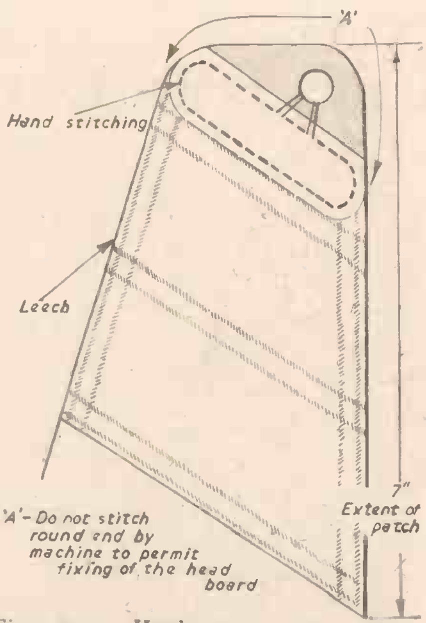


Fig. 7. — Head patch.

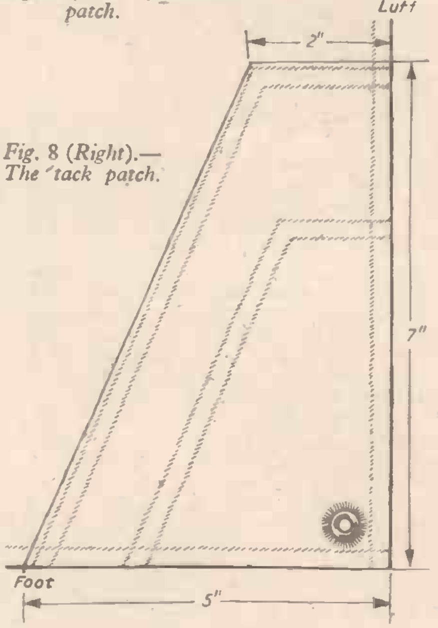


Fig. 8 (Right).—The tack patch.

Then at ¾in. from these creases on the luff and foot draw lines parallel to the creases. Cut off the strips beyond these lines. These strips of material are used to strengthen the foot and luff of the sail. This addition is called "tabling."

The Luff

On the strip cut from the luff, mark off a piece exactly 2½in. wide, as shown in Fig. 4, and cut off. At ½in. from the edges of this strip, crease as shown. Now fold down the ¾in. margin of the luff and place the tabling on top, as shown in Fig. 5.

Before finally stitching the tabling in place, move the tabling strip an inch or two up the luff so that the seams in the tabling and the sail do not coincide. Make two rows of stitching as shown.

The Foot

For the foot of the sail the tabling need not be so wide as for the luff. It should be 2¼in. in width and creased ½in. in from each edge, as in Fig. 6.

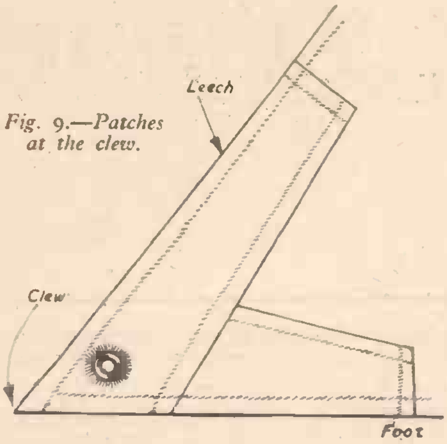


Fig. 9.—Patches at the clew.

The Leech

The leech has no tabling and is turned in and seamed, as shown in Fig. 5.

Patches at Head, Tack and Clew

Patches are sewn on at the head, clew and tack in order to give greater strength at these points of greatest strain. They are cut out from odd pieces of cloth to the dimensions shown in Figs. 7, 8 and 9, with a turn-in of ¾in. all round. Crease and turn in. Be sure that the direction of the warp and weft of the patches is the same as that at the position on the sail to which they are to be applied.

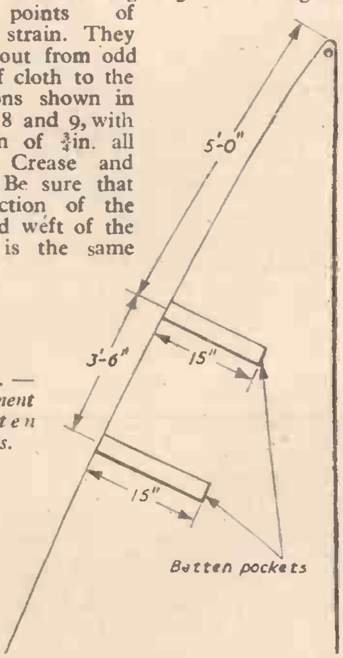


Fig. 10. — Arrangement of batten pockets.

Two patches are required at each point, one on either side of the sail. Stitch the patches in place with the rows of stitches ⅛in. and ½in. from the edges of the sail. Extra rows of stitching are shown by the dotted lines.

Remember to leave the top part of the head patches unsewn, as shown in Fig. 7, so that the headboard can be sewn into place by hand. The top corner of the sail is turned in so that the eye for the halliard is revealed. The headboard is stitched into place with the palm and needle using double linen thread.

Batten Pockets

For this sail two batten pockets will be needed each 15in. × 1½in. and fixed over the seam approximately 5ft. from the headboard and then a further 3ft. 6in. farther down the leech (Fig. 10).

The pocket is made from a strip of cloth 2½in. wide, see Fig. 11. Crease in ¼in. all round and stitch round close to the edge of the turn-in. Turn in the free end of the batten pocket for the two small eyelets, as shown. Put the pocket in position and stitch down. Do not stitch the last 1½in. of the pocket by the leech, so that the batten can be slipped in and out easily. Under the two eyelets on the edge of the leech a piece of thin cord is sewn on. When the batten is in place this cord passes through the eyelets and is tied to prevent the battens from falling out, see Fig. 12.

Roping the Sail

This sail has a rope sewn to the luff and foot. Before attempting to sew the rope to the sail it should be laid out along the ground after pulling it through the hands to remove any twists and kinks so that it is in a perfectly relaxed state. When the rope has been thus prepared it is a good plan to run a piece of chalk along the top of it and this line will give an indication of its remaining in the relaxed state during the stitching operation.

One end of the rope is whipped for a distance of about 2in. and this end is applied to the clew, as shown in Fig. 13. Keep the chalk mark along the rope along the edge of the sail when sewing it on. Pass the needle, with doubled linen thread, up through the sail and down through one lay of the rope, as shown in Fig. 13, and up through the sail again and so on.

A difficulty presents itself in that in use the rope will stretch more than the sail's edge. Therefore, when stitching on the rope a very small amount of the sail's edge must be gathered in at each stitch so that the edge will appear to be stitched on badly! The problem is to decide on how much fulness to allow.

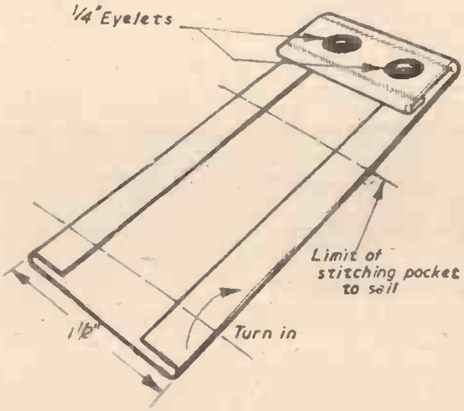


Fig. 11.—Batten pocket detail.

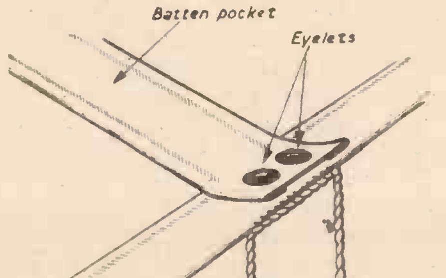


Fig. 12.—Method of preventing the battens from falling out.

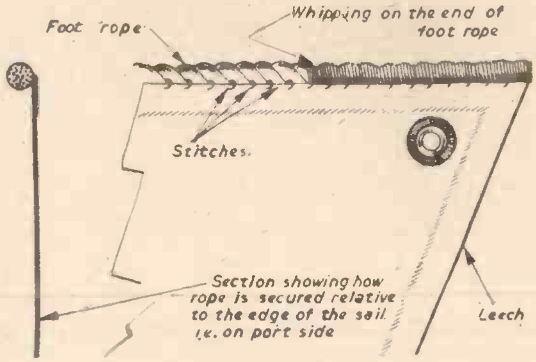


Fig. 13.—Details of the foot rope.

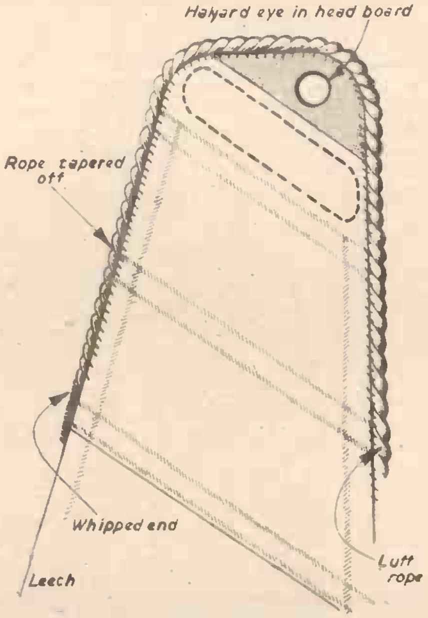


Fig. 14.—Details of the luff rope.

This decision may be arrived at by the following method. Stitch the end of the rope to the clew and hold at this point in a vice or by other methods. Stretch the rope tightly to another point about eight feet away. Apply the foot of the sail along the stretched rope but do not stretch the sail edge. Now make chalk marks across the edge of the sail and the rope at 12in. intervals like when making the striking-up marks or the sail seams. Now when the rope is relaxed again the 12in. spaces on the rope will contract slightly. When stitching the 12in. space on the sail to the corresponding rope space (now a little less than 12in.) the amount to be taken up per foot can be readily ascertained.

When the tack has been reached, the rope and sail can be held at this point whilst the luff rope is stretched and striking-up marks made as with the foot. Stitching can proceed up the luff and round the top of the headboard.

The rope can now be cut off, leaving about 8in. to be stitched down the leech. Before this end is stitched on, the rope must be tapered off by unravelling the rope about 8in. and tapering off the strands with a sharp knife. Twist up again to form a tapering end. This end is then stitched to the leech and finished off, as shown in Fig. 14, with a short whipping at the end.

The sail is now complete, but for fixing the eyelets at the clew and tack. Eyelets are also placed up the luff ½in. in from the edge of the sail close to each seam. These latter eyelets are where the mast sliders are lashed on.

Making a Dolls' House

D. V. A. Jenkin Tells You How It is Done and the Materials You Will Need

THE general appearance of the completed dolls' house can be seen from the photographs, Figs. 1, 2 and 7. The construction is carried out in hardboard, this being easy to use and having no grain. The main parts are cut from the two sheets of hardboard as shown in Figs. 3 and 5. Doors and windows are cut out with a coping saw and the doors hinged back into position with paper tape and strong adhesive. Small items not shown on the cutting plan are made from scraps of hardboard.

The measurements given produce a model to an approximate scale of ¾in. to the foot. Most dolls' house furniture on sale seems to be made to about this scale.

The model is made in four parts to simplify painting and decorating the interior.

Fig. 1.—A front view of the completed dolls' house.

Fig. 2.—How the house appears from the back.

Baseboard and Main Framework

The baseboard is made up from the sheet of plywood and 2in. × 1in. wood as shown in Fig. 4. It is large enough to provide a "front garden." The three pieces forming the bay window are nailed to three suitably shaped pieces of wood placed at top, bottom and level with the bedroom floor. The whole is then nailed on to the front of the house. The porch is also nailed on using scrap timber for the sides. Next the sides are nailed into position, using four 12in. lengths of ½in. × ½in. wood, one at each corner of the building. The assembled front and sides are fixed to the baseboard by means of two strips of ½in. × ½in. wood as shown. Each end of the back panel is strengthened with a strip of ½in. × ½in. wood and the back hinged to the side. A small hook and eye catch is fitted. Notice that the top inch of the back is a separate piece and is separately screwed to the sides. This is because the opening part has to clear the eaves.

The interior wall is nailed to the side of the porch and fixed to the floor by means of the two strips of quadrant moulding shown. These also serve to represent skirting boards and are continued round all the walls in the model. A chimney breast and fireplace is made from scrap wood and fitted. One of the lampholders is fitted in the fireplace. The stairs are made up from the three pieces shown, together with scrap wood.

Materials Required

- 2 pieces 4ft. × 2ft. hardboard.
- 1 piece 2ft. square plywood for base.
- 12ft. of 2in. × 1in. wood.
- 12ft. of ½in. × ½in. wood.
- 6ft. of ½in. quadrant moulding.
- 2 small hinges.
- 1 hook and eye catch.
- 2 sheets brick design paper.
- 1 sheet tile design paper.
- Scraps of wallpaper.
- Paint.
- 4ft. square of "Fablon."
- 15 amp fuse wire.
- 5 small bulbholders.
- 5 .25-volt bulbs.
- 1 press type switch.

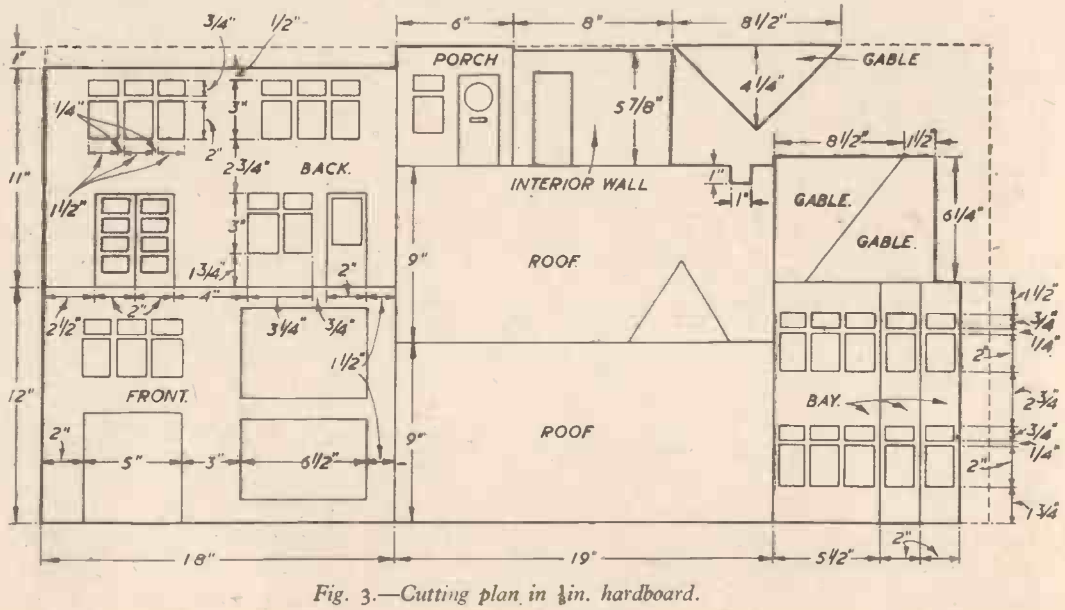


Fig. 3.—Cutting plan in ⅛in. hardboard.

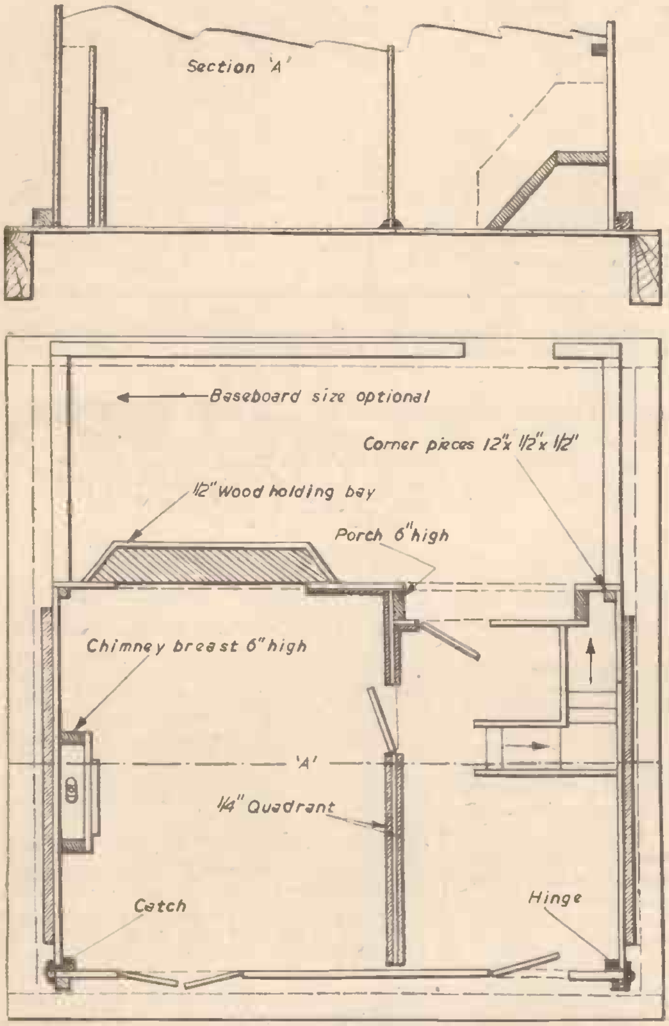


Fig. 4.—Details of the baseboard and framework.

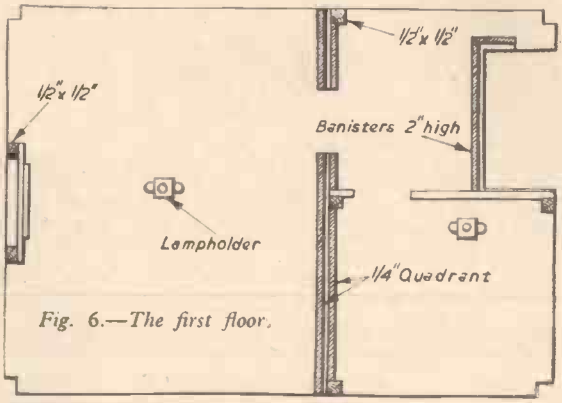


Fig. 6.—The first floor.

The steps themselves are bent from a strip of tinplate (or they can be omitted altogether, as they cannot be seen when the model is assembled).

First Floor

This consists of the first floor itself together with two interior walls, a small chimney breast and fireplace for the bedroom and the banister wall round the stair opening. These are all fitted into position using short pieces of ½in. × ½in. and ¼in. quadrant moulding. Two bulbholders are fitted into ½in. square holes as shown in Fig. 6.

Ceiling

This consists of the ceiling to the first floor rooms. Two holes are cut for bulbholders and a bracket to hold the battery is fitted. The gable roof is made up and nailed in position, but this part should be left until after the roof proper has been assembled, as only then can its exact shape and position be determined, see Fig. 8.

Roof

The two pieces forming the roof are fixed together using a strip of ½in. × ½in. wood at the ridge and two other pieces arranged so that when the roof is in position they rest on the ceiling.

The chimney stack is made up from scrap wood to the shape shown in Fig. 9. A hole is cut in its top and a miniature push switch fitted (this is the type of switch normally used in table lamps, etc.). The switch also represents a chimney pot. A short length of dowel represents the other pot.

When the model is assembled a screw at either side through to the roof holds the model firmly together and prevents the children from taking it to pieces!

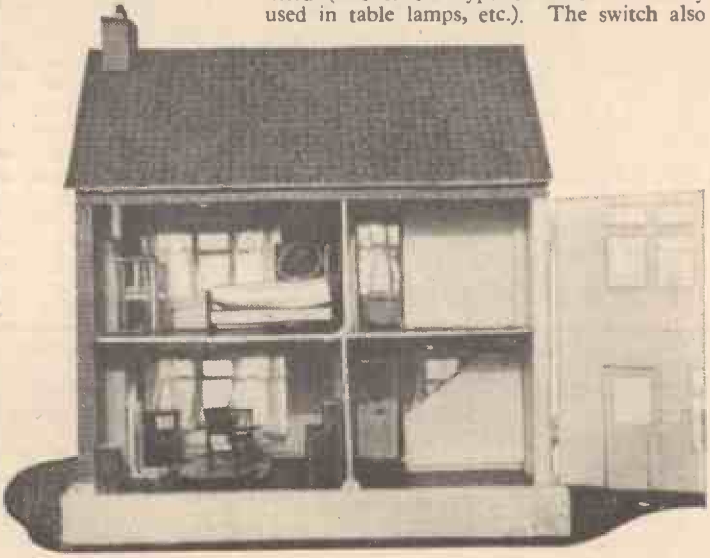


Fig. 7.—A view of the house with the back open.

Lighting

Five lamps are provided and they are wired up in parallel using 15-amp fuse wire. The wires run under the floor coverings and wallpaper and are held in position with pieces of paper tape. Being thin the wires hardly show. A "junction box" consisting of two screws partly screwed home to the inside of the roof space is used to make the connections between the various lights. Fit a fairly long lead from the switch in the chimney so that the wires can be con-

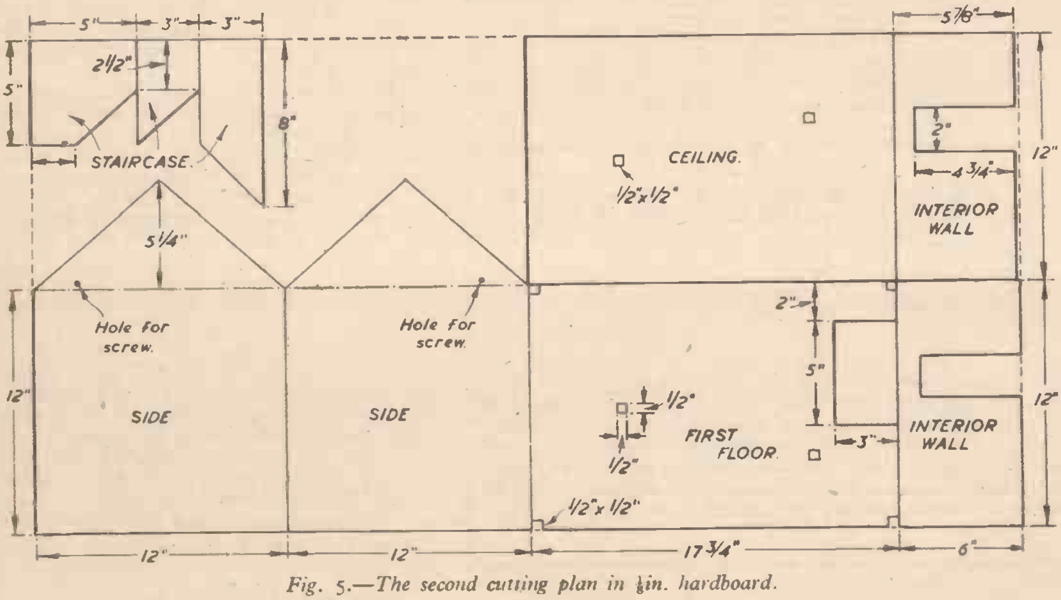


Fig. 5.—The second cutting plan in ⅛in. hardboard.

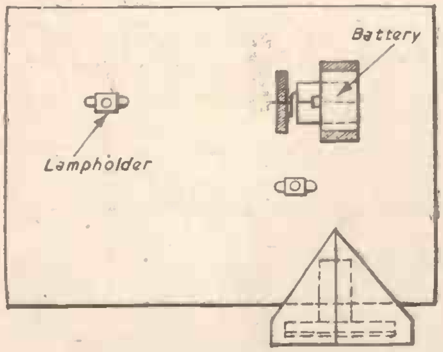


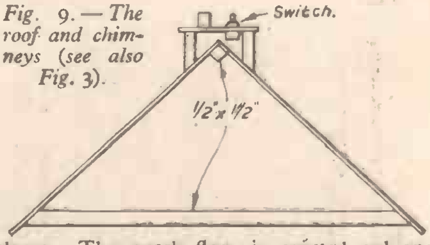
Fig. 8.—Details of the ceiling.

nected up with the roof off. I used a cycle lamp battery but as this has a very short life when working all five bulbs, a larger battery would be more suitable.

Finishing

All the parts to be painted are given an undercoat and a coat of gloss paint. Paint the surrounds to all doors and windows. The interior walls are papered with suitable scraps of wallpaper, cutting the paper to leave ¼in. border round all doors and windows. The exterior walls and garden wall are papered with brick design paper. Cut the paper again to leave ¼in. borders round doors and windows. The roof is papered with a tile design paper. These papers can be obtained from most model shops. The porch floor is painted red and the "garden" green. The floors in the house are covered with "Fablon." This is a self-adhesive material and can be obtained in walnut and oak patterns as well as plain colours. It makes an effective reproduction of a wood floor.

Fig. 9.—The roof and chimneys (see also Fig. 3).



Books Received

"The Exploration of Time," by R. N. C. Bowen, Ph.D., B.Sc. 138 pages. 21s. net. Published by George Newnes Limited.

WHEN the remains of past civilizations are discovered their age is assessed by relating them to the rocks, fossils, etc., in the vicinity of which they are found. This cannot always be done with complete accuracy and so the establishment of relative chronologies is still of major importance. It is the techniques and methods used for this purpose which form the subject of this book.

The first part of the book deals with the earth as a planet, the science of dating and the nature of time. This is followed by a section on the science of dating or geochronology and the contribution of all the sciences to it. The final section deals with new ideas and the revolution in thought which has taken place as a result of geochronological work.

"So You Want to Be a Photographer," by Arnold E. Bensusan. 83 pages. 6s. net. Published by Colin Venton Limited.

WRITTEN for the photographer who wishes to "turn professional" and for those who want to make photography pay, this book is down to earth and practical. It deals with the selection of the most suitable branch of photography, training and working conditions, studio layout, starting and running your own business, equipment, advertising, etc. A book list, lists of suppliers of materials and of registrars of business names are also included.

"Medical Electrical Equipment." Advisory Editor R. E. Malloy. 312 pages and 238 illustrations. 35s. net. Published by George Newnes Limited.

A TREMENDOUS amount of electrical apparatus and devices is now in use in hospitals, clinics and doctor's surgeries and both the medical staff who operate it and the technician who is responsible for maintenance must understand the principles involved, must have some knowledge of the construction and most important, have full information on the special care required to eliminate possible dangers to patients and staff. This book contains comprehensive information on these points, and sections are included which deal separately with particular equipments. The final section deals with the various types of small electric motors used in medical equipment.

"Uranium and Thorium," by L. Grainger, B.Sc., A.I.M. 200 pages with 30 diagrams and 8 photographs. 25s. net. Published by George Newnes Limited.

THE scientist and engineer who is concerned with fissile materials will find this book of great practical assistance, but it is also written so as to be intelligible to the layman. The book presents a comprehensive picture of the technology of uranium and thorium from their occurrence and extraction, through their chemical and physical properties, to their uses in the atomic energy industry.

"Aids to Workshop Practice," by C. T. Bower. 190 pages. 18s. net. Published by Odhams Press Limited.

THERE are a great number of work and time-saving gadgets and methods which can be used in the workshop. Some have been published from time to time in a great number of publications, but this book endeavours to bring those ideas, hints, methods and gadgets which can be applied in the majority of engineering workshops together in one volume.

They mainly apply to metalwork but there is material to interest the carpenter, builder, etc. The items are grouped into sections for easy reference.

PUZZLE CORNER

Giant Fallacy

THE idea of diminutive men and giant men is a well-worn theme in pseudo-science fiction and dates in fact from folk-lore. Dean Swift wrote of Lilliputians and Brobdingnagians long before H. G. Wells wrote "The Food of the Gods," where men and creatures are shown magnified. A very common fallacy in many of these stories is based on the following faulty idea. The writer decides to make his wonder creatures ten times as large as life and makes a few calculations as follows:

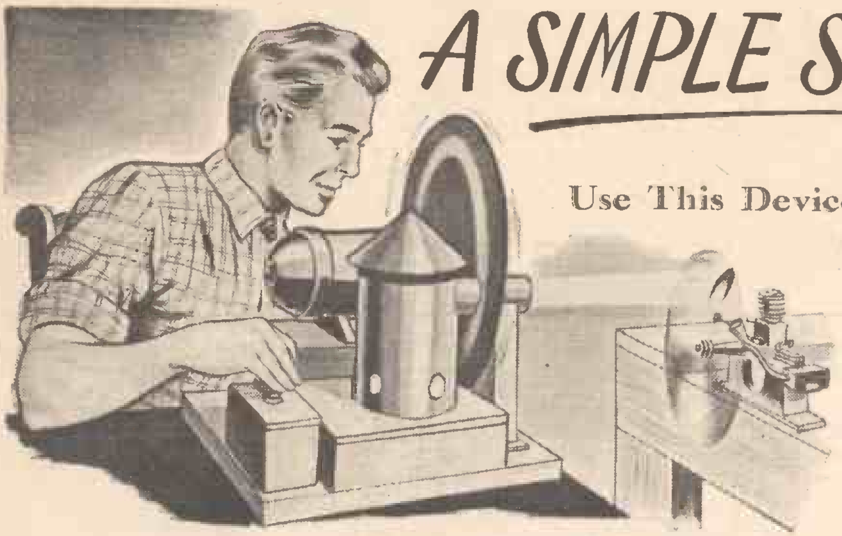
Man on earth is, say, 6ft. tall. Multiply by 10 and he will be 60ft. tall. He weighs, say, 12 stone; he will, in my story, weigh 120 stone, i.e., 15cwt. or ¾ ton. He can walk at 4 m.p.h., so that in my Utopia he can walk at 40 m.p.h. Why is this a fallacy?

If, before embarking on a flight of fancy, we look around and observe how Nature manages great and little things on this earth, we shall find, for example, that though an elephant may be, at a very rough guess, a thousand times as heavy as a mouse, it does not run a thousand times as quickly. An elephant which fell over a 100ft. cliff would probably be killed but it has been said that a mouse can fall half a mile without being harmed. Does an elephant eat in regard to its bulk, a thousand times as much as a mouse? Of course not. Thus, if we make up a yarn in which mice grew to the size of elephants we should be quite wrong in assuming that they could run a thousand time as quickly as normal mice, eat a thousand times as much, fall from the colossal height of 500 miles without being injured and so on.

The weight of a 12-stone man grown to ten times his height would not be 12×10, but 12×10^3 stone, i.e., $12 \times 1{,}000$ or 12,000 stone, or 75 tons, since he would expand 10 times in all three dimensions!

His feet, however, would expand in two dimensions. Very approximately, the area covered by two adult male feet is 75 sq. in. This would be increased by 10^2, i.e., each sq. in. would support 1/100 ton, whereas in ordinary life the 75 sq. in. support 12 stone, i.e., 1/1,000 ton per sq. in.

The materials composing the human body would not stand up to this strain. 60ft. men would have to have more than elephant-like legs (it is doubtful whether they could walk upright. They could certainly not walk at 40 m.p.h. The skin of these lumbering creatures would have to be thicker than that of a rhinoceros. Therefore, whilst it is not too far-fetched to imagine 60ft. men, it is fallacious to assume that they are ordinary men seen through a $10 \times$ microscope.



A SIMPLE STROBOSCOPE

By R. N. HADDEN

Use This Device for Inspecting Fast-moving Mechanisms

A STROBOSCOPE is an instrument that is used when it is desired to inspect the working of some mechanism that is running at high speed. With the aid of a stroboscope it is possible to see the operation of a car's valve gear, the cam gear of an automatic machine, or any similar device. The fact that the mechanism may be running at a speed of up to 10,000 r.p.m. does not prevent the observer from seeing the operation clearly

How it Works

The basic principle is that the stroboscope is a device for emitting rapid flashes of light of high intensity, the rate of flashing being controlled by the operator. In commercial instruments the flash of light is produced by an electronic discharge tube fed from a high voltage, interrupted supply, power pack. Each time there is a surge of current there is a flash of light. The rate of flashing can be varied from about five flashes per second to about 200 per second. The duration of the flash itself being about 1/10,000 second.

If this flashing light is used to illuminate some cyclic mechanism, the eye can only see the mechanism when the light is shining. For example, suppose the flashing light is used to illuminate a connecting rod and crankshaft mechanism which is rotating at 3,000 r.p.m. Suppose also that the stroboscope light is set to flash at 3,000 times per minute. Now it follows that the connecting rod and crankshaft are illuminated at the same point on each stroke, and as this is the only time that the eye can see the mechanism, it appears to be at rest. In this way any rotating, reciprocating, or cyclic mechanism can be made to appear stationary, permitting a detailed examination to be made. It is often possible to find faults that only develop at high speed, in this way.

If the speed of flashing is slightly less than that of the rotating part, the mechanism appears to be moving forward slowly. This is because the mechanism has moved forward slightly from its previous position, at each subsequent flash of light. Similarly if the speed of flashing is slightly faster, the mechanism appears to be moving backwards.

Measuring Speed

The foregoing describes how rotating parts may be examined while in motion. However, there is another very useful operation that a stroboscope can perform, and this is to measure speed. In many applications it is possible to measure the speed of, say, a rotating shaft, by connecting the shaft to a tachometer, when the speed can be read off directly. However, there are certain applications where the power taken to drive a tachometer would slow down or stop the rotating parts. An example of this is the measurement of speed of a model aeroplane engine.

For speed measurement the stroboscope is first of all calibrated in r.p.m. and is then used to "stop" the rotating part being studied. When this is done the speed can be easily read off. In this way the speed can be found without having a direct connection to the rotating part at all.

As stated above, most commercial stroboscopes are electronically operated, and are complicated and expensive. However, this need not prevent the man with a home workshop from having a stroboscope at his disposal as one can easily be constructed from simple materials. The stroboscope so constructed will be equal in every way to the commercial article, except for the intensity of light output.

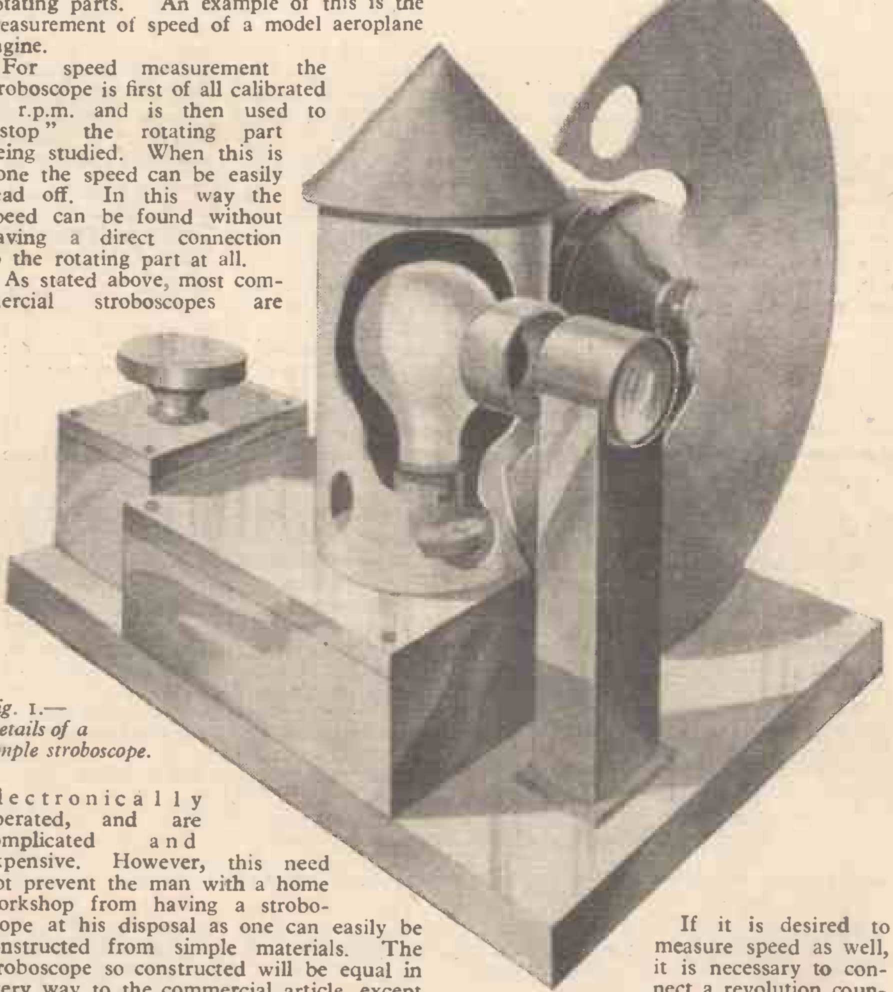


Fig. 1.—Details of a simple stroboscope.

Home-made Instrument

A simple stroboscope is shown in Fig. 1. It consists of a lamp house, constructed from tinplate, which contains a 100w. lamp. Cooling vents are provided in the lamp house to prevent overheating. If a more powerful lamp is used it will be necessary to have forced draught, if the stroboscope is to be used for long periods. In the side of the lamp house, and opposite the bulb filament there is a hole to transmit the light. In front of the hole there is a disc, which can be made from cardboard. Cut in the disc there is a hole to correspond to the hole in the lamp house. This hole uncovers the hole in the lamp house once per revolution, emitting a flash of light. The disc is driven by a variable speed motor, the speed being controlled by a rheostat.

In operation the lamp is switched on, and the disc is run up to speed. Each time the hole in the disc passes the hole in the lamp house a flash of light is transmitted. If required the light may be concentrated into a beam by means of the lens shown. The instrument is now ready to be used to study all cyclic mechanisms.

If it is desired to measure speed as well, it is necessary to connect a revolution counter or tachometer to the motor. In this way the speed of the motor is equal to the speed of the "stopped" object.

When this stroboscope is completed the handyman has a valuable tool which can be used to help him set car valves, measure grindstone speeds, measure model petrol engine speeds, and observe complicated mechanisms work as though in slow motion. If care is taken it is even possible to take photographs of high speed machines. *Warning.*—When using a stroboscope never touch any machine that may appear to be stationary. It may in fact be rotating at many thousands of revolutions per minute.

Making a Fibreglass Yacht

C. E. Bowden Describes the Most Modern Method of Constructing Model Boat Hulls

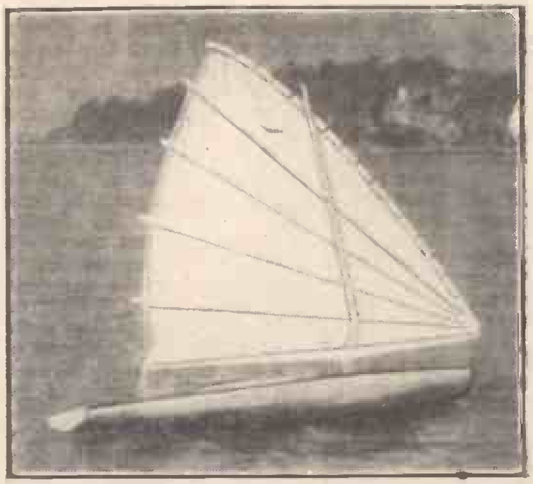


Fig. 1.—The author's 6ft. 8in. fibreglass model sailing under radio control with a folding Delta, fully battened rotating rig.

THE fact that lifeboats are increasingly being made in fibreglass, will doubtless emphasise the confidence in the great strength for weight, and the hard wearing characteristics of the material. These characteristics are also applicable to the model yacht.

As the description of making a model yacht in glass-fibre laminates, in this article, is fundamentally the same for making a small full-scale boat in the material, it may well be that some readers will eventually graduate, from the experience gained by making a model, to a full-scale dinghy.

Even large 60ft. full-scale power craft, correctly stiffened by simply bonding a glass laminate or two over paper tubes, aluminium U or hat-shaped sections, or even over balsa ribs, are being found to offer great advantages. Glass laminate is flexible, and, therefore, requires stiffening where large unsupported surfaces occur, but this very flexibility, without collapsing, absorbs the severe blows and forms its strength for boats. Curved boat sides, like an egg form, give strength. The comparatively small model hull, and the dinghy hull, seldom require stiffening. This is usually assisted by a curved shape, gunwales, and deck.

Great advantages in being able to produce the most efficient hull shapes and aerodynamic deck and cabin forms, are available to the designer, together with attractive styling produced in one moulding.

The constant attention required by a wooden boat in order to prevent deterioration and rot is no longer required in a fibreglass boat, and a moulded cabin top and deck cannot leak. The "glass" hull never leaks, once properly made, nor does it soak up extra weight in the form of water, whilst at moorings. Painting and varnishing are no longer necessary.

A glass-fibre hull will withstand much rough usage and it is easy to repair a hole, should one be knocked in it by some severe local blow.

Finally, and most important, a glass-fibre hull can be made by anyone who takes the trouble to follow a few quite simple directions, now that the technique of the wet lay up in a female mould has been satisfactorily evolved. The equipment is also quite simple and inexpensive, particularly if glass cloth is used instead of chopped glass mat, which requires a more difficult rolling technique.

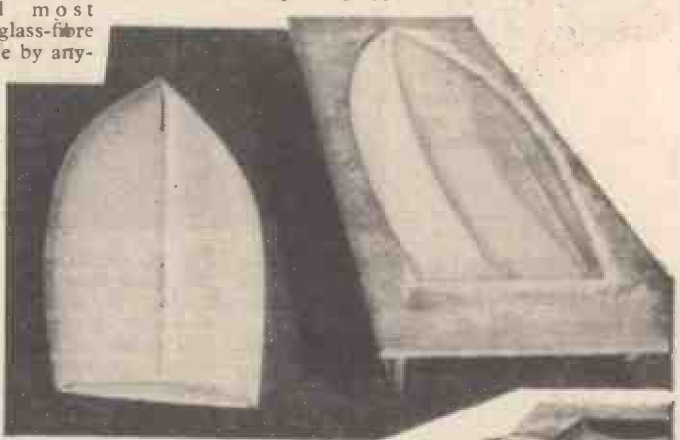


Fig. 3.—The original hull, with keel removed, is seen on the left, employed as the male form. The subsequent female mould made from this form in fibreglass is seen on the right.

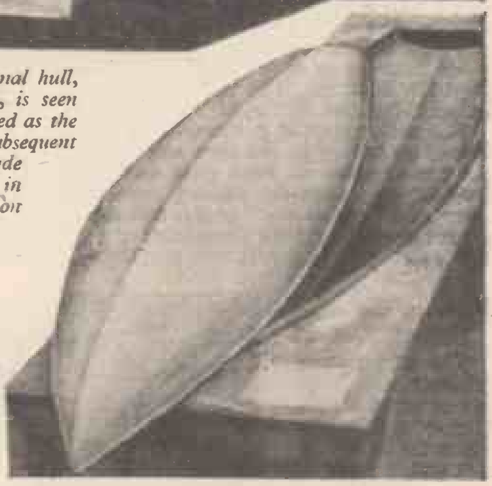


Fig. 4.—The larger fibreglass hull is seen taken from its female mould made from the author's 6ft. 8in. long light displacement design.

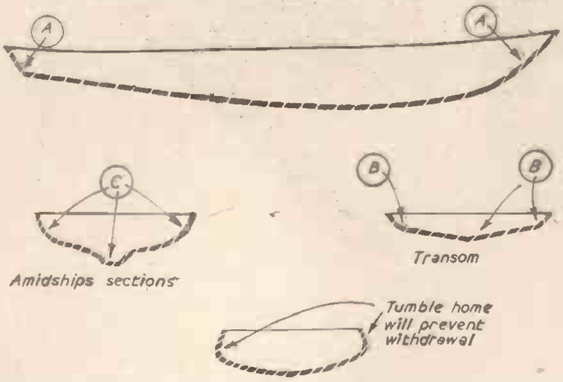


Fig. 2.—The form should be designed for easy withdrawal and have no tumblehome unless a split mould is used. A, B and C show the points to watch.

Construction

The model yachtsman can make himself a "one off" experimental hull by building in light balsa - wood planking, and then covering the outside with glass-fibre cloth and resin. This is sanded smooth, and finally stopped and painted, to cover up any slight blemishes and imperfections that may show. This hull will never leak, and the inside balsa form can be varnished to waterproof it.

However, the hull made from a male form and a female mould, although requiring a little longer to make, is vastly superior and well worth the extra trouble, for it provides a low-drag, smooth finish and replicas can be produced from the female mould. A perfect "One Design Class" can be started by a club in this way quite inexpensively, with every model yacht hull identical.

The Female Mould Method

There are a number of ways of making a female mould, but the best and most lasting for the amateur, and perhaps the most simple in the long run, is to make the female mould in fibre-glass from a male form. This form can be made on the "bread and butter" principle, or from a solid block of wood. A soft hardwood would be suitable, or even balsa, if not too large, for balsa wood is expensive.

A design can be purchased, of, say, a 50in. Marblehead, or a larger Ten Rater, or the large "A" Class yacht model of around 6ft. in length. The hull illustrated in Fig. 3 is in the Ten Rater Class and is 5ft. 6in. long, but very beamy as it is a semi-planing type.

The design, when purchased, can be made into a solid form, provided the design has no tumblehome, and that everything "looks outward." This is so that the finished hull can easily be withdrawn from its mould (see Fig. 2).

Unfortunately, there are not yet many specially thought-out model hull designs for fibreglass moulding. It may, therefore, be necessary to alter slightly a normal design to give the "outward" look.

It should be remembered that a hull that has a properly designed progressive outward look at the deck line is often a more stable and a stiffer sailing craft than one with tumblehome, because there is increasing buoyancy as the boat heels.

Making the Male Form

There are two methods of providing the male form.

The first is to make it from an old well-tried hull that has no tumblehome, or a hull with tumblehome eliminated by building on a balsa fairing. The keel and skeg are removed. The hull is then carefully filled, painted, and very highly polished with silicone wax polish. It must be remembered that every slight blemish will faithfully be reproduced in the female mould and so in the final boat hull.

It is, therefore, worth much time and effort to get the form as smooth as possible. Fig. 3 shows the well-tried hull used for the form to make the fibre-glass female mould for the smaller 5ft. 6in. long Ten Rater model.

The second method is to build a new form to the design that is decided upon. The 6ft 8in. larger hull, seen in Fig. 4, was built up from a new bread and butter hardwood form (see Fig. 4).

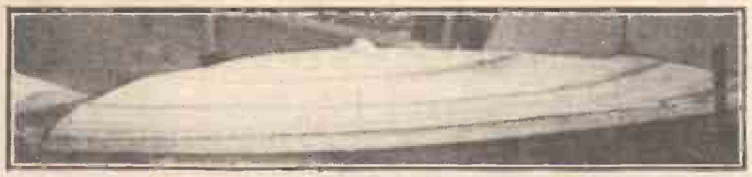


Fig. 5. (Left)—The form is glued up (bread and butter planks) and faired with the usual woodworking tools.

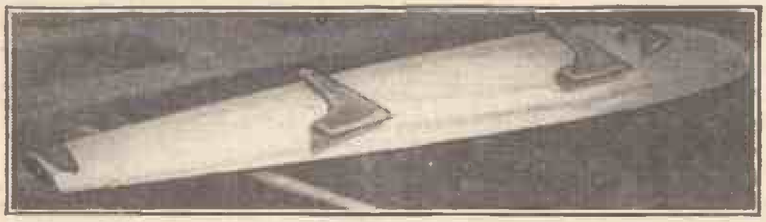


Fig. 6. (Right) — The shape is checked as construction proceeds by plywood or cardboard templates.

Fig. 5 shows the planks glued up and being shaved to shape by spokeshave, rasp, etc., to the drawings of the hull. In Fig. 6 we see how the form is checked for fairness, and equal dimensions on either side, by either three-ply or cardboard templates taken from the drawing. The form is then carefully finished and, finally, highly polished.

The real secret of a beautifully finished fibre-glass hull is in the time and care you put into stopping all wood grain and imperfections, then carefully rubbing down with water and "wet or dry" paper, followed by several carefully rubbed down coats of paint, and a final polishing with wax (see Fig. 7).

Fig. 7. (Right)—The male form is ready for the work of getting a very high polish. The smooth perfection of this finish will be repeated in the inside of the female form, and ultimately on the outside of the finished hull.

Making the Female Mould

The silicone wax polished male form is now given a thin, even coat of release agent by brush or soft rag. This is allowed to dry thoroughly. There are a number of release agents, but P.V.A. is a good one. It is soluble in water, and can, therefore, be easily washed off the form, mould, and finished hull, when the respective jobs are complete.

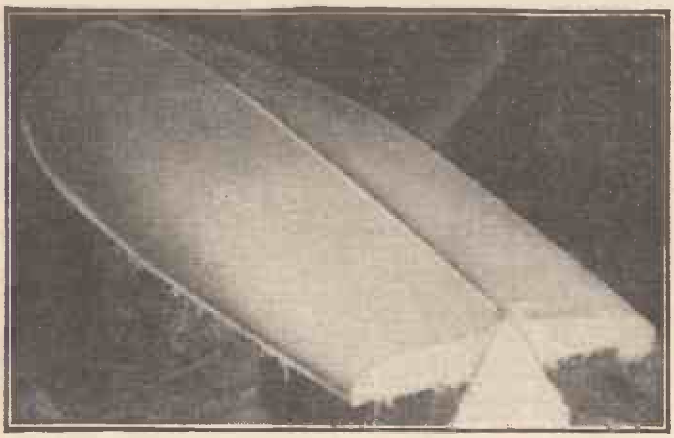


Fig. 8.—The male form is shown here covered by a glass cloth and resin laminate, and the resin is setting. This stage will be described next month.

The author buys resin, P.V.A. and chalk filler from Messrs. James Beadel and Co., Ltd., 110, Cannon Street, London. Blue coloured P.V.A. release agent shows any shortcomings of coverage when the moulds are coloured white.

A thick non-run "Jel" coat of resin is now mixed up, which will ultimately form the shiny inside surface to the female mould. This jel mix is made up from four parts resin (Filabond 8001), four parts thixotropic anti-run resin (Thixotropic Paste 626), two parts or more china clay filler, with a little anti-star resin (Filabond 1344). Stir very thoroughly and also stir in the chosen colour resin. In my case this is white.

For the smaller 5ft. 6in. boat, 2½lb. of this treacly anti-run mix for the jel coat was mixed. This provided a little over to be on the safe side.

Now stir in the correct amount of accelerator (C) to suit the temperature, which should not be lower than about 60 deg.

The correct amounts per lb. weight of mix are given by the makers to suit the temperature and the speed at which the worker wishes the resin to set. As the jel coat is required to set fairly quickly, put in a little more accelerator (C) than will be used in the main mix, for later laminations. Never mix accelerator and catalyst directly together at the same moment. When ready to start work, mix in the catalyst (K), and the hardening or setting process commences.

Stir in the catalyst last because the accelerator by itself does not harden the resin. The accelerator controls the speed of the catalyst, which actually hardens the resin. Mix the resins in a 5lb. saucepan, decanting into a 3lb./2lb. saucepan to suit the work. In this way too much resin mix will not be catalysed and waste will be avoided should the process of laying up the "glass" mat, or cloth, take longer than anticipated through some unforeseen hold up.

The thixotropic resin helps to prevent resin mix running wildly down the vertical sides of a boat mould or form. The china clay filler assists this and adds "body" and stiffness, as well as cheapening the process.

Having catalysed the jel coat mix, brush this with flowing strokes all over the male mould. Do not "work it." Put on thick and evenly, for this is going to form the smooth resin skin of the female mould. Let this jel coat just about set, so that subsequent work will just not disturb it, and immediately commence the next step.

This step is to brush on a coat of the main mix resin, and to work a layer of glass scrim (an open weave of glass cloth) evenly on to the just hardened and almost tacky jel coat, with fingers and a stippling action of the brush so that *absolutely no air is trapped between jel coat and scrim.* In other words, the open weave glass scrim backs up the outside jel coat. A badly-made mould, or boat hull, will often have little air-pockets behind the outside resin surface, which will ultimately cause the resin to crack, star, or break up. The Filabond 1344, anti-star resin, added to the jel coat will provide better elasticity and will discourage starring of the surface.

Let the scrim layer, or lamination, just set, and whilst tacky, but not easily disturbed, the next lamination of glass cloth is put on.

The Main Mix

Make up 5lb. of main mix for the model being described. This provides a little more than is usually required, but the residue should be kept for final operations, described later. Put on two glass cloth laminations after the scrim. A smaller boat, say a 36in. hull, will be strong enough with scrim and one layer of cloth.

The main mix is made from 3 pts resin, 1 pt. thixotropic resin, 2 pts. china clay filler and white-coloured resin, well stirred in.

The accelerator is then stirred in very thoroughly to give a setting time to suit the working temperature, according to the time the operator will take to put in a glass cloth lamination. Two hours will be safe for a newcomer to the work. Previously, cut scrim and cloth to rough shape to save time, whilst the jel coat is setting.

Chopped glass mat is slightly cheaper for the two laminations that follow the scrim. However, mat is not very suitable for a model, for a number of reasons, and the more easily worked and stronger woven glass cloth should be used. When making a full size dinghy the chopped mat is worth the more difficult technique of wetting out the mat by rolling. A mat has the glass strands laid in any direction and can be thinner in places than in others. A woven glass cloth has an even weave and content of glass strands, which take less weight of resin, mould more easily into the small curves of a model and make a lighter, stronger hull as well as being easier to make.

(To be concluded)

A Power Pack Lamp

By R. TEECE

A Useful Inspection or "Emergency" Light

THE power-pack lamp described here will provide light for a very long period. If used around the house for planned periodical usage, such as stoking up on central heating, nightly rounds of inspection,

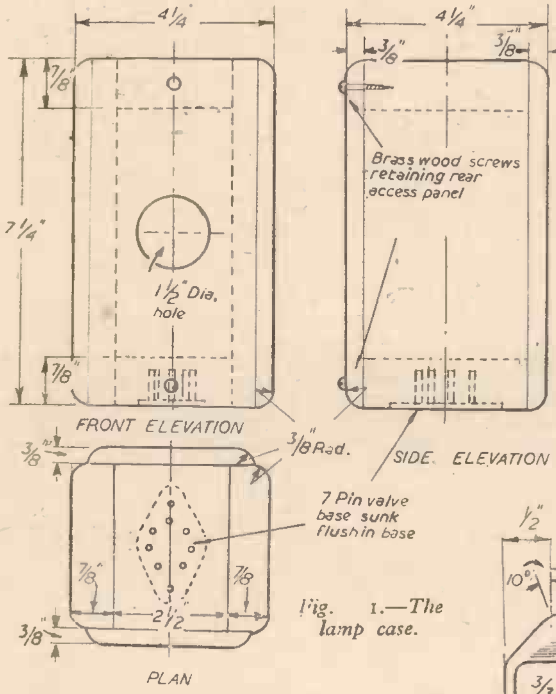


Fig. 1.—The lamp case.

and any other purposes, it will last at least three months.

A feature of this lamp is the six-cell battery pack which provides a total power of 27 volts.

In the base of the lamp, with outside access, means are provided for quickly isolating used cells. The simple movement of a wander plug brings a fresh cell of 4.5 volts into circuit. It often happens that the cells used earlier have recuperated and these can be brought back into service with the wander plug. Under the base of the lamp and surrounding the wander plug is a thick rubber mounting which makes the lamp shock-proof and gives security against wet working conditions. This shock-proof base is shown in Fig. 8.

Construction

The battery case is made from American Oak. The top and base of the case and two walls are of 7/8in. thick material. The remaining two walls are of 3/8in. thickness. This construction will withstand rough usage. Fig. 1 provides all dimensional details of the case and needs no explanation except that all parts are glued together.

The lamp has a spotlight beam which can be adjusted for "wide" lighting. Fig. 2 illustrates the method of incorporating a large spotlight torch in the lamp. Regarding the bulb, this can be .3 amp. The 20 s.w.g. plate is passed over the torch section and soldered to the flange. The flanged end and the attached plate are arranged inside the lamp case and the whole secured with four 3/8in. round-head woodscrews.

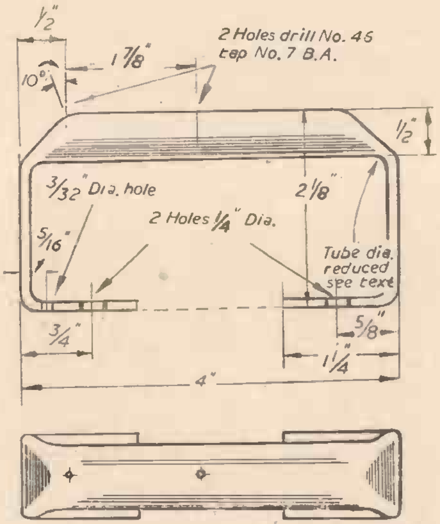


Fig. 3.—The handle.

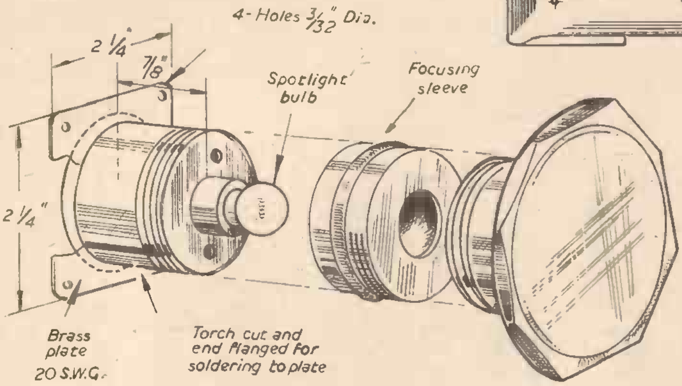


Fig. 2.—Method of using an old spotlight torch.

The Handle

This is shown in Fig. 3 and is bent cold from 16 s.w.g. mild steel tubing. It is fixed to lamp case with two bolts, one of which is shown in Fig. 5. The lower portion of the handle, which is attached to the case, is pressed flat by means of a vice. It is also necessary to place the grip portion of the handle in the vice and squeeze until a slight flat is produced on the top and underside. This not only improves the grip by widening but also provides a partly flat surface for the attachment of the switch.

The switch is illustrated in Fig. 4 and the fixing holes for it should be "jigged" from the existing holes in the switch case.

There is a third hole which, for clarity, is not shown in Fig. 3. This hole provides a passage through the handle for the wire (E) shown in Fig. 5. This wire comes from one side of the bulb and is finally soldered to

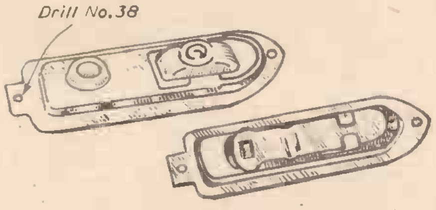


Fig. 4.—The switch (top and underside views).

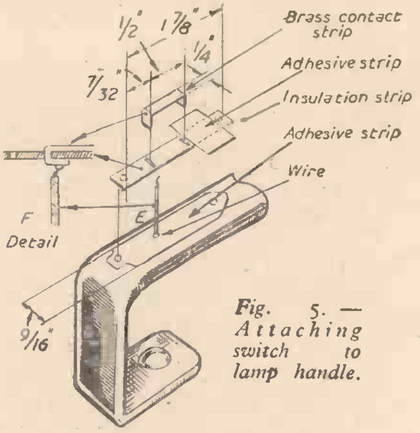


Fig. 5.—Attaching switch to lamp handle.

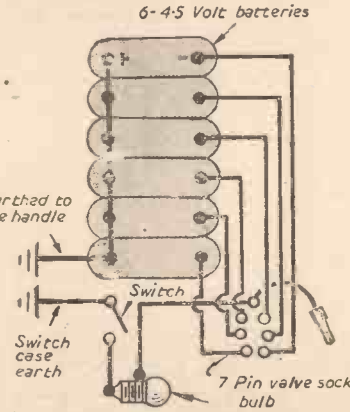


Fig. 6.—Wiring diagram.

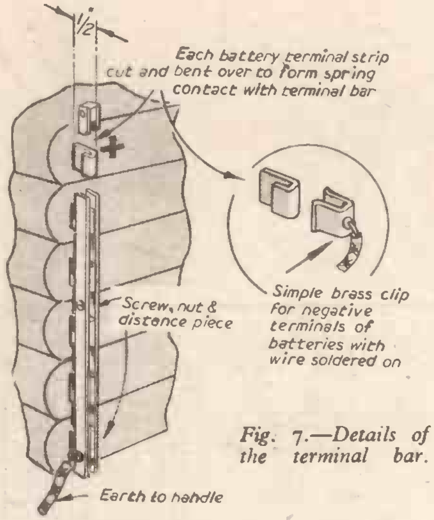


Fig. 7.—Details of the terminal bar.

the contact strip shown enlarged at "F." This hole must be "jigged" separately from the insulation strip. The adhesive strip ensures that the insulation strip lies quite flat on the surface of the handle.

Small differences in dimensions of the switch parts available will necessitate suitable adjustments of hole centres, but the general procedure should not be affected.

Wiring

Fig. 6 is the wiring diagram and it will be seen that the power-pack consists of six units connected together, yet providing for separate tapping of any cell unit by means of a wander plug. Note that one end of the positive terminal-bar is connected or earthed to the lamp handle. This can be accomplished by attaching a lead from the positive terminal-bar to one of the holding-down bolts of the handle. The remaining earth shown in the illustration is formed automatically by the screws of the switch case.

Fig. 7 illustrates the simple construction of the terminal-bar. A small label can be attached to each wire bearing a number to indicate its clockwise relationship to the seven-pin valve socket base.

When attaching the shock-proof base, 1in. panel pins are used. This base and method of fixing is shown in Fig. 8. The panel pins can be driven below the surface of the rubber which then closes over the panel pin heads and so makes them invisible.

This base was made from part of a rubber mat taken from the luggage boot of a disused car. The entire lamp was made from scrap. Due to the fact that the lamp case is made from wood the usual trouble from batteries being left in the case too long is entirely obviated.

The case was sprayed scarlet, leaving all plating clean. The resulting construction, and finish, was equal to any factory made article.

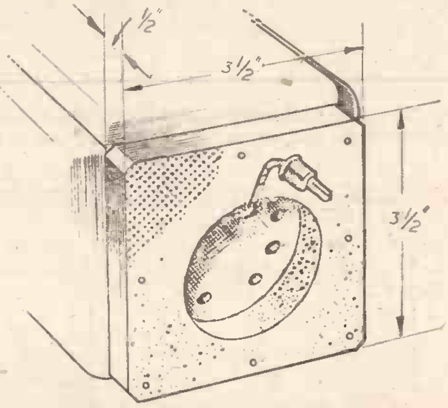


Fig. 8.—Attaching the shock proof base.

EXPLOITING AN INVENTION

By JOHN LYMESTER

ONE of the most difficult things which happens to the practical home-trader is to try to exploit on the national market something that he has invented and which is of considerable value.

To illustrate, I have had experience of a man who has invented a very good cleaning preparation which he can sell to all of his friends in his own district, but which he has found very difficult to exploit elsewhere.

If you have an invention of any type you must protect it by a patent and also if you have a special name for it, to protect this by a trade mark registration.

Both of these procedures are technical and you should employ a patent agent and a trade mark agent.

When you have safely got the registrations in the United Kingdom you must consider whether there is any potential market overseas and, if possible, should it be a possible world seller, protect the invention throughout the world.

Exploiting the Invention

Having got the invention fully protected, normally the home-trader has not sufficient money to go further, the obvious thing then is to see if you can contact a manufacturer, in the type of market for which your invention applies, to exploit it.

If you can find such a manufacturer there are a number of methods by which the idea can be exploited, but probably the best is to arrange for the manufacturer to make the goods and sell them, and for him to pay you a royalty on the production.

The royalty agreement between yourself and the manufacturer should contain a clause whereby he undertakes a certain amount of advertising and also gurantees a minimum royalty every year.

If you can obtain these terms from a manufacturer, obviously it would be best to consult a solicitor as to the actual legal agreement, the expense occasioned will be well worth while because it will protect your interest.

Manufacturer and Distributor

If you cannot find a person who will manufacture, sell and pay you a royalty, the second solution is to find a person or persons who can distribute it.

If you can find certain firms who can obtain orders for you then undoubtedly it will be fairly simple to find a person who will manufacture and deliver to your distributors.

In such a case you must be certain that the price of manufacture and the price of sale to the distributor are such as to permit you a reasonable profit to cover all expenses you may incur and to leave you with something for your invention in the nature of a royalty.

To illustrate further, in the case of cosmetics many firms will arrange for the distribution of such cosmetics, but will not undertake to manufacture, and other firms will undertake the manufacture but not the distribution. If you therefore have a good product in this field, undoubtedly it is not too difficult to obtain a distributor and then, having got the distributor to effect the sales, to arrange for the manufacturer to deliver as requested by the distributor. In such arrangements you must be very careful that you, yourself, are always covered, and that there is no possibility of the manufactuerer and distributor getting together and leaving you out.

Again, if you have such an invention, and you do not know what to do with it, but you have got it covered by a patent and a trade mark, then there is a great possibility of exploiting it further by advertising in a trade press for which the item is applicable.

For example, if it is an engineering product, then it should be advertised in an engineering journal; if it is a motor product, then it should be advertised in a motor journal. You will undoubtedly have a number of replies and from these you can sort out the best method to deal with it.

Apparatus for Electro-Static Experiments

K. G. Vine Describes its Construction Using Modern Materials and the Tests Which Can be Carried Out With it

(Continued from the May issue.)

FIRST of all strip the earphone completely, retaining only the cap and the container. If the hole in the cap is less than ½in. diameter carefully file it to ¾in. Then make an identical hole in the metal back (a plastic type case is not really suitable, but could be used if covered with foil on the inside). Make two metal brackets and screw them on to the back of the phones, probably some of the holes which previously fixed the magnets will come in handy. Keep the heads of all bolts inside, preferably countersunk. Screw the brackets to a wooden base about 3in. square and ½in. thick or use a typewriter spool tin filled with cement or plaster to give it weight.

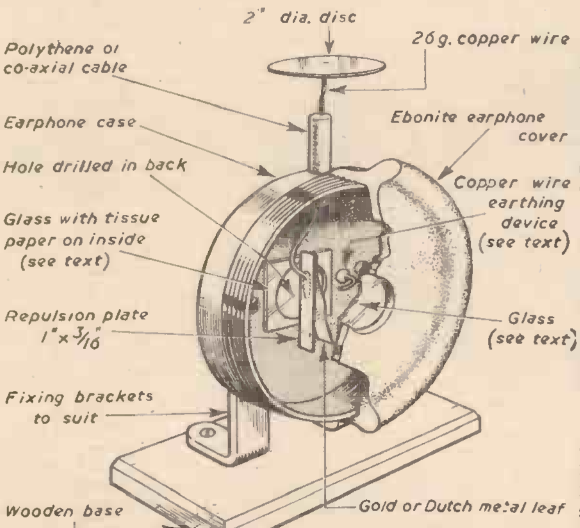


Fig. 13.—Details of the Type "C" Electroscope.

Prepare a length of coaxial cable as for Type "A" or use a polythene plug and wire as previously described. Drill a hole just a little smaller than the polythene in the top of the mounted electroscope (earphone). Fig. 13 will make this clear. Attach a repulsion plate with solder and bend the wire so that the plate is in the centre of the viewing window and in the middle of the phone when the cap is screwed home. Attach a metal disc as in Types "A" and "B."

Solder a small ½in. length of copper wire on one side of the hole in the back. This is bent to touch the leaf when it is repelled to an angle of about 60 degrees. The instrument then becomes discharged which is preferable to having the leaf damaged. It also prevents the leaf bending sideways on high voltages, when it is attracted by the metal backplate.

The Windows

Take an ordinary gas filled electric lamp with a clear glass, an old one is quite suitable, wrap it in a piece of sacking and hit it gently with a hammer or better still do it up in a vice until it breaks. Select two small "windows" with a convex surface. Gently chip any odd corners away with pliers and attach to the viewing holes on the inside with cellulose cement making sure the concave surface is inside, and the convex outside. Do not get glue on the viewing area, as it is difficult to remove. The finished job gives the instrument a professional appearance. Microscope slide cover slips would also be quite suitable for the job; ordinary window glass would take up too much room. Plastic or celluloid is best avoided as a window material, especially in the back plate. Stick a tissue paper circle to the inside of back window.

Fig. 14.—Projecting the deflection of the Type "C" electroscope on to a screen.

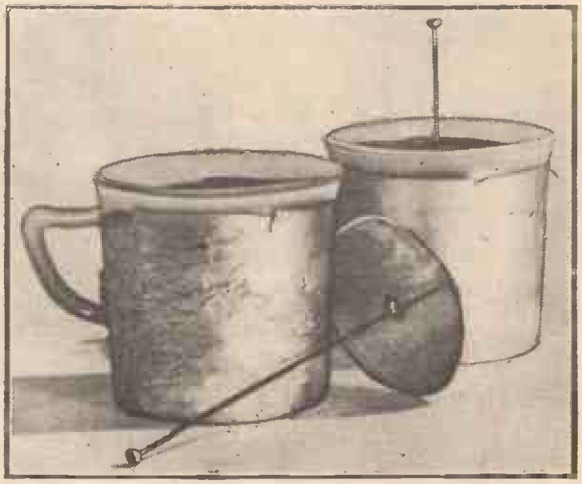


Fig. 15.—Two Leyden jars made from polythene beakers.

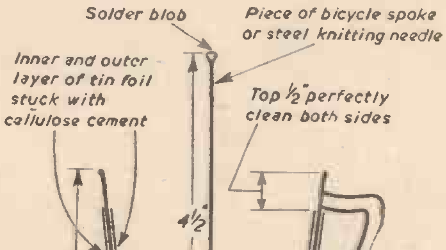


Fig. 16.—Constructional details of the Leyden jar.

Extra care is taken to have a perfectly smooth and flat leaf which is attached as before. If it gives trouble on test by tending to "double" or "bend sideways" carefully experiment with a slightly shorter leaf (have it as near 1in. as possible) and with various adjustments to the discharging wire.

The tinplate disc may be replaced if desired by a large ball bearing, but this is not essential. A terminal may be fitted to the

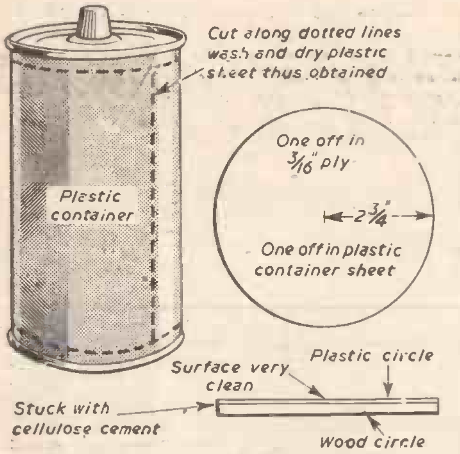


Fig. 17.—The electrophorus base.

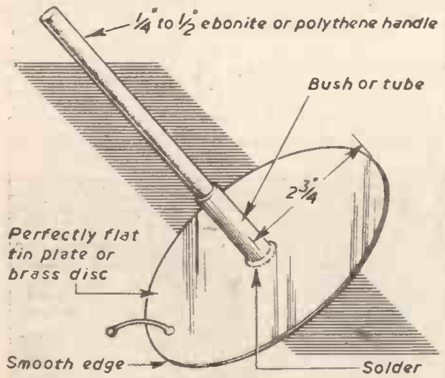


Fig. 18.—Details of the electrophorus.

case (metal) for earthing or testing potentials which are not with respect to earth. A terminal could also be fitted to the top disc but it is better to solder a wire on if it is ever needed.

In use under normal conditions the instrument is placed in front of a window or an electric lamp (a small 3.5 flashlamp is quite enough). Any article with a small static charge on it will then cause a deflection of the leaf. If the top disc is connected to the H.T. of a radio the leaves will of course be deflected, the instrument being in effect an "electro-static voltmeter." However, it is not the purpose of this instrument to measure actual voltages although they may be judged and compared. Twice a certain deflection means roughly four times the voltage, three times a deflection nine times the voltage (see physics books for "square law") etc. Fig. 14 shows the electroscope used in conjunction with a flashlamp bulb and battery to project the deflection of the leaves on to a screen.

Suggested experiments for all electroscopes will be given later in this series.

The Leyden Jar

Of all simple electro-static apparatus the Leyden jar (Fig. 15) is the most interesting as one can easily store charges for use in experiments, sparks of the "fat blue" type being easily obtained by the beginner. The results of experiments showed that a thin vessel of Polythene of about ½ to 1 pint capacity with tin-foil inside and out provided the best results.

Fig. 16 shows the construction of such a jar. A largish drinking cup of polythene with straight sides was purchased and thoroughly cleaned and dried. The inner and outer surface was gently roughened with medium sandpaper, save for the top half inch, which was left perfectly smooth. Cellulose cement was then worked into the roughened surface with the fingers and tinfoil from a radio condenser treated with cellulose cement on one side. When both lots of cement were nearly dry the inside and outside of the cup were covered with the foil. The bottom was treated in the same way. Later, any small pieces sticking out were removed or stuck down. Great care was exercised to see that the top ½in. of jar was not adulterated in any way, inside or out.

A tinplate disc was cut to fit the inside of the bottom of the cup (2¾in. in the prototypes). A piece of knitting needle was then soldered to its centre and allowed to extend 1½in. above the top of the cup. A dent was made in a piece of wood with the head of a round-headed screw. Solder was then placed in the hole and the tinned tip of the knitting needle was inserted in the hole. A hot soldering-iron then melted the solder to a neat, round blob. When cool, the disc and needle were removed and fitted as shown in Fig. 16.

Fig. 19.—A collection of electrophori.

To use the Leyden jar an electrophorus is required.

The Electrophorus

Basically this consists of a good, flat insulating surface which is charged by rubbing with flannel or fur. A specially insulated disc is then charged with the use of the insulated plate referred to. The main problem was one of getting a really flat polythene surface cheaply.

The problem was solved with the use of a soft, squashable detergent container. Take an old container and cut round the top and bottom with scissors and then down one side. You now have quite a sizeable piece of polythene. Rub off the printing with medium sandpaper. Scribe a circle of 2¾in. radius (see Fig. 17) and cut round it with scissors. Cut a disc of hardboard or plywood to the same size and apply cellulose adhesive to the wood and to the roughened surface of the polythene. Let it dry (say about one hour). Apply another coat, leave it 10 minutes to get stiff and press the two discs together. Immediately place the discs inside a large, old book and put bricks or other heavy objects on top. Leave for 12 hours. In this way the polythene will stick readily and not tend to curl up.

The insulated disc is of the same size and is cut from sheet tin or brass, especial care being taken to round the edges afterwards with fine emery paper. The insulated handle is a rod of ebonite or polythene. A small ½in. length of brass or copper tube is soldered to the centre of the tinplate disc and the insulating handle fits tightly into the tube. A suitable piece of tubing may be made up by rolling some cocoa tin metal round, say a pen holder, and running solder round it. Cellulose cement could be used to hold the handle in the tube. Another idea which proved satisfactory was to solder on a suitable piece of tube to hold a cork which, in turn, fitted into a small polythene bottle (Fig. 19).

A 1in. length of 26g. copper wire is given a solder "blob" at one end, or a steel ball bearing is soldered on. The other end is soldered to the disc about ⅛in. from the outside circumference (see Fig. 18). Some completed electrophori are shown in Fig. 19.

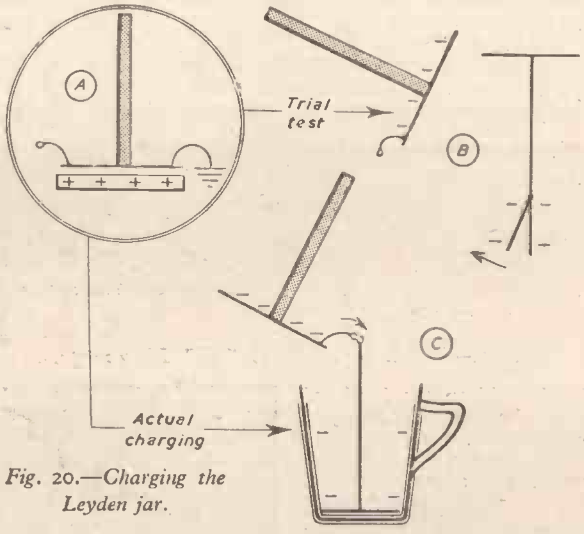


Fig. 20.—Charging the Leyden jar.

Using the Electrophorus

This is shown in use in Fig. 20. Use it away from steam or an atmosphere fouled by moisture. A living-room is ideal. Rub the polythene plate briskly with an old piece of fur coat or Harris tweed material (you can experiment with others, too). Make sure it is getting a charge by gently holding the plate to the electroscope. Give it as high a charge as you are able.

(To be concluded)

X-RAY Pictures

How to Produce These by Means of Waste Gas-mantles

THE common gas-mantle consists of a skeleton composed of 99 per cent. of thorium oxide and 1 per cent. of cerium oxide, the small proportion of cerium oxide being absolutely essential to the light-producing powers of the mantle.

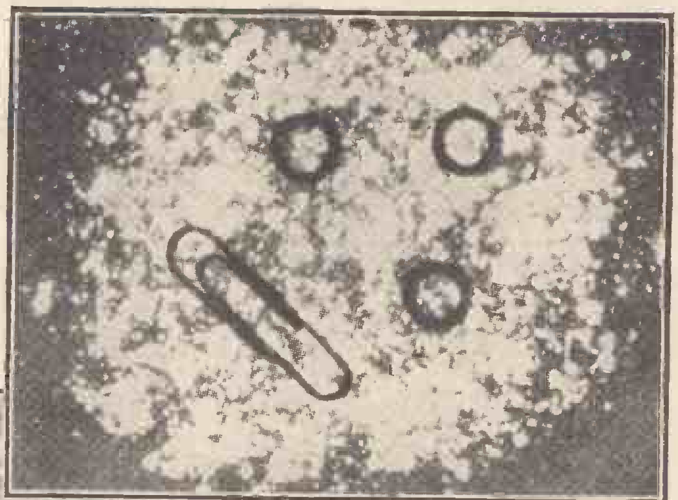
Thorium, in common with uranium and other elements, is radio-active. Hence, all its compounds are radio-active also. Thorium compounds, of course, have not a tithe of the intense radio-activity of true radium preparations. Nevertheless, all such compounds and preparations of thorium are definitely slightly radio-active and, in many instances, this radio-activity can be applied to an interesting purpose.

Gas-mantle Powder

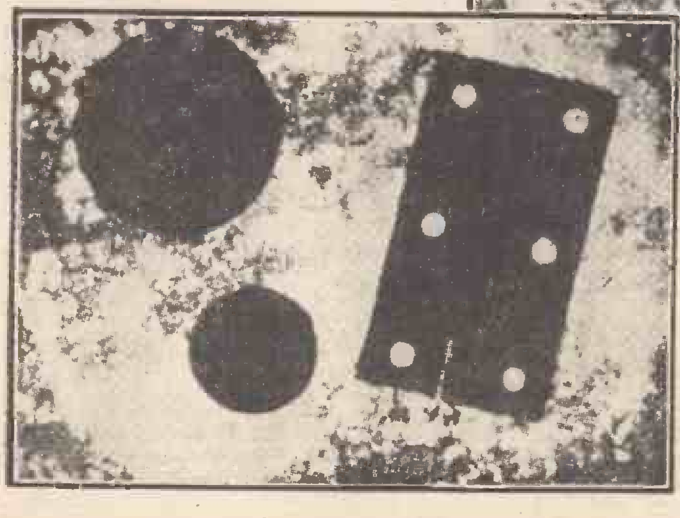
A readily available example of the radio-activity of thorium compounds consists in the making of simple X-ray pictures by means of waste gas mantles. Broken and disused gas-mantles should be stored until half a dozen or more are obtained. Crush up the broken mantles and pass the resulting powder through a fine sieve in order to filter out the grosser particles. The sieved material is then stored in a dry bottle. It will not deteriorate in any way at all, and it may be used over and over again for the photographic experiments described here.

In order to make an "X-ray" picture, take a plate or cut film of medium speed, place it in an empty box provided with a light-tight lid and place on the emulsion side of the plate or film (which faces upwards) a small, flat metal article such as a modern key, one or two coins, a pen-nib or some similar object. Then scatter over the surface of the plate or film a little of the sieved gas-mantle powder, taking care that the plate surface is fairly well covered with the powder.

The whole of the above operations must, of course, be conducted in a dark room and in ruby light.



(Above and below).—Examples of pictures produced by the use of thorium.



Using the Plate

The lid is placed on the box containing the plate and then placed on a shelf and allowed to remain absolutely undisturbed for a period of between 40 and 50 hours. At the end of this time, the plate is again removed from the box (under the darkroom red light, of course), the gas-mantle powder carefully dusted from its surface and collected for further use and finally the plate is developed in any ordinary strong developer. The result will be that a silhouette image of the metal object will develop on the plate.

If contrasting images are desired, these can best be obtained by "exposing" the plate for about 3½ days (approximately 80 hours), and then by developing it in the following hydroquinone developer:

Hydroquinone	40 grains	2.5	grams
Sodium sulphite (cryst)	½ oz.	15	"
Caustic soda	40 grains	2.5	"
Potassium bromide	5 "	0.3	"

The shadow images so obtained are not true X-ray images for the rays from the thorium oxide in the gas-mantle powder possess but very feeble penetrative powers and are incapable of passing through an appreciable thickness of metal. Such pictures are, however, interesting for their own sake.

Letters and Designs

By cutting out letters or designs in silver paper or tinfoil and by pasting down such characters on the emulsion surface of the plate, and by finally dusting the entire plate surface over with gas-mantle powder, silhouetted or shadowgraphed letters and designs can be obtained.

In most instances it is not advisable to prolong the "exposure" of the plate or film to the gas-mantle rays for an undue period. An "exposure" of from 40 to 50 hours is about average, and it should never exceed, say, 65 hours. If such exposures are doubled, the image, instead of being more clearly defined or more contrasting, will, on the contrary, be rendered flatter and less distinct owing to the general fogging effect of the thorium rays on the emulsion of the plate or film.

Interesting effects can often be obtained by mixing the gas-mantle powder with varying proportions of some inert and finely powdered material such as chalk powder, the finest sand, fine metal filings, boric acid powder and many other similar materials. These have the effect of diluting the active gas-mantle powder and spacing its constituent grains farther apart. Note, however, that gas-mantle powder thus diluted does not necessitate a greater exposure than the average being given to the plate or film.

Ordinary Bromide Paper

If the individual experimenter has not available a supply of plates or cut-films with which to make experiments on the above lines, he should note that such experiments can be conducted with ordinary bromide paper in place of plates or films. In such instances, however, the necessary exposure will have to be increased very considerably, according to the make and speed of the bromide paper used. Even gaslight papers can be used for the above purpose, but, in such instances, the requisite exposures generally run into weeks.

The "gas-mantle radiographs" results on photographic papers are never so good as those which are made on plates or films. Moreover, such paper prints will be negatives, that is to say, the silhouetted image will be in white on a dark background. These paper negatives can be printed only by copying through the camera, using a piece of bromide paper for the reception of the copied image instead of the usual plate or film. In this way positive images can be obtained from the paper negatives of the gas-mantle radiographs.

It is advisable to use backed plates in order to get the best results from the gas-mantle exposures. The backing of the plates prevents the scattering of the rays from the thorium oxide in the gas-mantle powder and thus assists in the production of a cleaner-cut image. If, however, backed plates are not available, a fair substitute for them may be made by pasting a piece of black paper or, better still, black cloth over the back of the plate. With films no such precautions are usually necessary.

A Warning

Do not on any account allow particles of the gas-mantle powder to fall into a box or envelope containing unused plates, films or papers. Even a single grain of the radioactive gas-mantle powder will play havoc with the light-sensitive material in its vicinity.

A Combination of Fishing Boat and Helicopter

The Latest Sport from America

THE B-7B Gyro-boat is essentially an ordinary small boat in which has been installed a helicopter rotor. When towed behind a power boat, it rises into the air.

The B-7B Gyro-boat takes off at an air-speed of about 20 m.p.h., which means that in a 15 m.p.h. wind its "water" speed is actually only 5 m.p.h. It normally lands with a forward speed of about 7 m.p.h., but can also land vertically.

Two photographs showing the Gyro-boat in use. The rotor blades are driven automatically by the force of the wind on the "autorotation principle."

Towing the craft in the air takes 10 horsepower and the normal towline pull is about 120-150lb. This horsepower figure refers to the excess power left over and above what is needed to propel the boat at that speed.

A 30-horsepower outboard has been used successfully.

Actually, the stronger the wind, the less horsepower is required. In a 20 m.p.h. wind, no motor at all is required—just tie the rope to a dock, or a pier, and the Gyro-boat will fly like a kite!

Flight Safety

Since lift is derived from a helicopter-type rotor, the machine will not stall, spin or go out of control, as fixed-wing planes do. The rotor will continue to rotate and provide lift even when forward speed is reduced completely to zero. The pilot cannot stop the rotor in flight even if he should try. Rotor blades are driven automatically by the force of wind, whether the craft is flying forward or descending vertically.

Helicopter-like control action permits the pilot of the flying boat to make banks and turns at will, and even fly over the shore above the trees, if he wishes. In addition, the forward and backward movement of the control stick commands the rise and descent of the machine, so that the flyer can make a landing within inches of the desired spot.

Construction

The original Model B-7B Gyro-boat was designed around a standard 12ft., 48in. beam fishing boat. However, almost any small boat weighing up to 200lb., can be used in its construction, but the lighter the better. Most rowboats, outboards, dinghys and prams can be converted into flying boats by adding the flying attachment named the "Rotosail." The latter consists of a helicopter-like rotor mounted on top of an aluminium mast, which is clamped on to the boat.

The rotor is composed primarily of two plywood blades shaped in airfoil form with a steel spar running the full length of each blade. Rotor blades are sold in either material kit form, semi-finished form or in finished, ready-to-fly form.

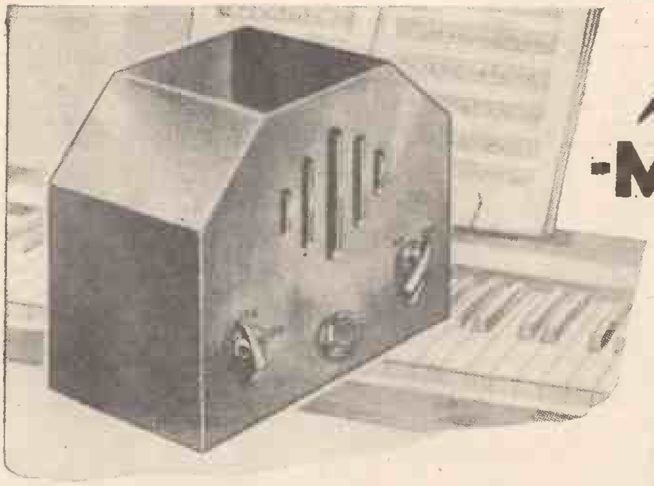
The rotor is attached to the mast by means of a rotor head, which contains all ball-bearings and flight controls. A control stick hangs from the rotor head; it is equipped with a pair of hand-grips similar to bicycle handlebars. The rotor head requires some accurate machining, but otherwise is surprisingly simple in comparison with rotor heads of conventional helicopters. The rotor head, too, is available both in material kit form and in ready-to-fly form.

The mast is a 2in. tube of aluminium alloy held to the boat by three stainless steel cables. All fittings and attachments are standard aircraft or marine hardware. No welding or brazing are used in construction.

Design of the Rotosail has been developed bearing in mind the facilities of the average home workshop. It can be built by a novice in two weeks to a month, working in his spare time and using readily available tools.

The Rotosail can also be bought in ready-made form, completely finished and assembled, with or without the boat and the entire flying boat can be readily carried on top of a car.

The makers are the Bensen Aircraft Corp., Box 2725, Raleigh, N.C., U.S.A.



An Electronic -M-E-T-R-O-N-O-M-E

D. May Tells You How to Make Up This Up-to-date Unit

THE metronome described here was constructed very simply and cheaply and has proved quite satisfactory in service. The battery used was purchased from an ex-Service surplus store for 1/-; doubtless there will be many more about at a similar price, and as the first gadget of this type made up ran night and day for several months without the battery being exhausted it will be seen that operation is quite economical.

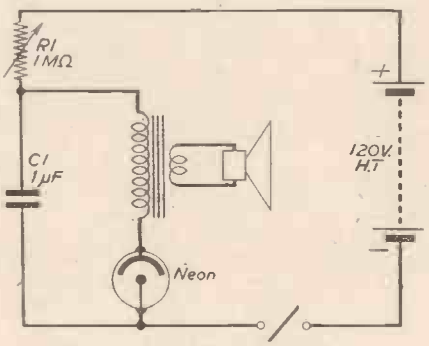


Fig. 1.—The theoretical circuit.

The remainder of the bits and pieces, consisting of a 1μF condenser, an on/off switch and a 1 MΩ volume control (used as a variable resistor), are equally easily and cheaply obtainable. An exception is the loudspeaker which, however, can be of the 5in. permanent magnet type, with transformer, such components being fairly reasonably priced, or it may be the speaker from an old battery set which has ended its useful life. Alternatively, the speaker may be replaced by a high resistance earphone or it may be omitted altogether and the flashing neon light used to indicate tempo and to regulate playing.

How it Works

The instrument works on the well-known principle of the relaxation oscillator. Referring to Fig. 1, the theoretical diagram, the explanation of the working is as follows:

When the unit is switched on condenser C1 commences to charge up through resistance R1 and its voltage rises rapidly from zero. The rate of charging depends upon the amount of resistance and the capacity of the condenser, being slower when either is increased and vice versa. When the voltage has increased to the striking voltage of the neon lamp the lamp lights, draws a heavy current, and very rapidly drains the condenser until its voltage is down to the extinguishing voltage of the lamp, when it goes out, and the cycle starts again as the condenser begins, comparatively slowly, to charge up again.

Each cycle thus produces a flash from the neon lamp. The frequency at which these flashes occur may be controlled by making R1 variable. In this instrument, with the values given, the rate of flashing can be regulated in the approximate range of 40 to 200 per minute, which is adequate for musical purposes.

By arranging that the neon lamp shall discharge through the primary of the speaker transformer a click or, more accurately, a "pop" is heard each time the lamp flashes.

The Case

The housing of the parts may be carried out to individual taste as also may the layout of the components, neither of these being in the least critical. Fig. 2 shows the design adopted by the writer, which was dictated mainly by the materials to hand.

Increasing Volume

An advantage would be obtained if the resonant frequency of the containing box could be arranged to coincide with that of the speaker cone as this would reinforce the volume of the "pops."

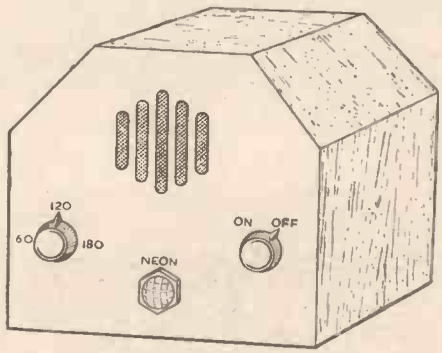


Fig. 2.—The suggested case.

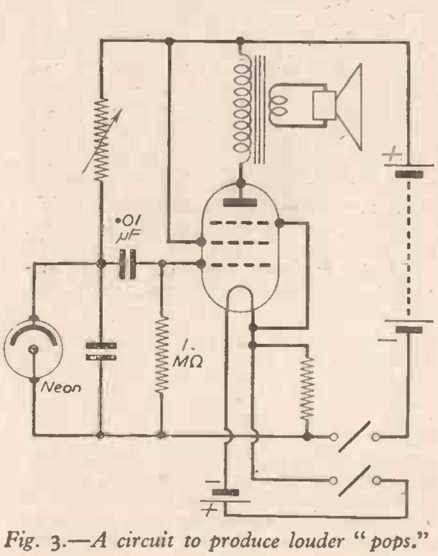


Fig. 3.—A circuit to produce louder "pops."

Calibration

Calibration of the knob for setting the speed is very simply carried out by counting either the number of "pops" or the number of flashes which occur in one minute, using a watch with a seconds hand, and by marking the scale to suit. If the scale is made so that it may be moved round the knob, if required, checking of the speed and subsequent adjustment of the scale may be made to compensate for slight slowing down of the unit as the battery ages.

The scale should also be marked with musical instructions, such as Andante, Moderato, Allegro, etc., and the number of beats per minute to coincide with these can be obtained from various pieces of music.

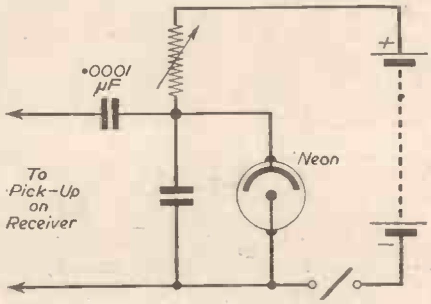


Fig. 4.—Using the radio amplifier.

Alternative Circuits

The flashing of the lamp can easily be seen "out of the corner of the eye" if the instrument is stood on top of the piano when playing, and itself gives quite a good guide to tempo. The loudness of the "pops" is sufficient to be used as a guide when practising solo, and it is not necessary to play loudly. If, however, it is desired to regulate several players at once it is advisable to build the unit, as in Fig. 3, with the addition of a small valve of the output type, together with a battery for its filament supply. This will give much louder "pops," but will drain the battery more quickly. Alternatively, as in Fig. 4, the unit may be connected to the pick-up terminals of an ordinary radio receiver when the volume will be adequate for all purposes.

Our artist's impression of the completed xylophone in a modern setting.

Making a Xyl

Full Details for Making and Su

By F. BARBER

THE xylophone, which is included in the percussion section of orchestras, is derived from an instrument which seems to have had its origin in darkest Africa. This instrument, which was mentioned by the great explorer Livingstone, was called a Marimba or Balaso. The African natives used the instrument in a portable form slung around their necks by a cord. Fig. 1 shows such a player in action. The slabs of wood used for the instrument were tuned to a musical scale and the sonority of the notes was increased by securing gourds underneath the slabs. Sometimes the gourds had holes at various places which was presumably for the purpose of increasing the musical effect.

Fig. 1.—A native playing the marimba, of which the xylophone is a development.

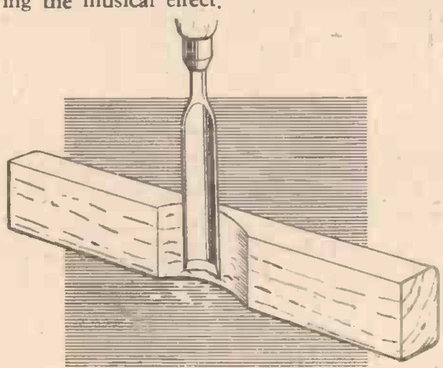


Fig. 2.—Paring the tuning arch with the scribing gouge.

In the modern instrument the volume of sound from individual notes is increased by suspending underneath each note an open tube which is tuned accurately to the note of the wooden key above.

Very simple xylophones may be made without the resonating tubes by placing the notes on bearers; the latter are secured in a shallow wooden box when a certain amount of resonance or echo effect will increase the sound from the keys.

Almost any kind of wood can be used to make the keys of the xylophone shown in the heading sketch and in Fig. 8, but, of course, the hardwoods give the brighter effect. The best wood of all is rosewood and this timber may be obtained from most reputable importers of hardwoods.

Rosewood, like mahogany, seems to have

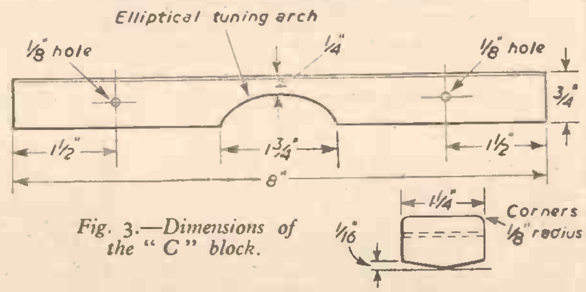


Fig. 3.—Dimensions of the "C" block.

grain running in all directions. When purchasing a plank of the timber ask to have it machine planed to ¾in. thickness. It might be an advantage, too, to ask the timber yard to saw it to the width required for the notes, namely, 1¼in. The final finish to the wood can be given by a scraper and glasspaper.

Materials Required

Twenty-five ft. run 1¼in. × ¾in. (finished size) rosewood. 72 ¼in. dia. wooden beads (or

glass if wood is not available). 2ft. ¼in. birch dowel rod. Macrame twine or fishing line (25lb. Cuttyhunk or nylon).

For the frame: 2 pieces 32in. × 2in. × 1in., deal prepared; 1 piece 22in. × 2in. × 1in. deal prepared; 1 piece 12in. × 2in. × 1in., deal prepared.

For the key supports: 4 pieces 32in. × 2¼in. × ⅝in., deal prepared; 4 pieces of felt 36in. × ¼in.

lophone

ggestions for Tuning

For the resonator supports: 2 pieces 32in. × 2in. × ⅜in., deal prepared.

For the legs: 4 pieces 36in. × 1½in. × ⅜in., deal prepared; 2 pieces 36in. × 1in. × ½in., deal prepared; 4 2in. × ¼in. bolts with wing nuts.

For the resonators: 30ft. of 1¼in. dia. aluminium tube.

For hammers: 2ft. 3/16in. dowel rod; 2 ⅝in. dia. wooden beads.

Sundry glue, nails and screws.

A good musical ear is a necessity in tuning the notes of such an instrument as this, and much perseverance and the co-ordination of hand tool operations together with the critical judgment of musical pitch are called for. Probably the best way for the practical mechanic to tune the instrument is by a process of comparison of the xylophone notes with those of a piano. Needless to say the piano should be one which has been recently and accurately tuned.

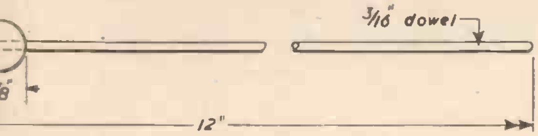


Fig. 4.—*Dimensions of hammers.*

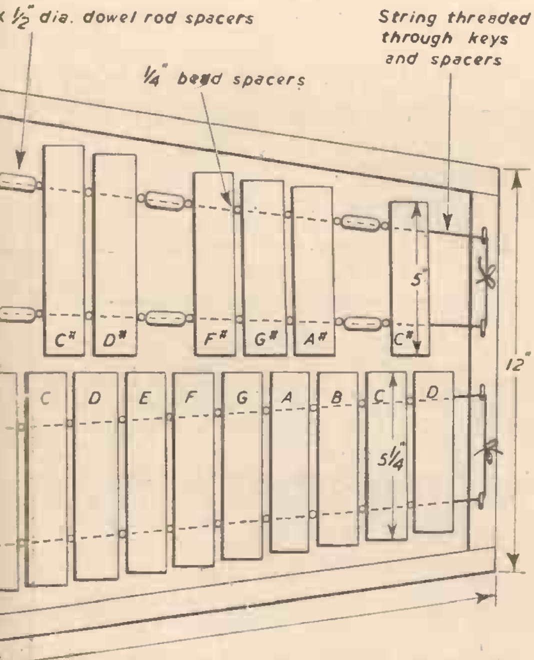


Fig. 5.—*Plan of the xylophone keyboard.*

In addition to the piano one or two tuning forks such as an A and C will be of great help in tuning the resonator tubes as will be explained later.

Construction

A plan of the keyboard of the xylophone and its supporting frame is shown in Fig. 5. It covers a range of about two-and-a-half octaves. The continuous row of notes to the bottom of the instrument represents the white notes of the piano keyboard and the groups of two and three notes at the top of the diagram represent the black notes.

The wooden keys are sawn from 1½in. × ¾in. finished size rosewood, and the top edges of the keys should have a slightly rounded edge as shown in Fig. 3.

It may be advisable to commence with the lower C of the scale, a note which will represent in pitch the C above middle C on the piano keyboard, or the C tuning fork. The size of this note is shown in Fig. 3.

Saw off the 8in. length required and smooth off with fine glasspaper. The underneath surface of the note is bevelled up 1/16in. on both sides so that when suspended on the strings it will rest on the felt-covered bearer on the kind of keel thus formed.

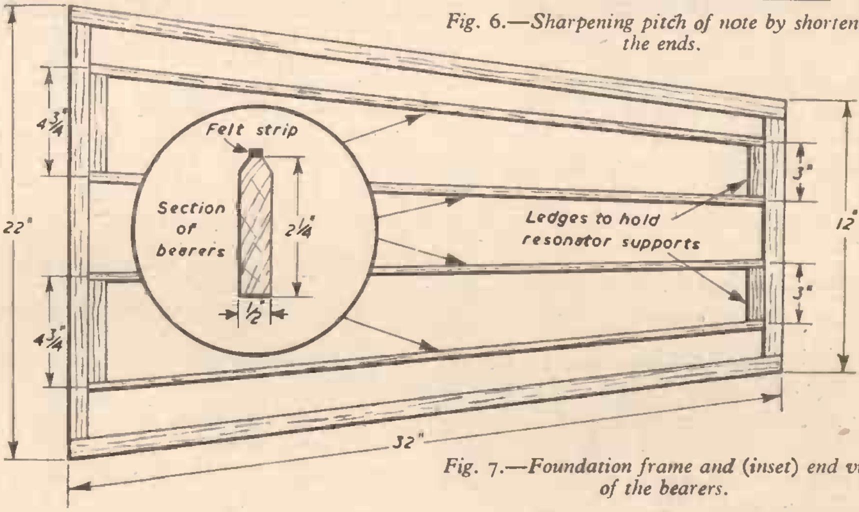


Fig. 7.—*Foundation frame and (inset) end view of the bearers.*

Next saw out the semi-elliptical tuning arch, as shown, with a fine bow saw.

The key may now be rested on the felt bearers and tapped in the middle of its length with one of the hammers, when a musical note will be produced. The construction of the hammers is shown in Fig. 4

Now comes the test of one's musical powers. Repeatedly tap the note and try to hum or sing the note which is produced. Having thus well established the note in the mind go to the piano keyboard and try to locate it on the piano. It should be C above middle C or near to it. It may, of course, not be any particular note but may be slightly sharp or flat.

Suppose, for example, the note is the note D above the C required, i.e., the xylophone note is too sharp and its pitch must be lowered or flattened. This is achieved by removing some material from the tuning arch by the use of what is known to the joiner as a scribing gouge. Remove only a shaving or two at a time and then tap the note and compare with the piano. Repeat this process again and again until the correct note has been produced. This tun-

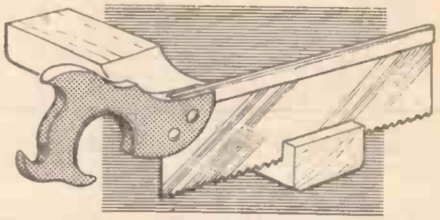


Fig. 6.—*Sharpening pitch of note by shortening the ends.*

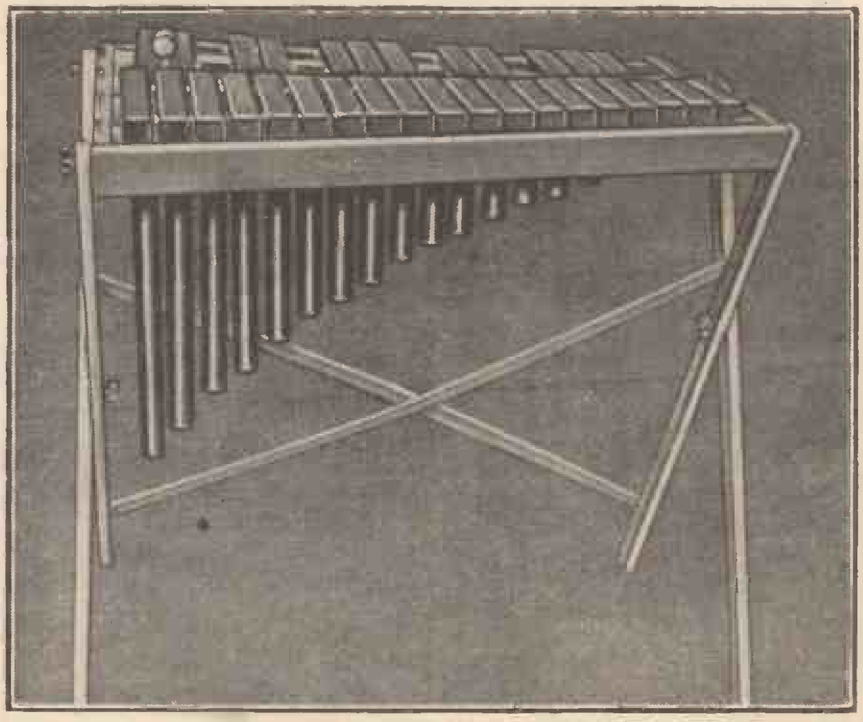


Fig. 8.—*A view of the completed xylophone.*

ing process is shown in Fig. 2. In removing this wood from the tuning arch always try to keep the symmetrical semi-elliptical shape.

If the note on the xylophone is lower than C, it is too flat and must be sharpened. This is done by sawing off a very short but

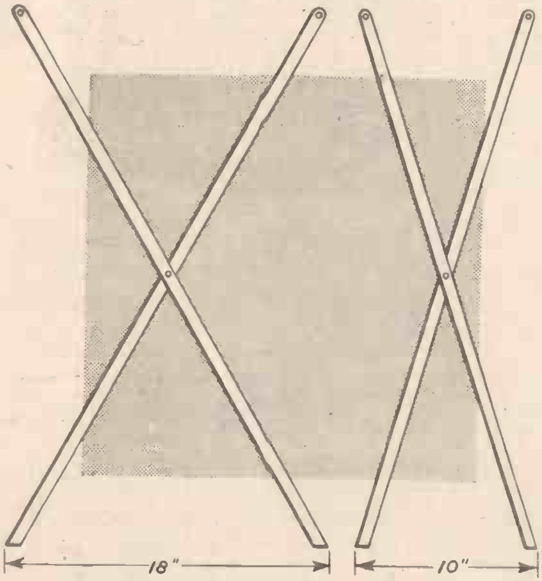


Fig. 9.—The cross-frames for legs.

identical piece from each end of the key (Fig. 6).

In both processes of sharpening or flattening it is essential to keep each end of the key exactly balanced or equal in length.

At this stage it is advisable to draw out a full-sized plan of the keyboard as shown in Fig. 2 on a piece of paper. The lengths of the three C notes are given, and from these the lengths of the intervening notes can be marked off as shown.

When tuning proceeds, provided the pitch of the notes is correct, slight variations from the lengths given may be arrived at, but this is relatively unimportant provided the correct pitch is obtained.

The Supporting Frame

The foundation frame is composed of lengths of 2in. × 1in. material jointed together in a tapering frame. The overall length is 32in., at the wider end the measurement is 20in., and at the narrower it is 12in. If the reader has sufficient skill the frame could be dovetailed together. The fact that the corners are not at right angles makes an extra complication for the amateur. For the less skilled a butt joint nailed and glued will suffice (see Fig. 7).

The four bearers for the keys are cut to fit into the inside length of the frame. They are 2¼in. wide and approximately ½in. finished thickness. The top edges are bevelled to ⅛in. on which are glued the felt strips (Fig. 7). These bearers are held in place with some nails at their relative positions in the frame.

When the 19 front row notes have been roughly tuned, they may be drilled with ⅛in. holes to take the string which will keep them together. Observe that the back holes will be drilled at right angles whereas the front holes are at a slight angle which can be drawn on from the full-sized drawing of the layout. When threading up the keys, interpose a ¼in. bead between each note as shown. The completed row is placed in position and held in place by looping the thread over four small cuphooks screwed into the top of the frame.

The back row of notes representing the sharps or flats of the piano are next dealt with in the same way as the front row. Between A sharp and C sharp there is a space as also between D sharp and F sharp. These spaces are preserved by a spacer made from a 1¼in. length of ½in. dowel rod through which is drilled a ⅛in. hole.

When the two rows of notes are finished and secured in place, it is time to go over the whole instrument once more and test its accuracy from the piano notes. An assistant to sound the piano notes whilst you tap and tune the xylophone is a great convenience and time saver.

The instrument may now be used for playing tunes. Improved tone may be produced by standing the assembly in a shallow wooden box. The effect is somewhat similar to that produced by the gourds fixed under the instruments played by the natives of Africa.

The reader will, of course, wish to make his instrument more professional, and so the making of a stand and the resonators will be the next step (see Fig. 8).

It is as well to make the stand first of all. This is very simple and consists of two cross frames, one at either end of the frame supporting the keys. A cross frame between the two end frames gives rigidity to the construction (Fig. 9).

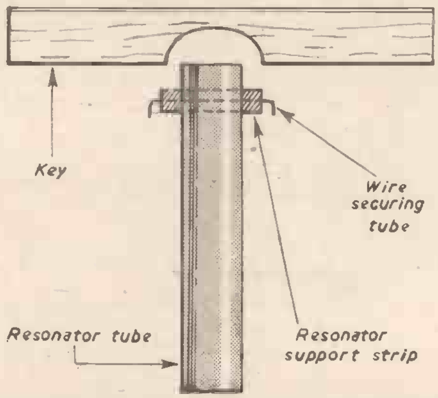


Fig. 10.—Relative positions of resonator tube and key.

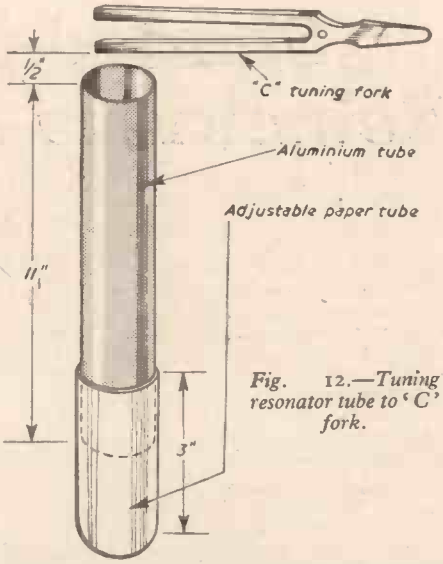


Fig. 12.—Tuning resonator tube to 'C' fork.

Making the Resonators

The resonators are made from some aluminium tubing 1¼in. outside diameter. Other material besides aluminium could be used as well. For instance, in the instrument shown in Figs. 8 and 11 the tubes were of fibre.

These tubes are suspended on a board so that each tube is under the note above in the centre of the tuning arch, the top of the tubes being on a level with the bottom side of each note, as can be seen in Fig. 10.

Before proceeding to tune the whole range of resonator tubes try a simple experiment in sound, as follows.

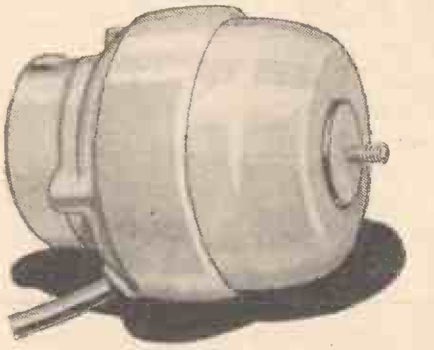
Cut off a piece of the tubing 11in. in length. Glue up a paper tube to slide over the end as in Fig. 12. Hold the tubes and make sure that they slide in and out smoothly. Get a helper to strike the C tuning fork and hold it ½in. from the end of the tube. Whilst listening carefully slide the two tubes in and out of one another. At a certain point the sound of the tuning fork will very appreciably increase in volume. Strike the fork

(Concluded on page 439)

Fig. 11.—Front row of keys removed to show resonator tubes.

Shaded-pole and Reluctance-start Motors

J. L. Watts Explains the Characteristics and Uses of These Motors



THE enlarging sphere of electrical power and control for various apparatus has increased the demand for small and inexpensive single-phase motors. Shaded-pole and reluctance-start motors may be used for driving fans, blowers, humidifiers, motorised valves and similar apparatus.

Production of Revolving Magnetic Field by Pole Shading

Shaded-pole motors are normally not made in sizes above about 1/30 h.p. For drives such as air-circulating fans where accidental overload is impossible such motors may be rated up to about 80 per cent. of the maximum torque of the motor, but for other applications the motor may be rated at about 50 per cent. of maximum torque.

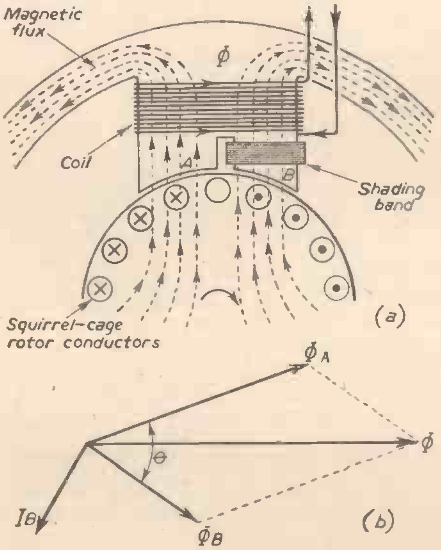


Fig. 1.—Principle of the shaded-pole motor.

Shaded-pole motors have a normal squirrel-cage rotor, and usually have a concentrated-pole stator of the general type indicated in Fig. 1a. A slot is cut near the centre of each pole face, into which is inserted one side of a short-circuited copper shading band which encircles 30 to 50 per cent. of the pole face. This band acts as the short-circuited secondary winding of a transformer, of which the stator winding acts as the primary winding. It is preferable for the shading band to be continuous, but in some cases the ends of the shading band are joined by silver soldering.

As is well known, a single-phase induction motor will only be self-starting when the current in the stator windings produces a magnetic flux which revolves round the stator. The flux Φ produced by each pole of the shaded-pole motor is alternating or pulsating. However, the effect of the induced current I_B in the shading band causes the magnetic flux Φ_B in the encircled portion B of the pole face to lag behind the flux Φ_A in the plain portion A of the pole face by the time-phase angle θ, as indicated in Fig. 1b. Thus the peak flux Φ_B in the encircled portion B occurs $\theta/360$ of a cycle after the peak flux Φ_A in the plain portion A, so that a revolving magnetic flux is produced, although the value of the flux is not constant as it passes round the stator. Current is induced in the rotor conductors which reacts with the stator flux to produce torque which tends to turn the rotor in the direction from A to B.

Types of Shaded-pole Motors

There are various practical arrangements of shaded-pole motors. One miniature motor has a rotor which consists of a disc of aluminium or copper which revolves between the poles of a shaded-pole electromagnet. Fig. 2 shows one design of a small two-pole motor which has a single stator coil. Fig. 3 shows another design in which wedges of iron or other magnetic material are fitted which act as magnetic bridges between the poles. It will be noted that the portions X and Y of the stator laminations shown in Fig. 2 also act as magnetic bridges. These bridges reduce the motor current somewhat and improve its performance.

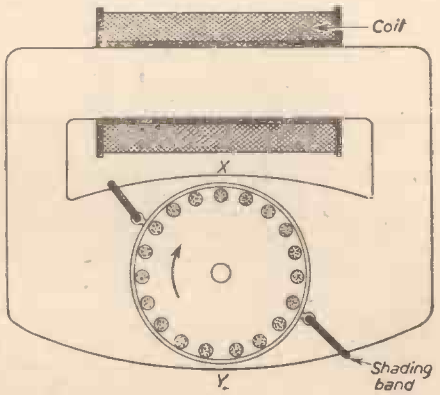


Fig. 2.—Shaded-pole motor with single stator coil.

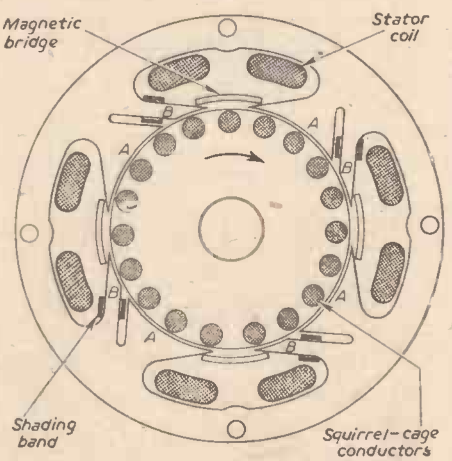


Fig. 3.—One arrangement of a four-pole shaded-pole motor.

Some shaded-pole motors have a laminated slotted stator of the type used in normal squirrel-cage motors, with a uniform air gap between the stator and rotor and distributed stator windings. In these motors the shading winding may consist of two or three turns per pole of comparatively thick insulated wire in the form of a wave winding, as indicated in Fig. 4. Usually the ends of the shading winding are short-circuited together inside the motor, although they may be brought out to terminals and short circuited externally. When the motor is running, a component current is generated in the squirrel-cage rotor conductors due to them cutting the stator flux; this component current creates a flux which is displaced both in time and place from the stator flux. Thus the shading winding is required only during starting and the short circuiting connection can be removed from the external terminals of a shading winding after the motor has started, in the same way that the starting winding can be switched off a single-phase induction or capacitor-start motor.

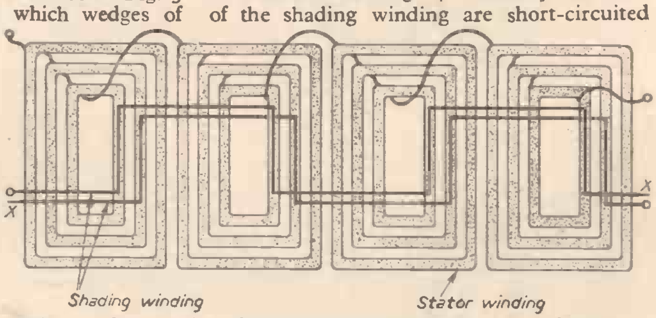


Fig. 4.—Distribution of distributed stator windings in a four-pole shaded-pole motor.

A Slow-speed Shaded-pole Motor

As in the case of other induction motors the synchronous speed of a shaded-pole motor in r.p.m. is equal to $\frac{60\ f}{P}$, where f is the frequency of the supply and P the number of pairs of poles for which the stator is wound. Thus a large number of poles are required on a slow-speed motor which is to run on a supply of normal frequency. The arrangement of a slow-speed shaded-pole motor may, therefore, be reversed as in Fig. 5. The squirrel-cage windings are fitted in a laminated core in the casing which is carried on bearings; thus the casing is the revolving element. The insulated winding fed from the supply is fitted on alternate poles of the central slotted laminated portion which is fixed. With this arrangement there are as many pairs of poles as there are stator coils connected to the supply.

Characteristics of Shaded-pole Motors

The usual type of shaded-pole motor, which has permanently short-circuited shading bands or windings, has a very low efficiency which may be in the region of

8 per cent. to 15 per cent. on full load, but the efficiency factor is seldom of great importance in such small motors. Fig. 6 indicates that the power factor is fairly constant over a wide range of load. The starting torque may be 20 per cent. to 60 per cent. of the maximum torque of the motor. Generally speaking, the higher starting torque, but lower efficiency, is obtained from a motor in which the shaded-pole area is about half that of the pole face, reduced starting torque being obtained with reduced shaded-pole area. Some motors have two or three shading coils per pole, encircling different areas. Reduced resistance of the

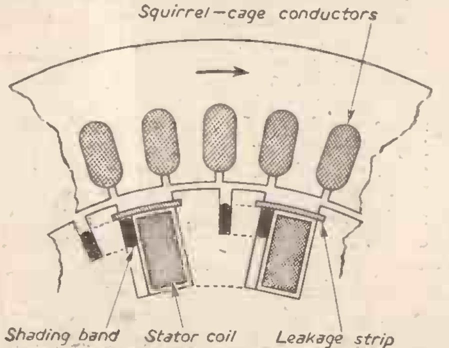


Fig. 5.—Arrangement of a multi-pole inverted shaded-pole motor.

shading bands increases the current in these bands with increase of starting torque. However, the increased I^2R losses reduce the motor efficiency.

The starting current of many shaded-pole motors is little more than the full-load running current, as indicated in Fig. 6. Consequently such motors can often be stalled for long periods without serious overheating. The no-load speed of a shaded-pole motor may be appreciably less than its synchronous speed. The full-load speed will be still lower, as indicated in Fig. 7, depending on the full-load rated torque as a percentage of the maximum torque of the motor.

Speed Control of Shaded-pole Motors

In some cases it is possible to obtain a useful degree of speed control by reduction of the voltage applied to the stator windings. As will be seen from Fig. 7 reduced voltage considerably reduces the motor torque developed at all speeds. Speed control by voltage reduction is almost impracticable in the case of a load which requires a constant torque at all speeds. For instance, in the case of the motor considered, if the load required 50 per cent. of the maximum torque of the motor at maximum speed (86 per cent. of synchronous speed) it would require more than 90 per cent. of rated voltage to start the drive. If a larger (de-rated) motor was used which developed four times the load torque at maximum speed, it would only be possible to reduce the speed from 91 per cent. to 82 per cent. of synchronous speed by reducing the applied voltage to 67 per cent. of rated value.

However, speed control by voltage reduction is quite practicable in the case of a load, such as a fan, which requires much less than full-load torque on reduced speed. Considering the fan characteristics A-B in Fig. 7 which requires 70 per cent. of the peak motor torque on 82 per cent. of synchronous speed. Such a drive could be run at 78, 73, 63, or 45 per cent. of synchronous speed by running the motor on 90, 80, 67 or 50 per cent. of rated volts. The applied voltage can be controlled by feeding the stator windings through a tapped transformer or auto-transformer, or through a variable choke coil or resistor.

Pole-changing is also a practicable proposition on some types of shaded-pole motor. Fig. 8 shows a motor which can be operated at either of two speeds, having a ratio of two-to-one, by simply reversing the connections to one of the stator coils. For operation as a four-pole motor the two stator coils are connected so that the poles A and B have the same magnetic polarity, consequent poles of opposite magnetic polarity then being produced at C and D as shown. For operation as a two-pole motor the connections to one coil are reversed by means of a double-pole two-way switch so that poles of opposite polarity are produced at A and B with no flux through C and D. The stator coils can be connected in series for use on one voltage, or in parallel for use on half voltage, with no change of the speed-torque characteristics. On either connection the voltage tolerance may be plus or minus $12\frac{1}{2}$ per cent., with 50 to 60 cycles frequency range.

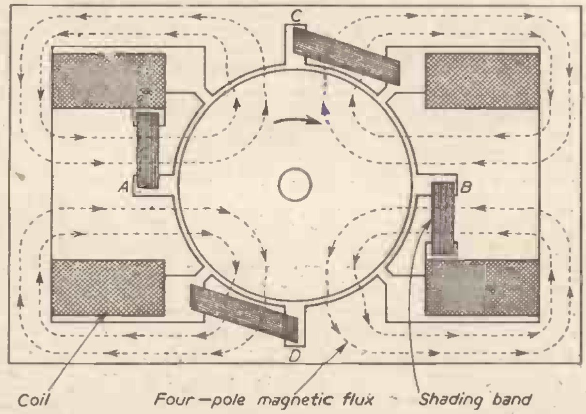


Fig. 8.—One arrangement of a two-speed shaded-pole motor.

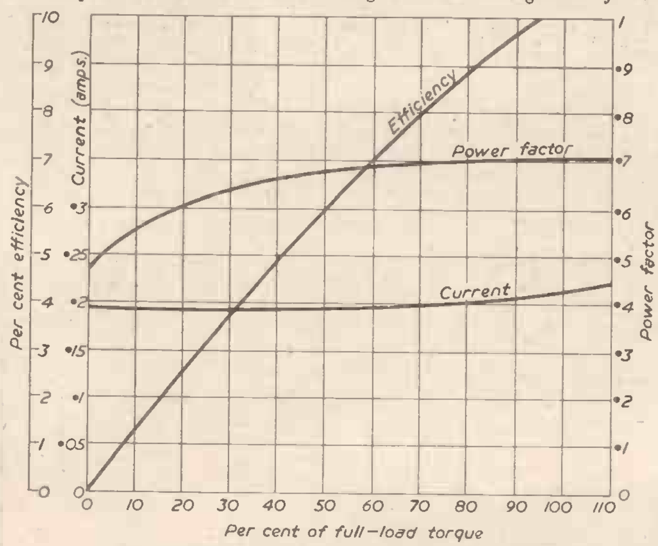


Fig. 6.—Performance of a small shaded-pole motor.

Reversal of Shaded-pole Motors

The rotor always turns in the direction of the shaded portion of each pole face from the unshaded portion. Reversal of a normal shaded-pole motor therefore involves reversing the stator in the casing or end shields, or reversal of the stator and end shields on the bearings or shaft. However, specially wound shaded-pole motors are available which can be reversed by means of a switch, as indicated in Fig. 9. Fig. 9 (a) refers to a motor which has two distributed stator windings, with a single short-circuited shading winding. A single-pole two-way switch is used to control the motor which can be run in either direction depending on which stator winding is energised.

The arrangement shown in Fig. 9 (b) may be used with a single stator winding of the concentrated-pole or distributed type; when used in a concentrated-pole motor the centre of each pole is slotted with a shading winding round both halves of the pole face. A single-pole two-way switch is used so that either shading winding can be short-circuited, depending on the direction of rotation required. Fig. 9 (c) refers to a reversible motor having distributed stator windings, with a short-circuited shading winding; the motor can be reversed by means of a double-pole two-way switch used to alter the position of the poles. The motor has a fairly high efficiency since all the stator windings are used for either direction of rotation.

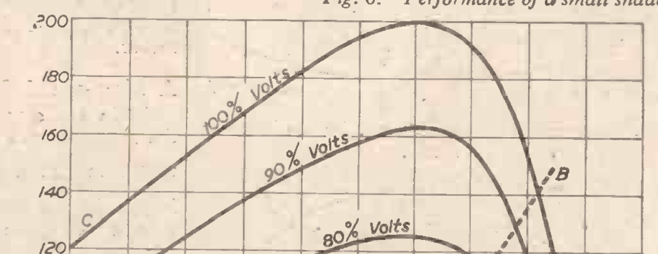


Fig. 7.—Speed-torque characteristics of a shaded-pole motor on various voltages.

Reluctance-start Motors

A still similar type of single-phase induction motor is the reluctance-start motor indicated in Fig. 10. Due to the reduced length of radial air gap under the portions B of each pole face most of the magnetic flux produced by the stator coils will pass through this portion of the air gap, and the flux density under the portions B of the pole face will be greater than that under A. However, due to the longer air gap under the portions A of the pole face, the flux crossing the air gaps under A will reach peak value before that crossing the air gaps under B. As a result, a form of revolving

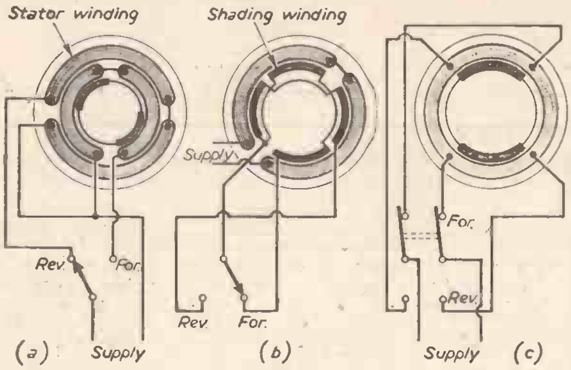


Fig. 9.—Connections of reversible shaded-pole motors.

magnetic flux is produced which passes from A to B.

The characteristics of these motors are very similar to those of shaded-pole motors. The motor may be reversed by reversing the stator in the casing or end shields, or reversal of the stator and end shields on the bearings or shaft. A reluctance-start motor can, however, be arranged with two distributed stator windings, as in Fig. 9 (a), so that it can be reversed by means of a single-pole two-way switch. In this case the tips of the stator teeth are cut off half-way between the two windings to provide a larger air gap at that part. The arrangement shown in Fig. 9 (c) can also be adopted in a reversible reluctance-start motor.

Voltage Conversion and Possible Motor Troubles

In order to convert the shaded-pole or reluctance-start motor for operation on a different voltage at normal frequency it is necessary to rewind the primary stator coils with a number of turns proportional to the voltage, using wire having a cross-sectional area inversely proportional to the voltage. In this case, the full-load torque, maximum torque, horse power, starting torque and speed will be unchanged. The shading windings of a shaded-pole motor require no alteration.

Low starting torque may result from lack of lubricant in the bearings, or the use of unsuitable lubricant. Other causes are high resistance of rotor due to faulty soldering of the rotor conductors at the end rings, or a faulty joint in a shading band. Faulty casting of aluminium conductors in such rotors may have a similar effect, in which case a new rotor may be required. An earth fault or a short circuit on the primary stator windings will also affect the starting and running performance. The former fault may be confirmed by means of an insulation-resistance test set, such as a " Megger." A short-circuited stator coil may be detected by comparing the resistances of the coils.

Faulty starting or running may also occur if the bearings are worn so that the rotor rubs on the stator core. The motor may also refuse to start when the rotor is in certain positions, especially if the starting load is fairly high. This trouble seldom occurs with a rotor which has skewed slots, and a possible solution may be to reduce the diameter of the rotor by about 0.005in. Vibration may be due to mechanical out-of-balance of the rotor, faulty windings, or faulty joints in the squirrel-cage rotor or shading bands. Noisy operation in general may result from worn bearings, bent shaft, a loose iron leakage strip (shaded pole) defective windings or loose stator stampings.

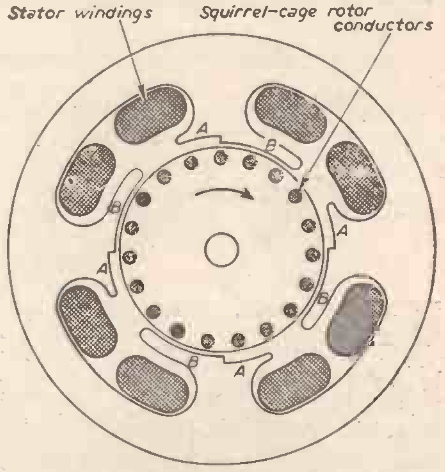


Fig. 10.—Reluctance-start motor.

New Breeder Reactor

A NEW breeder reactor which may enable natural uranium to be used instead of only fissionable uranium-235 is under construction in America. The reactor is to have a heat power rating of 62,500 kilowatts and a net electrical output of 17,500 kilowatts. It is due to go into operation in 1960.

A breeder reactor is one which produces more fissionable material than it uses.

Density of the Earth's Atmosphere

SCIENTISTS who plotted the changes of the orbit of the Russian Sputnik I now believe that the earth's atmosphere 240 miles up is 40 times more dense than originally thought. This figure will have to be taken into consideration when planning orbits for future satellites.

Dial Phone Between U.S. and Britain

THE American dial toll telephone system is being designed so that it can ultimately be interconnected with Europe. It is also planned to connect up with Hawaii and Canada. This means that sometime within the next five to ten years American telephone subscribers may be able to dial a call to Britain.

Multi-lingual History Computer

AN electronic computer on show at the Brussels World Fair will, on the insertion of any year on the keyboard, print out a concise statement of the main events of that year. Not only this; it will use any one of ten languages, including Interlingua and Russian, English, French, Spanish, Italian, German, Dutch, Swedish and Portuguese.

Strength of Sea Ice

THE old theory that fresh water ice is stronger than sea ice is disproved by new tests which prove that sea ice is over twice as strong. It has also been established that the strength of sea ice can vary a great deal—as much as 30 times.

As the temperature droys, the ice changes. At zero degrees Centigrade (32 deg. F.) pure ice is formed. The salts in sea water precipitate out of solution at varying temperatures below this, until a complete solid is formed at −54 deg. C. or about −65 deg. F.

Alpine Radio Link

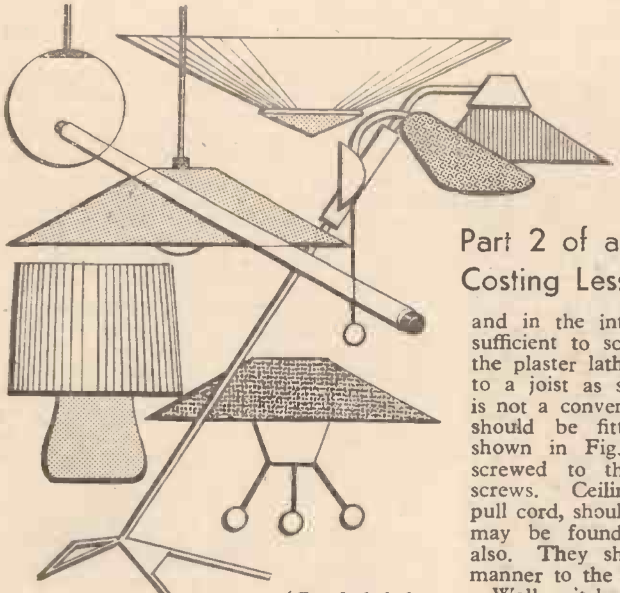
STANDARD TELEPHONES AND CABLES LIMITED recently completed a new S.H.F. Radio Link for the Austrian telephone network between Graz and Klagenfurt. 240 high-quality telephone circuits can be handled.

One repeater station was built on KorAlpe, where strong winds are often accompanied by sub-zero temperatures. The approaches are impossible for vehicles and all the station equipment had to be man-handled to the site.

Tracks on the Ocean Floor

SCIENTISTS at Lamont Geological Observatory, New York, recently took photographs of the floor of the Arctic Ocean, over a mile below the surface. On the photographs tracks resembling those of a chicken were clearly seen and so far scientists are puzzled to explain them.

In the photograph above can be seen a model of Sputnik II. This was the type of rocket inside of which the Russian dog " Laika " was projected into space last year. The satellite weighed 1,120lb. and was 15ft. long. The model is being exhibited in the Russian pavilion at the Brussels Universal and International Exhibition.



How to Wire Your House for Electric Light

Part 2 of an Article Describing a Prefabricated Wiring System Costing Less Than £10

By J. VOSE

(Concluded from the May issue.)

THE length of oval conduit not only gives increased mechanical protection to the cable, but it also allows it to be withdrawn from the conduit and replaced if ever this becomes necessary. Neat chases can be easily made by cutting through the plaster on either side of the chase with an old saw, and then knocking out the remaining plaster with a screwdriver or chisel.

The threading, or fishing through of the cables, should be carried out one at a time, and care should be taken to avoid undue kinking. Wherever a cable passes through a wall, or where it enters or emerges from a conduit, the insulation must be protected, either by an insulating bushing, or by a heavy wrapping of insulating tape. Where cables pass through floors, walls, partitions or ceilings, the hole should be made good with cement, or fire-resisting material to the full thickness of the floor, wall, etc. The cables are amply strong enough to support

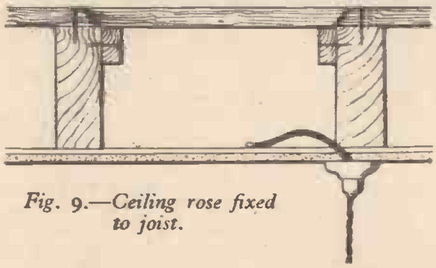


Fig. 9.—Ceiling rose fixed to joist.

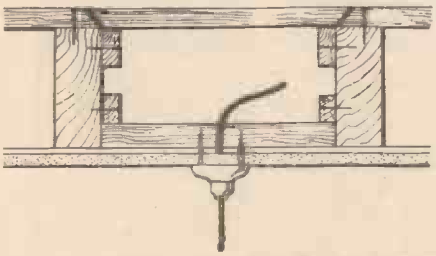


Fig. 10.—Ceiling rose fixed to an inserted wood bridge piece.

their own weight when draped across joists, but any excessive spans can be bridged by light wood battens, the cables being supported on them and secured by suitable clips.

Fixing the Accessories

The ceiling roses and the switches must be securely fixed, both for good appearance and in the interests of safety. It is not sufficient to screw the ceiling roses up to the plaster laths. They should be screwed to a joist as shown in Fig. 9, or, if this is not a convenient position, a bridge piece should be fitted between the joists as shown in Fig. 10, and the ceiling rose screwed to the bridge piece with long screws. Ceiling switches, actuated by a pull cord, should be used in bathrooms, and may be found useful in other positions also. They should be fixed in a similar manner to the ceiling roses.

Wall switches, if of the surface mounting type, should be screwed to a wood mounting block, which should, in turn, be securely fixed to the wall by *two* wood screws long enough to penetrate into plugs drilled into the brickwork. These holes can be easily drilled with a mansonry drill ¼in. diameter, held in a brace or breast drill. Flush switches should be fitted into a proper metal or plastic box let into the plaster, and securely screwed to the brickwork.

Two-pin plugs may be used in a lighting circuit for such purposes as an electric clock, a radio or T.V. set, or for a stand

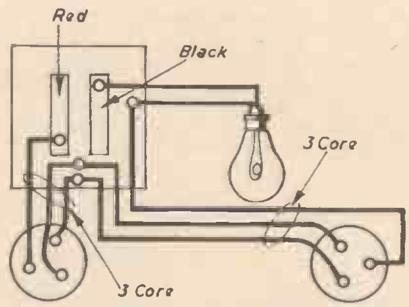


Fig. 11.—Wiring for two-way switching.

or table lamp, but it must be noted that such appliances must be of completely insulated construction, and must have no metal parts exposed. Two-pin plugs should be fitted on to a wood block exactly the same as for a surface switch.

Two-way Switching

Figs. 11, 12 and 13 show three different methods of wiring up two-way switches. They are all exactly the same electrically, and a choice may be made of the one which best suits the particular installation being carried out.

The system shown in Fig. 11 has the advantage that it continues the principle of having all the connections made in the junction box, so enabling the testing of the circuits to be carried out before installation. It is necessary to run separate three-core cables to each of the two-way switches.

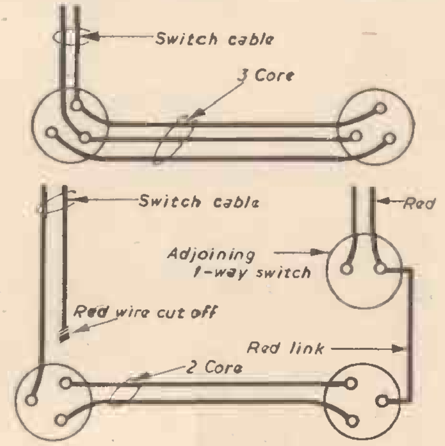
The circuit Fig. 12 cannot be pre-tested, but it has merits of its own. First it requires less three-core cable than Fig. 11, and secondly it can be used for converting an existing installation from single-way to two-way switching.

The circuit in Fig. 13 can only be used in positions where one of the two-way switches is mounted alongside a separate single-way switch, as so often happens. In this circuit advantage is taken of the fact that the red wire is common to all the switches in the installation, and so the necessity of carrying the red wire from switch to switch is avoided, as in circuit Fig. 12, and an ordinary twin cable for "strapping" between the switches can be used. The omitted red wire is replaced by a short link wire between the two-way switch and the single-way switch as shown.

Main Switch and Fuses

The installation being thus far completed, we are left with the two free ends of the feed cables at the meter position. These must be fed through the "consumers" main switch and fuses (to distinguish them from the supply authorities fuses). It is convenient to have the switch and fuses combined in one box known as a "switch splitter," and the type required to feed two junction boxes is an insulated, two-way, single pole and neutral switch splitter, 15-amp size. A board is required on which to mount the switch splitter and this may be of thick plywood or solid wood, as preferred. The board may be about 6in. × 6in., but if it is intended to install a power circuit also, the board may be 12in. × 6in., as this will be large enough to accommodate the switch-fuse for the power circuit also.

The board must be securely plugged to the wall, in a position close to the meter



Figs. 12 and 13.—Alternative ways of wiring for two-way switching.

board. Note that the meter board is the property of the supply authority, and the consumer is not allowed to fix anything to this board. Fig. 14 shows how the two cables are connected at the top of the switch splitter. The two black wires are twisted together and connected to the neutral terminal marked "N." One of the red wires is connected to one of the line terminals marked "L," and the other red wire is connected to the other line terminal —"L." These two "L," terminals are immediately above the fuse bridges. Note that in the photograph one of the fuse bridges has been removed so that the terminal can be seen. Thus one fuse is protecting one of the junction boxes, and the other fuse is protecting the other junction box. It is a good plan to mark the fuses so that it is easy to tell which fuse needs replacement, in the event of a blow out.

It will be noted that the fuses are in the line, or live, side of the circuits only, instead of being in both the line and neutral as is often the case. It is safer this way, as when a fuse blows in the line side it renders the whole circuit dead. In the case of double pole fuses, it is quite possible for the neutral fuse only to blow, thus leaving the circuit still alive through the line fuse. Neutral, of course, is at earth potential, and it should not be possible to get even the slightest shock from it.

To connect the switch splitter to the meter, two "tails" are required. These are short lengths, about one yard each, of 7/044 single-core cable. One should be red and the other blue, or black. These are connected to the line and neutral terminals on the bottom of the switch splitter, as shown in Fig. 14, the red to terminal marked "L" and the blue, or black, to terminal marked "N." The free ends of these cables are left for connection to the meter by the supply authority. The installation is completed by fitting 5-amp fuse wire in each of the fuse bridges.

The local supply authority may now be notified that the installation is ready for connection. A simple form will have to be filled in, and then the installation will be tested. If the test proves satisfactory, the connection will be made.

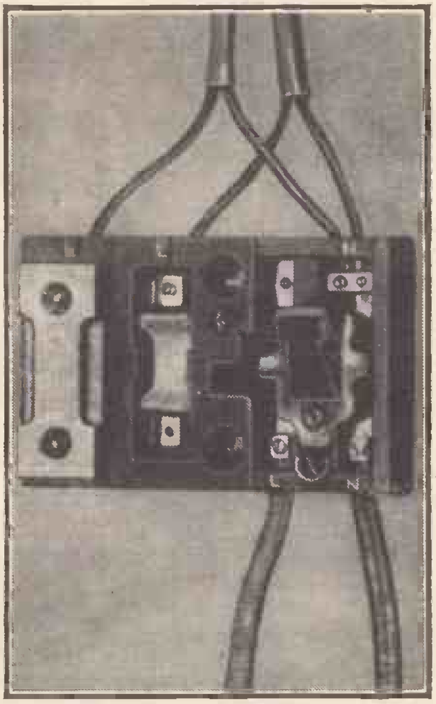


Fig. 14.—Main switch and fuses.

Finally, here are a few points to bear in mind.

Do not use cheap, undersized cable. It may overheat, and cause excessive voltage drop.

Be careful to insulate the cables properly, especially around corners and at conduit ends.

Do not allow cable to come into contact with water or gas pipes. If it is necessary to cross these pipes under floors, fit a piece of board between the pipe and the cable.

Do not expose more of the wires at the cable ends than is necessary to fit the terminals.

Do not allow loose strands of wire to stray when making connections to flex leads. It is a good plan to assemble ceiling roses and lampholders with their connecting flex, before fixing the ceiling roses. This avoids a lot of fiddling work on a step ladder.

Plug wall holes securely, and make firm and permanent fixings for all accessories.

Do not fit oversized fuses. Five-amp fuse wire should be sufficient for any lighting circuit. It must be emphasised once again that this circuit is intended for lighting only and difficulties may be experienced if it is attempted to supply power socket outlets from the junction box.

All the materials mentioned can be obtained from electrical supply houses which cater for amateurs. The total cost of the installation as described and illustrated (about 12 points) should be under £10.

Does Your Tent Let in the Rain?

H. A. Robinson Tells You How to Reproof It

WHEN not used for some time, a tent is inclined to lose its waterproof qualities. If you have any doubts about your own give this simple test.

Testing for "Spraying"

Set it up in the garden and going inside get someone to play a hose or syringe on the sides from such a distance that the water falls with about the same force as would a heavy shower of rain.

Inside you turn your face towards the area getting the "shower" (the face is more senstive than hands). If you are conscious of a fine spray of water on your face the material has lost its natural armour against rain and needs treatment. Test each side of the tent separately, also the ends. During the experiments the material should be fairly tightly stretched.

To stop the "spraying" and to restore rain-resistance, the whole tent must be given one of the several recognised waterproofing processes. If possible do the work on a good drying day, for considerable wetting is called for and the sooner the tent is dried out again the better.

Reproofing

The simplest method or reproofing a light-weight tent is by the use of soap, isinglass and alum. This has the advantage of not discolouring as do oil processes. Also it does not alter the "feel" of the material or add to weight or stiffness.

Required for the treatment are 1½oz. of isinglass, 1oz. commercial alum (not chrome) and ¼oz. white Castile soap.

Also required are two pans, one to hold at least 2 pints, and the other 4 pints. Water for the work must be "soft"; rain water is ideal.

Put one pint of the water in the smaller pan and dropping in the isinglass boil till perfect solution has taken place. This then goes into the larger pan, and to keep the liquid clear it is as well to strain through a muslin bag.

Wash out the 2-pint pan and into it pour another pint of the rain water, this time also putting in the Castile soap. Boil again till full solution has come about, mix the soapy water so obtained with the isinglass in the bigger pan and strain again.

Wash out the smaller container and this time put in the two pints of water and the 1oz. of alum. Bring to boil as with the other ingredients and pour in with the rest. The big pan now holds everything and it is brought up to a fairly high simmering point. Stir all the time.

After a little simmering the proofer is ready for use, and it is applied warm.

It is best to treat a tent out of doors, but if the weather is bad the work can be carried out in an attic. The tent is slung over a rope and the side guys pulled out and attached to anything convenient. In either case the canvas should be quite taut.

Apply the warm solution with a whitewash brush, taking the pan back for re-heating at times if necessary. Give the material a good all-over soaking and work quickly and evenly. One coat will generally give all the water-proofing necessary, but if the material is in a very bad condition, a second can be given when the first is perfectly dry, even another one again. The work is additive and there is no question of a new coat washing off a previous one.

Making a Xylophone

(*Concluded from page 434*)

repeatedly and make final slight adjustments until the overall length of tube arrived at will give the loudest volume of sound. It will be found that the total length of the tube for the point of resonance will be about 12in. Now transfer the tube to its place under the lowest C on the xylophone. Now tap the note with the hammer and note the increased strength of the note compared with those without a resonator. Finally, a complete length of tubing can be cut to correspond with this experimental arrangement and fixed on the resonator support.

The resonator supports are made from some 2in. × ⅜in. wood and supported in place on some little ledges fixed on the inside of the keyboard frame at each end. Holes for the tubes are bored out with a centre bit and brace. To hold the tube in place in the hole a 1/16in. hole is drilled through the wood support and tube through which passes a suitable piece of wire, bent down at each end (see Fig. 10). Alternatively some long 1/16in. split pins could be used, if obtainable, 2½in. or 2¼in. long. Be sure that the resonator is exactly under the width of the note and that the top of the tube is level with the underside of the note.

If the reader has some tuning forks other than the C, such as the A fork, which is commonly obtainable, a tube for these notes can now be made and fitted in the same way as described above.

When these tubes have been made, hold one in the hand and, holding it to the lips, blow across the top of the tube. A sound or note of definite musical pitch will be produced which will be found to correspond with the note required. It is by this method that intermediate note resonators will be tuned. Use the adjustable tube method to get the correct length and then saw off a complete length of tube to match this for fitting on the xylophone. These lengths of tubing used for experiments in obtaining the correct lengths of the resonators need not be wasted as they can be used for the shorter tubes higher up the scale. As a further guide, it should be noted that once the first octave has been tuned the notes an octave above will have resonators half the length of those in the lower octave.

A Simple Cross-bow

You Can Have a Lot of Fun With This Device But Use it Away From People

By W. S. ROGERS

THIS weapon employs a stretched rubber cord as the propelling agent, thus resembling the catapult.

Construction

The stock may be cut from a piece of straight-grained deal, 1in. thick, to the pattern shown in Fig. 1. The top surface must be grooved half round, as in Fig. 2, to a full 5/16in. radius, so as to provide a channel for the bolt, which is made from ⅜in. dowelling. This groove should be well smoothed with glass paper. If no suitable plane is available, use a small gouge, and even the surface with a rat-tail file before glass-papering.

Cut the slot shown at A 1in. by ¼in., and fit to it the cross-member, as shown in Fig. 1. This should be tapered in width to ½in. at each end.

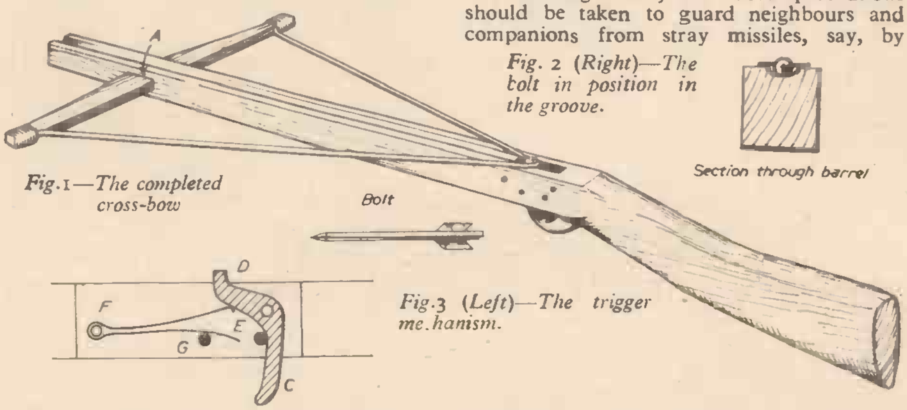


Fig. 1—The completed cross-bow

Fig. 2 (Right)—The bolt in position in the groove.

Fig. 3 (Left)—The trigger mechanism.

The Lock

Make a vertical slot centrally as shown in Fig 1, ⅛in. wide, and long enough to house the lock mechanism. The trigger C (Fig.3) may be cut from thick brass sheet. It is secured with a screw, taking care that it pivots on the plain part of the screw. Its turned-up point D must stand above the upper surface ¼in. for a ¼in. diameter cord. When the adjustment is made, a screw should be driven through the stock at E. A lockspring is used to give the return action to the trigger, fixed in place by the two screws F and G.

The Elastic

Wrap the ends of the rubber with a strip cut from a piece of old kid glove and bind them firmly with thin copper or brass wire to the cross-member. The length of the cord must be ascertained by experiment. It should be sufficient to admit of hitching it over the trigger head when stretched to nearly its limit.

The bolts may be 8in. long, cut from ⅜in. dowelling. A wire nail is driven into one end, and the "feathers" may be cut from thin celluloid in one piece and glued into a saw-cut made from the back end of the bolt. There is no need to put a notch in the end.

As this form of cross-bow has considerable driving force, the usual precautions should be taken to guard neighbours and companions from stray missiles, say, by devoting part of the garden to a range and fixing up a sufficiently large target.

The latter may be an old packing-case lid marked out in circles, with a conspicuous bull's-eye.

Puzzles and Posers

Supporting the Ship

A LONG canal passes over an aqueduct. When a heavily-laden ship of, say, 500 tons passes over, is there an added stress of 500 tons on the structural columns?

No. As soon as the vessel is in the water, either over the aqueduct or miles away its weight is equally and evenly distributed over the bed of the whole canal. It makes no difference where the ship is, and therefore there is no added stress on the columns of the aqueduct when the ship passes over. Though the ship may be heavy we will find that if we divide its weight by the number of square feet on the entire canal bed (which may be 20 or more miles long) the added weight per square foot is insignificantly small. Of course, the water displaced by the ship weighs exactly as much as the ship itself. Thus, when there is no ship over the aqueduct the structure may carry 10,000 tons of water. When the ship is over it will carry 500 tons of ship and 9,500 tons of water.

Melting Ice

BEFORE you is a glass of water filled to the brim and containing some lumps of ice, partly submerged and partly standing out of the water. When the ice melts, will the water run over?

No. Water expands when frozen into ice (which is why water pipes burst when the water is frozen), and, therefore, ice "contracts" into water. Thus the extra water occupies less bulk than the ice from whence it was derived.

If the glass originally contained warm water, the ice, in melting, would chill the water causing it to contract, so that when the ice had melted the water would be below the rim.

H. and C. Again

WILL hot water freeze faster than cold water?

Obviously no, but water which has first been boiled will freeze faster than tap water owing to the fact that a certain amount of air bubbles are driven out by the boiling. This explains why the water (cold) in a hot water pipe system is always first to freeze.

Some people have the impression that things weigh differently according to whether they are hot or cold. Obviously a pound of water weighs the same whether hot or cold, but a pint of hot water, by expansion, takes up more room than a pint of cold water, and so weighs less, since it has to "spread" itself more. But a pint is not a weight. What has happened is that there has been a difference in the relation between a certain weight of water and its volume (or vice versa).

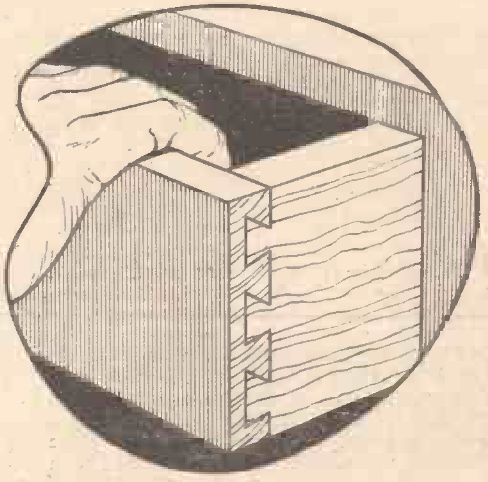
Your Career . . . .

THREE booklets have been published by the United Steel Companies, Ltd., entitled "Careers for Graduates," "Training for Student Apprentices" and "Careers in Research and Development." The booklets describe the prospects and training facilities in each sphere of the company's activity and should be of great interest to those who intend to make their career in this type of work.

These booklets and any further information are available from The Company Recruitment Officer, The United Steel Companies Limited, 17, Westbourne Road, Sheffield, 10.

A new illustrated booklet in the Central Youth Executive's "Choice of Careers" series, "Engineering Work for Girls" is now available, price 1s. 3d. The booklet is No. 77 and may be obtained from H.M. Stationery Office.

Woodworking Joints



No. 5.—Joints for Veneered Plywood, etc.

By W. J. Stannage

This article is included as an "Extra" to the series which ended last month

THERE is now on the market, and available to the home woodworker, a very wide range of veneered plywood and similar factory-produced timbers, and these are ideal for countless home workshop projects. Such projects range from the making of a simple bookcase to the turning out of a complete suite of furniture. However, before such projects can be undertaken it is necessary to have some understanding as to the jointing of these timbers, because if the edges are not concealed in some way the "make-up" of the timber is exposed to view.

Rebated and Grooved Frames

Consider for example the construction of a cupboard or wardrobe, or some similar

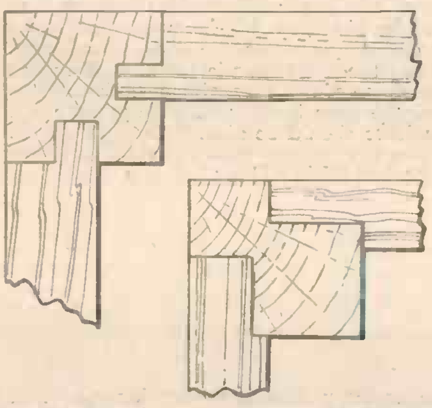


Fig. 2.—Use of grooved block.

Fig. 1.—The use of the rebated block.

article, and it will be appreciated that the front edges and the ends of the timber must be hidden in some way and strong joints are necessary. Fig. 1 shows how this may be carried out. The drawing shows a block of solid wood which is rebated on two faces and there is a mating rebate cut in the plywood. In actual construction the block illustrated would, in fact, become the main framework of the structure, and the plywood panels would be cut to fit into it. The panels can be fixed in place with a good glue (a two-part glue is ideal for this type of work) and, if desired or thought necessary, screwed from the inside.

Fig. 2 is a variation of the first method, but in this case the block, or framework, is grooved. The ends of the plywood are cut to fit into the grooves taking care that the outer faces of each panel come flush with the framework. Some workers prefer to leave the framework slightly overhanging the panels and then sand them down flush. This is quite practical in some cases, but if a power sander is used there is the danger of marking the plywood veneer while the sanding operation is in progress. The panels can be fixed by gluing and it is hardly necessary to use screwnails.

Mitres

Fig 3 shows a mitred joint, but you will observe that the bottom part of the mitre is flat and at 90 deg. to the panel faces. This means that there is a flat base upon which the second part of the structure can rest and this makes cramping very much simpler than would be the case if the usual type of mitre were used. The joint is not advised for large structures, but rather for small articles upon which no great strain will be imposed.

A loose tongued mitre is illustrated in Fig. 4 and this is the more common type of mitre which is carried across the complete width of the timber. A groove is cut along the entire length of each face, and into this is fitted a strip of timber which, with the aid of glue, holds both parts together. The tongue is, of course, glued into the groove. The grooves are easily cut on the circular saw or spindle, but if such power tools are not available, the groove can be cut with the plough plane, but it is a rather tedious operation.

Dowelled Joints

In many small jobs the dowelled joint (Fig. 5) can be employed, and if this joint is used a piece of moulding can be glued to the raw edge of the plywood, thus hiding it. The most important thing in the making of this type of joint is accurate marking out and it is advisable to make up a simple template to aid this part of the work. The holes should be

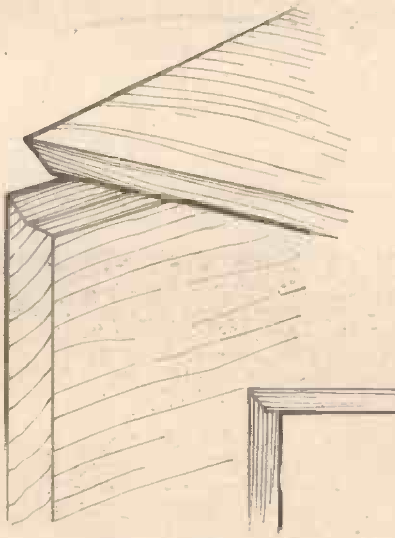


Fig. 3.—Mitred joint.

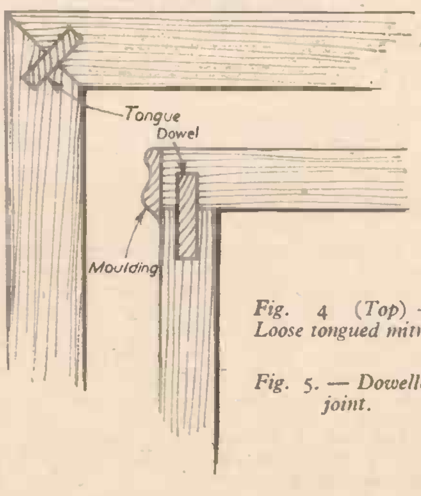


Fig. 4 (Top) — Loose tongued mitre.

Fig. 5. — Dowelled joint.

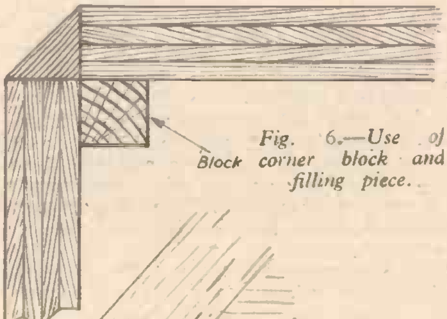


Fig. 6.—Use of corner block and filling piece.

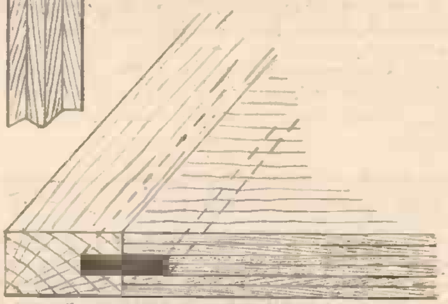


Fig. 7.—Loose tongued lipping.

drilled to a uniform depth, so it is a great help to have some simple form of depth stop fitted to the bit. Another very important factor is that there must be a groove running down the side of each dowel. Such a groove allows the surplus glue to escape as the dowel is tapped into place. Using an ungrooved dowel may result in the glue being trapped under the dowel, thus preventing it from being driven fully home and causing the dowels to sit at different heights. Again, if the glue is compressed to any great extent under the dowels by trying to pull the second piece down into place with the cramp, the timber may split.

For some types of job it is possible to use a corner block to aid the jointing of two pieces of timber, and this method is depicted in Fig. 6. The edge of each panel is brought level with the face of the block, which is fixed with glue and woodscrews from the inside. This means that both edges of the panels are exposed in the shape of the letter "L" and a triangular piece of solid wood is used to fill this gap. The illustration shows both the block and the filling piece in position.

Edge Lipping

When making doors from factory-produced timber it is often necessary, for the sake of appearance, to lip the edges. A simple form of edge lipping is to obtain some strips of timber—usually hardwood—and pin and glue these direct to the door-edges, using a mitre joint at each corner. This makes quite a good job provided the pins are punched below the surface of the wood and the holes so formed filled with a good filler. However, for better class work a loose tongued lipping, which can be seen in Fig. 7, can be employed. A groove is cut in both door edge and the edge of the lipping in much the same manner as used for the tongued mitre joint. Again a strip of wood is fitted into both grooves, so joining the lipping to the door.

A very neat form of lipping is shown in Fig. 8, namely a tongued lipping. Unlike the loose tongued lipping, the tongue in this case is part of the lip and is cut on the circular saw or spindle, or indeed with a plough plane. A groove is then cut in the panel into which the tongue is fitted with glue.

In the case of a very wide piece of timber it is advisable to use two tongues as this

Fig. 8.—Tongued lipping.

Fig. 9.—Lipping for thin plywood table top.

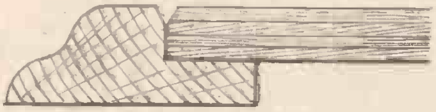


Fig. 10.—Giving a panelled look to table top.

eliminates any danger of the lipping rising at the edges, and so pulling away from the panel.

The same type of lipping can be used to form an edge for a table top and in such a case the outer face can be worked to a pattern to form a moulding.

However, it is not in every instance that a piece of ply or similar timber used for a table top is thick enough to permit the use of the lipping shown in Fig. 8 to be used. This problem can be overcome by using the lipping shown in Fig. 9. This shows a piece of solid wood with a rebate cut on one face, the rebate being deep enough and wide enough to provide a good seating for the plywood. The outer edge of the wood can be cut to a pattern to give a moulded edge.

If it is desired to give a panelled look to such a table top this can be easily carried out by removing the sharp edge from both the plywood and the rebate as seen in Fig. 10. However, the "V" so formed should be very slight or the appearance of the finished job will suffer.

Simple Conjuring

These Tricks Will Baffle Your Friends

Passing a Coin Through a Hat

ARRANGE a hat, penny and glass tumbler as in Fig. 1. Obtain five or six pennies from the company and tell them you will make one of the coins pass through the hat into the tumbler. The coins are then tossed into the hat one by one; the jar caused by each as it falls into the hat makes the prepared coin fall into the glass with a clink, giving the appearance of passing through the hat.

Splicing String with Your Teeth

TAKE a length of string and tie the two ends together, thus forming a circle (see Fig. 2). Now form it into a double circle as shown and grasp this with your hands. Now request someone to cut through the string, apparently cutting into two pieces. Show the four cut ends; place them in your mouth and pretend to chew upon them and, when taken from your mouth, it has apparently joined into one length of string again. The secret is to form the double string into a loop, as in Fig. 2. Now, by holding the string (the left hand covering the loop), a cut can be made in the string, but only an inch or two is cut away.

This is removed by the tongue and kept in the mouth when you pretend to splice the string with your teeth.

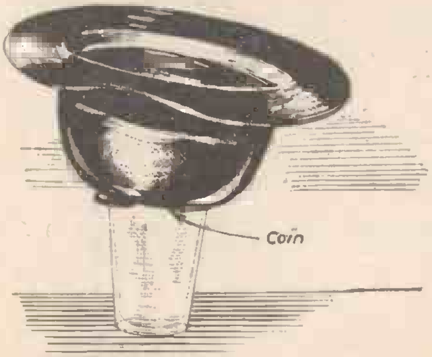


Fig. 1.—Hat, penny and tumbler.

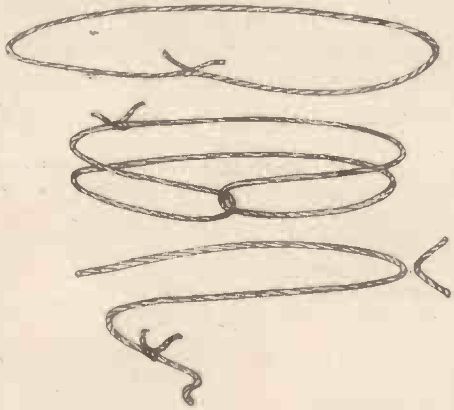


Fig. 2.—Details of the string trick.

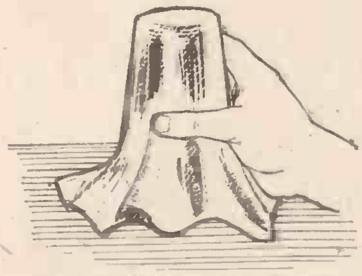


Fig. 3.—The disappearing glass.

The Disappearing Glass

BORROW a penny and place it on the table and cover it with an inverted glass. Over these place a newspaper and press well down on the glass (see Fig. 3). Now grasp the glass through the newspaper and lift both, exposing the penny. Now state that you will make the penny disappear and replace the newspaper over the glass. A member of the company is then invited to strike the glass with a hammer as hard as possible. If he refuses, you must do so yourself. Imagine the surprise when the hammer descends on the newspaper and, instead of the sound of breaking glass, they only hear a dull thud as the hammer strikes the table. You then apologise, for the glass has disappeared instead of the coin! The secret is to press the newspaper well down over the glass so as to make a mould of it. Now sit down behind and, when you lift up the glass and paper, draw them towards you and let the glass fall into your lap where it can be placed on the floor out of view. When the newspaper is replaced, it retains the shape of the glass, giving the impression that the glass is still under the paper. The audience should be directly in front of you.

The Vanishing Eggs

A POCKET handkerchief is produced and shown to the audience. You then crumple it up and produce an egg from its folds, the egg being placed into a hat. This is done six times, until you have produced six eggs, each one going into the hat. Now make a few passes into the hat, turn it upside down and, behold, it is empty! The secret is that an egg is "blown" in the ordinary manner by making a hole in each end and removing the contents. Attach the egg to a piece of cotton, the other end of the cotton being attached to the border of a handkerchief (see Fig. 4). Each time you appear to produce an egg and place it in the hat, it is pulled out again as soon as the handkerchief is taken up.

One of the secrets of being a good conjurer is practice. No trick should ever be shown to an audience until not only the actual handling of the trick is perfect but also the "patter" which accompanies it.

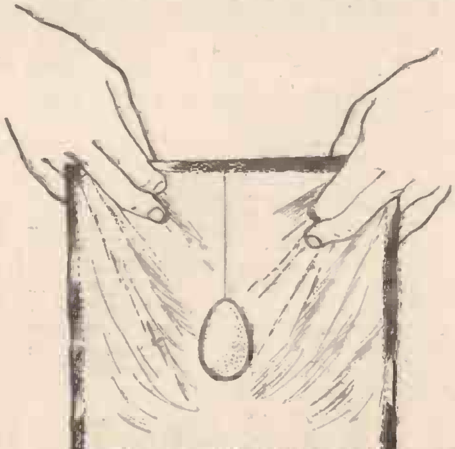


Fig. 4.—The egg and handkerchief.

Letters to the Editor

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

"G" Force

SIR,—In his letter, March issue, 1958, D. Wightman states that "G" force is not a force in itself. Although we all know under what circumstances "G" force becomes apparent, it is still nevertheless a force in itself.

"G" force is simultaneous with the motion of a body and acts as the backward pulling force.

At a maintained speed of motion, "G" force remains a force potential, and in the conventional flying vehicle it will always remain a potential force. "G" force becomes apparent on acceleration, deceleration and on, as your correspondent put it, rapid change of direction. It is this intangible force that severely restricts the limits in which the conventional vehicle can manœuvre since the conventional flying vehicle is not designed to reverse its (the intangible force's) direction.

When by motion we overcome the inertia of a body we are automatically increasing the force of inertia. This force is a well-established law and holds good whether the flying vehicle be in atmosphere or in space, or if you wish, whether the flying vehicle be under the earth's gravitational pull or far out beyond it in space. The vehicle's forward motion will always produce a "backward pull."

The "Saucer," on the other hand, is designed and operated to turn the backward pull into forward pull. Therefore the "Saucer" defies a well-established law, i.e., the "third law of motion." "To every action there is equal and contrary reaction." Then let us say at once that to the "Saucer's" forward motion there is "no" reaction. It must now be seen why the "Saucer's" performances are referred to as "fantastic."

Lawton's third law of motion applies to the "Saucer" only while it is rotating at the one point, but at the moment the "Saucer" moves off in flight it begins to take on another "form of motion," which is known as a "motion of translation." When this happens the third law of motion ceases to apply. The situation thus becomes one of action with *no reaction*.

In other words since the "Saucer" is generating "centrifugal force," it simply means that the centrifugal component no longer exists as an opposing force, but instead becomes one with, and in the same direction as, the centrifugal force, which of course is an "outward seeking force." Thus when this "outward seeking force" is given direction, as I know it can be, the "Saucer" becomes massless, but only in respect to direction. That is to say, if the "Saucer" is travelling along a straight course, from point "B" to point "A" all its mass force is towards "A" and none towards "B." Therefore no matter in what direction the pilot wishes to travel the vehicle "falls" in that direction with a speed that can be ever accumulating.

D. Wightman also states that the "Saucer" defies the triangle of velocities. Velocities, no matter in what pattern you may find them, or what laws you would like to put upon them, just do not apply when there is no reaction to forward motion.—V. A. MILBURN (Sittingbourne).

Specific Gravity Calculations

SIR,—With reference to the question sent in by W.T.F. (Leeds) in "Your Queries Answered," January 1958 issue, the formula for obtaining the amount of water in the 1.20 mixture is $\frac{x + 1.26}{x + 1}$ where x is the amount of water in grams thus:

$$\frac{x + 1.26}{x + 1} = 1.20$$

$$\therefore\ x + 1.26 = 1.20 + 1.20\,x$$

$$\therefore\ .2\,x = .06$$

$$\therefore\ x = .3 \text{ grams.}$$

The check for this is

$$\frac{.3 + 1.26}{.3 + 1} = \frac{1.56}{1.3} = 1.20$$

—J. P. DRIVER (Bradford 9).

The Speed of Light

SIR,—The letter by F. O. Brownson of Bedford (PRACTICAL MECHANICS, March, 1958) on the speed of light raises some ticklish problems. The views he expresses and so clearly expostulates were current about the beginning of this century. He cites the doppler effect in air of a whistle by a railway locomotive. The effects are correct, providing that the air is not in motion, if the air current is following the train. The pitch is increased to an observer on the side of the line if the engine is approaching, or the doppler effect is further increased by the speed of the wind. If, on the other hand, the speed of the engine were to be increased to the velocity of sound in air (1,100ft. per second) the observer would not hear any sound until the engine passed him, when there would be a tremendous bang, then silence. This means that all the noise from the engine reaches the observer all at one instant, and thereafter the engine cannot send any noise backwards because its velocity forward is as great as that of sound backwards. Further deductions and expansion of this reasoning are easily performed. With light the subject is still more obscure and difficult.

Bradley discovered and demonstrated the doppler effect of light from one of the nearest stars about 1750. Light travels through space at an assumed velocity of about 186,000 miles per second. I say assumed because our measurements are taken on earth in a gravitational field and our measurements of space depend on this measurement of velocity.

The world is moving around the sun at a velocity of $18\frac{1}{2}$ miles per second, or about $\frac{1}{10000}$ of the velocity of light.

It was thought in the nineteenth century that this motion of $\frac{1}{10000}$ could easily be observed with the necessary apparatus. Further, it is known that the sun itself has a very large proper motion in the region of 200 miles per second, or $\frac{1}{900}$ of the velocity of light. It was thought that at least this latter figure could be detected and measured if the light flowed in its own sea at its own speed, as is described by Mr. Brownson. When an experiment or experiments were performed to try to measure or detect the above motions, no result was obtained. The way was then open for Albert Einstein to propound his theory of relativity to explain the impasse.

Whether or not he succeeded in doing so is, in my opinion, dubious, but very many great scientists prefer to believe his explanation and many other scientific explanations of obstruse phenomena by Einstein proved to be perfectly correct.

There is an island universe in the square of Pegasus that is receding from us at the velocity of 40,000 miles per second (or one-fifth the velocity of light). This is by spectrographic measurement.

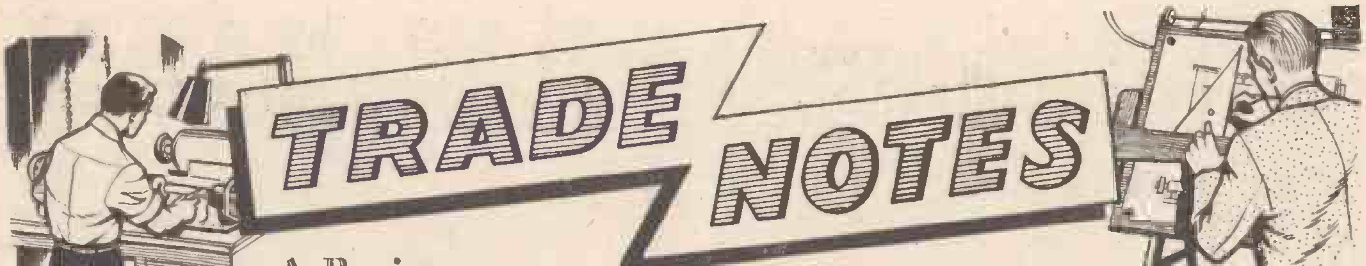
The argument would therefore be that if there are scientists in this island universe measuring the velocity of light, its velocity relative to them will be a "cockeyed" affair; it will have a velocity towards the Milky Way of four-fifths of 186,000 miles per second or, 148,800, and away from the Milky Way of six-fifths of 186,000, or 223,200 miles per second. On the other hand the scientist on the above mentioned island universe may be convinced that on the Milky Way the velocity of light is a "cockeyed" affair because it is receding from him at 40,000 miles per second, while on his universe it is perfect in all directions. This assumes that he has not an Einstein to explain the impasse by a theory of relativity.—THOS. H. WEBSTER, A.M.I.C.E. (Northumberland).

Incorrect Address

WE regret that in the letter "Dirt and Damp-proofing," page 355, April issue, the address of Ians Ltd. was given incorrectly. The correct address is: Cail's Buildings, Quayside, Newcastle-on-Tyne, 1.

Contemporary Electric Clock

MESSRS. FRANKS of New Oxford Street, who were mentioned as suppliers of the movement for the contemporary electric clock described in the April issue, regret that they have sold their stock of these movements. They can, however, supply the sychronous motor used in the electrical time switch described in the same issue.

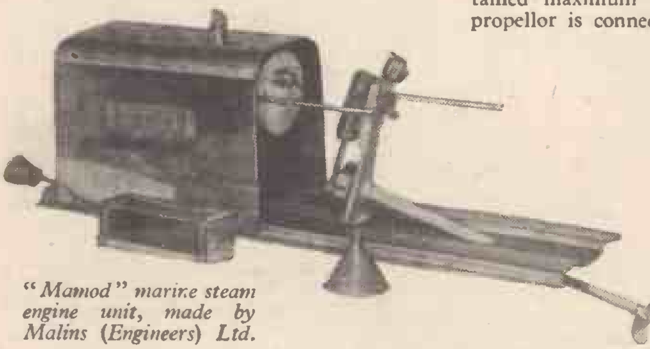


A Review of New Tools, Equipment, etc.

"MAMOD" MARINE MODEL STEAM ENGINE

THE complete unit is mounted on a base plate of light and rigid construction designed to give heat insulation and provide adequate protection to the boat. The boiler is made from seamless brass tube and is fitted with safety valve and water level plug to ensure dry running throughout and protected by a detachable chromium plated windscreen. The engine unit, which is mounted on a cast brass frame, includes a complete lubricating system to ensure sustained maximum output. The two-blade propellor is connected direct to the flywheel through a stern tube. The engine is designed for easy installation in both flat and "V" bottom hulls. The boiler is fired by an efficient spirit vapourising lamp and a tun-dish is provided for boiler filling.

The base plate measures 12in. × 3¼in. and the overall length, including propellor, is 13½in. The overall height is 3⅜in. The weight is 21oz. The engine costs 45s.



"Mamod" marine steam engine unit, made by Malins (Engineers) Ltd.

"Maclow" Thermoplastic Holderband

MADE from polythene in a wide range of colours the new device for pipe holding shown in the sketch is made by Industrial Heating Products Co., 15a, Howe Street, Edinburgh, 3. The base is fitted to the wall by means of a wood screw and to hold the pipe inside the band the cap needs only to be finger tight. Sizes available are from ¼in. to 2in., but the makers intend to add larger sizes as well as to produce a version which will withstand high temperatures. Prices range from 12s. per doz. for the ¼in. size to 46s. per doz. for the 2in. size.

The "Mcclow" holderband.

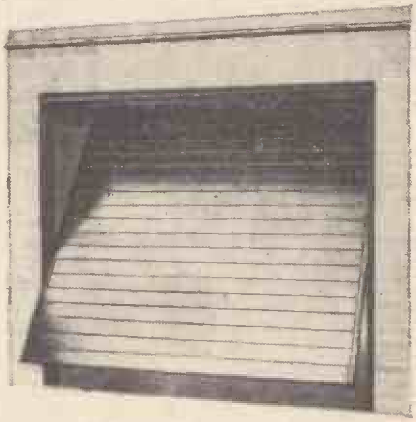
Remploy Soldering Irons

THESE soldering irons are available in 25, 65 and 125 watt capacities at prices from 22s. 6d. to 49s. They are supplied by Remploy Ltd., the national organisation for the employment of the severely disabled, and distributed by Foster Electrical Supplies Ltd., 75, Marylebone High Street, London, W.1. All models are designed so that the bit will not come into contact with the neck when laid down. The bit is tinned and both bit holder and stems are cadmium plated.

A flanged bakelite handle safeguards the operator's fingers from accidentally touching the stem of the iron.

Slide Over Garage Doors

THESE doors are marketed under the trade name "Alborough" and are made by A.B.C.D. (Raynes Park) Ltd., 34, Alpha Road, Surbiton, Surrey. The door is of steel welded and riveted construction, is 6ft. 4in. high and available in three widths. Prices for the door and gear complete range from £18 10s. Erection instructions are supplied with the door.



"Alborough" garage doors.

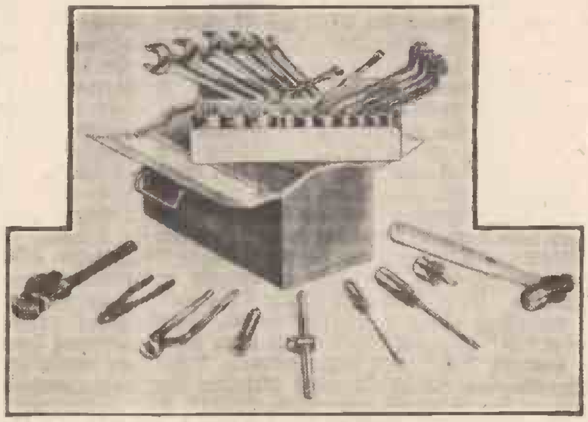
NEW GORDON TOOL KIT

THE new kit shown in the photograph is known as the No. 10W and is made by Gordon Tools Ltd., Allan Works, Rockingham Street, Sheffield, 1. It costs £13 16s.

The kit comprises: One each 3/16, ¼, 5/16, ⅜, 7/16, ½, 9/16, ⅝, 11/16, ¾ Whitworth sockets, ½in. square drive; one set No. 451 Whitworth open-ended spanners including ⅛ × 3/16, 3/16 × ¼, ¼ × 5/16, 5/16 × ⅜, ⅜ ×7/16, 7/16 × ½, 9/16 × ⅝; one set No. 773 Whitworth long offset ring spanners, comprising ⅛ × 3/16, 3/16 × ¼, ¼ × 5/16, 5/16 × ⅜, ⅜ × 7/16, 7/16 × ½; one each sliding T. Bar and piece, ½in. square drive, Nos. 2000 and 2001; one 5in. extension, ½ square drive No. 2006; one No. 907/6in. electrician's turn-screw; one No. 905/6in. engineer's turn-screw; one No. 906 Chubby turn-screw; one pair No. 601/10in. gland nut pliers; one No. 506/10in. pipe wrench; one pair No. 535/6in. slip joint pliers, black; No. 851 1lb. engineer's ball peen hammer; one mechanic's tool box.

Alternatives are American A/F or Metric sockets and spanners in place of Whitworth sizes.

The tool kit will find its chief sphere of usefulness in small engineering workshops, repair shops and garages as well as in the larger home workshop.



The Gordon tool kit.

READERS' SALES AND WANTS

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

PHOTOGRAPHY

PHOTO-ENLARGER Castings and Bellows for 35mm., 2¼in. x 2¼in., 2½in. x 3½in., 35/- per set; s.a.e. for details. V. J. Cottle, 84a, Chaplin Road, Easton, Bristol, 5.

BELLOWS, Camera, Enlarger, Process. Industrial Collapsible Machine Guards. Beers, 4, St. Cuthbert's Road, Derby. (Tel.: 41263.)

HOW TO USE ex-Gov. Lenses and Prisms. Nos. 1 and 2, 2/6 ea.; Vertical Enlarger Plans for 35mm. to 2¼in. sq., 3/6 ea.; Optical Condensers and Achromatic Lens to suit, 33/-. Lists; s.a.e. H. W. English, Rayleigh Road, Hutton, Essex.

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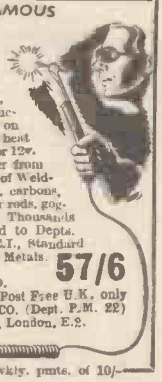

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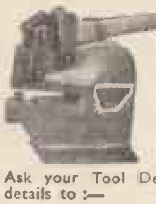

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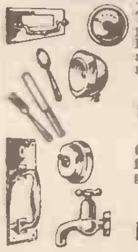

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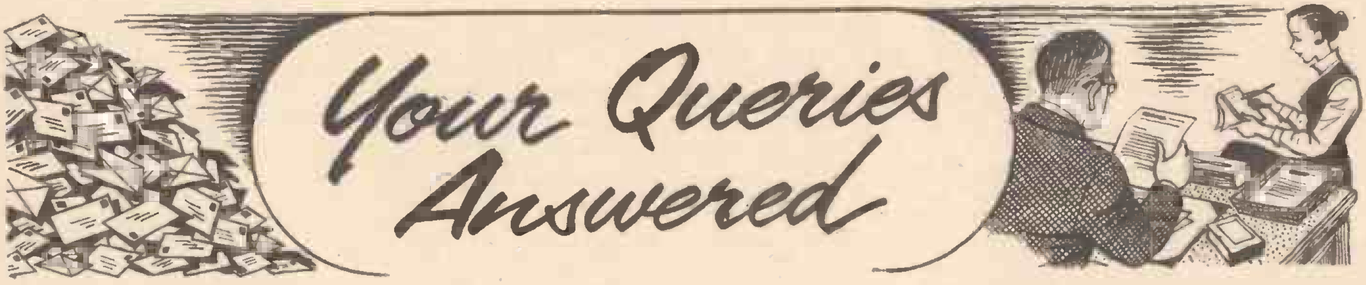


Dinghy in Aluminium

WITH reference to Aug. to Nov. 1956 issues of Practical Mechanics which contained the article on the Eight Foot Sailing Dinghy: Would it be possible to use an aluminium sheet for the sides in the place of marine ply? If so what is the most suitable gauge?—W. Crozier (N.I.)

IT should be possible to substitute aluminium sheet for plywood in covering the hull of the dinghy.

If aluminium is used it is suggested that it should be bedded into "Seelastic" jointing compound and screwed, instead of using the Aerolite glue as for plywood. The gauge used is not important; say 16 or 18. The thicker the sheet the more easy it would be to make a good joint.

Hardening Concrete

PLEASE advise me as to the best mixture for hardening a cement and sand mixture. It is to be used as a large block gate stop.—C. B. Wigdon (Bristol).

THE first point is that a sand/cement mixture is being used. This is unsuitable, and a better mix would be: two parts small stone chips, two parts sand and one part cement.

The most common mistake made is to try to dry out the concrete quickly as many people are of the opinion that the drying hardens the mix. This is not so. Hardening is a result of a chemical reaction between the cement and the water, and this reaction continues as long as the temperature is right and moisture is present. It will be evident that if the concrete has been exposed to strong sun it will be defective. In sunny weather it should be covered with a wet sack, kept moist by sprinkling with water.

We know of nothing which will increase the hardness of concrete. The only suggestion we can make is that rapid hardening cement be used as this will give greater strengths at the same age compared with Portland cement. Typical test figures are as follows:

Ordinary Portland

1 day	lb./sq. in.	Nil
3 days	lb./sq. in.	1,790
7 days	lb./sq. in.	2,750
28 days	lb./sq. in.	4,470

Rapid Portland

1 day	lb./sq. in.	1,040
3 days	lb./sq. in.	2,600
7 days	lb./sq. in.	3,950
28 days	lb./sq. in.	5,710

The above are for 6in. cubes made from one part cement, two parts sand and four parts coarse aggregate.

Use rapid hardening cement with the mix stated and let it cure slowly. If this is done the resulting block will, after about 28 days, have strength of more than 5,000 lb./sq. in.

Motor for Lathe

I AM taking delivery of a small lathe $1\frac{5}{8}$in. flexispeed, back geared and auto-traverse. I wish to drive it by means of an electric motor; can you tell me what motor to use?—S. Bolden (Margate).

GENERALLY lathes operate at about 300 r.p.m. using the mean speed but much will depend on the work you will undertake. If brass and aluminium form the bulk of your turning, then we suggest a higher speed will prove much more satisfactory—say up to 500 r.p.m.

An $\frac{1}{8}$ h.p. motor is sufficient for this light type of machine though we do suggest you give careful thought to this because a higher rated motor is often a useful asset in the workshop because, eventually, you may require it to drive additional machinery. It will naturally use more power, but if it drives a countershaft you can also apply it to operate a drill or small grindstone.

We have seen these light lathes operated by a foot treadle working a floor countershaft. This idea leaves both hands free for operating the machine and we advise you to give this consideration.

A $\frac{1}{4}$ h.p. motor running at 1,450 r.p.m. driving this member appears the most useful motor you can employ.

Sunburn Lotions

PLEASE tell me how to make sunburn lotions.—R. Gilyard (Yorks).

WE give below two formulæ, one for a lotion and the other a liniment.

Sunburn Lotion

Subnitrate of bismuth	$1\frac{1}{2}$ dr.
Powdered french chalk	30 dr.
Glycerine	2 dr.
Rose water	$1\frac{1}{2}$ dr.

Mix the powders and rub down carefully with the glycerine, then add rose water. Shake bottle before use.

Sunburn Liniment

Water-white steam distilled pine oil	75%
Medicinal olive oil	25%

The finished product is almost water-white and is an effective treatment for sunburn.

Poster Paints

CAN you please tell me the composition of waterproof poster paint?—Michael Keating (Eire).

WE do not know the composition of any waterproof poster paint used by poster writers. But there are several waterproof paints in which the pigment is mixed with celluloid lacquer (celluloid dissolved in either acetone or amyl acetate). This dries very quickly, almost too quickly, for handling on big surfaces.

A slower drying paint and very convenient for a single job at a time, can be made from artist's tube oil colours. Squeeze out sufficient of the colour on to a piece of clay surfaced "art" paper, such as that used in printing high-class magazines. Spread the colour, as thinly as reasonable with a palette knife. Leave for 10 minutes or long enough for most of the oil to be extracted by the clay surface, then scrape all colour up again on to a palette and add a sufficient amount of Japan gold size to make it a stiff liquid. Finally, thin it with turpentine to a working consistency. We believe that cellulose paints can be obtained in small tins and whether you use this or the artist's tube colours will depend upon the size of the job to be executed. Also upon the nature of the painting. The cellulose will dry in 10 minutes, the other in about 2 hours.

Transfer Ink

I DRAW Celtic designs for embroidery, but do not know how to print them on to the material. Can you help me please ?—N. McHugh (Eire).

A FORMULA for transfer ink which you might find suitable for your purpose is as follows:

(1) Ultramarine blue .... 50 parts
(2) Gum mastic .... 30 parts
(3) Beeswax .... 10 parts
(4) Petrolatum.................... 10 parts

Melt (3) and (4), work in (1) and mix with melted (2).

Alternatively we would suggest that you write to: The Royal School of Needlework, 25, Princes Gate, London, S.W.7.

Machining Lead

CAN you give me some information on the machining of lead? The lead is in bar form (1in. sq. section). It is to be cut up into blocks on a milling machine, and finally chilled and c/bored to take 5/16in. B.S.F. sk./hd. screw. Should the drill be ground to a specific angle, and what are suitable milling and drilling speeds ?—J. Gwynne (Glam).

DEALING first with the speeds for this material we would suggest about 600 feet per minute as the rim speed while milling, using a feed of approximately 15 feet per minute. Use a cutter with comparatively few teeth as this soft material is inclined to clog, and grind a rather prominent hook angle of 7 degrees.

For counterboring you can either use a flat blade type of cutter or one with three teeth—we prefer the former if you must feed this tool down very deep.

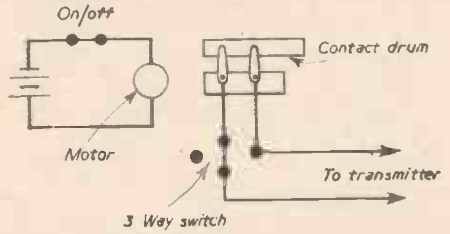
When drilling we do not think you will gain much by altering the orthodox angle of 118 degrees, but an increase in the clearance angle to about 20 degrees is perhaps advantageous. You can use something in the nature of 700 r.p.m. for the drill of this metal—probably the highest speed available on the machine, and you can apply soluble oil as a coolant.

Counterboring is possibly the most awkward operation as there is a tendency for lead "to cling," so make several withdrawals if the hole is deep.

Because of this tendency, grind the milling cutter sides to give just that extra clearance as this will eliminate any rubbing when the tool becomes slightly dull.

Radio-controlled Models

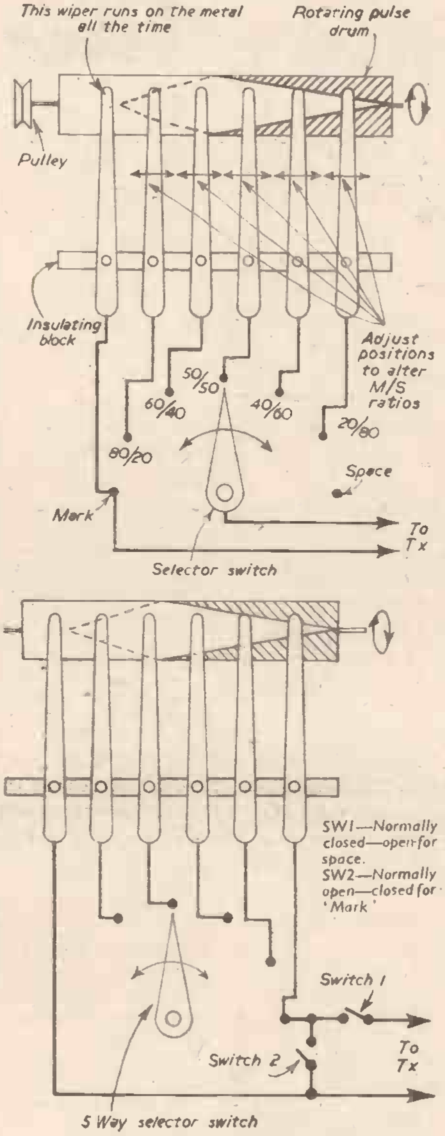
I WISH to build a transmitter, control-box and receiver and have read your articles on the subject, published in past issues of Practical Mechanics. I wish to use the mark/space system for rudder control utilising a contact drum. Below is the control-box wiring circuit.



In position 1 the H.T. supply to the transmitter is broken (space) giving "full port rudder." In position 2 the contact drum switches the H.T. on and off (50/50) and steers the boat straight ahead. Position 3 gives continuous H.T. current (Mark) and "full starboard rudder."

In addition to mark, space and 50/50, I wish to obtain ratios of 20/80 and 60/40 in mark and space. Can you tell me how to do this ?—V. Farag (Birmingham).

WE understand from your letter that you wish to generate five mark/space ratios with your control-box for use with a proportional steering unit.



Figs. 1. and 2.—Methods of producing different ratios.

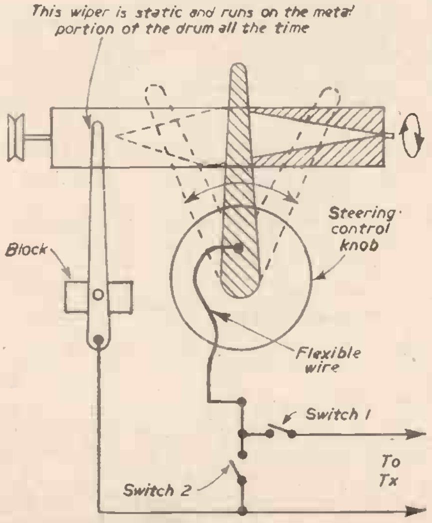


Fig. 3.—Using a wiper control.

The different ratios you require can easily be produced by adding further springy wiper arms to the pulse drum as shown in Figs. 1 and 2. Ratios will be produced according to the position of each along the length of the drum as indicated. The ratio you desire to transmit can be selected by position of the selector switch and "mark" and "space" can be obtained by either of the methods shown.

If you are using the resistance track method of producing proportional control it is, however, much simpler and more effective to use a wiper control as shown in Fig. 3. This is connected to a knob which is the steering control for the model. "Mark" and "space" can then be obtained by separate switches (if desired) and used to give engine speed control in the model.

A Small Telescope

I WISH to construct a small pocket telescope for observing star fields and clusters. I intend to use a ⅝in. orthoscopic eyepiece; could you please tell me what focal length objective lens to use in order to obtain the richest possible star field? Magnification is a secondary consideration, the object glass to be of about 40mm. diam.—T. F. Took (Lincs).

IT is suggested that you obtain an achromatic object glass from one of our optical advertisers and let the diameter of it be 2in., and the focus say 20in. This will be large enough to give you all the magnifying power and light which you will want without being unduly large for carrying. The magnifying power with a ⅝in. eyepiece, will be 32x.

The 2in. objective will, of course, be achromatic, a simple lens would be of no use for the purpose for which you will use the instrument.

Insulating Material

I HAVE recently been trying to make a low voltage electric soldering iron for miniature radio work. However, I have not been able to successfully insulate my element from the copper bit. A commercial model I examined recently seemed to have only a thin "paint" between the two. Can you help ?—W. J. Pullar (Scotland).

THE insulating material which you have seen was probably magnesium oxide. However, you will probably find that best results would be obtained in your case by placing a thin strip of mica on both sides of the element and clamping this by means of a strip of mild steel to the copper bit. In order to obtain good heat transmission, which is necessary to avoid the element burning out, the element must be tightly clamped to the bit.

Information Sought

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

8ft. Dinghy Modification

LAST year I made the 8ft. dinghy published in PRACTICAL MECHANICS. It was sailed frequently and with great success. I added a jib, simply by fitting a bowsprit which fitted the mast and the bow. This has added greatly to the speed of the boat.

I find, however, that I cannot make very much ground close hauled in a heavy wind, and wonder if any of your readers who built the dinghy can suggest a modification to the design.—A. J. BLEZARD (Sussex).

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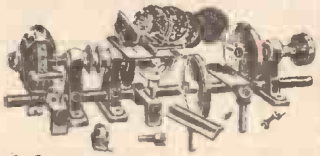

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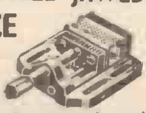

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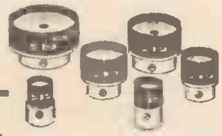

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THE Cyclist

Editor : F. J. CAMM

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WHAT I THINK By F. J. C.

THE CYCLE SHOW

THE Council of the British Cycle and Motor Cycle Industries' Association, at a recent meeting, reaffirmed their previous decision that the London Cycle and Motor Cycle Exhibition will be on a biennial basis in future. After this year's show, subsequent shows will be held in 1960, 1962, etc. I think that an exhibition every two years is adequate, for the industry has, so to speak, become more or less standardised in its products and there is insufficient novelty to attract visitors in sufficiently large numbers to support an annual exhibition. To talk of new models in bicycles is Gilbertian, when we remember that the only thing new about the latest models is the colour scheme. The fact must be faced that boots, bedsteads and bicycles have in their present form become standardised throughout the world and they cease to be a public attraction. It must also be admitted that the cycle industry has become somewhat hidebound in its outlook, and it would be far better to run the exhibition purely as a trade show on the lines of those promoted by other industries and on a smaller scale.

Far better for the industry to spend its money as it has been doing on national bicycle publicity schemes.

Is it beyond the brains of our cycle manufacturers to break away from tradition as has been done with motor cycles and produce some fundamental changes in design? Is not too much attention being given to the sporting machine, which appeals mostly to the racing clubman, and those who seek to imitate him? A sports cycle fitted with a racing saddle is most uncomfortable and has fortified the belief held by many inexperienced cyclists that cycling is hard work. Much more could be done to make the touring cycle more comfortable. The tourist requires a seat not a perch, and a sprung frame is long overdue. Tubular construction is out of date, and so are most of the present braking systems. Whilst the industry pays lip service to the healthy pastime of cycling and joys of touring, it does very little to ensure that the bicycle lives up to their claim. A publicity scheme drawing attention to comfort and modern improvements would do far more to sell bicycles than platitudinous slogans not supported by fact. The industry should not listen too much to the noisy minority—club cyclists, who do not total more than one hundred thousand.

THE OVAL CHAIN WHEEL

THE announcement that that famous racing cyclist, Oscar Egg, has produced an improved model of the Velo-Bolide reminds me of the fact that many years ago he endeavoured to popularise the oval chain wheel for which it was claimed that much greater speeds could be obtained. Of course, the idea, like so many other cycling notions of the Pennington era, was based on a complete lack of knowledge of the principles of mechanics, apart from the frequent chain trouble which it caused and the expense of cutting the teeth. Another crazy notion was the Simpson Lever Chain. If you believed in the claims made for this fraudulent device you would come to the conclusion that the chain drove the bicycle, through the medium of springs inserted between the links.

A further device for extracting money from gullible cyclists was the Bent Crank which, it was claimed, combined the advantages of the short and long crank. Although only six and a half inches from the centre of the bottom bracket spindle to the pedal spindle centre, the length of the crank around the curve was 7½in.; thus, said the makers, you have a six-and-a-half crank and a seven-and-a-half-inch crank in one! Those were the days when fraudulent promoters like Terah Hooley, Joseph Pennington and others made fortunes by floating numerous companies to exploit these fraudulent devices. Cyclists to-day are far more mechanically minded. But, even so, they still have an absurd idea about the weight of bicycles. A few pounds extra on the weight of a bicycle cannot make any measurable difference. It can only have the mildest effect, if any, on braking or on starting from stationary. Indeed, a lighter machine can be harder to propel than the heavier because of frame distortion. You waste a large part of your pedalling effort before you start to propel the bicycle. Some years ago, a famous racing cyclist, who believed in the lightest possible weight, was handed two bicycles to test over a measured distance. He did not know which was the lighter but he actually achieved the faster time on the heavier machine. Once a heavier machine is in motion it requires less effort to keep in motion than a lighter machine. Newton's laws of motion apply. Momentum still equals mass times velocity!

Arundel Castle from the bridge.

Cycling scribes who advise cycling tourists that changes of clothing are not worth carrying because of the weight, please note! It frequently happens that cycling writers without any knowledge of the mechanics of the bicycle and with precious little knowledge of mathematics will write learned disquisitions on the subject of bicycle mechanics. The formula for finding the best all round cyclist is a case in point, for it does no such thing, as has been pointed out in print and otherwise to the R.T.T.C. The result which the present formula produces from a paper contest is artificial. Just recall the nonsense which has been written around frame angles, for example, very little supportable from scientific fact. The classic work on the subject of the mechanics of the bicycle was a highly scientific work by the late Professor Sharp, which was published over 50 years ago. Yet it is as up to date to-day as when it was written. Writers on the mechanics of the bicycle could read this book with profit. Bicycles have become so standardised that it is doubtful whether many manufacturers really understand the mechanics of the subject. I was chatting to one the other day, and asked him why the tangent spoked wheel was introduced and what were the advantages. He could not explain why it was originally termed a "suspension wheel," and, indeed, went on to support direct spoking for front wheels as used on some bicycles to-day! It is not an industry which attracts the best designers because the salaries paid are comparatively low. That, perhaps, accounts for the lack of new developments.

Could not the industry offer a substantial prize for an improved yet non-freakish bicycle design? Attempts to break away from tradition have been made in the past with such freakish monstrosities as the Recumbent Bicycle, the Dursley-Pedersen (the latter a most comfortable machine, it is true, with hammock saddle) and similar designs based on false premises.

The Cycle Saddle

The Various Types : Care and Maintenance : Positioning

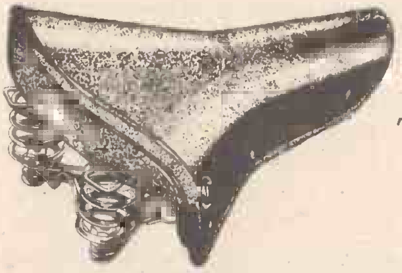

Fig. 1.—A comfortable sprung saddle.

TO describe all the various types of saddle available would be a profitless undertaking because cyclists have such widely differing opinions on the subject and widely differing physiques, that it becomes impossible to generalise. Two types, however, are shown in Figs. 1 and 3; one the typical clubman saddle with a leather top and no springing other than the leather itself and the frame which supports it, and the other a "featherbed" type including both springs and foam rubber in its make-up. It will be noticed that the frequent and experienced rider will prefer the unsprung saddle (after it has been well broken in to his own physique) while the occasional rider who may never sit a saddle long enough to become "hardened" will be included in the majority of cyclists who have a preference for the sprung saddle.

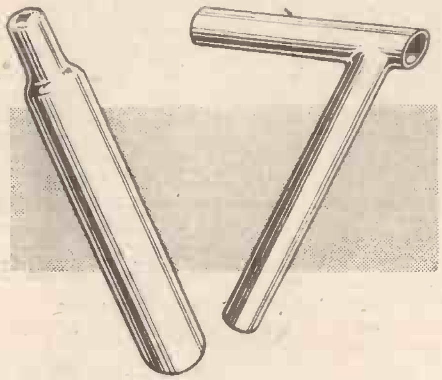

Fig. 2.—Two types of seat pillar.

Saddle Position

It is not necessary, as many people seem to think, to have the saddle top exactly horizontal. If it is found to be more comfortable or if a better pedalling action can be obtained, the saddle can be tipped either forwards or backwards, as preferred. The saddle must not, however, be out of line sideways. The peak of the saddle must always point straight along the top tube, or chafing on the inside of one or other of the thighs will result.

Another factor in saddle positioning is the type of saddle pillar used. There are two types, and these are shown in Fig. 2. The first, which is merely a tube with a reduced diameter at the top to suit the saddle clip is the most common, and the only adjustment for the saddle forwards and backwards is that permitted by the straight parallel portion of the saddle frame. With the inverted "L"-shaped pillar, as will be obvious, a considerably larger range of movement is permitted.

Saddle Care

A new saddle, as it is ridden, will stretch and, as the leather sags, it should be re-tensioned by means of the tensioning bolt under the saddle peak. If difficulty is found in tightening this nut, your cycle dealer will probably be able to supply a special spanner made by the cycle manufacturers for the job. The saddle should never be re-tensioned after a long ride or when it is wet and must not be over-tensioned. Leather soap applied to the underside of the leather top of the saddle will help to keep the leather supple and in good condition.

Water is one of the chief enemies of the leather saddle and should be avoided

Fig. 3.—The unsprung sports saddle.

as much as possible. A light shower will do no harm, but a prolonged soaking might cause the leather to contract unevenly and the saddle to spoil.

A saddle which has sagged badly but is otherwise in good condition can often be sent back to the makers for "reblocking," a service which is not expensive and which will considerably extend the life of the saddle.

For the road-riding cyclist, who must ride without mudguards in wet weather, a specially shaped plastic protector is available to fit underneath the saddle to prevent the mud and water from the back wheel spoiling the leather.

Reseating the Valve

A Method of Extending Tube Life

IT sometimes happens that a leak will be found round the base of the inner-tube valve where it is seated in the tube. This is quite easy to repair, but before starting on this work, try tightening down the locking nut. This may check the leak without necessitating any further work. If it does not, a patch must be positioned round the base of the valve.

Remove the valve insert after first taking off the dust cap and the knurled lock nut. Unscrew the lock nut at the base of the valve and take off the washer, exposing the inner tube underneath and then clean the rubber of the tube all round the valve with fine sandpaper.

Applying the Patch

Now select the largest patch in the puncture outfit—this is usually of rectangular or elliptical shape and measures $1\frac{1}{2}$in. × 1in.—and make a small hole in the centre. This can be done with a meat skewer or a hammer and punch and should by no means be as large as the diameter of the valve. Apply rubber solution to the tube around the base of the valve and when it has become "tacky," force the patch over the valve by stretching it to enlarge the hole. This ensures that when the rubber of the patch reasserts its

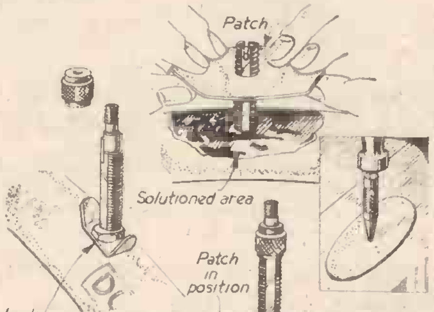

Fig. 1.—Steps in reseating the inner tube valve.

shape it will fit snugly around the valve stem.

The steps in reseating the valve are shown in Fig. 1.

When the patch is firmly in position, replace the washer and locking nut and reassemble the valve. Partially fill the tube with air and immerse the valve in a bowl of water to check that it really is airtight.

This same technique of fixing a large patch around the base of the valve is used when a puncture is discovered close to the valve seating but not right under it. A small patch is unsuitable because the valve seating prevents it from being placed centrally over the puncture.

Re-siting the Valve

If, when the valve locking nuts, etc., have been removed, the hole in the inner tube is found to be badly worn by the friction of the valve base, the whole valve stem can be removed by stretching the tube to elongate the hole and pulling the circular base of the valve through. The hole is then patched, using the largest patch available. It may be found advisable to use a motor car patch as these are thicker and will stand up to the pressure of air better. Some of these have chamfered edges and if used inside a fairly heavy tyre will not be noticeable.

When the old valve hole has been adequately patched a new site must be selected for the valve, a small hole made and the valve stem replaced. If the new hole is made small enough and neatly enough it will not be necessary to reinforce the seating with a patch, but if in any doubt, a large patch should be applied as already described.

A patch applied in this way will considerably lengthen the life of the tube and postpone indefinitely the day when a new one must be purchased.

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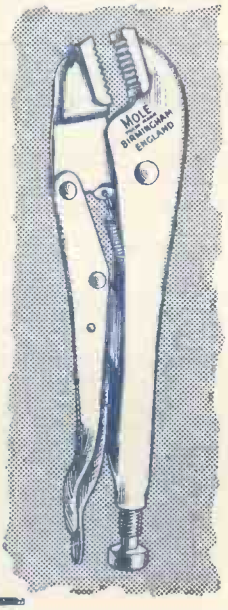

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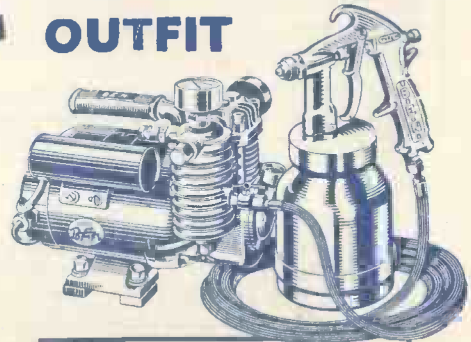

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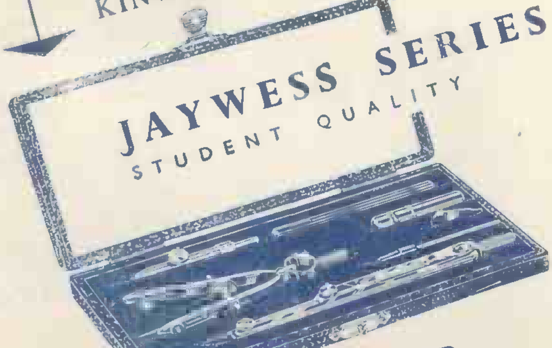

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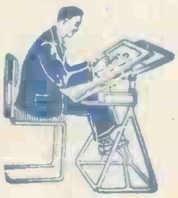

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By D. J. Richardson

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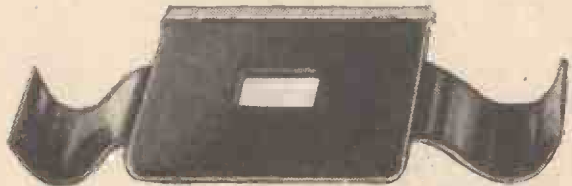


Fig. 1.—The completed negative carrier.

Black Perspex is the construction material and not all the dimensions are shown as they will differ from one enlarger to another. Cut the top half with a fine hacksaw to the size of the negative carrier space in the enlarger and fretsaw the negative size in the middle of the Perspex.

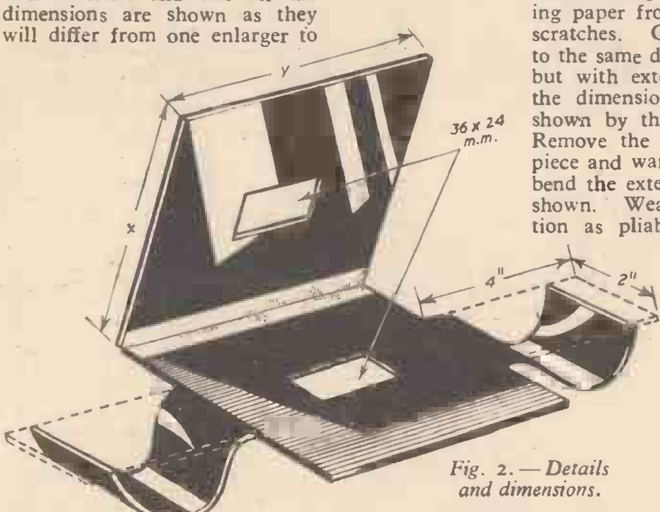


Fig. 2.—Details and dimensions.

For this stage do not remove the backing paper from the plastic as it easily scratches. Cut out the bottom half to the same dimensions as the top half, but with extensions on either side to the dimensions given and the shape shown by the dotted lines in Fig. 2. Remove the backing paper from this piece and warm it till it is pliable and bend the extension pieces to the shape shown. Wear gloves for this operation as pliable Perspex is very hot. Check that the flat surface of the top half makes perfect contact with the bottom half and tape the two together, using medical tape as a hinge.

Other materials could be used to construct this negative carrier, and metal would probably be suitable provided it is smoothed off to a very fine finish and blackened to prevent light reflection. The 35mm. user could probably adapt this design to suit the universal enlarger described on page 41.

Methods of Removing Stains

Only a Few Simple Chemicals are Required

THERE are many kinds of stain which can appear on bromide prints, but it is not always necessary to throw the print away when this happens as some stains can be removed.

Rust stains, for instance, can be taken out. The procedure is to breach the print in permanganate and then wash it and redevelop in the normal developer. Ink stains too can be eliminated by making up a weak solution of oxalic acid and immersing the print in it, or alternatively the permanganate mentioned above may be used, followed by redevelopment.

When using a sulphide solution for the sepia toning of prints, blue stains sometimes result. Iron in the water causes these and they may be removed by immersing the affected prints in a 5 per cent. ammonia solution.

Sometimes after fixing in an alum solution white marks may be noticed. Immersion in a weak solution of sodium carbonate for a short time is the cure for these. These white markings are the result of a badly mixed alum fixing bath.

Cleaning a Film

A film when used for printing in the enlarger should always be free from fingermarks, etc., and a film which is badly affected by this type of mark can be cleaned by wiping it with a piece of photographic sponge dipped in the following solution:

Ethyl alcohol	85 parts
Methyl alcohol	10 parts
Strong ammonia	5 parts

The use of this cleaner will not charge the film electrically and so cause dust to be attracted to it.

How to Obtain "13 On"

By E. G. Gaze

IN these days of high prices the amateur photographer often hesitates before "shooting"—with an eye to the number of exposures left on his film spool. On the popular 120-size spool, in cameras where 12 shots of 2¼in. square are obtained, it is possible to squeeze on an extra exposure to make 13 exposures on the standard 120-spool instead of 12.

How it is Done

Instead of winding on film for your first exposure until the figure 1 shows in the red winding window, wind only to the first warning dot which warns that the figure one is almost due to appear. By the time this dot shows in your winding window, the film emulsion will be right across the negative aperture frame: you can test this with an old spool of film backing paper with the camera back open—checking where the film would lie by noting where its leading edge was fixed to the backing paper by its sticky tape.

With Automatic Wind

Now, if your camera has an automatic film wind and counter combined, all you need do is to set your first exposure when the first warning dot shows in the window—and leave the automatic counter to take over as usual for the rest of the spool. When twelve is reached on the automatic counter, set it back to one (or zero, according to type) and advance the film one more normal turn of your winder, and expose. A little practice and it's easy to judge the amount of winding turn needed.

Without Automatic Wind

In a camera without automatic wind and counter combined, advance the film for each exposure as far as the first warning dot preceding each exposure number. You will have to remember how many frames you have used, but here a piece of card tucked into the camera case and ticked off at each exposure is an aid to the memory.

It is very rarely that a film is slightly under normal length (although enough for 12-on) and the attempt at 13-on fails. It may seem a small saving, but its great usefulness is apparent when that extra not-to-be-missed-shot jerks the viewfinder to your eyes and you remember you just haven't got another frame to expose. This method means that you have one extra exposure. And it adds up to saving one spool in 12—all for nothing, save a little care in winding!

Getting Ready for the Holidays

Now is the Time to Start Your Preparations

MOST people use almost as much film during the annual holiday as they do throughout the remainder of the year. In addition, the value attached to these photographs is high, for it is impossible to take again any spoiled pictures. Every care should be taken to ensure that the results are as near perfect as it is possible to make them.

Successful holiday photography depends largely upon the steps taken beforehand to eliminate any difficulties which could affect the quality of the pictures. Therefore, the time devoted to getting everything ready cannot be otherwise than a sound investment.

The New Camera

A large number of new cameras is bought every year during the holiday season, and it is reasonable to suppose that many receive their initial try-out on actual holiday photographs. This is not a wise practice for, even though the camera may be brand new and perfectly adjusted, it usually needs some degree of familiarity with the general handling and the mechanical controls before picture taking becomes a sure and easy habit.

If you intend to have a new camera for the holidays, buy it as soon as possible, study the instruction booklet thoroughly and practise making the various adjustments and releasing the shutter gently, without any movement of the camera. See that you know how to load the film, and make a series of trial exposures to ascertain whether the lens focus markings are correctly positioned, that the shutter speeds are approximately right and, very important with the less expensive equipment, that the viewfinder is accurately aligned. The fact that the viewfinder may not show precisely the area recorded on the film, especially at short ranges, is not vital provided that you know how great an allowance to make for the difference in viewpoint.

The Exposure Meter

This, particularly if it is of the photoelectric type, is a decided asset for holiday photography. With its aid, the majority of the guesswork is taken out of exposure determination, but only if the readings indicated by the meter have been closely related to the camera shutter speeds, the photographer's choice of negative developer and the type of negative preferred. It may be that a combination of these variable factors will require the exposure meter to be used in conjunction with a film speed rating different from that shown on the manufacturer's lists.

Fig. 1.—A typical kit for holiday photography, comprising camera in ever-ready case, tripod, cable release, self-timer, lens brush in case, spare films, lens-hood, filters and case, cleaning tissues, exposure meter and record book.

Fig. 3.—The flash equipment and the sling type bag for carrying.

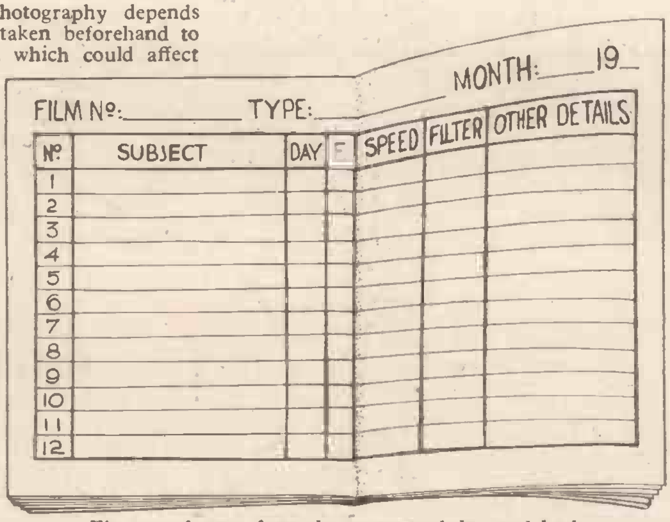


Fig. 2.—A page from the recommended record book.

Recently purchased filters, too, should be checked to ascertain whether their stated exposure factors agree with the results required in practice. Colour filters require different exposure multiplying factors when used in conjunction with films of varying types and speeds, and experiment will provide the most satisfactory data on which to work.

The Film

Since the choice of film is so closely related to the various other matters detailed above, and in which some research should have been carried out to ensure that the best results are obtained, many photographers prefer to make certain of adequate supplies of the right material by purchasing it before the holiday. Select a medium speed panchromatic film of any of the leading brands, as this is the finest material for all round general use. Its fine grain structure will enable considerable enlargement of the best pictures.

Well before the holiday, lay out all your photographic gear and decide which items you are likely to need while away. A typical holiday kit is shown in Fig. 1. Note that

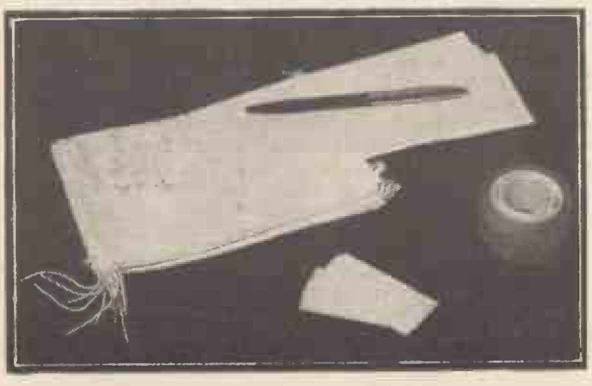


Fig. 4. (Left)—Linen bags with tags attached, paper labels, ballpoint pen and adhesive tape, useful for packing exposed films and identifying them.

cleaning materials have been included, since these take little space but their use will prevent the pictures being spoiled by dust on the lens and other vital parts. A lightweight tripod, cable release and a self-timer, if your camera is not already fitted with a delayed-action device, solves the age-old problem of getting an outsider to take a group photograph.

An Exposure Record

A record book should definitely be included in the holiday outfit, for the clear recollection of all the details of photographs taken at a particular time often becomes impossible some while afterwards. The record book can be bought ready printed with columns for various items of data and other information relating to each shot. However, the writer has found that a neat pocket-sized notebook, ruled and headed, as shown in Fig. 2, is ideal for the purpose. The example shown is for a camera taking 12 exposures on a rollfilm, but the columns can be extended or contracted to suit other requirements. For a 35mm. camera, taking 36 exposures at a loading, use several pages for each film. Enter each shot, immediately after it has been taken, and the system will be found most useful.

If there is any prospect of taking photographs indoors or after dark, take along your flash unit, extension lead for remote lighting, and a small supply of bulbs ; not forgetting any bulb cap adaptors which may be necessary. A sling-type outfit case to hold both the ordinary and flash equipment is a boon when on holiday (Fig. 3).

Carefully packed and correctly labelled exposed films simplify the processing arrangements after the holiday, and prevent any damage through light penetrating the convolutions of the backing paper. Immediately a film has been used and unloaded from the camera, enclose it in its foil-lined wrapper and return it to the carton, securing the flap with adhesive tape. Either stick a white label on the carton with tape, or drop the box into a linen bag with string tie and attached tag. Mark the film number on the label or tag, using a ballpoint pen for clarity (Fig. 4).

Just before going away, give the equipment a final clean and load the first film so that everything is ready for use.

A RANGEFINDING DEVICE

Instructions for Making It Yourself are Given

by D. May

THIS little device which can be made from the most everyday materials will provide the amateur photographer with a reasonably accurate rangefinder which folds away and stows in the waistcoat pocket.

Principle of Operation

The principle of operation is the same as that employed in expensive optical rangefinders, i.e., it measures the difference in angle subtended by a distant object at two points on a base line at a fixed distance apart. In optical instruments, these two points are usually two windows about 2in. apart. In this device the two points on the base line are the users own two eyes.

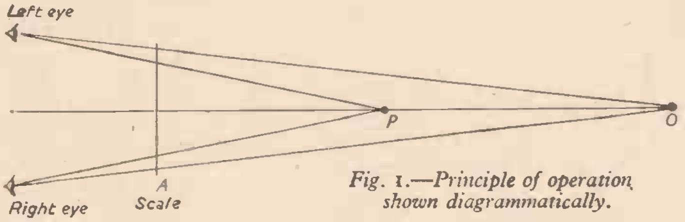


Fig. 1.—Principle of operation shown diagrammatically.

Reference to Fig. 1 will explain how it works. The diagram shows how the " lines of sight " from each eye to the object, O, pass a different point on the scale A. The two lines of sight to object O cut the scale at a greater distance apart than those to object P and it is the distance between points where the lines of sight cross the scale which gives the distance from the scale to the object.

How it is Used

To make use of this principle the rangefinder is made in the form of a frame which contains two holes, one for each eye, and has a fold-away handle. It also has a slot which is placed over the nose and it is used as one would use a lorgnette. A swivelling shutter obscures each eye in turn so that the object is viewed first by one eye and then by the other. See Fig. 2.

As the object is viewed through this contrivance a scale is held in the other hand between the eyes and the object and a cord between the scale and the frame ensures that the scale is held at a constant distance from the frame. The object is viewed first with the left eye uncovered and the scale is moved so that zero coincides with a strong vertical line in the object. The right eye is then uncovered by moving the shutter and the same vertical line in the object will be seen to " jump " to coincide with another point on the scale, thus indicating the range of the object.

The details of construction from stout " ivorine," celluloid, or sheet metal are self-evident from Fig. 2.

The length of the cord between frame and scale can conveniently be made about 1ft. and the distance between eyeholes should be chosen to suit the user's eye spacing. When these distances have been chosen and incorporated into the completed frame and scale, the scale may be calibrated by ranging on various objects at known distances and by marking the scale to suit.

If the handle is made to fold along the frame and the scale is made the same size and shape as the frame, the whole outfit will pack away into a leather sheath.

Fig. 3 shows the construction of a transparent scale which enables the instrument to be used by anybody regardless of their particular eye spacing, the method of operation being to select for use the particular scale on which one sees a very distant object at infinity on the scale. In this, the top and bottom scales may be calibrated separately by persons of suitable eye spacing, and the calibrations joined by the diagonal lines, or the whole scale can be made from a large scale drawing on the lines of Fig. 1.

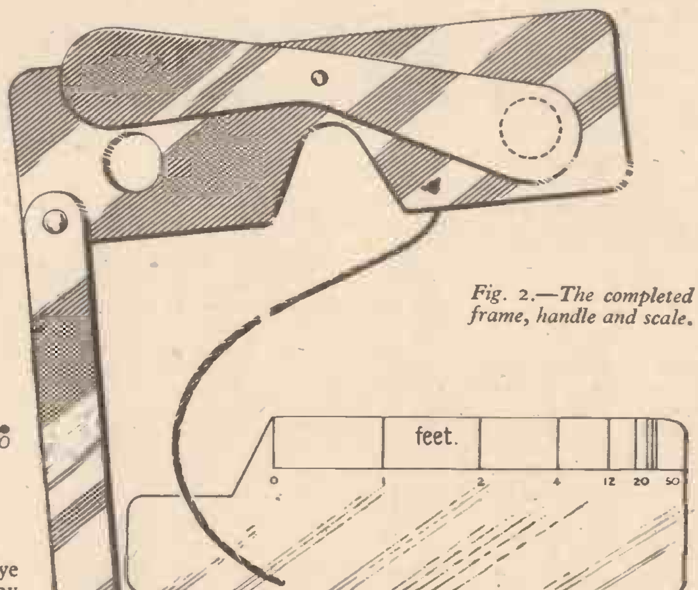


Fig. 2.—The completed frame, handle and scale.

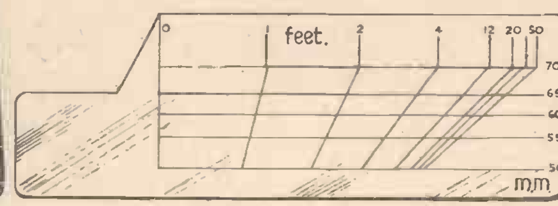


Fig. 3.—A scale suitable for various eye spacings.

An Adjustable Masking Frame

Give Your Prints an Attractive White Border! By W. F. B.

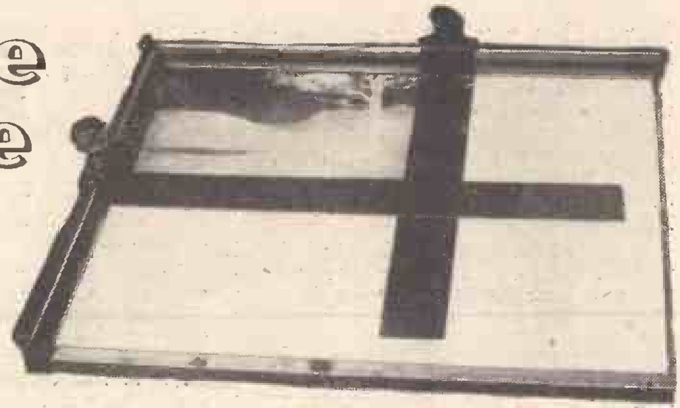


Fig. 1.—The completed masking frame.

THIS masking frame is intended for use with a vertical enlarger, and is suitable for prints of any size up to 12in. × 10in. The completed frame is shown in Fig. 1.

The Baseboard

For the base a piece of $\frac{1}{2}$in. plywood, slightly larger than $14\frac{1}{2}$in. × $12\frac{1}{2}$in., is required. The edges should be accurately squared off and planed down to size, and finally rubbed down with fine glasspaper round a wooden block.

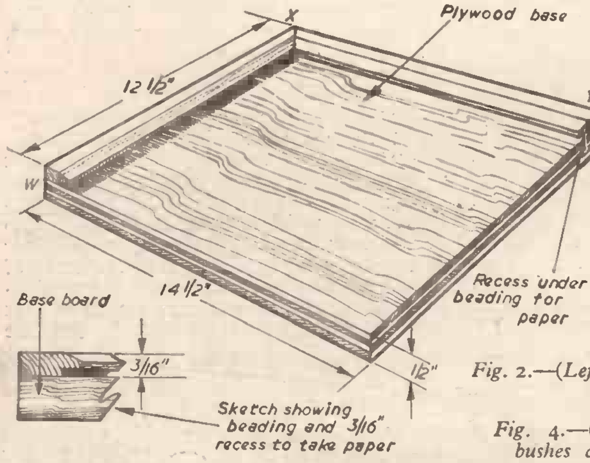


Fig. 2.—(Left) The baseboard and moulding.

The Beading

A lath, preferably oak, $\frac{1}{2}$in. × 3/16in. × 2ft. 6in. long has a rebate 1/16in. deep × 3/16in. wide cut on one face as shown in Fig. 2, the top edge being bevelled slightly. This rebate produces a 3/16in. white border on two sides of the print. The borders on the other two sides are produced by the two adjustable blades provided for that purpose. After completing the rebate the lath is cut to the measurements shown in Fig. 2, to fit where shown. One end of each piece is mitred to form when jointed together a perfect right angle. The prepared lath or beading is now pinned and glued in position on the baseboard with the rebate pointing inwards.

The Adjustment Bar

The adjustment bar is made from 5/16in. round, mild steel rod, two pieces being joined together at right angles by welding or brazing. If this is not possible, a piece bent at right angles will serve equally well. Cut to the lengths shown on the drawing and file a flat surface on what will eventually be the top part; this is done to provide a suitable surface on which the locking screw can grip. The bar is pivoted between two small brackets, and to secure it in place and allow it to move up and down, two No. 31 holes are drilled and tapped 4 B.A. at B and C in Fig. 3, to take 4 B.A. cheese-headed screws.

The Brackets

The three small brackets (Fig. 3) are made from sheet metal. Three pieces $\frac{1}{2}$in. wide × 1 11/16in. are cut from a sheet of 18 or 20 gauge metal, they are then bent at right angles $1\frac{1}{8}$in. from one end. On the long side make a centre pop $\frac{1}{4}$in. from the top on the centre line, and on the short side two centre pops 5/16in. apart. Drill these 1/16in. and countersink them on the underside. On the long side drill 9/64in. holes for the pivot screws. One of these brackets which is used as a rest will require the 9/64in. hole opening out to 5/16in. and the metal between this hole and the top edge of the bracket removed to form a slot for the end of the adjustment bar to rest in, as at A (Fig. 3).

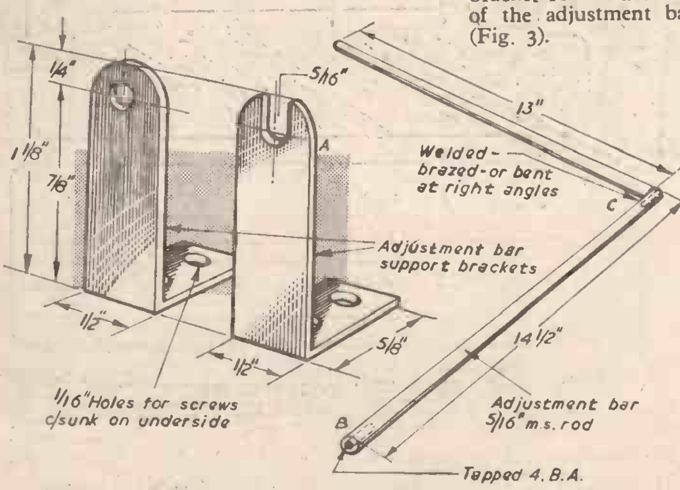


Fig. 3.—Details of the brackets and the adjustment bar.

The Sliding Bushes

The sliding bushes to which the steel blades are attached are made from $\frac{3}{8}$in. square or round brass bar. Two pieces $1\frac{1}{4}$in. long are cut off, and a 5/16in. hole drilled through the centre, lengthways, as shown by the dotted lines in Fig. 4. The ends of the bushes are squared off with a smooth file, and if round bar material is used for these bushes a flat must be filed for the steel blade to fit on. Three holes are drilled on what will be the top surface and two No. 31 holes tapped 4 B.A. for the blade securing screws. The centre hole is tapped to take the type of locking screw used, which in the writer's case is an "Exide" accumulator terminal.

Assembly

First fix the two adjustment bar support brackets at X and Y in Fig. 2. When fitting these see they are below the level of the underside of the baseboard as in Fig. 5. The third bracket is fitted at W (Fig. 2), and as previously stated is for the adjustment bracket to rest in when the paper is in the correct position for printing. Place a bush on each bar, and secure the completed adjustment bar with bushes between the two support brackets with the two cheese-headed 4 B.A. screws, a small brass washer being placed under each screw before fixing.

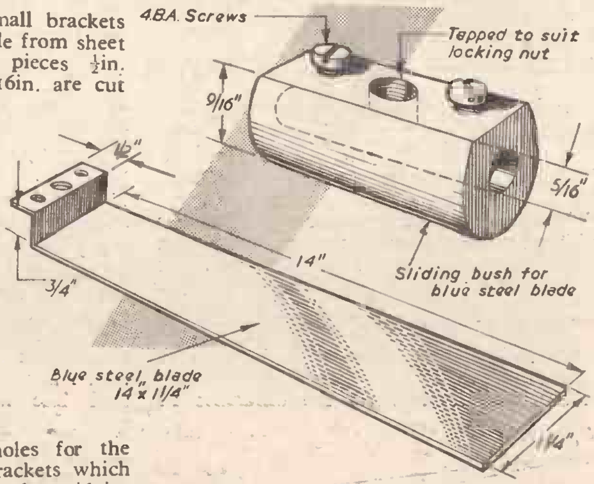
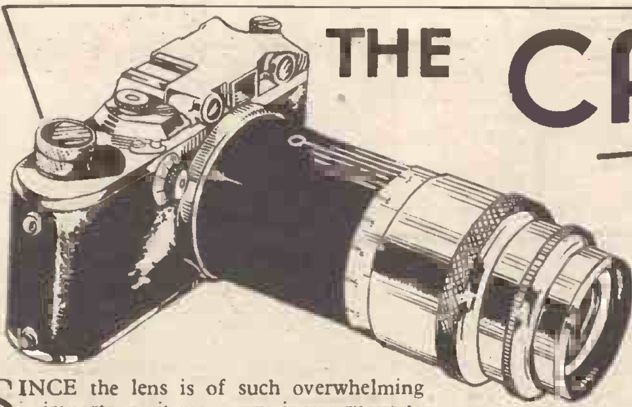


Fig. 4.—(Right) The sliding bushes and blade details.

The Blades

The two blades are made of 20 gauge blue steel, obtainable at any model engineer suppliers. Two strips $1\frac{1}{4}$in. wide × 16in. long being required. This material is easily bent to shape in a small vice. Bend one of the blades at right angles 14in. from one end, and the other 12in. from one end. The distance from the baseboard to the top flat surface of each bush, which incidentally should be exactly the same in each case, is measured from the bend on each blade and a line scribed across the blade at this distance on the short side. On this line the blades are again bent at right angles but this time in the opposite direction to the previous bend. The surplus material is now cut off, and the edges trimmed up with a smooth file. Details of one of the blades are shown in Fig. 4.

(Concluded on page 46).



THE CAMERA LENS...

Part 1 of a Short Series Which Explains in Simple Language How the Camera Lens Works

By J. C. Lowden

SINCE the lens is of such overwhelming importance it may seem incongruous to suggest the construction of a camera which will function with no lens whatever. However a pin-hole camera will prove both interesting and instructive (Fig. 1).

Construction

Take any "salvage" box camera—the older the better. Ensure that it is at least light-proof, even if it is necessary to resort to swathing it with black cloth or using "gum-strip." See that the shutter is capable of a time exposure. If the shutter is absent, or damaged beyond repair it should not be too difficult to rig up a pill-box, matt-blacked inside, to serve as a lens tube. The lid of the box, similarly blacked, will serve perfectly as a lens cap (Fig. 2).

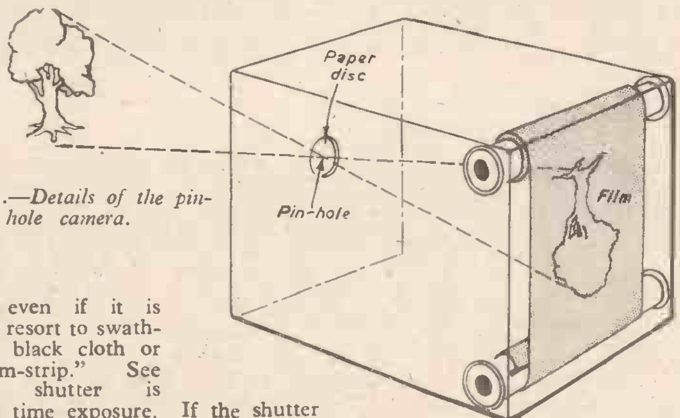


Fig. 1.—Details of the pin-hole camera.

Remove the lens, if any. Acquire a disc of black needle-paper, large enough to cover the lens hole. Paste the paper tightly and evenly over the hole, making sure that the cover is light-proof.

As closely as possible to the centre of the lens opening make a pin hole. The size cannot be clearly defined, but it must be circular in shape; and it must be clean. The most efficient way to make the hole is to apply the point of a (No. 10) sewing needle, heated to red heat, to the paper. The hole will be more accurate, the waste being charred away. Thin metal foil blacked, and drilled with great care, will make a more permanent job.

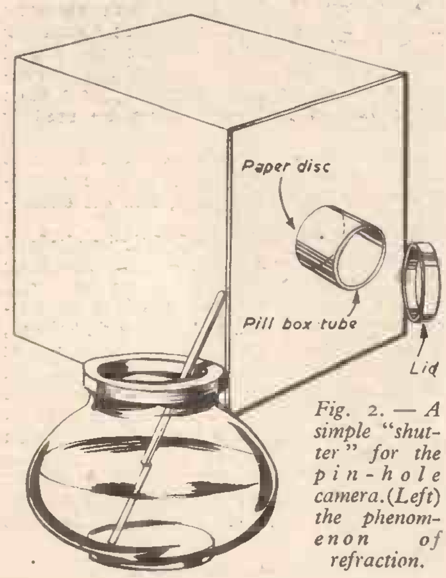


Fig. 2. — A simple "shutter" for the pin-hole camera. (Left) the phenomenon of refraction.

Trial Exposures

Load up the camera, in subdued light, preferably with Orthochromatic film. Take it outdoors, where bright sunlit conditions are required and mount it on a stable support. Choose a static, brightly-lit subject at a range of about 15ft. Using a watch with a seconds hand, open the shutter, expose for five seconds, close the shutter and wind on the film. Expose the next "frame" for ten seconds, and continue exposing, using the same "doubling" progression for six or so of the shots. If you depart from this progression, make a note of the time against the frame number.

Precise times cannot be given because of the wide range of variable conditions of light, film speed, etc., but the suggested range will be a good basis for a first attempt.

Develop the film normally. If you do not do your own processing, ask that the film be returned uncut—no prints need be ordered.

Examination of the film should reveal the following results. The first frames will be virtually clear film base. The final frames will be opaque. Somewhere in between should be a fairly well defined and adequately exposed image. In all probability, both the frame immediately preceding and that following will yield fair images, even though they have been severely under- and over-exposed.

We have taken a photograph—but without a lens. Why, then, pay a small fortune for a most complex piece of equipment? The answer lies in the long exposure time called for, quite impractical in general photography. The obvious measure would appear to be to increase the size of the pin-hole, thus allowing more light to fall upon the film. In actual practice the result would be a hopelessly blurred image. Thus is demonstrated the need for a more efficient method of transmitting the light and forming the image—a lens.

What is a Lens?

A lens is a slab of transparent material, usually optical glass. Plastics have been used in the making of lenses for less expensive apparatus, but there is no apparent indication of plastics supplanting optical glass in the high-grade lens range.

Although a lens *can* be made in virtually any superficial shape (viz.: spectacle lenses),

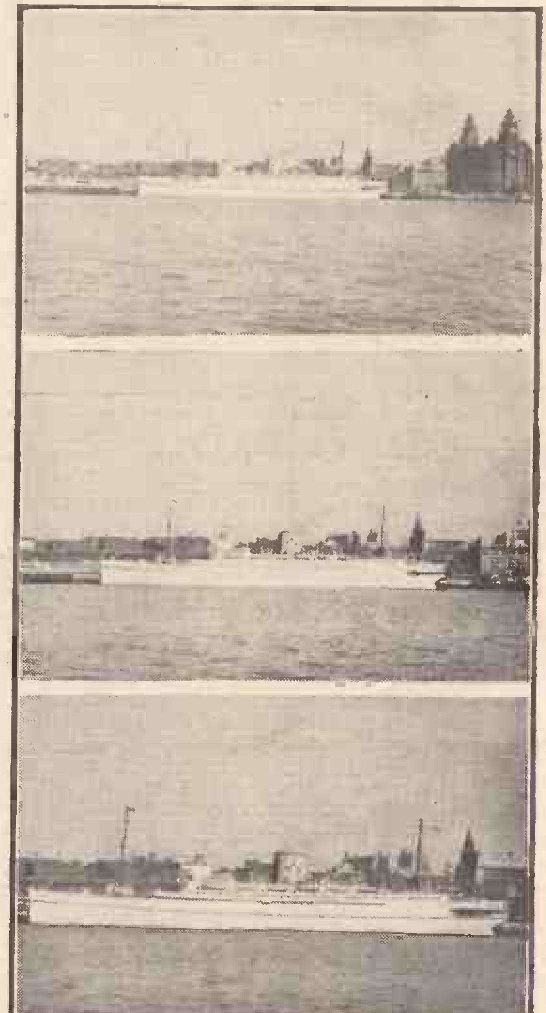


Fig. 3.—The field covered by lenses of differing focal lengths. (Top) The wide angle lens. (Centre) The standard lens with 45 deg.-60 deg. angle of acceptance. (Bottom) The long focus lens.

it will be more realistic to think of it as a disc.

The vital properties of a lens are its ability to transmit light, and its ability to refract (bend) rays of light. The first function is inherent, of course, in that the material of which it is made must be transparent. The second function of refraction is given by the cutting of the lens in such a way that all surfaces of the lens which are collecting light are cut as parts of a sphere. The extent of refraction is controlled by the degrees of curvature, as specified by the designer.

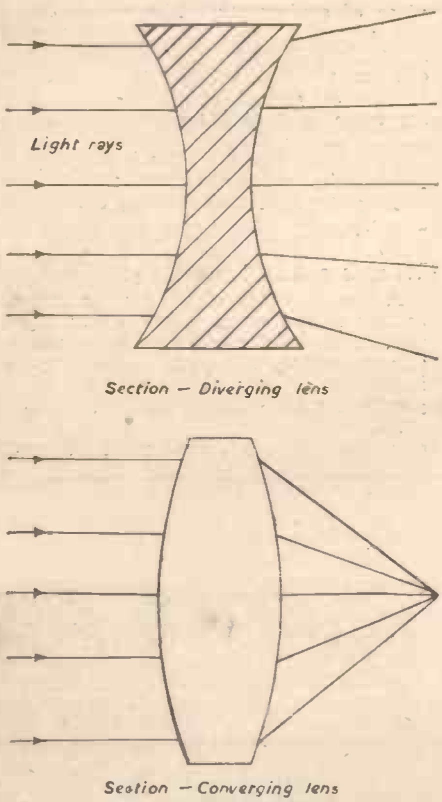


Fig. 4.—The function of the diverging lens and the converging lens.

The phenomenon of refraction can best be observed by dipping a straight rod into a glass bowl filled with water (Fig. 2). The precise degree of refraction given by any medium is referred to as its refractive index. The refractive index of the lens material must differ from the refractive index of the substance (this would normally be air) on each side of the lens, if the lens is to function efficiently.

Convergent and Divergent Lenses

By manipulation of the section of the disc, a lens can be made which "bunches together" the light rays transmitted (convergent lens), or one which "spreads out" the rays (divergent lens). Although both types play a vital part in the computation of compound lenses, it will be more helpful to think of a convergent lens, unless a divergent lens is stated. Both types are shown in Fig. 4.

The Size of a Lens

The diameter of the disc is the most obvious dimension, but the working efficiency of a lens cannot be decided from the superficial area alone. This is only one of the two factors by which the efficiency of the lens, in terms of light transmission, is determined.

In actual practice it is found that the extreme edges of a lens perform their functions less efficiently than the centre. This is mainly due to the physical difficulties of working the edges of the disc to the same degree of accuracy as the centre. The general efficiency of a lens is normally improved by reducing its working area. This is done by placing in close proximity to the lens a blackened disc, in the centre of which a hole is pierced. This hole is less than the lens, thus restricting the light passing through. Such a disc is called a "stop," and the process is called "stopping down."

The Angle of Acceptance

The lens views only a restricted sector of the scene in front of it and the size of this is controlled by the angle of acceptance of the lens (see Fig. 3).

The "standard" or "normal" angle of acceptance for most cameras with non-interchangeable lenses, sold for general purpose use, lies between 45 to 60 deg. The exact angle for each model is usually stated in the maker's literature, and the viewfinder is fitted in accordance with this angle.

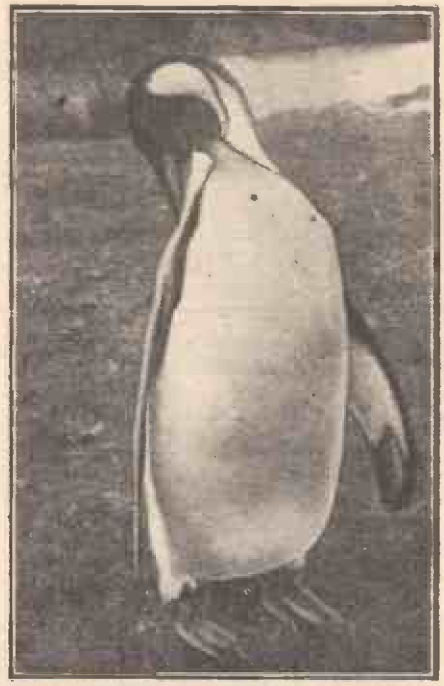


Fig. 5.—The type of subject for which the long focus lens is useful.

Lenses covering a wider field of view, in excess of 70 deg. or so, are referred to as wide angle. These are normally available only to the user of an interchangeable lens camera.

Lenses covering a narrower field of view than the standard, i.e., 40 to 20 deg., are referred to as long focus lenses. Long focus lenses reach their highest form in the telephoto range. When it is impossible to get close enough to fill the frame, the telephoto lens comes into its own, see Fig. 5.

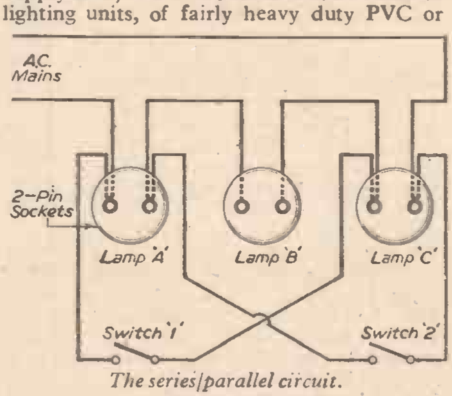
(To be continued)

A Simple Series/Parallel Switchboard

An Aid to Bulb Economy By J. W. Parsons

KEEN amateur photographers who take pictures by artificial light using the special photographic under-run bulbs, will know that the bulbs have a very short life, and this may vary from a couple of hours for the cheapest to a hundred or so for the more expensive ones. However, no matter which type the bulbs are, their life can be lengthened considerably by allowing them to warm up slowly on reduced power, before switching them to full brilliance. A simple switching arrangement to enable three such photographic bulbs to be run on reduced power, and then switched to full power after they have been allowed to warm up, is shown here. In actual practice it will be found that the lighting may be arranged, and the sitter become accustomed to the lights, whilst they are on low power, merely switching them to full for a short period to enable the actual exposure to be made.

The arrangement is a simple series/parallel circuit utilising three two-pin sockets, into which the lighting units are plugged, and two single-pole on-off switches. The electrical circuitry is shown in the diagram, and is quite simple to follow. Inter-component wiring should be done in good quality rubber or PVC covered wire, rated at least at 5 amps., and it is advisable to make the mains supply lead, and also the leads to the various lighting units, of fairly heavy duty PVC or TRS cable, as they will be subjected to strains and stresses as they are dragged about the studio floor.



The series/parallel circuit.

The components are mounted on a baseboard, which can be fixed to the wall or left portable, as desired. In the original the base was formed from a piece of wood 6in. square × ½in. thick, with channels chiselled out on the under-side to accept the wiring. Before mounting the plugs and switches the base was smoothed with glass-paper and then french-polished, although other finishes could, of course, be used at the discretion of the individual. After assembly and testing, a plywood cover is screwed to the underside of the base to conceal and protect the wiring, and the switchboard is ready for use.

When plugging in the lighting units and switching on the supply, both switches on the board are left in the *off* position, and the bulbs will be found to light at low-power only. If switch "1" only is closed, lamp "C" will go on full power, whilst "A" and "B" will be extinguished. Similarly, lamp "A" only will be on, if switch "2" is closed with "1" left open. Closing both switches puts all the lamps on full power.

The complete unit can be made in an evening, and will be found to prove extremely useful in the studio. A considerable increase in economy of bulbs will be noticed when it is installed.

Light & Shade in Photography

Making Pictorial Photographs Using Everyday Things

By A. E. Bensusan

THE entire basis of photography is the accurate rendering of details or effects in terms of light and shade. Here, it is shown how this principle can be taken a stage further and used to provide pictorial photographs from everyday subjects which would not otherwise be considered suitable for, or even worthy of, the expenditure of a negative.

Lighting Angle

The main requirement for successful photography employing the effects of light and shade on simple subjects, is that the photographer should be capable of visualising the results of different lighting angles and intensities on a subject, without actually having seen them. By this means it is possible to estimate, with a fair degree of accuracy, that a subject which is unsuitably illuminated at, say, mid-day, will prove just right for a photograph in the evening when the angle of the light is much lower.

As the first example, let us take a small boat lying on a shore. With the light coming from the front the shadows thrown by the boat and the irregularities of the beach are long but away from the camera, while light from immediately above causes shadows in any direction. In either event, the result would lack relief and dramatic effect, on both of which this form of photography depends. In Fig. 1, the angle of the lighting is still relatively high, but now it comes from behind the subject matter and the sense of relief and, perhaps, the dramatic quality, has been increased out of all proportion. Sharp focus on the boat, and a slight but perceptible softening elsewhere in the picture ensures that the attention is concentrated where it should be; on the main subject matter.

Fig. 1.—A simple subject photographed against the light and showing the value of light and shade.

Adding Relief

The use of light and shade to add relief, or a three-dimensional effect, to a picture is of inestimable value for subjects which have a fairly consistent colour and in which it is impossible to show the form and shape by any other means. Fig. 2 shows a door and part of a window set in a wall, having considerable shape but no colour or texture variation. By using a carefully controlled side lighting, the various contours have been thrown into relief and given an acceptable degree of depth of shape. The darker areas now look more naturally placed and they now have, in themselves, minor high-light and shadow areas which aid the impression of a faithful rendering. This matter of light and shade is of especial use in photographs of an architectural nature and, before photographing a building or any part of a building, it is a sound plan to view the subject under as many different lighting conditions as possible.

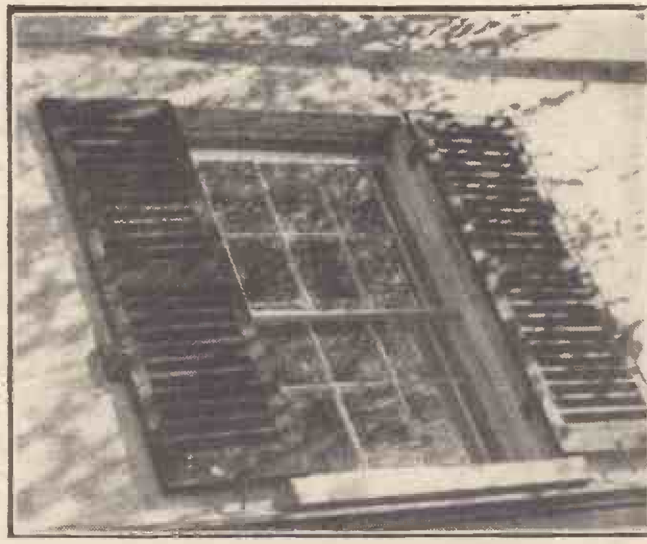


Fig. 3.—Delicate shadows play their part in increasing the interest value of simple subjects.

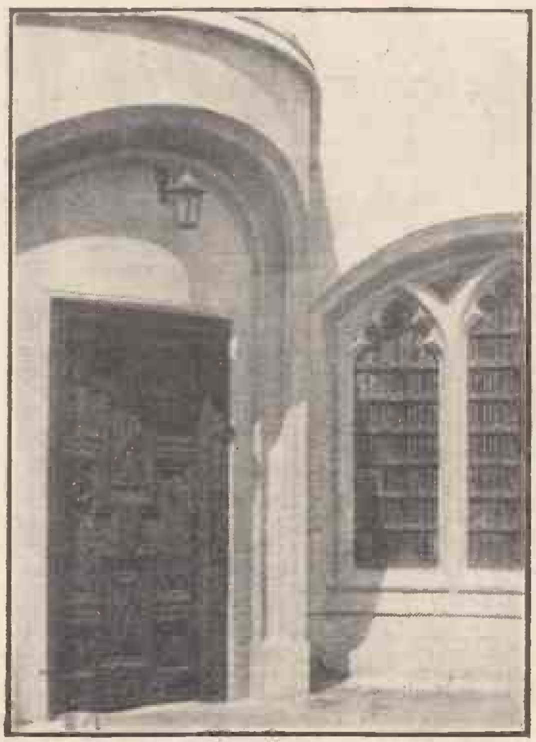


Fig. 2.—Subtle use of light and shade to increase relief.

Fig. 4.—Extreme contrasts of light and shade are often useful.

Using Shadows

A more subtle use of this technique is to take full advantage of shadows caused by some other object and falling across the centre of interest of the picture. The employment of this system generally requires that the shadows should be sufficiently clearly defined as to be easily recognisable, and a photograph of this type can be seen as Fig. 3. Here, an attractively shuttered upstairs window, situated close to a large tree, is shadowed by the foliage. The leaves cause quite sharply outlined patterns on the wall, as do the smaller branches, while the numerous reflections of light from the shiny surfaces of the leaves, and from the direct rays of the sun passing in between the obstructions, can be seen in the windows.

Under other lighting conditions there would not have been the possibility of a picture worth taking, but the presence of shadows has entirely altered the nature of the result. Perhaps this is an opportune moment to remind you that pictures based on light and shade can often be found well above eye level. This illustration proves that it pays to look up as well as in any other direction, and that a small feature, suitably illuminated, is sometimes far more effective than a view on a grander scale.

Using High Contrast

There are occasions when high contrasts may be used to carry this principle of light and shade one step further. By using rather dense shadow areas alongside bright highlights, it is often possible to record attractively an otherwise unpromising subject. This is particularly true where certain undesirable features have to be included in the picture area, but need to be rendered unobtrusive to avoid introducing distracting elements.

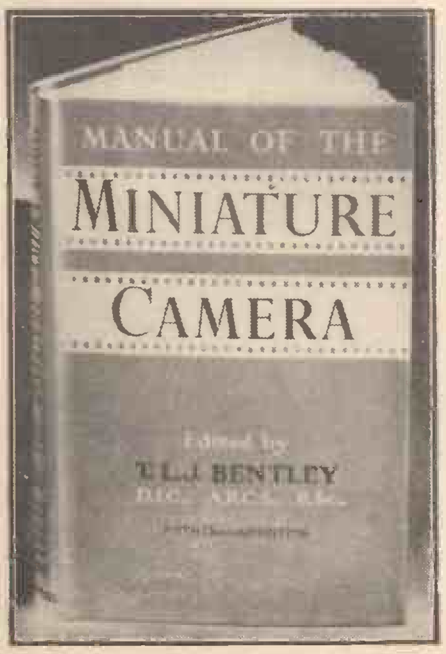
Fig. 4 shows how the use of large and heavy shadow areas can serve to concentrate the interest on smaller highlight and delicately toned regions. If the surrounding features were of similar density to the leaves on the overhanging branches, the view would be flat and lifeless. As it is, there is an impression of coolness caused by the dark shadow areas contrasting with the bright light in the background.

Exposures must be determined with a clear idea of the results expected. Where the shadow areas are required to be relatively free from fine detail, the exposure can be slightly on the short side so that emphasis is laid on the highlights. Conversely, when full and delicate rendering is required in both highlight and shadow regions, the exposure may be slightly full. In any event, the development of the negatives should be carefully controlled so that excessive contrast is not built up, and the qualities of light and shade are not destroyed during processing. Aim for a negative which will print easily on a normal grade of bromide paper, without having to print in any highlights, and the desired effect will be rendered most accurately.

Practical Books for Photographers

THE publishers of this journal, who are renowned in the book world for their practical technical books in many fields, have a particularly useful batch of titles on photography, which will appeal to readers of this supplement. The books are all popularly priced and written by established authorities. They are not dry-as-dust technical expositions, but are books which the photographic enthusiast will find pleasant to read and stimulating to newer and better pictures.

An outstanding success of last year and about to come out in a second edition is "Colour Photography for the Amateur," by M. Lillington Hall, M.A. (21s. net). This delightfully produced book gives up-to-date "gen" on all the available films and processes, and also deals fully with exposure,



colour rendering, conversion and correction filters, and the art of taking colour photographs indoors and outdoors by daylight, artificial light and flashlight. It deals not only with the taking of the pictures, but gives instructions for amateur printing and developing. With 66 illustrations and eight in full colour, an attractive full colour dust jacket reflects all the exciting atmosphere of this most fascinating of all photographic interests.

Another Newnes success within the recent past, also of an intensely topical interest, is "Making and Showing Your Own Films," by G. H. Sewell, F.R.P.S. It is an authoritative guide to film making and projection. The first part deals with cameras, lenses, films, and details of necessary ancillary equipment. The second and major portion deals with film making and projection. Chapters are devoted to lighting, correct exposure and colour interpretation. It is lavishly illustrated and costs only 21s. net, a very small sum in relation to the help it will give to amateurs and cinematographers.

For those who wish to be free-lance photographic journalists, there can be no better short cut to success than "Photography for Profit," by "Nettel" (10s. 6d. net), now in its second edition. This book tells you the kind of pictures to take, how to take them, and where to find a market for them.

George Newnes Limited also publish the standard handbook, "Amateur Photography," edited by Thos. Jamieson (15s. net), now in its ninth edition. It is fully illustrated.

The "Photographers' Pocket Reference Book" (10s. 6d. net), is full of concise and practical information on cameras, accessories, plates, films, flash equipment, developers and printing papers. Particulars of up-to-date apparatus and materials will be found in each section enabling a quick choice to be made of the items most suitable for a required purpose.

Perhaps of less interest at this time of year but a wonderful book for the amateur photographer in the winter is "Enlarging for the Amateur," by S. B. C. Williams, M.A., B.Sc., now in its second edition. This is particularly valuable to those who wish to produce exhibition pictures. Mr. Williams has personally tested all the processes described in the book.

"Indoor Photography," by R. W. Unwin, A.R.P.S. (15s. net), is for all enthusiasts who wish to take up indoor photography successfully as well as for those who have already ventured into this entertaining field. It fully covers cameras, auxiliary equipment, close-up lens, parallax, lighting terms and film speeds, artificial lighting, determining exposures, flash, colour, television pictures, etc.

The last, but by no means least, in the impressive list of practical photographic volumes is "Manual of the Miniature Camera," edited by T. L. J. Bentley, D.I.C., A.R.C.S., B.Sc., now in its fifth edition (21s. net).

Any or all of these volumes can be obtained on demand from your bookseller or from most photographic dealers; but in case of difficulties, just drop a postcard to the following address and a copy will be sent to you C.O.D.:

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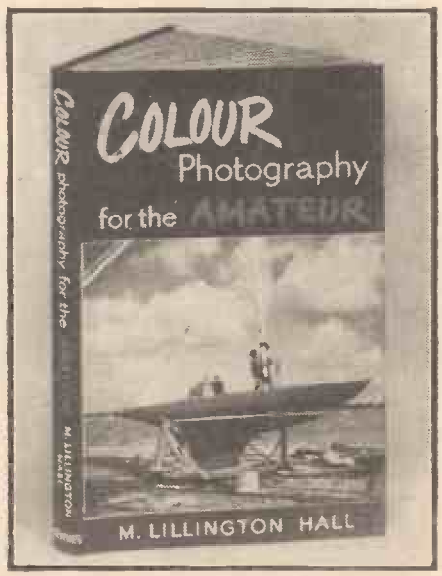


The publishers are always pleased to hear from photographers about their day-to-day problems or, indeed, about their particular successes. It may be that their accumulated experience may help you, or, alternatively, maybe you have something to contribute to the art of photography about which they would be interested to learn.

Camera Cases

MOST people are careful enough to keep their camera clean but how many forget to clean the case? The leather storage or ever-ready case for the camera protects it against damage and dirt but is also prone to pick up dirt itself. Remember to clean the case frequently, taking especial care to brush the velvet lining thoroughly. The dirt, dust, grass, etc., picked up when the camera case is stood down when out of doors must not find its way back to the darkroom.

A UNIVERSAL ENLARGER...

Part 2 Describes the Focusing Unit, Lens Panel, Bellows and the Lamphouse

By W. F. BUTTERY

(Concluded from the May Issue)

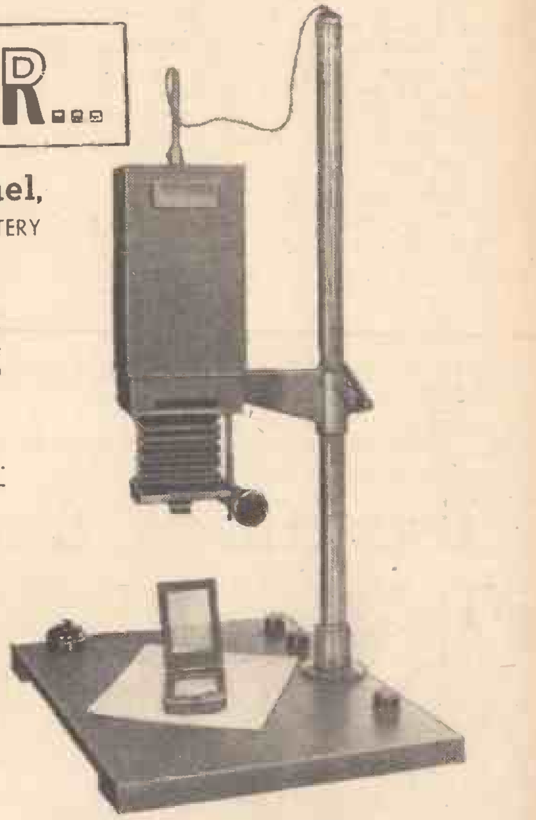
IN Fig. 9, details of the various parts required to fabricate the focusing unit are shown. Finished parts may be available from the firms mentioned in last month's article. It is not a difficult piece to make, but careful filing and fitting are necessary if an easy movement free from slip is to be attained.

A piece of ⅜in. square bright mild steel bar 6in. long is needed for the rack. At one end it is reduced to ¼in. dia. for about ½in. to fit the small retaining bracket. At the other end it is drilled and tapped 3/16in. to receive a 3/16in. cheese-headed screw and washer which act as a stop for the pinion block.

bellows and the side of the condenser housing. This bracket is fitted on the same side as the enlarger arm, directly on the centre line of the condenser housing, with two small round-headed wood screws.

The Pinion Block

The pinion block which is shown in Fig. 10 will need careful fitting if the neces-



The completed enlarger.

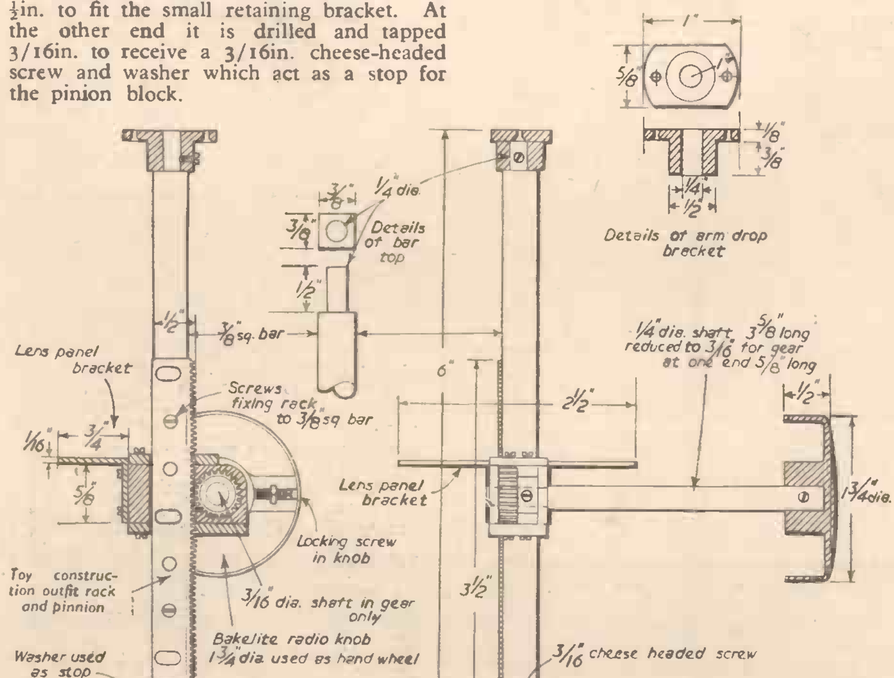


Fig. 9.—Details of the focusing arrangement.

the surplus metal between the lines using the bar with rack attached as a guide. Drill No. 37 holes where indicated for the top and bottom covers and lens panel bracket, and tap them 5BA. The top and bottom covers made from ⅛in. brass sheet are fitted

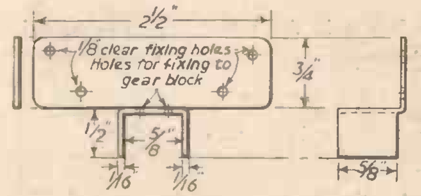


Fig. 11.—Lens panel bracket.

On one side of this bar a rack from a toy construction outfit is fitted, as can be seen in Fig. 9. This rack is 3½in. long, and is quite long enough for 2¼in. square negatives, if however the constructor contemplates using the smaller negative sizes, such as the 35mm size, then a longer rack should be fitted in order to bring the lens nearer to the negative, the lens used in this case would be of a shorter focal length, and the 4in. condenser would be replaced by a 2½in. deep curve condenser.

Directly above this rack a cheese-headed screw is fitted to act as a stop. The retaining bracket is made to the dimensions shown and the flat sides are filed to fit between the

sary smooth focusing action is to be obtained. A piece of bronze is ideal for this work, but brass will serve very well if bronze is not available. A piece of ⅝in. square bar 1½in. long is marked out to the dimensions given in Fig. 10. Drill the hole for the shaft 3/16in. and also a 5/16in. hole inside the lines marked out to accommodate the ⅜in. square bar and pinion wheel. With a file and metal saw remove

to act as guides; these require careful making. They are fitted to the block by two 5BA screws through ⅛in. clear holes. The shaft is a piece of ¼in. mild steel rod, reduced for ⅝in. at one end to fit the toy construction

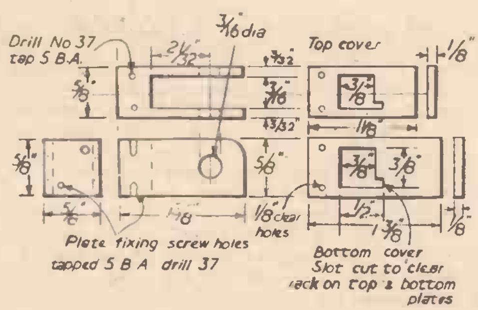
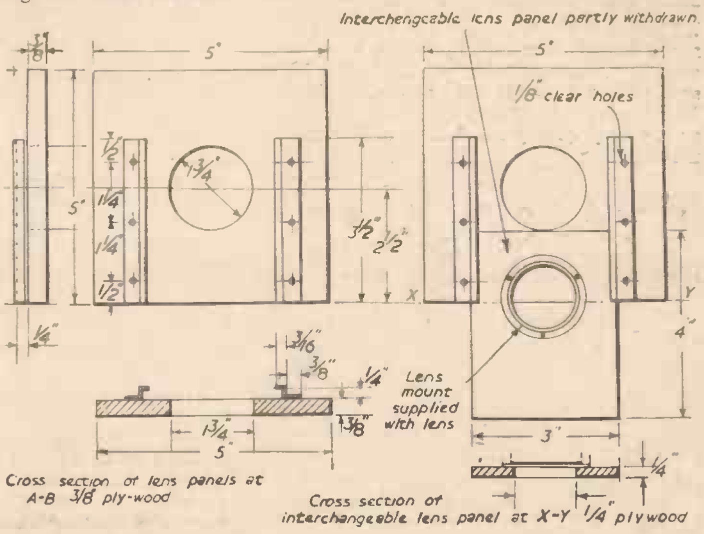


Fig. 10 (Left).—The gear block and covers.

Fig. 12 (Right).—The lens panel.



kit pinion wheel. The hand wheel is an old radio knob.

The lens panel bracket is bent to fit snugly round the end of the gear block. The surface to which the lens panel is fitted should be parallel to the baseboard and at right angles to the rack. The bracket is shown in Fig. 11.

The Lens Panel

The lens panel (Fig. 12) is cut from ⅜in. plywood and is 5in. square with a 1¾in. hole cut in the centre. This is best done by drilling half-way with a centre bit, then turning the piece of wood over and drilling right through; this will avoid ragged edges on one side. Clean up with glasspaper and paint matt black all over. Two pieces of angle brass 3½in. long are drilled where shown for the fixing holes, and are then fitted to the lens panel to allow the interchangeable panel which is 3in. × 4in. to slide between them. On this panel the lens mount is fitted over a suitable hole cut for it. This panel is also painted matt black.

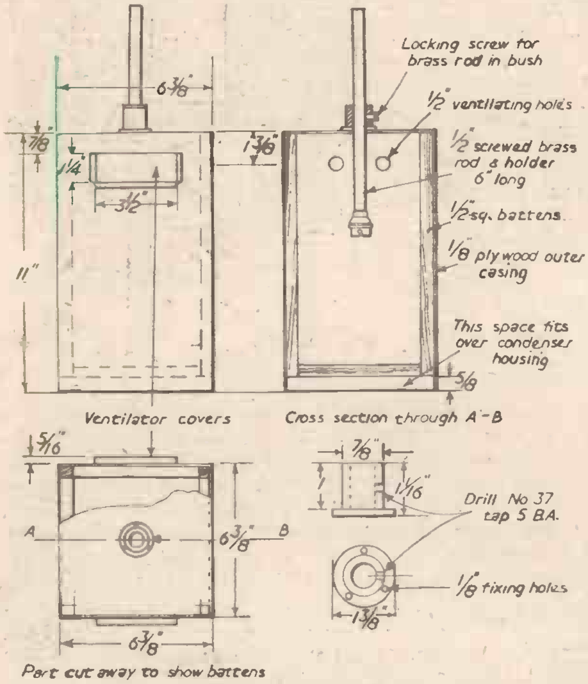


Fig. 13.—Details of the lamphouse and the brass bush for lamp adjustment.

The Bellows

The bellows on the prototype enlarger were made of cartridge paper and painted black inside and out. Several attempts were made before a satisfactory pair were produced. However, the price quoted for a specially made set of imitation leather bellows for this enlarger is very reasonable and it is probably not worth while making them.

The bellows are secured to the condenser housing with glue, strips of cardboard are then laid on the last folds on each side and pinned down, making a light tight joint. The same arrangement is used to fix the bellows to the lens panel, which operation should be carried out first.

With the bellows in position the bracket attached to the focusing unit should now be fixed to the lens panel, and the focusing unit tried up and down the full length of the rack. Fix the completed unit in position on the column and make tests to see that the lens panel is parallel with the baseboard in all positions from the bottom to the top of the column. The negative carrier should also be checked in this way; any errors must be corrected before proceeding further. Needle sharp enlargements cannot be expected if these parts are not parallel with one another, as this will result in a print being in focus on one side and out of focus on the other.

The Lamphouse

The lamphouse, as shown in Fig. 13, is very easily constructed from ⅛in. plywood on ½in. square battens, pinned and glued together to form a box 6⅜in. square by 11in. long. The battens are on the inside, and finish ⅝in. from the bottom edge, this forms a space which fits over the condenser housing when the lamphouse is in position. Three ½in. ventilating holes 1⅝in. from the top are drilled on two of the sides, and they provide ample ventilation when the enlarger is in use for long periods. These holes are covered with a light metal cover made of tinplate, painted black and secured to the sides with small wood screws. (See Fig. 14.)

The top of the lamphouse is made of the same material as the sides and measures 6⅝in. square. A ½in. hole is drilled in the centre, and over this is fitted the lamp adjustment bush. It is located in position with the ½in. brass tube to which the lampholder is attached. Finally, with glue and panel pins, the top is fitted to the body of the lamphouse and left to set. When dry, the inside is painted white, and the outside black.

The small adjustment bush is a straight-forward turning job. It is provided with a locking screw at the side to lock the enlarging lamp in the correct position for the condenser used. The brass tube to which the lampholder is attached, is a piece of ½in. dia. tubing 6in. long, threaded at one end to take a standard ½in. lampholder. This tube complete with lampholder can be purchased at any electrical store.

The loose end of the flexible cable already connected to the column connector, is now pushed down the inside of the brass tube and the ends connected to the lampholder.

The enlarger is now ready for its first try out, assuming of course that a lens, condenser and suitable lamp, have been purchased and fitted.

The lamp used in the enlarger described, is a 75 watt Helios enlarging lamp, and has proved in service to be ample for the writer's requirements. The 3¼in., F4/5 Supar Wray lens, together with the 4in. condenser gives excellent enlargments from the writer's 2¼in. square negatives.

35mm. Negatives

The 35mm. enthusiasts who require the enlarger for this kind of work, should replace the brass cover on the condenser housing with one which will take a 2½in. deep curve condenser in a mount, and the position of the enlarging lamp adjusted for even illumination. The lens required to work in conjunction with this condenser, would be one having a focal length of 2in. The negative carrier already described could be used for 35mm. negative material,

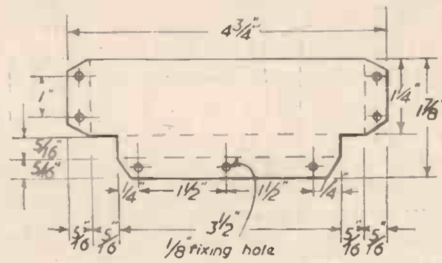


Fig. 14.—Tinplate ventilator cover, bent to shape on dotted lines.

but it would mean cutting the film. A far better method would be a glassless carrier made of 18 or 20 gauge sheet metal in the form of two plates hinged together, the inside surfaces of which should be highly polished to a smooth surface before painting dull black to avoid scratching the negative material. With this kind of negative carrier, whether it be made of metal or plastic, the advantage lies in the fact that the whole length of the film may be enlarged without cutting, this is standard practice in the commercially made models for this size of negative.

Two small brackets to support the rolled up portion of the film which is not in use, can be easily constructed from sheet metal, and screwed to the sides of the condenser housing.

A 35mm. negative carrier of this type, made in black "Perspex," is described on page 33, and should be suitable for this enlarger.

To be truly universal, the condenser, negative carrier and lens should be made interchangeable.

Is Your Safelight Safe?

THE modern safelight made by well-known manufacturers will keep the light-sensitive materials, for use with which it is recommended, free from "fogging" for a considerable time, although there is no such thing as a "perfectly safe" safelight. They will all permit fogging, provided the materials are exposed long enough.

One particular safelight screen may not be suitable for all types of films or printing papers and this is a point which is worth checking. If you handle your negative materials under a safelight, particularly a home-made one, check the negatives when they are developed for any fogging in the space round the exposure. The edges of the film and the space between the exposures should be perfectly clear gelatine. It may perhaps be slightly tinted but this is easily distinguishable from fogging.

When using printing papers, the best way to check is to look at the white border of the print for signs of grey fogging—the border should, of course, be a clear white.

Using an unsuitable darkroom lamp is one of the common causes of lack of contrast in enlargements and if this is suspected check the darkroom lamp by the following method. Place a piece of medium or contrast paper face upwards on the enlarger baseboard and on it place a coin—a penny will do. Leave it for five minutes with the darkroom lamp on and then develop it in a covered dish. Finally fix it. If there is any trace of grey where the paper was not covered, the lamp is causing fogging. If fogging is still present after only three minutes of the foregoing test, this will be a more definite confirmation of the trouble.

The solution, of course, is wherever possible to standardise on one well-known type of printing paper and use the manufacturer's recommended safelight.

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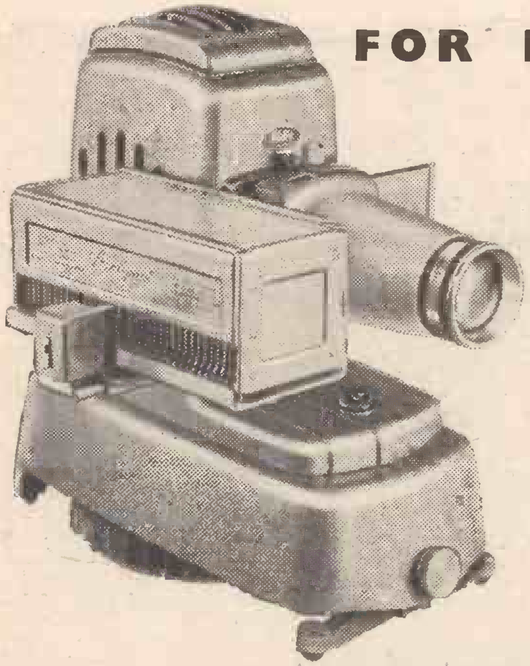

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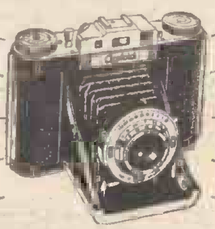

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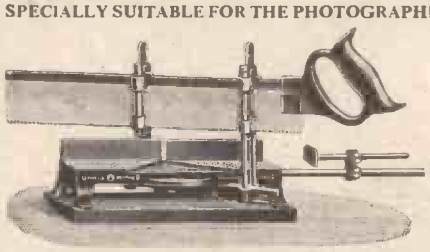

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A DARKROOM SAFELIGHT

M. Katers Describes the Construction of a Lamp With Interchangeable Screen and Wall Bracket Fixing

THE safelight shown in Fig. 1 can be adjusted to any angle so that its light can be turned in any direction. The idea being to obtain varying light conditions, if necessary, while working. The safelight screen is removable and, therefore, changeable and also gives access to the lamp.

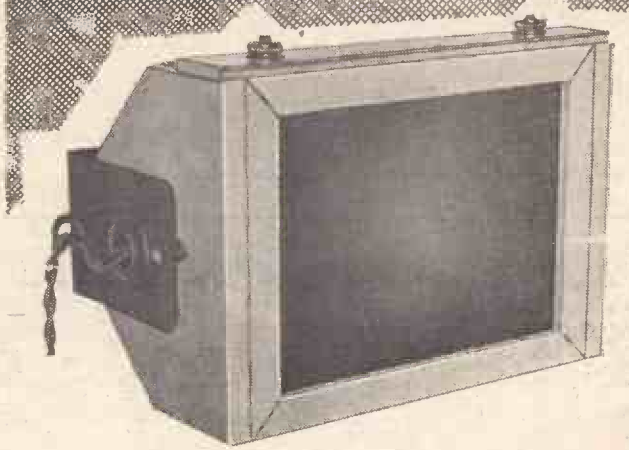


Fig. 1.—The completed safelight.

The Case

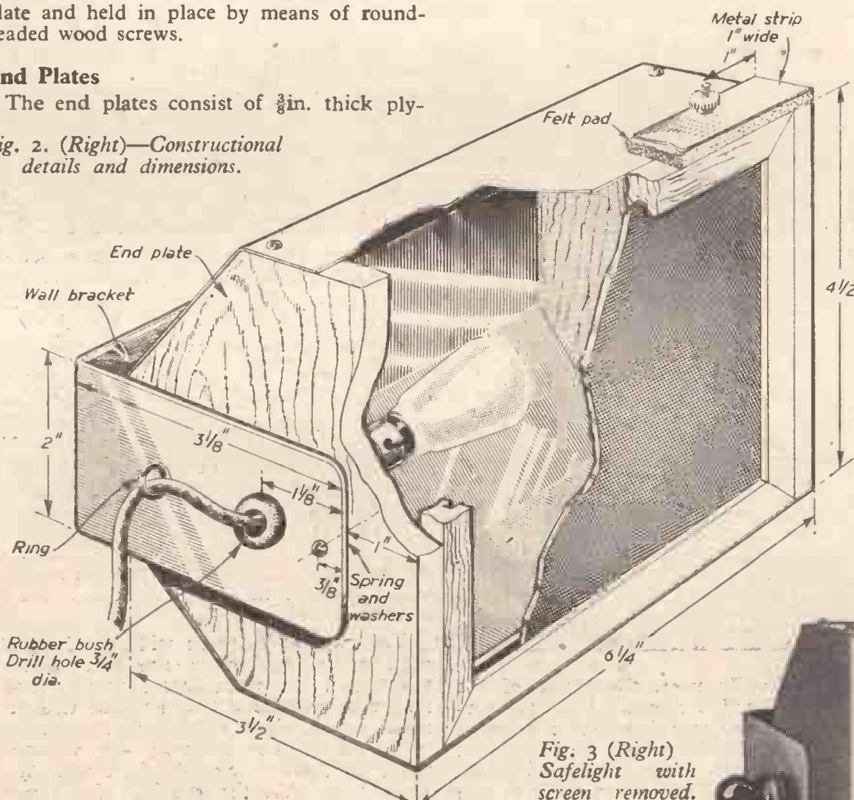
The screen is a sliding fit in a ⅛in. grooved, ½in. square stripwood frame. The stripwood takes any standard 5in. × 4in. safelight screen. If the larger, 7in. × 5in., screen is desired, then the frontal dimensions shown in Fig. 2 are increased but the depth remains the same. One of the long sides is not fixed but is replaced in position when the screen is in place. This piece of stripwood is held in place by a metal plate. This has a twofold purpose; to prevent the screen from falling, with consequent damage, and to hold the felt pad light-trap in position.

The stripwood corners are mitred and the end plates are nailed to the short pieces. The case cover can then be bent to the shape of the end plates. This cover can be made from thin sheet aluminium or tinplate and held in place by means of round-headed wood screws.

End Plates

The end plates consist of ⅜in. thick plywood, and can be of any shape, provided the overall dimensions shown in Fig. 2 are approximately the same. Semi-circular or rectangular shaped end plates may be preferred. The only difficulty with semi-circular end plates is in folding the metal cover round them. With this shape of end plate the prevention of light leakage is tricky, even with the rather thick end plates.

Fig. 2. (Right)—Constructional details and dimensions.



The Pressure Pad

The pressure pad consists of a metal strip, 6½in. × 1in., and a similarly sized piece of felt ⅛in. thick. The felt acts as a light trap for the sliding screen. The metal strip holds the pad in place by means of two 2BA screws. The 2BA nuts were knurled ones obtained from a 4½V. disused dry battery and are far better for the purpose than the usual hexagonal-shaped nuts. The screws were tapped into the sheet metal cover, and as an extra precaution the heads were soldered in.

The Screen

The screen can be commercially bought glass or a piece of ⅛in. thick transparent deep red Perspex. The author uses such a piece of Perspex under all photographic conditions, except for panchromatic films which are preferably handled in total darkness. If doubtful about the safety of Perspex, use a small red bulb as an additional safeguard. The Perspex is only a fraction of the cost of a commercial screen and it also has the advantage that it can be attached to the movable side of the grooved stripwood.

Care must be taken in drilling Perspex. To pop mark this material prior to drilling usually results in the Perspex shattering or cracking. A cross scratch with a scriber at the drilling point is all that is required.

The Bracket

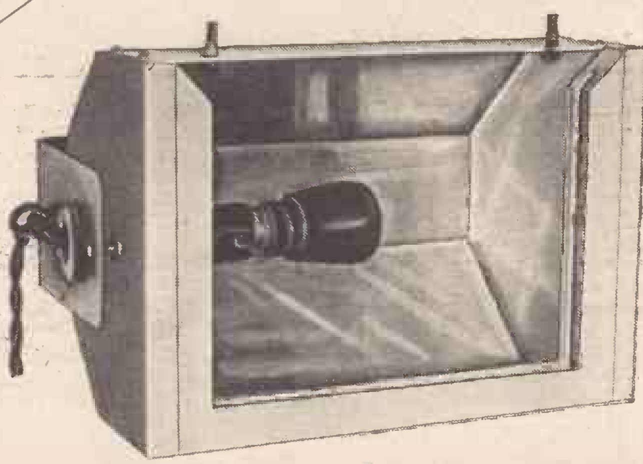
The bracket consists of a 13in. × 2in. × 1/32in. strip of mild steel. The distance between the end lugs gives about ¼in. to ⅜in. clearance on the length of the case. The hinge-holes are wood-screwed through the lugs on to the end plates. One side of the case is separated from the bracket by a washer to prevent rubbing, and the other by a spring to give the required tensioning and clearance for the flex. The spring-hole end of the bracket (Fig. 2) has a hole wide enough for the flex to pass through and to give plenty of freedom. If this is not done the flex will jam and tear the rubber protecting bush from its position. This will become at once apparent if the case is turned through 180 deg.

The lamp is a 15 watt, either miniature or standard, in a batten type holder. If the lamp bulb glass is clear, it is best to lacquer it to get a diffused light effect.

A pleasing finish is obtained by giving the case a coat of cream lacquer, and the bracket one of black.

The finished safelight, which is shown with screen removed in Fig. 3, can be mounted in a horizontal or a vertical position.

Fig. 3 (Right) Safelight with screen removed.



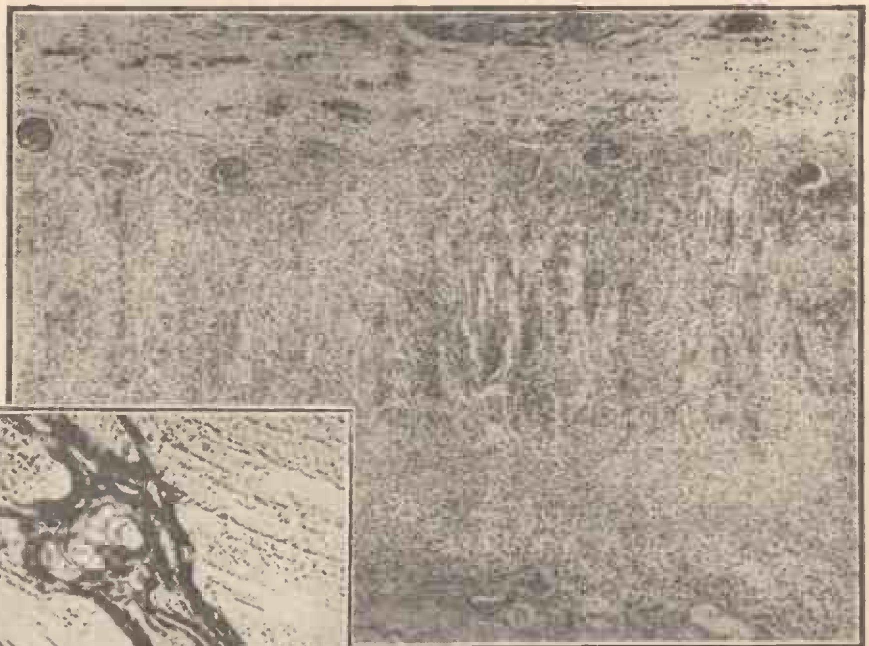
Close-up Photography

Part 2 Deals Mainly With Photomicrography

By E. CLEMENTS

(*Concluded from the May Issue*)

IT should be remembered that exposures need to be considerably increased when using double extension (approximately four times), and triple extension (approximately nine times). When using various lenses on field cameras it is probably quickest to make a calculation of the working "F" number by measuring the actual aperture and distance between that and film plane; by dividing one into the other the "F" number is found.



Photomicrograph of blood cells in the stomach wall of a sheep. Magnification X90.

(*Left*). *A photomicrograph of a soap smear. Magnification X60.*

Photomicrography

This is a specialised technique which to any photographer who has, or can borrow, a microscope will well repay cultivation. The manufacturers of microscopes produce elaborate set-ups for the efficient production of photographs but the amateur with only basic equipment can achieve very creditable results.

The first essential is a solid support for both microscope and camera which, if at all possible, should be locked together when exposing. In any event it is necessary to be able to swing the camera into position over the microscope after inspecting the image in the eyepiece without disturbing the latter; an enlarger column with extending arm could be adapted for the purpose. A normal roll film camera with undetachable lens should be set at infinity; it is, however, better to use a good camera body without lens but having a back focusing screen; the latter should be in absolute register with the emulsion plane. It is necessary, after viewing the image in the eyepiece, to form a light tight connection between camera front and microscope, this may be done with black cloth or tubes. Final focusing can be carried out on the camera body.

It may be pointed out that magnification depends primarily upon the power of the microscope objective, secondly upon the eyepiece and further magnification is achieved by the length of bellows up to a certain limit beyond which only "empty" magnification occurs. Only the objective can really resolve the image, the other factors only magnify the picture in order that it may be seen with the eye. It is not practicable to offer advice upon which objectives and eyepiece should be used for any given subjects as these will necessarily depend upon availability. It is, however, preferable to commence with a low-power objective, say a "2/3" in combination with a 4X or 6X eyepiece. After exploring the possibilities of these with different slides a good idea of what is required by way of exposure and the magnification possible with a given set-up will be obtained.

For material it can be said that if a plate such as the Kodak 0250 is used in combination with a dark green filter a monochromatic rendering will be obtained which will give maximum definition with good contrast. This recommendation is, however, only a starting point for the colour of the filter will necessarily vary with the staining of the slide. It is as well to be fully acquainted with one plate as a start.

An Adjustable Masking Frame

(*Concluded from page 36*)

Two 9/64in. holes are drilled for the fixing screws, and between these two holes drill a clear hole for the locking screw. Attach the blades to the bushes, insert the locking screws, and the frame is complete.

Tighten the blade locking screws; this keeps them rigid. Lift up the adjustment bar complete with blades and slip a selected piece of paper on which a print is to be made under the beading. Replace the adjustment bar on its rest, release locking nuts, and adjust both blades to give a 3/16in. border on the two remaining edges of the paper, tighten the locking nuts and everything is ready for the print to be made. To remove the paper for development after exposure, lift the adjustment bar which will also lift the blades and release the paper.

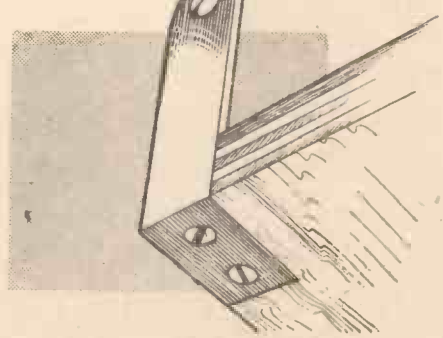


Fig. 5.—Fitting the brackets.

Replies to Readers' Letters

Masking a Viewfinder

I HAVE replaced the broken viewfinder of my camera with another old one, which is somewhat larger. Masking presents no difficulty, but I am at a loss to know how to make the field seen through the viewfinder agree with that shown on the negative. Can you help, please?—I. S. M. (Northants).

ACCURATE masking of the viewfinder can be achieved by fitting the camera on a tripod, with back open, no film in, and shutter set open. Place a piece of ground-glass in the position normally occupied by the film. Comparing the view on the glass with that in the viewfinder will enable you to mask the latter so that it agrees with the scene embraced by the lens.

As viewfinder and camera lens are in slightly different positions, the former cannot be correct for very near subjects, but will be suitable for the usual range of about 5ft. to infinity. Very thin tissue paper on two spare spools may replace the ground-glass if the lens aperture is fairly large and a dark cloth used to shade the camera back.

Enlarger Lens

I AM interested in building an enlarger for negatives up to $3\frac{1}{4}$in. × $2\frac{1}{4}$in., but am having difficulty in finding a suitable lens. I have tried binocular lenses without success.

Difficulty is found in enlarging all the negative, only part being enlarged. Can you suggest any way that these lenses may be adapted? If not could you please give me details of a suitable lens which is not too expensive?—G. R. Jay (Plymouth).

TO secure proper definition in the enlargement, an enlarging lens is desirable. In order to cover $3\frac{1}{4}$in. × $2\frac{1}{4}$in. negatives, it will need to have a focal length of about 4in. Lenses of about 4in. to $4\frac{1}{2}$in. are commonly used for this size. A doublet or old camera lens would be cheapest. More expensive enlarging lenses will pass more light (reducing printing time) and give better definition.

An achromatic lens of the above focal length may be used. Definition will be improved, with this, by placing opaque material with a central hole behind the lens. The smaller this aperture, the better will definition be, but the more dim will the projected image become. For such a fixed aperture, a $\frac{1}{2}$in. hole would do, giving an aperture of about f/8.

Achromatic doublets may be obtained from Charles Frank, 67-73, Saltmarket, Glasgow, C.I. Secondhand lenses and other parts may be obtained from Brunnings, 138, High Holborn, W.C.1.

Reflex Type Viewfinder

I WISH to construct a large camera reflex "brilliant" viewfinder. Such I understand is merely a mirror at 45 deg. between a front lens and a top one. But I do not know the best specification for the two lenses. Can you please give me this information? I should like the finder to give a picture of about $2\frac{1}{4}$in. × 1 19/32in. ($3\frac{1}{4}$in. × $2\frac{1}{4}$in. format).—I. E. Mercer (Northampton).

THE type of finder mentioned consists of a lens on the same plane as the camera lens, a surface-silvered mirror at 45 deg. behind this, and a further lens mounted flat above this mirror. The latter lens is usually square. As a round lens would require a very large housing, here, and it would be extremely difficult to cut away the edges, it is suggested you use the lenses and mirror employed in the type of box camera with such large finders, as these will be obtainable (as replacements) through a camera shop, or direct from the maker.

These three items may be mounted in a wood or metal casing, according to the form of construction preferred. If the top lens is square, a mask will be necessary to obtain the equivalent of the $2\frac{1}{4}$in. × $3\frac{1}{4}$in. negative. The total separation of the two lenses is equal to their focal length, which is the same for both. A focal length of $2\frac{1}{2}$in. is usual. With the mirror, this will mean that a space of $1\frac{1}{4}$in. exists from each lens to the centre of the mirror. If you move one lens slightly, you will immediately see the correct position, as others cause distortion of the image.

YOUR OPINION

*[We have received a large number of letters of appreciation and congratulation from photographically minded readers who have read the new supplement. The letter below, in addition, contains some comment.—*ED.*]*

SIR,—May I be allowed to comment on the new Practical Photographer Supplement, which, since photography is my principal hobby, I particularly welcome?

This first issue, in providing such articles as "Developing a Film" and "The Use of Filters," seems to me to fulfil a long-felt want, both being very clearly set out. With regard to these articles, however, I would like to make a point or two in respect of each since it is a good thing to form good habits early on from the beginner's point of view!

In developing films by time and temperature it is, of course, essential to have the developer at correct temperature—usually 68 deg. F. these days. I submit, though, that to maintain this temperature throughout the intermediate wash and fixing time is just as important, if only to avoid reticulation. I advise too prefilling the tank with film in place with clean water at 70 deg. F.

On using the intermediate wash and fixer from the measures, in succession, the temperature is kept constant until the final wash and here, to avoid sudden change, water at 68 deg. F. is poured into the tank after the fixer has been poured off and before placing under the cold tap.

An added advantage of the pre-soak at 70 deg. F. is that the "wetted" film permits the developer to get to work more quickly and evenly. Also, the coloured dye is washed away and cannot contaminate the developer which may be of the type to be re-used.

In the article on "Correction Filters" it is obviously taken for granted the photographer has correctly estimated the basic exposure before applying the appropriate filter factor, but I feel that as so many beginners over-expose anyway, a word of warning may help. Simply this: "Over-exposure will completely ruin the effect of the filter."

Finally, with correct pan film a 2X yellow/green filter will make the most of a sun-bronzed beach figure photographed in sunny conditions.

In conclusion I should like to wish the new venture every success.—J. B. KNIGHT (Yeovil).

TRADE NOTE

G.R. Exposure Meter

A COMPLETE kit of parts for constructing a high light exposure meter is being marketed by Messrs. G. R. Products, Ltd., 22, Runnymeade Avenue, Bristol, 4. The meter measures the incidental light reaching the subject and operates in both natural and artificial light. A high sensitivity meter movement is operated by a selenium cell and a reading is obtained in "light units." When this is applied to a conversion dial the correct exposure may be calculated.

The kit is accompanied by a sheet of full scale diagrams and comprehensive constructional details. The information is easy to follow and the few tools necessary will be possessed by most people in their home-workshop.

The completed meter measures $3\frac{1}{2}$in. × $2\frac{1}{4}$in. × $1\frac{3}{8}$in. and as can be seen from the photograph the opaque black Perspex used makes a robust and attractive case.

The price of the kit is 50s.

The G.R. High Light Exposure Meter.