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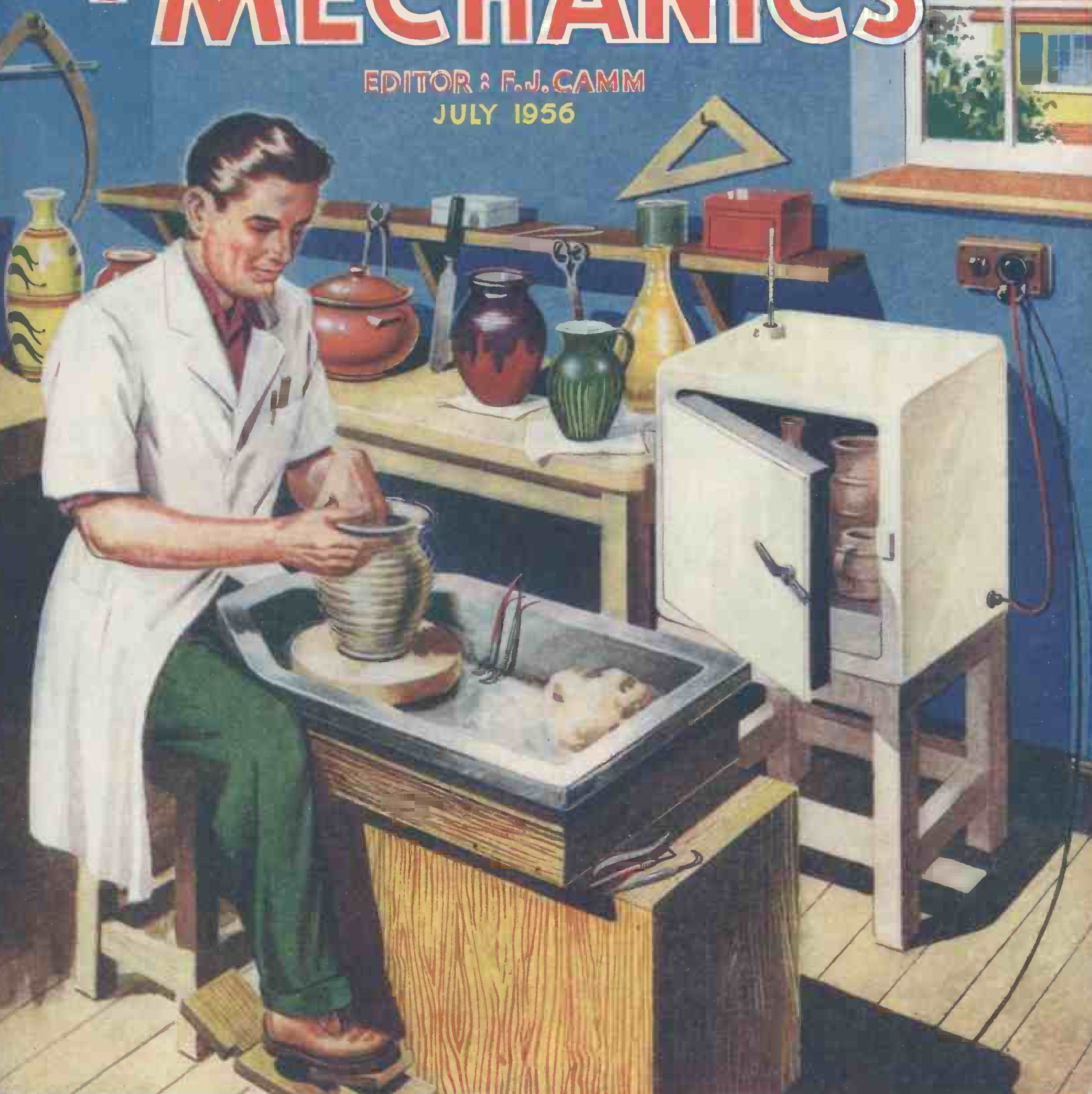
EDITOR: F. J. CAMM

JULY 1956



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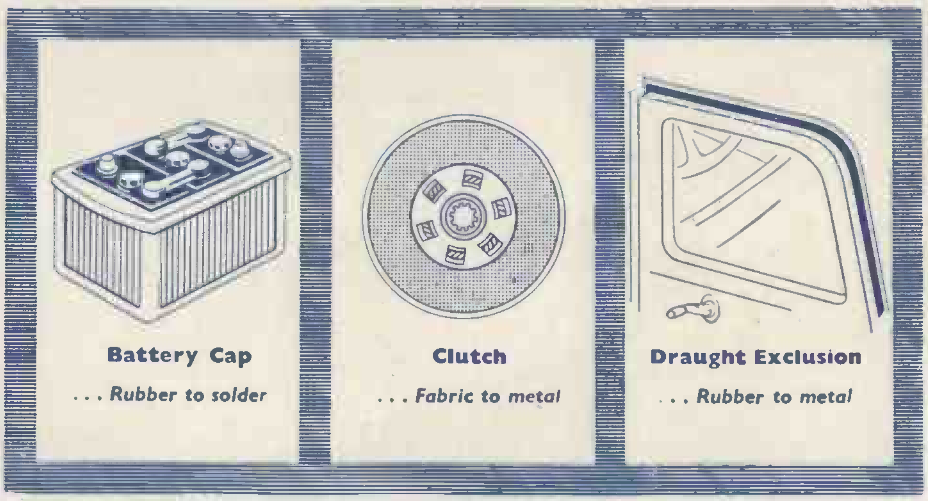

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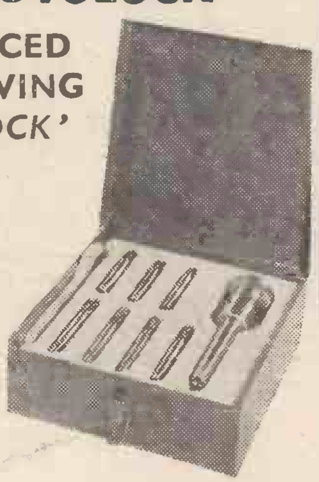

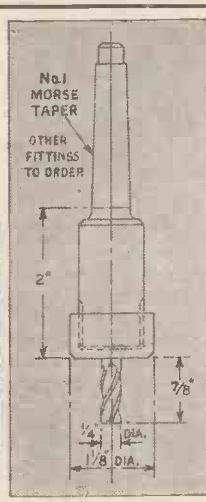

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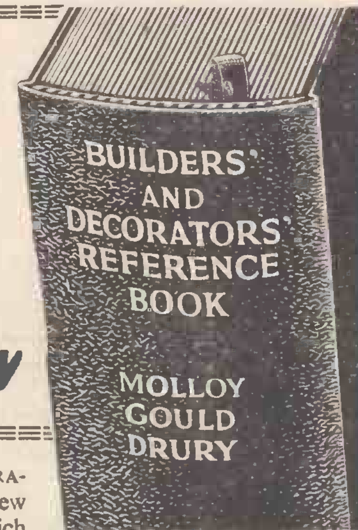

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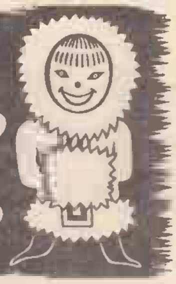

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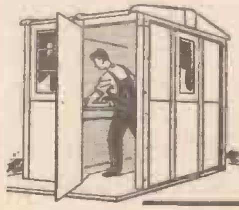

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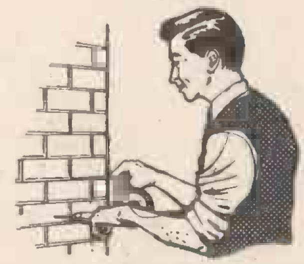

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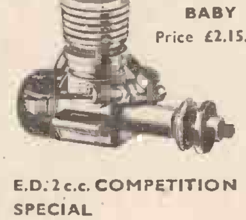

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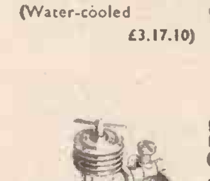

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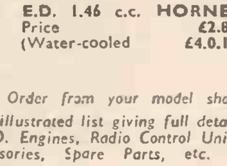

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The "Cyclist" and "Home Movies" are temporarily incorporated
VOL. XXIII. No. 269
JULY, 1956
Editor: F. J. CAMM

FAIR COMMENT

By

The Editor

Artificial Satellites

THE next step towards interplanetary travel has been announced from Washington. Scientists now considering the final design of the first space satellite are now tackling the problem of how to draw it back to the earth when its function has been fulfilled, and a stainless steel balloon is the device suggested by one of those responsible for the project. It has been decided to build a recoverable sphere, although the plans have been held up until the basic design of a non-recoverable satellite has been selected. This has been narrowed down to a few basic designs.

One of the questions now being considered is whether to use beryllium magnesium or aluminium for the 20in. sphere that will be projected 800 miles into space by a three-stage rocket.

The construction of the first non-recoverable satellite is expected to start in the near future, in the naval research laboratory at Washington, and the possibility is that private industry will get contracts for the 11 spheres that will be launched by the United States during the International Geophysical Year. The design at present being contemplated makes use of a sphere with a total weight of 20 lbs., which is within $1\frac{1}{2}$ lbs. of the limit set for the vanguard satellite. A balloon will fit into the third stage of the rocket, and attached to it will be a container for a film for recording cosmic rays, and a gas capsule to inflate the balloon as well as a small radio unit and a small decelerating rocket. The radio will report the position of the sphere in space, and will also be used to release the gas capsules and decelerating rocket and flash a signal during the descent to assist in locating the landed satellite.

The sphere will be 3ft. in diameter and its stainless steel skin will be only 0.003 of an inch in thickness.

Thus will start the first attempt of man to conquer space and to investigate the mysteries of other planets. Many would have us believe that we have been forestalled by other planets who are already investigating us, by means of flying saucers. I need not reiterate my views concerning this. This journal has made all arrangements to keep its readers informed of all authenticated experiments as distinct from fantasy, science fiction and auto-suggestion.

The Russians and Model Making

I LEARN that, for the first time, Russia will be exhibiting some of the models made in her country, outside her own territory, for about 20 marine models accompanied by two model makers and an interpreter, will appear at the next model engineering exhibition to take place in August. We are told that this will provide an excellent opportunity for model makers of both countries to exchange views and experiences and the hope is expressed that it will widen the scope of cultural relations between Britain and Red Russia. I should like to feel that that hope will be fulfilled. But the attitude of Russia on more important problems, where it was even more important to establish cultural relations, does not encourage the thought that this is any more than a pontifical and unctuous expression of what is known in advance to be the unattainable. If it is necessary to widen the scope of cultural relations between the two countries, this should be done through a wider medium than model making, although we can well understand the wishes of the promoters of the exhibitions.

In my view it is nothing of the sort, although it may be interesting to model makers not interested in cultural relations to see how far the Russians are on a par with, or superior to, our own model makers. We are warned that "the standard of these [Russian] models may surprise many people in this country," but as the organisers of the exhibition cannot yet have seen the models, we are left to form our own conclusions as to whether our surprise will be in the direction of admiration or disappointment. I am a great believer in model engineering and, as with music and mathematics, I believe it to be an international interest outside of the barriers of iron curtains and national frontiers. The fact that the Russians are exhibiting models over here has no more significance than that, and such an unimportant event should not be elevated to one of international importance. After all, our first concern should be to organise on a national basis the model makers of this country, with the exhibits of the Russians thrown in as a tasty morsel. I hope that too much will not be made of this Russian exhibit.

After several years of the Iron Curtain, this country should not be too ready to subjugate its own and national interests to a country which is anxious, having acknowledged its mistakes, to "muscle in." Let us push British model making for all it is worth. We do not share the optimism of the promoters in advancing the Russian exhibits as a reason for visiting the exhibition. British models should be the attraction and I for one do not believe that the Russian exhibits will show that Russian model makers are superior to British.

I am fortified in this view by a perusal of Russian literature. I cannot trace that there is any Russian journal which encourages model making on the lines of PRACTICAL MECHANICS, which is the only English journal which covers all aspects of model making and is really the only national "make-it-yourself" magazine. Our interests are wide. We are not only concerned with model locomotives, model boats and workshop equipment, but with the whole field of model making. Perhaps that is why this journal has the largest circulation of any British model engineering magazine or periodical. Incidentally, if you wish to "do-it-yourself" as well as "make-it-yourself," the only two journals in this country catering on a national scale with these two aspects of practical hobbies are *The Practical Householder* and, of course, PRACTICAL MECHANICS, each costing 1s. 3d. every month.—F. J. C.

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AQUARIUM ACCESSORIES

By I. W. BRASSINGTON

THERE are several additional pieces of apparatus with which the beginner will soon be confronted and it is an advantage for him to know a little about them.

The Net

One of the most important is, most certainly, a net. There will come a time when a fish *must* be removed from the tank, either for breeding purposes or isolation in the event of disease. The net should be a straight-sided one, as shown in Fig. 1, and a convenient size for a 24in. tank is 5in. or 6in. by 4in. When a fish is to be netted, sudden, darting movements should be avoided or the fish will respond in the same manner and the frantic owner and the even more frantic fish will end up by chasing each other around a whirlpool of floating debris. With the net, quietly coax the fish towards the front of the glass until it is possible to close the four sides of the net round him and against the glass, then gently lift out. Now put the other hand under the net (to support the fish) and close the fingers very gently round net and fish, to prevent him from jumping out.

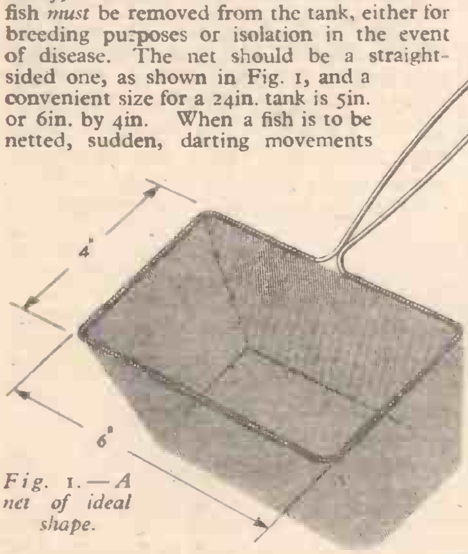


Fig. 1.—A net of ideal shape.

A Syphon

Some form of syphon is another necessary piece of equipment. Decaying leaves, uneaten food particles (however careful we may be) and excreta collect on the surface of the gravel and although a certain amount is beneficial to the plants, through the formation of humus, most of it should be removed from time to time. A plastic or glass tube with a large reservoir is illustrated in Fig. 2. A finger is placed over the end of the tube and the reservoir end is then lowered into the water. When positioned over the spot to be cleaned, the finger is released and the mulm is sucked up into the syphon. A piece of ½in. bore glass tube, about 18in. long, may be used in the same way for the removal of isolated bits of rubbish.

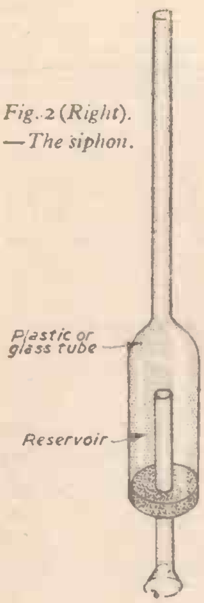


Fig. 2 (Right).—The siphon.

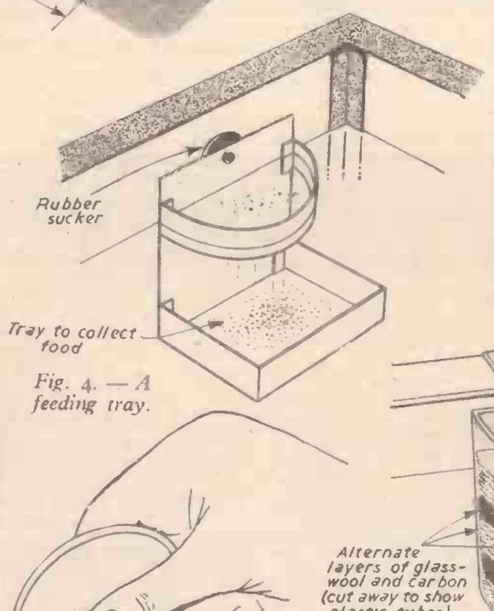


Fig. 4. — A feeding tray.

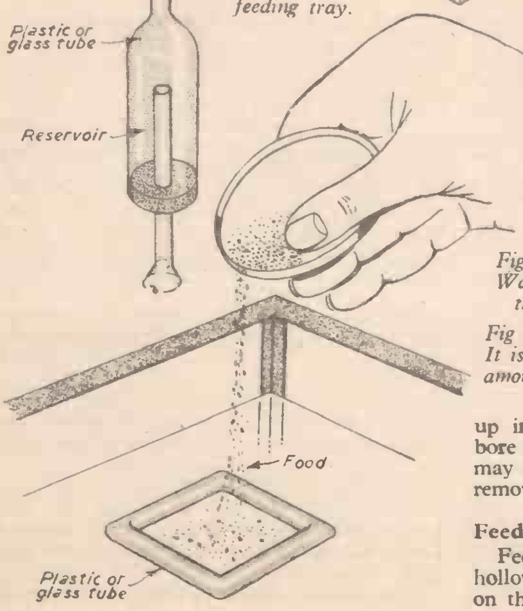


Fig 3 (Left).—A typical feeding ring. It is advisable to measure out the exact amount of food before tipping to avoid over-feeding.

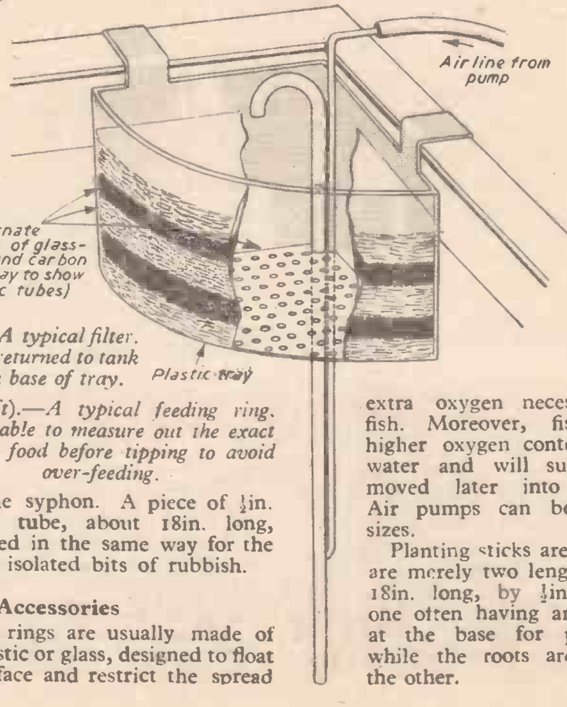


Fig. 5.—A typical filter. Water is returned to tank through base of tray.

Feeding Accessories

Feeding rings are usually made of hollow plastic or glass, designed to float on the surface and restrict the spread of dried food, so that when the uneaten particles sink they may be easily collected with the syphon from one small area only.

The feeding tray goes a step further by providing a tray into which these particles fall and from which the fish can feed when they feel like it. See Figs. 3 and 4 for illustration of these two accessories.

Optional Items

Filters and aerators are optional; some aquarists would not be without them, but I feel quite strongly that the beginner is best without either. The filter certainly does help some fanciers to keep the water beautifully clear, but I have seen tanks of crystal-clear water with and without the aid of filters and, in fact, have no filters in my own tanks. Filters are usually made of plastic and have an inlet to which is attached a rubber air-line from an electric air-pump (see Fig. 5). The tray at the top of the filter is filled with alternate layers of glass wool and carbon.

Aerators are also connected to a pump and consist of a porous stone cube (the diffuser) which is lowered to the gravel on the end of a length of plastic tube, known as the diffuser stem. The air supply may be controlled directly at the pump and/or by the aid of a thumbscrew somewhere along the air-line. This apparatus forces a steady stream of tiny air bubbles into the aquarium. If the tank is inclined to be overcrowded with fish then an aerator is very useful, but therein lies a danger. One is apt to overcrowd *because* one has an aerator which will provide the extra oxygen necessary to support more fish. Moreover, fish get used to the higher oxygen content of artificially aerated water and will suffer if they have to be moved later into non-aerated quarters. Air pumps can be purchased in various sizes.

Planting sticks are often advertised. These are merely two lengths of wood, each about 18in. long, by ½in. wide and ⅛in. thick, one often having an inverted V-shaped cut at the base for pegging a plant down, while the roots are being dibbled in with the other.

Make Your Own HORIZONTAL ENLARGER

A Cheap and Simple Design Using the Camera

By G. HINSON

IF you possess a camera with a back and lens shutter that can be held open, it is possible to make an efficient enlarger for considerably less than 10s. The quality of the enlargement will depend on the lens of the camera, a good camera producing a picture that will compare very favourably with many manufactured enlargers.

The enlarger consists of three parts: the lamp house (which also includes the negative carrier), the camera platform and the screen. They are each mounted to slide horizontally along a 4ft. batten. The size of the enlargement is controlled by varying the distance between these three parts, see Figs. 1 and 2.

A further advantage of this arrangement is that it is possible to reduce a negative when required. A brilliantly clear print, thumbnail size, can be made from an ordinary negative, as easily as an enlargement.

The Batten

This is a piece of well-seasoned, accurately dressed wood, 4ft. by 3in. by ¾in., that is free from warping.

The Lamp House

In its simplest form this consists of a round tin, about 10in. long by 7in. diameter, laid on its side. A 100-watt pearl bulb is mounted in the bottom and an aperture cut in the lid about the same size as the back of the camera. Some ventilation holes should be cut in the tin. It is not absolutely necessary to mask the light which escapes from these, though a cowl soldered over the holes would be an improvement. See Figs. 3, 4 and 5.

Fig. 4.—The lamp house and negative carrier.

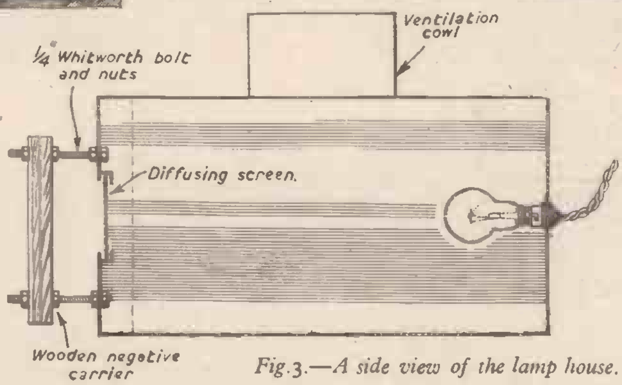
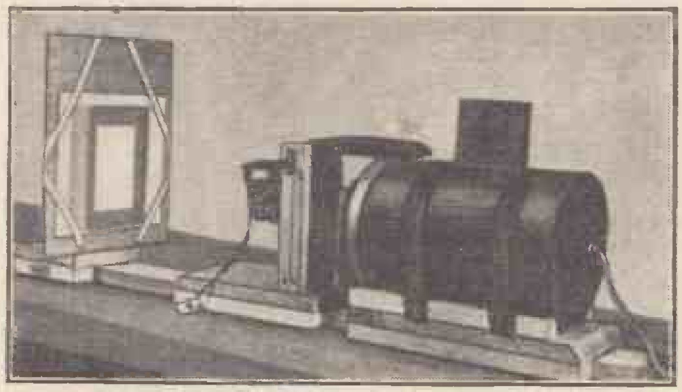
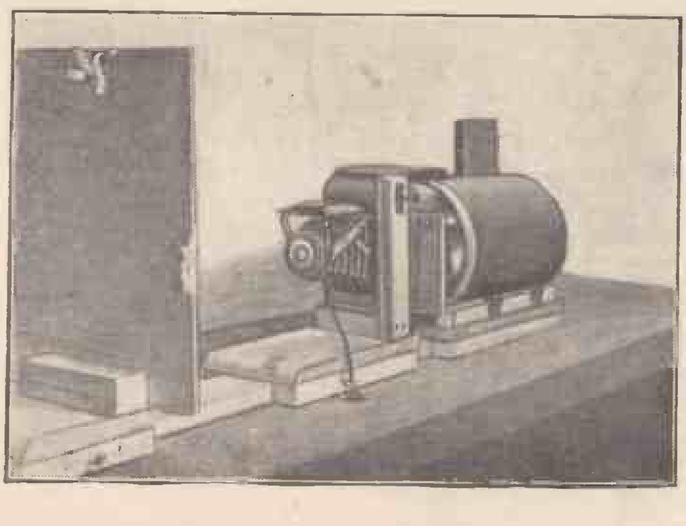


Fig. 3.—A side view of the lamp house.



Figs. 1 (Below) and 2 (Right).—Two views of the assembled enlarger, showing how all three parts slide on a centre batten.



No condenser is needed, but a diffusing screen between the aperture and the bulb is absolutely essential to ensure even distribution of light. If you decide to buy a pearl diffuser sold for enlargers, do not cut the aperture in the lamp house until you know the size of the diffuser, for the aperture must be slightly smaller. The diffusing screen is held behind the aperture by metal clips soldered or bolted to the tin. A simpler diffuser may be made from "frosted" gelatine sold for stage lighting. It is cheap and may be cut with scissors to the exact size you need. Three thicknesses will be necessary.

The Negative Carrier

The negative to be projected is held between two thin sheets of glass, about 4¼in. by 3¼in., hinged with Sellotape. Two old quarter plates, cleaned of their emulsion by washing in caustic soda, will serve very well. The sheets of glass slide into a wooden frame which must be grooved on the inside to receive them. See Figs. 4, 5 and 6. As the glass does not have to be an exact size it is probably easier to make the frame to fit what glass you have, than the other way about.

Grooving the sides can be easily accomplished. Lay the glass on the bench and surround the two sides and the bottom with three strips of plywood, about 1in. wide and slightly thicker than the glass. Each side strip is then sandwiched between two other strips of wider plywood, projecting about ¼in. over the glass. When the plywood is firmly screwed together the glass will be held in a grooved wooden frame with an open top, out of which the glass may be slipped.

Fixing the Negative Carrier

A ¼in. diameter hole is now drilled at each corner of the wooden frame, which is then lined up around the aperture in the front of the lamp house. Four similar holes are drilled to match in front of the lamp house and 2in. bolts are passed through them from the inside and fastened by nuts.

The wooden frame is slipped on to these bolts and held in place by further nuts. By adjusting these nuts, the negative carrier can be brought as close as desired to the aperture in the lamp house. About 1in. away should prove satisfactory. Any surplus portion of the bolts projecting forwards should be cut off so that the camera may be brought as close as possible to the negative carrier.

The Slide Arrangement

The lamp house and negative carrier is now laid on its side and mounted on a wooden sledge which fits over the central batten and slides along it.

The sledge consists of a piece of wood about

10in. long by 7in. wide (or whatever size your lamp house is), mounted on two runners about 2in. wide and the same thickness as the batten. These can be simply made by cutting a section of the batten lengthways. When the runners are screwed on the sledge it should sit as snugly as possible over the central batten and slide along it without jamming. A little soap may help as a lubricant.

The lamp house is fastened to the sledge by two strips of tin plate looped over it and screwed to the sides of the sledge. If two wedge-shaped pieces of wood are laid lengthways along the base of the lamp house they will form a cradle and help to prevent it slipping out of alignment.

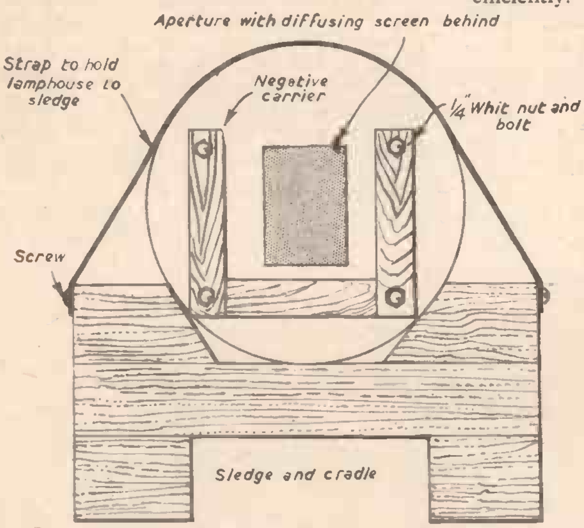


Fig. 5.—A front view of the lamp house and negative carrier.

The Camera Platform

It is not possible to give exact details of this because the design will depend on the type of camera used. Basically it consists of a second sledge to which the camera is fastened.

My own camera has a hinged back which prevents it from being brought close to the lamp house. This difficulty was overcome by turning the camera upside down and holding it in place against a wooden upright by means of a ¼in. Whitworth bolt which screws into the tripod bush, as shown in Fig. 6. This, however, is unnecessarily elaborate. Most cameras will sit quite firmly on the sledge without any form of fastening, though use can be made of the tripod bush if the camera has one. It is important only to make sure that the opening in the back of the camera is in line with the negative carrier.

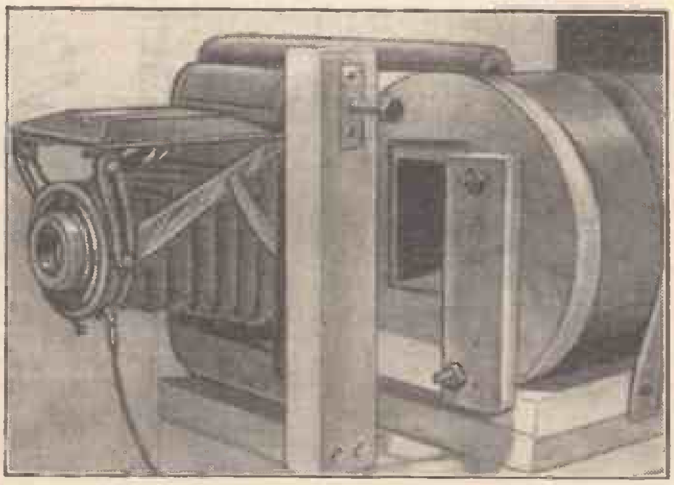


Fig. 6.—Method of holding the camera in place.

The Screen

A third sledge is used to which a 12in. by 10in. piece of plywood is screwed vertically, as in Figs. 1, 2 and 7. On to this the image is projected, and it is big enough for most enlargements. The printing paper and mask may be drawing-pinned into position on the screen, but it will be found convenient to have some easier method of adjustment.

This can be done by stretching ½in. garter elastic across the corners of the screen, in the manner of a letter rack. A square of cardboard is slipped behind the elastic and the mask is hinged to this. The printing paper may be held in place behind the mask by gummed corners of the type sold for mounting photographs in albums.

If the elastic is stretched tightly, it should hold the cardboard mount quite firmly and allow an inch or two of adjustment in any direction.

This completes the essential parts of the enlarger. Light must not escape between the lamp house and the camera, but there is no need to make elaborate bellows. The distance between camera and lamp house is unlikely to be more than 6in. (unless you are reducing a negative) and a thick cloth laid over the gap between them will work most efficiently. When reducing a negative the cameras will sit quite firmly on the sledge gap may be as much as 18in., and in this case it will be necessary to make a tent by laying a batten as a ridge pole from the top of the camera to the lamp house, and draping the cloth over it.

Some form of locking device on the sledges will be found useful, for otherwise there is the risk of the picture being jolted out of focus too easily. A bolt screwed through one of the runners, as shown in Fig. 8, will lock a sledge to the central batten.

The thread of a metal bolt will not grip for long in a wooden hole, so a nut must be sunk into the wood. Drill a hole large enough for the bolt to pass freely through the runner and countersink the nut so that it lies flush with the outside surface of the runner. The nut must not be able to turn in its socket and to prevent it falling out a tin plate should be screwed over it with a hole drilled to allow the bolt to pass through. The bolt is passed through the plate, screwed through the nut and passed down the hole in the runner to bite on the central batten. Finger pressure is enough to lock the sledge firmly.

A similar arrangement may be used to lock the camera to its sledge by means of the tripod bush mentioned earlier and shown in Fig. 6.

Notes on Procedure

The negative should be placed between the sheets of glass in the carrier, shiny side towards the lamp house and upside down. Rough focusing is accomplished by varying the distances between the screen, camera and negative carrier. If your camera has a focusing lens this can be used as a fine adjustment.

Fig. 7.—The screen.

Do not focus the picture on the back of an empty mount, for when the printing paper is placed in position it will bring the picture nearer to the camera by the thickness of the paper and throw it slightly out of focus. An old print should be placed back to front in the mount and the picture focused on this.

List of Materials Required

Wood—6ft. of dressed deal 3in. by ¾in.
18in. of dressed deal 7in. by ¾in.
1 sq. ft. of plywood.
Glass—(obtainable at any photographic supplier). 2 pieces of thin glass 3½in. by 4½in. 1 Pearl diffuser.
8—¼in. Whitworth bolts, 2in. long.
16 nuts for the above.
Bulb holder, flex and switch.
100-watt bulb.
3ft. of ½in. garter elastic.

Once the printing paper is in position, no light must be allowed in the room unless it is from a "safe" bulb or screen. The time of the exposure will depend on the size of the enlargement, the aperture of the camera, the strength of the bulb and the density of the individual negative. This can be easily determined by trial and error, but as a rough guide it will be found that with the camera set at f.8 and using a 100-watt pearl bulb, a quarter plate enlargement of an average 120 negative will require about 12 seconds

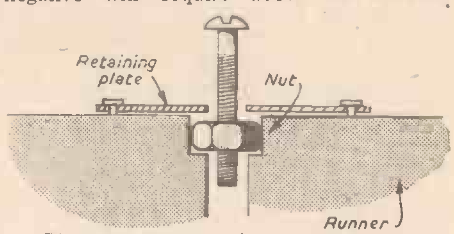
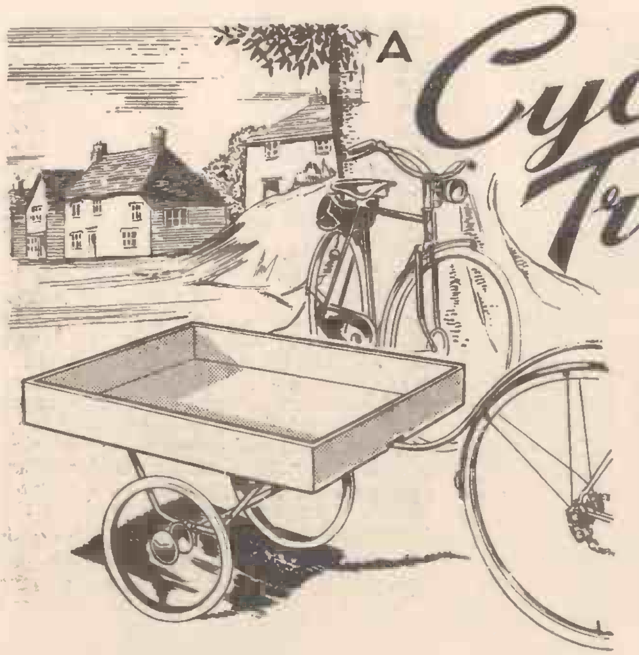


Fig. 8.—Device for locking the sledges.

A Cycle Trailer



Constructional Details of a Robust and Versatile Carrier

By L. J. EDWARDS

THIS trailer was designed for carrying a 3ft. radio-controlled model launch and its accompanying gear. The simple but effective shock absorber prevents the intricate radio gear from the damage which would be inevitable if the trailer had a rigid axle.

The Platform

This is made from ½in. "Weyroc" timber measuring 40in. by 30in. Although this wood is of a heavy nature, due to its processed manufacture, it has proved to be very suitable for the job. A lighter material such as hardboard would have necessitated a very rigid framework and entailed numerous joints. Using the "Weyroc" timber has eliminated the need for this and makes a much stronger platform.

Commence construction by cutting the 40in. by 30in. platform to size and then nail to the underside edges the pieces of 1in. square obeche. This edging provides a good foundation for the ⅜in. dowels which form the pegs on the sides. Before nailing the obeche edging it is necessary to mark a line ½in. from the edge of the platform all the way round and then drill holes at intervals of approximately 5in. Use a 3/32in. drill for these pilot holes which provide an easy entry for the 1½in. nails for securing the obeche edging. Details and dimensions are given in Fig. 1.

The Sides

Two pieces of ½in. deal or obeche 40in. by 4in. and two pieces 29in. by 4in. are required. Clamp the two identical pieces together for the purpose of drilling the ⅜in. hole 2in. deep. This forms the groove for the ⅜in. pegs. See Figs. 1 and 2 for the spacing distances. A good idea for holding these pegs in the groove while the glue is setting is to use panel pins driven in from the opposite side of the groove. When the glue has set the pegs are filleted with plastic wood and this makes a good anchorage for them as they are subjected to quite a lot of pulling and pushing when the trailer is being set up for use.

Bore the holes in the platform for the side pegs, using a $\frac{7}{16}$in. bit. The slightly oversize hole will make removal and replacing easier. The pegs will be a firm fit owing to the depth of the hole. The pegs face to the inside of the trailer.

The Chassis

A start can now be made on the shaping of the tubular chassis, which is made of ¾in. conduit tube. Two pieces about 7ft. long are required. A suitable setting block for bending the tube can be made from a block of wood about 3in. square and 3ft. long. A 1in. hole is bored in this approx. 3in. from one end. When making the bends care must be exercised to avoid flattening the tube and this is

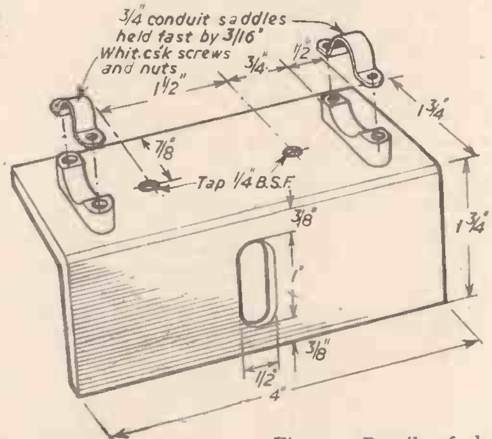


Fig. 3.—Details of the shock absorber.

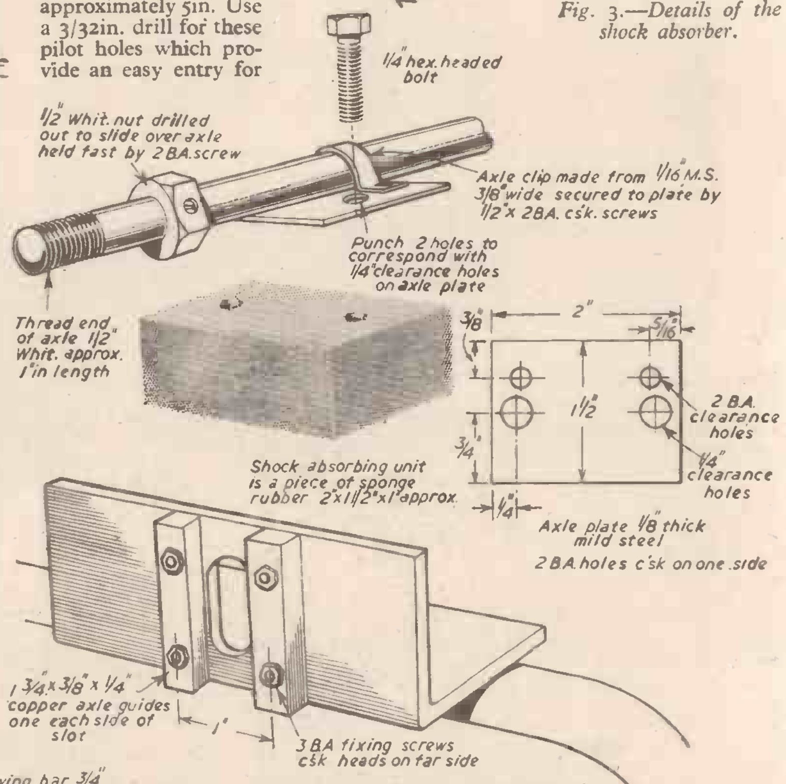


Fig. 4.—Details of the axle plate and clip, sponge shock absorber and angle plate shock absorber unit.

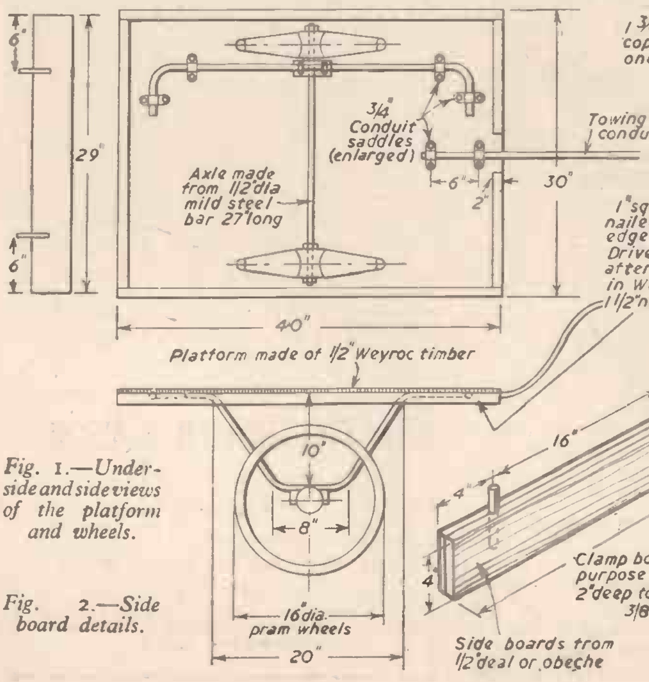


Fig. 1.—Underside and side views of the platform and wheels.

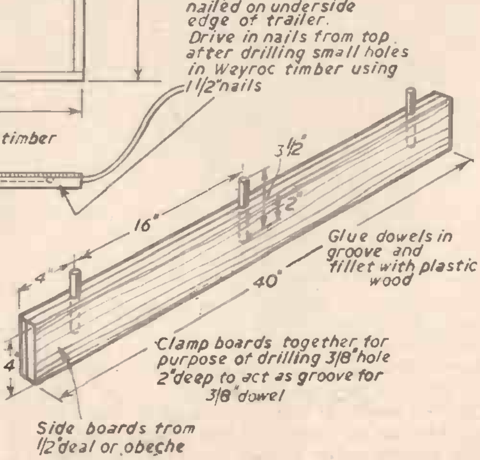


Fig. 2.—Side board details.

ensured by easing the tube through the block slightly after each set until the required angle is obtained. See Figs. 1 and 2 for the shape and dimensions.

The chassis is held in position on the underside of the platform by means of conduit saddles which are secured by ⅜in. screws.

The Shock Absorbers

Details of these will be apparent from Figs. 3 and 4. Secure the angle iron portion of the shock absorber to the chassis by means of the conduit saddles, making sure they are at right angles to the platform. Slide the axle plates and clips on to the axle, but do not tighten them into position. Place the ends of the axle through the slots in the angle iron and line up the axle plates to coincide with the holes in the angle iron. Tighten up the axle plates by means of the 2 B.A. countersunk screws and nuts which should hold the axle securely to the plate. Make certain that the correct amount of axle (about 4in.) is protruding through the slots of the angle iron at each end.

Insert the sponge rubber between the axle plate and the horizontal portion of the angle iron and push the ¼in. B.S.F. through both the plate and the rubber and screw into the angle iron. Tighten up the bolts until the rubber begins to compress slightly. This completes the shock absorber assembly.

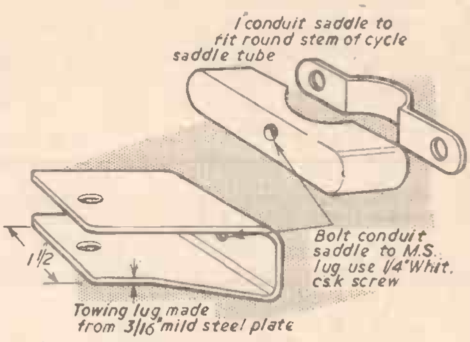


Fig. 5.—Method of attachment for towing bar.

The Wheels

These are held in position on the axle by means of a ½in. Whit. nut, which is drilled out to slide over the axle. Drill and tap one of its hexagon sides to take a 2 B.A. steel grub screw, which holds the nut securely on the axle. The wheel retaining nuts are also ½in. Whit. A neat job can be made by sawing a nut carefully in two parts, thereby providing two thin nuts for tightening against each other.

The Towing Bar

No dimensions are given for the beads in the towing bar, which is made of ⅜in. conduit tube, as these may vary slightly according to the cycle's size. Adequate clearance of the rear wheel is all that is required. The tube at the cycle end is hammered flat and a hole drilled for receiving the bolt which engages in the towing lug (see Fig. 5). A ¼in. or 5/16in. Whit. bolt will be satisfactory for this purpose. To make a towing lug for fitting to the saddle pillar of the cycle a 1in. conduit saddle can be utilised. Fig. 5 gives the necessary dimensions and the method of fixing.

A BIRD SCARER

A Device for the Handyman Gardener

By T. H. E. MARSH

THE Japanese type of bird scarer is possibly the most effective and efficient type ever used and they are not difficult to make. They may be hung from cross bars or poles, brackets fixed to the corner of the house, garage or even hung from a branch of a convenient tree. Several of these devices distributed around the garden will very effectively keep birds away as they tinkle and flash the sunlight in any gentle breeze. If all the "bells" are a different size or shape there will be nothing regular in the tune or in its frequency of repetition. The performance will be continuous.

Fig. 1.—The bird scarer.

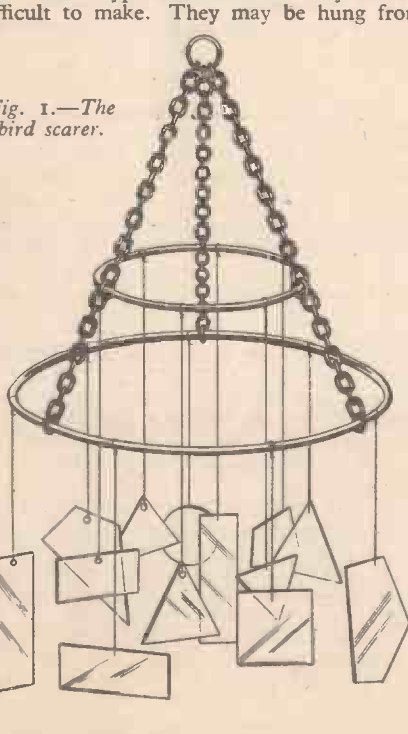
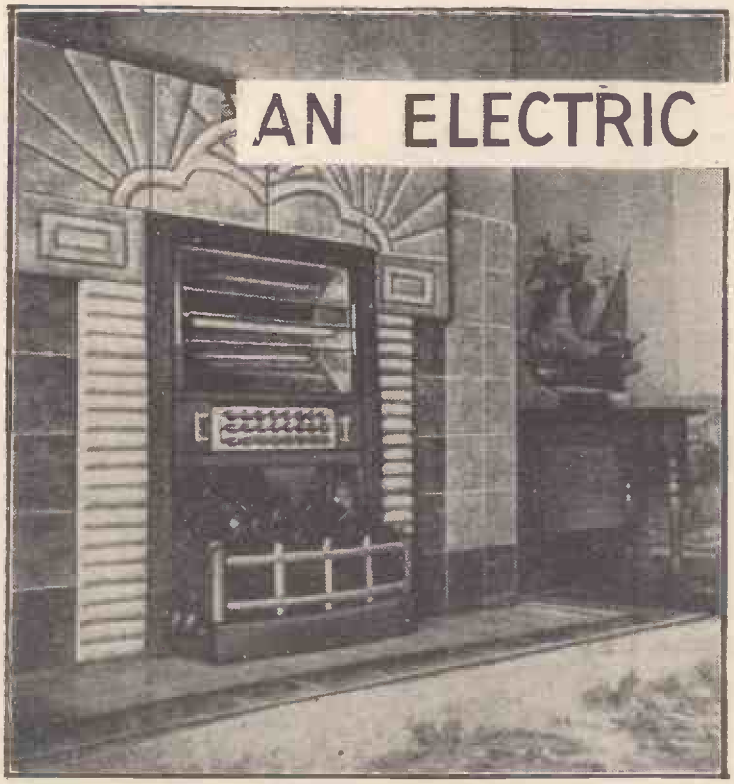


Fig. 1 gives the general idea. The framework can be made from any suitable wire. Twenty inches will be required for the larger of the two rings and about 12in. of wire is necessary for the smaller. The joints in the rings are soldered or welded to make the ring quite firm. Small chain, string, fishing line, or catgut may be used to hang the "bells" to the wire rings. A hook at the top takes the ends of the chains supporting the rings and serves to hang the scarer to its support. This allows ample freedom for the scarer to move with a gentle breeze. The individual "bells" are hung so that they are not free to rotate without knocking against their neighbours, thus giving rise to the tinkling sound.

The "bells" need not all be the same size or shape; in fact, it is better to have each one of them differently shaped or sized, as they then give a variety of tinkling notes. Square, rectangular, triangular or round will be found most suitable but rhomboids or four-sided polygons may be used to add variety. They can all be cut from picture glass or old photographic plates with the emulsion washed off. The most suitable sizes to choose are between ¾in. and 2in. wide and 2in. and 4in. long. The glasses can be bored quite easily with one of these new "carbide-tipped" drills using a hand drill and turpentine as a lubricant.

If a successful job cannot be made with glass then "bells" may be made of metal but the glass gives a much more pleasant sound. Metal slips made of tin, brass, steel tempered or hardened, can be used, and should be made in the same variety of shapes and sizes as the glass slips. Any thickness up to about 3/32in. will be quite suitable. The tinplate may be cut from empty fruit cans, etc., the brass or steel may be obtained from almost any tinsmith's scrap bin.

In use these devices are very effective. They are not so troublesome or noisy as hooters, bells or buzzers and take less maintenance.



AN ELECTRIC *Imitation Coal Fire*

By C. D. BOOTH

This Article was Received in Response to a Request Published in "Information Sought"

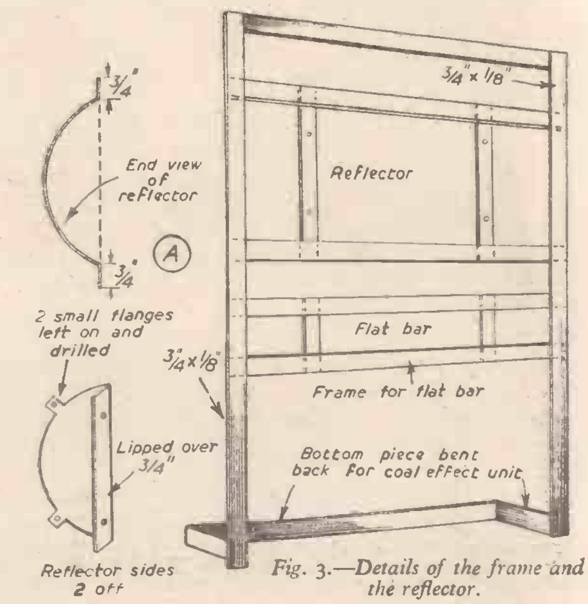
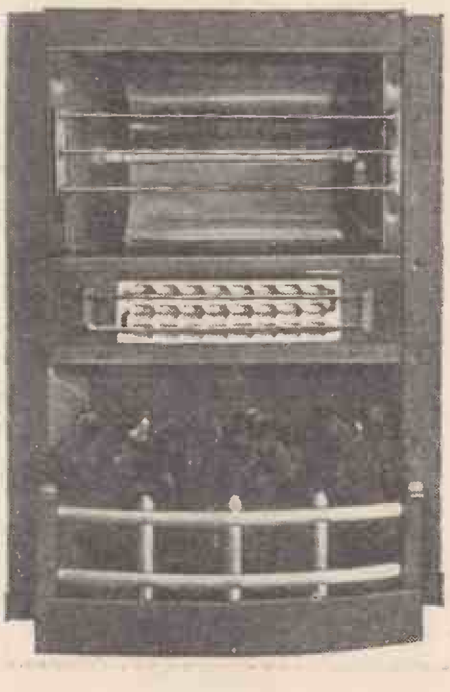


Fig. 3.—Details of the frame and the reflector.

I HAVE made to my own design two electric fires with imitation coal effect; one is a two-bar reflector type and the other incorporates in addition a flat bar element. Both were made to fit my own fireplaces, so that measurements may have to be adapted to suit specific circumstances. In this latter fire, shown in Figs. 1 and 2, the combined imitation coal and flicker unit was made separately with a back which can be removed to give access to the bulb. The coal unit was set back 2in. from the main frame of the fire so as to give a chimney effect and also to stop the unit from projecting into the hearth too far.

The frame was made as in Fig. 3, with dimensions to suit my own fireplace, but the general shape should be apparent from this sketch. For the grate unit a base was made of heavy wood, covered with asbestos. The corner pillars were made from ¾in. square soft iron, shaped as shown in Fig. 4 and the horizontal bars of the grid are stout aluminium beading, the ends of which are let into holes drilled on the inside of the corner pillars. The pillars are drilled and tapped at the sides so that the sheet copper side pieces may be screwed to them and underneath so that they may be screwed to the wooden base. The 2in. wide metal strip shown in Figs. 4 and 5 is screwed to the edge of the wooden base and also to the corner pillars. The three vertical metal pieces forming the front of the grate are half-jointed to the horizontal bars.

The side pieces are cut and fitted as shown in Fig. 2, the parts behind the frame and the back being made from one sheet of polished copper.



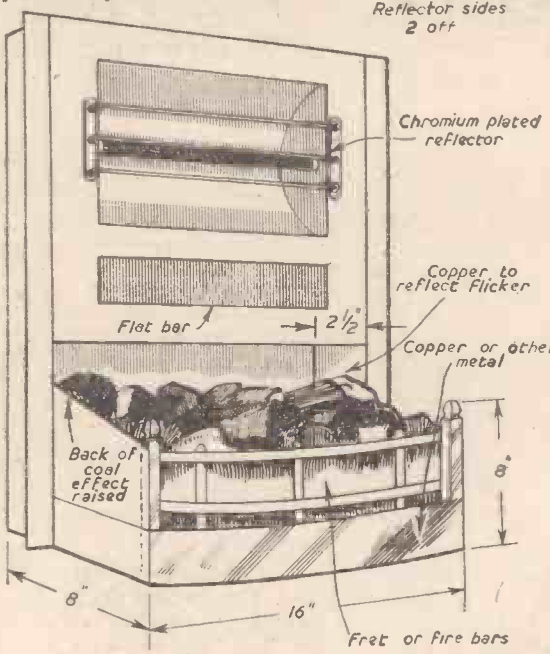


Fig. 1 (Left).—A front view of the completed fire.

Fig. 2 (Above).—Diagram showing general arrangement of fire.

Fig. 4 (Right).—Details of the grate.

The "Flicker" Unit

I bought a flicker control, fan and assembly, a 60 W. red-coloured lamp and a brass lampholder and fitted these up with the fan over the centre of the bulb, approximately in the centre of the unit. The best position for the bulb can be found by trial and error and it may be either upright or horizontal. What is required is an attractive "flicker" effect on the polished copper backplate.

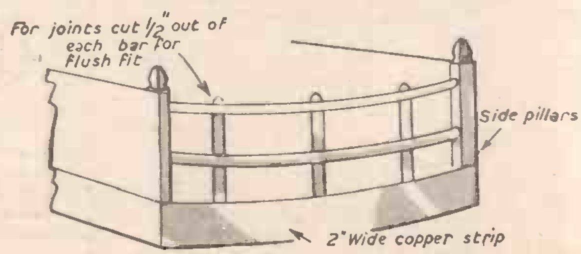


Fig.5(Left).—A side view of the partially completed fire.

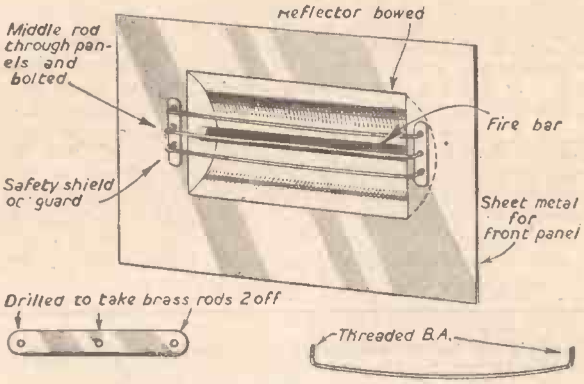


Fig. 7.—The reflector and safety shield.

Imitation Coal Effect

Deal with the front first. Take a piece of small-mesh wire netting and fasten it to the inside of the bars and pillars with very thin wire; then cut irregular holes in it. Obtain some steel wool, soak it in black paint and let it dry. Thread it through the netting irregularly, some places thick, some thin, leaving the holes already cut clear or with just a strand or two of steel wool across.

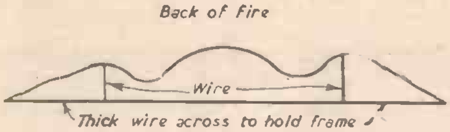


Fig. 6.—A sectional view of the imitation coal.

Now work on the top. First make a frame of 16 g. wire to fit round the inside of the top, the front wire fitting behind the top bar. Bend some more wire netting to the required shape as shown in section in Fig. 6. Treat in the same way as the front, irregularly covering the wire netting with the steel wool and leaving the holes clear. About 4-6 oz. of steel wool will be required. Next fasten down some small pieces of coal with florist's wire, one piece in the centre, one in each rear corner and the rest anywhere. Finally paint the lot, wire wool, coal and wire, with the heat-resisting black paint.

The effect produced is not the same as the commercial models, but gives a realistic effect of a fire made of small pieces of coal just burnt through and looks very warm. The coal effect must not go right back to the copper backplate or the flicker effect will be obscured.

The back of the frame can be held up with small pieces of rigid wire or rod as shown in Fig. 6. The reflection of these rods will be thrown on to the back reflector and the flicker fan as it travels round will play on these and give a curling effect.

The Electric Fire

The sheet metal front is cut to size and bolted to the frame after having a rectangle of metal cut away for the reflector and flat bar element if this is to be used.

The reflector is shaped as shown at A, in Fig. 3, with two edges forming lips which should be drilled and bolted to the frame. Construction of the reflector sides is also shown. A piece of rod, cut to length and threaded at each end is passed through the holes in the tabs and tightened to pull the sides up close to the reflector.

The elements must, in the interest of safety, have some form of protection across the front and the method suggested is shown in Fig. 7. The rods are made from approximately 3/32in. brass brazing rods, obtainable from ironmongers or welding shops. The reflector is best made from copper, then both reflector and safety rods can be sent for chromium plating.

The two side pieces are of brass and they are drilled to clear the rods. The rods are bent as per Fig. 7 and threaded to a B.A. size at both ends to approximately ½in. from the bend. Nuts are then screwed on up to the end of the thread, then the brass side pieces slipped on and finally another nut on each to lock it all together. The threaded ends of the top and bottom rods are then trimmed right down to the locking nuts, but the ends of the middle bar are left so that they can be passed through holes in the front panel of the fire, locked by nuts at the rear. Thus the guard is easily removable in case of need.

The back of the fire should be partly covered in, making it impossible to touch the connections. All the usual safety precautions must be observed with regard to the wiring and the fire should be properly earthed. Switching, wiring, etc., will depend upon the elements used and the maker's particular requirements.

All my sheet panelling was copper, a metal which will look very well when oxidised, but this may be too costly and, of course, any other metal can be used, but it should be remembered that it will get very hot when the fire is in use.

Fig. 8 shows the other fire mentioned, which is built into an older style fireplace and which does not include a bar-type element.

Fig. 8.—The author's second fire.

First Electric Train to Use Germanium Rectifier

THE first electric train in the world to be fitted experimentally with a germanium rectifier for converting alternating current from the overhead wire to direct current for driving the traction motors has completed successful trials on the Lancaster, Morecambe and Heysham section of British Railways (London Midland Region). These trials were undertaken in conjunction with the British Thomson-Houston Co., who have carried out important pioneer work in this field, and who have produced the rectifier unit used on the train; this unit is of 750 kW capacity, arranged for full-wave rectification.

The conversion of the train to accommodate the germanium rectifier unit was carried out in the London Midland Region's workshops at Meols Cop, near Southport.

The experiment is of particular interest in view of the British Transport Commission's recent decision (which is subject to the approval of the Minister of Transport) to adopt for future electrification the 25 kV 50-cycle alternating current system with overhead conduction. The Eastern Region line between Fenchurch Street and Bow Junction, on which further trials are being made, is at present electrified on the 1,500 volts D.C. system, and the trial runs have therefore to be made at night when the D.C. can be switched off and an A.C. supply put on the overhead wires at 6.6 kV. (This is the voltage to which the new B.R. standard of 25 kV will be reduced when the conductor-wires have to be carried under certain bridges and tunnels, and at other places where clearances are restricted.)

Germanium is a comparatively rare metal found in certain ores, such as silver and zinc. It has properties akin to those of the crystals used in early wireless sets, and acts in a similar way to a radio valve. By passing an alternating current through a series of germanium wafers, the A.C. is converted to D.C. before reaching the traction motors. This enables the robust characteristics of the D.C. motor to be retained, while obtaining all the advantages of A.C. supply.

RADIO CONTROLLED MODELS

By Members of I.R.C.M.S.

11.—Radio Control for Model Aircraft (Sequence System)

THE radio equipment for controlling model aircraft can very well be that described in the September and October, 1955, issues of PRACTICAL MECHANICS. In these issues were described a single-valve super-regenerative receiver of a type which is very widely used for model control and the associated transmitter. For model aircraft work, however, every fraction of an ounce is important and the receiver could be made up on a slightly smaller base. The meter socket as originally described will also be inconvenient for most aircraft, and a suitable metering point should be made on the fuselage. The meter should be fixed here for tuning up and then withdrawn for flight. The photographs of Mr. T. Rickelton's "Radio Queen" (Fig. 1) clearly show his meter in position. The receiver should be suspended within the fuselage from taut rubber bands which will permit considerable freedom of movement, absorb engine vibration, and at the same time protect the receiver in the case of a hard landing.

The transmitter can make use of the quarter-wave vertical aerial (8ft. 6in.) as originally described, but for model aircraft use many enthusiasts prefer a "Vee" type of half-wave dipole. This consists of two 8ft. 6in. rods (either sectioned or telescopic for transport) mounted as shown in Fig. 2. An array of this type produces a stronger and better radiation pattern than the vertical aerial. The energy from the transmitter is directed in a lobe vertically upwards and extending almost to ground level on each side of the aerial at right angles to the axis of the aerial rods. A vertical aerial has a dead spot directly overhead, which is, for model aircraft work, the worst possible place.

Suitable Type of Model

The type of model aircraft to be employed for radio control should have certain attributes. It must be robust, easily constructed, large enough to carry the radio, batteries and control gear and have inherent flying stability to enable the model to recover from any peculiar attitude which the inexperienced pilot can so easily produce.

In order to meet these requirements we would suggest a fuselage of rectangular section often referred to as a "Slab Sider." Models of this type can be made to look very realistic, are easily constructed, and readily repaired should damage be sustained.

The size depends on the complexity of the intergear intended, but it is strongly recommended that the beginner should stick to simple rudder control, which will enable him to execute most known aerobatics. It is suggested that the wing span should be between 4ft. and 5ft. with a wing loading of between 12ozs. to 14ozs. per square foot. The front end of the fuselage should be sheeted from the nose to the rear of the cabin as this is where all the radio weight is carried and most damage sustained in the event of a hard landing. The tailplane area should be approximately 30 per cent. of the main plane, whilst the fin should be in the region of 9 per cent. and the rudder 25 per cent. of the fin area. It is more effective to steer by moving a large rudder a small amount than vice versa.

There is a considerable freedom in the choice of engine to be employed as either glow-plug, diesel or petrol is suitable, but for the size of plane suggested the engine should not be less than 2.5 c.c. in capacity.

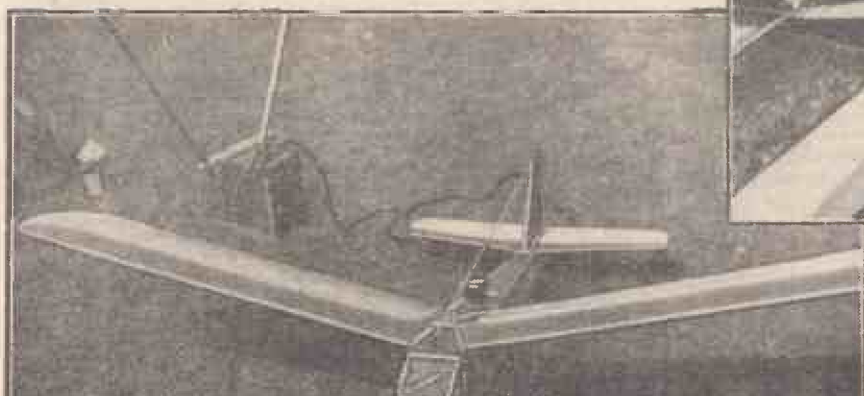


Fig. 1.—Two views of Mr. T. Rickelton's "Radio Queen."

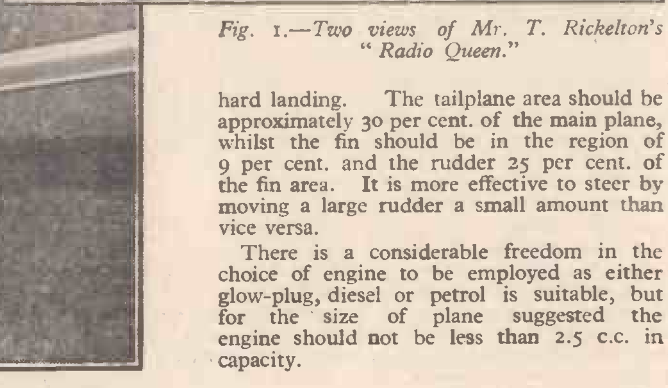


Fig. 2.—Vee type aerial for use with model aircraft, giving increased radiation and a better field strength pattern.

Simple Control System

The easiest mechanical method of obtaining controlled rudder movement in a model aircraft is by means of a simple rubber-driven actuator, which converts the radio signal received into controlled mechanical movement.

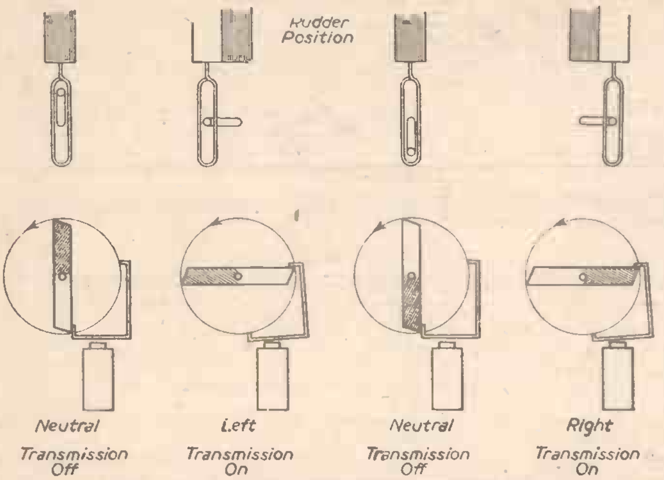


Fig. 3.—The principle of the rubber-driven actuator, showing the sequence.

There are several types manufactured and available through the model shops. They usually consist of a two-armed star or pawl driven by a skein of ¼in. or 3/16in. rubber, often only one loop being employed. Fig. 3 illustrates the principle employed. The star is prevented from rotating by means of a claw ended armature which is operated by an electromagnet. When the actuator is at rest one end of the star wheel is held against one of the claw ends of the armature. On receipt of a signal from the transmitter the receiver anode current drops and the receiver relay opens, thus completing a circuit through the magnet bobbin of the actuator and creating a magnetic force which pulls the armature claw towards it and releases the star wheel. This now rotates until caught by the claw on the other end of the armature, which is so positioned that it will hold the star wheel after a quarter of a turn and on cessation of the signal will allow the star to turn another quarter of a turn when the opposite end is caught by the first claw. This operation is repeated for each signal transmitted. To complete the mechanical application it is necessary to attach a crank to the spindle of the star wheel which, when coupled to the rudder by means of a hairpin loop within which it rotates, moves the rudder to the desired position.

During the absence of a transmitted signal the crank is arranged to be in a vertical position. On receipt of a signal the crank moves a quarter of a turn to a horizontal position, thus moving the rudder to the left, where it stays for the duration of the signal. When the signal ceases the crank rotates a further quarter of a turn and now rests in the opposite vertical position when the rudder is once again at centre or neutral. The next signal will give right rudder returning to the original centre or neutral position, when transmission ceases.

This is known as the self-centring type of actuator, and it will be seen that to go left and then left again means passing through the right position of the rudder. This, however, happens so quickly that it has no apparent effect upon the model. Should the aircraft fly out of control this system ensures the rudder being in the neutral position, thus avoiding the possibility of a spiral dive to the ground. Its only defect is the need to remember whether the next signal to be transmitted will give left or right rudder.

An Escapement-controlled Actuator

An improvement on the actuator just described, which will enable the operator to select the direction of turn at will, can easily be made, using a commercially manufactured actuator unit, with current-saving device embodied in its construction. These can be procured from most model shops, and the general arrangement of the unit, when modified, is shown in Fig. 4 (A to E).

The first alteration is concerned with slowing down the speed at which the driving shaft and star wheel rotate when released by the armature claw. This is necessary to enable the operator to transmit a definite signal sequence during the period of a revolution (or part of a revolution).

The actuator is first mounted on a piece of thin paxolin or other insulating material which is 1/16in. thick and shaped to fit into the required position in the fuselage of the plane. On the opposite side of the paxolin the driving shaft extends through a suitable hole and is shaped to form a hook upon which the elastic motor is attached (Fig. 4B). On to this shaft is soldered a toothed wheel, which is made roughly the size and shape of a penny. The writer's is 1¼in. diameter with a 1/16in. hole drilled in the centre, to be a nice fit on the actuator drive shaft. The perimeter is filed into teeth 1/16in. deep with 90 deg. sides, using a small square file. The 1¼in. diameter wheel has 32 teeth, whilst a smaller wheel used by the writer has only 24 teeth. (The number of teeth is not important.) The discs should be made from steel, as a softer metal will wear too rapidly. C and D in Fig. 4 illustrate these stages of the construction. The finished toothed wheel is soldered to the actuator drive shaft so that it is approximately ½in. from the baseboard and rotates truly. When finished, the drive shaft must be perfectly free to turn. An escapement is now made from a piece of thin steel sheet about 23 or 24 s.w.g. This is shaped as shown at D in Fig. 4 and drilled to take a brass tube which acts as a bearing on a 6 BA bolt; this tube is soldered at right angles and protrudes ⅛in. on each side.

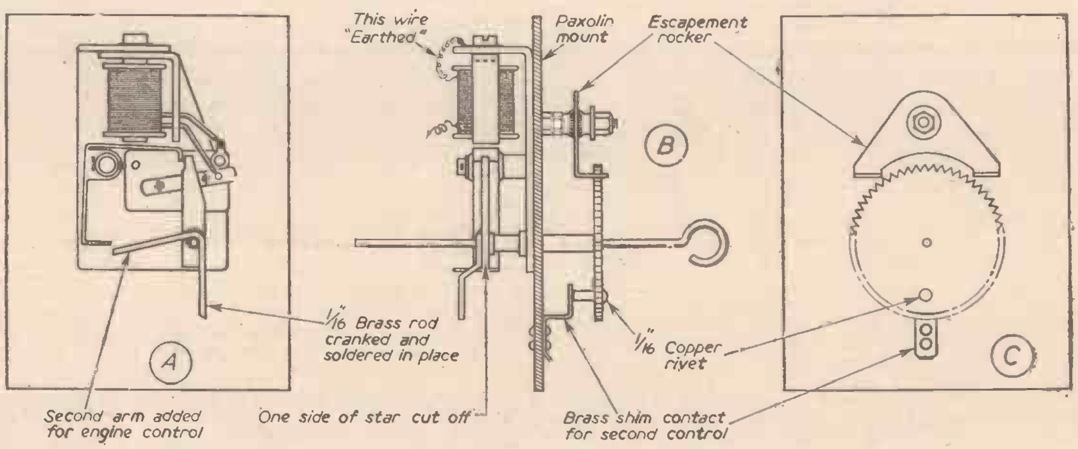
A hole to take the 6 BA countersunk-headed screw is drilled ⅜in. from the centre of the drive shaft on the centre line of the paxolin and a ⅝in. long 6 BA screw fitted and locked up tightly with two lock-nuts. The escapement is now mounted on this and held in place with a washer and "Simmonds" self-locking nut, which is taken up until all surplus play is restricted, yet the escapement is perfectly free to oscillate.

The vertical edges of the escapement are now filed and adjusted until when one side of the escapement enters a toothed groove the other side of the escapement rides over a tooth into the next groove. This causes the escapement to rock quickly and retards the speed of the driving shaft. This speed can be further reduced by adding weights to the wings of the escapement. The correct speed is about ¾-1 sec. per revolution. Weights can be added simply by adding blobs of solder to the wings of the escapement.

Alterations to the Actuator

The type mentioned has one wire from the electromagnet earthed, i.e., taken to the metal frame of the actuator. This feature will be employed later to obtain another channel of control.

The clawed armature is first removed and a



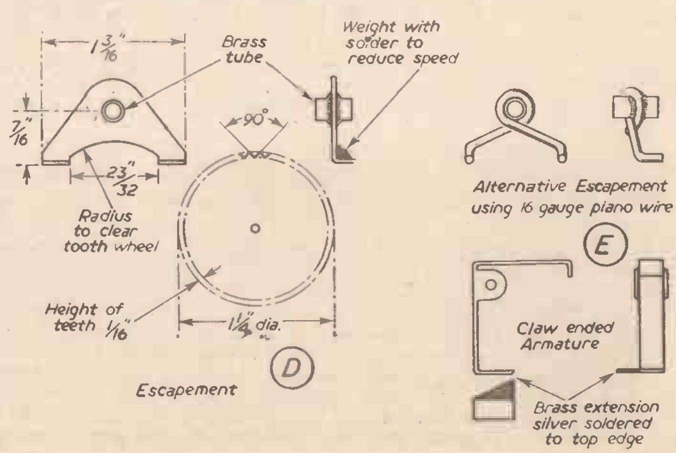


Fig. 4.—The improved compound actuator. A, B and C are three views of the actuator; D gives details of the escapement and E shows an alternative escapement and the claw-ended armature.

tongue of brass of similar thickness is soldered (silver soldered for preference) to the top edge of the claw, which is away from the magnet. The height of this attachment is ⅛in. and the whole is filed and dressed up perfectly smooth with the original (see Fig. 4E).

The rotating two-armed star wheel now receives attention. One arm is sawn off about ⅛in. from the centre and a piece of brass wire (welding wire will serve) which has previously been cranked about ⅛in. is soldered on in such a position that it will stop the rotation in the same position as the part removed except that it will now be done by the raised tongue and will pass clear of the normal position of the armature (Fig. 4B). In operation the original half of the star is lying against the armature claw beneath the magnet.

The magnet on being energised attracts the armature, releasing the star from the neutral position, allowing it to rotate and be caught by the claw at the other end in the normal manner, giving left rudder. On release, however, it completes the circle to its original starting place, so that there is now only one neutral position. Now to obtain right rudder all you have to do is transmit one short signal which produces the above result, then break transmission and send a second signal, with as short a space as possible between the signals. This releases the left rudder position and allows the cranked wire on the other end of the star to pass over the neutral position and be caught by the new tongue on the armature, thus giving right rudder. The sequence of signals is now as follows: one continuous signal—left rudder for as long as the transmission is held, then back to neutral—right rudder—one short signal followed by a very short space and then a second signal, which is held on as long as right rudder is wanted, i.e., one signal left rudder, two signals right rudder—no wondering which comes next in the sequence.

A Compound Actuator

Once you have experienced the thrills of flying a model plane equipped with this type of steering control you will probably wish to add another control. This could be either engine or elevator control, and it is arranged to work as a sequence from the actuator just described. A second actuator is employed for the second control.

The modified actuator just described will now require to be further altered so as to be able to control the second actuator when required. Means must be found of stopping the star wheel in a predetermined position which will not affect the steering of the model, but in which a contact can be made to release the following actuator. This can be done by making another cranked arm of 1/16in. wire and soldering it on to the star wheel in such a position that it holds the star wheel shortly before the neutral arm reaches the neutral position (Fig. 4A). In the writer's equipment this is about 3/16in. before the neutral claw stops rotation. This naturally produces a slight amount of offset rudder, but in practice the amount is so small that it has no noticeable effect upon the flying of the model. In addition, the offset position is held for only the very short time taken to release the second actuator, and in practice this is nearly instantaneous.

To make the alterations the star wheel is held in its new position, then the whole assembly is turned over and marked near the periphery of the escapement wheel. The point of marking should be selected so that a 1/16in. hole can be drilled and a copper rivet inserted and soldered in position in the hole in such a way that it will contact a ⅛in. wide piece of springy brass foil fastened underneath on the paxolin. The foil should be so shaped that as the rivet comes round it will pass over the leading edge of the foil without making contact, but will make a light but firm contact when stopped by the new positioning arm. The rivet should protrude about ⅛in. and the springy brass should be fastened to the paxolin with 1/16in. rivets or 12 B.A. bolts.

We now have a new contact which can be selected at will and which when wired up into the circuit of the second actuator will act as a switch controlling the operation of the second actuator.

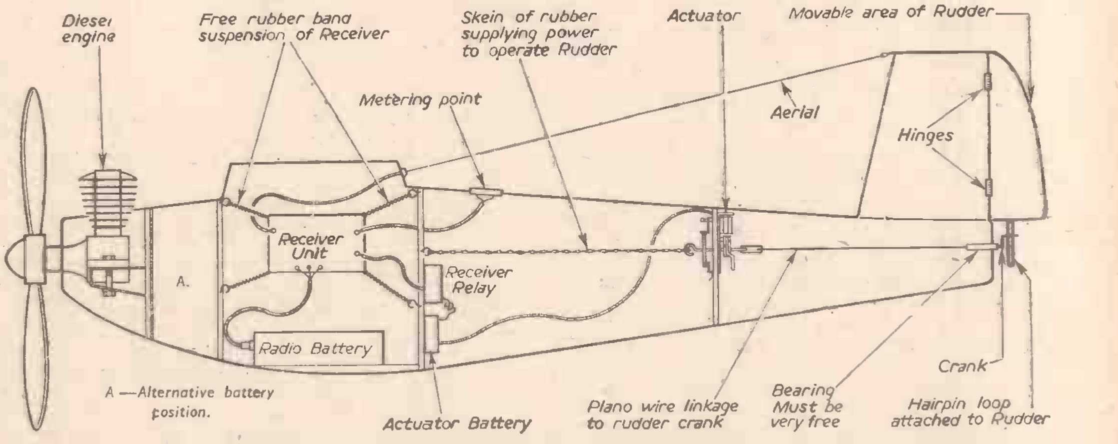


Fig. 6.—Lay-out of control gear in model plane. Flying trim is obtained by adjusting battery position.

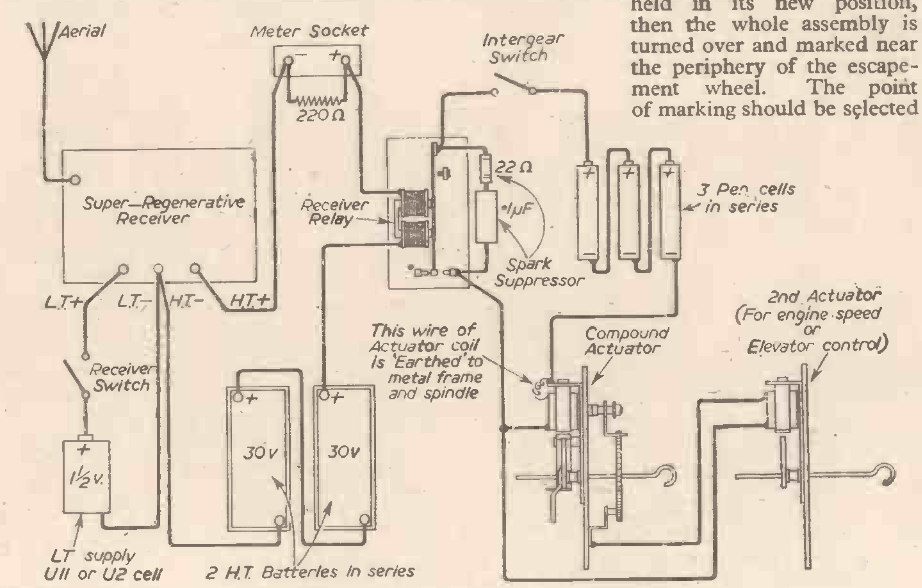


Fig. 5.—Complete wiring diagram of radio-controlled plane.

It was previously mentioned that the actuator employed had one end of its coil earthed to the metal framework and this is employed in the following manner. When the receiver relay drops out, due to the transmitter being keyed, current from the actuator battery flows through the first actuator coil and according to the sequence transmitted holds on the desired control. Should this coincide with the copper rivet being in contact with the brass contact which is wired to the second actuator (see Fig. 5), this will also be energised causing it to make a quarter-turn. On cessation of the transmission both actuators will be released, the first returning to neutral and the second completing a half-turn. The second actuator can be connected to the engine and will give full throttle and slow speed in sequence. Should it be desired to operate the elevator, neutral position of the second actuator should be arranged for normal flying, whilst on signal "up" or "down" elevator should be arranged in sequence.

It should be pointed out that since the new contact on the first actuator acts as a switch for the second actuator it operates only when the receiver relay contacts are closed (i.e., when a transmission is being received). Thus when left or right rudder signals are sent and the actuator is returning to neutral it passes over the third contact position without energising it as the receiver relay contacts are then open. Therefore, no circuit is made and the second actuator does not operate. The second actuator will work only when three rapid signals are sent and the third signal held on.

Control

For model aircraft control, using this system, a control box for keying the transmitter, such as that employed for model boats, is not necessary and a "micro-switch" is usually employed to key the transmitter. To recapitulate, the control sequence is as follows:

Left rudder: one signal held on for as long as the turn is required.

Right rudder: one short signal, a rapid space followed by a long signal for as long as the turn is required.

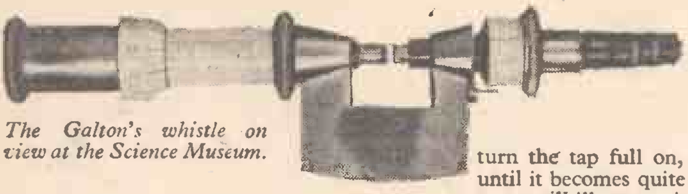
Engine speed or elevator: two short signals, with rapid spaces followed by a long signal for as long as required to effect the second control.

It should be noted that these signals must all be sent within the period during which the

(*Concluded on page* 417)

GALTON'S WHISTLE EXPLAINED

With this Type of Whistle it is Possible to Determine the Limit of Audibility of the Human Ear



The Galton's whistle on view at the Science Museum.

SOUND, as everyone knows nowadays, is due to vibrations or waves. Sound waves which are capable of being heard by ordinary human beings range from 60 to 40,000 semi-vibrations a second; those undulations which we know as heat, begin at 65,000,000 vibrations, whilst visible colours range from 400 to 900 trillions.

Let us consider very briefly, the compass of the notes given by one of the best-known musical instruments—the organ—which occupies the whole field of audible vibrations, nearly 10 octaves; the piano has about seven octaves. The pipes in an organ vary immensely in both length and breadth, and a Galton's whistle is simply a minute organ pipe.

For special purposes pipes have been constructed varying in length from 20 metres to 0.5 millimetres and in frequency from 8 p.p.s. to 100,000 p.p.s.

Now the limit of audible sound vibrations varies considerably in different people, many people being incapable of hearing the chirp of a grasshopper or the twittering of sparrows, whilst there are others who claim to have heard specially constructed tuning forks giving vibrations of about 70,000 a second. These intensely shrill notes produce an undefinable uneasiness in a person which lingers for some time. There is little doubt that some animals hear sounds quite inaudible to human beings. Human audibility also varies with age.

Pure Notes

In experimental acoustics first importance attaches to those sources of sound which emit pure notes, consisting of a single fundamental tone unaccompanied by harmonics or overtones (see Fig. 2). The flute and diapason pipes of an organ give the nearest approach to purity. Tuning forks, when vibrating in their simplest manner, give remarkably pure notes, and another extremely good example is an ordinary tin whistle.

Galton's Whistle

In order to determine the limit of audibility in human beings, and as far as possible in animals, Galton devised a miniature organ pipe in the form of a whistle, provided with certain adjustments, and blown by means of a rubber pressure ball similar to that used on scent sprays (see Fig. 3).

Experiment with Whistling Kettle.

If you happen to possess a whistling kettle try the following experiment. Half-fill the kettle with water and place it on a gas-ring, with the gas turned half on, and leave it until the kettle is whistling shrilly. Then slowly turn the tap full on, noting the rise in note until it becomes quite inaudible. This experiment will illustrate, in a very intensified form, what you actually hear with a Galton's whistle.

A Very Simple Type of Galton's Whistle

Obtain an ordinary penny tin whistle—it must be one that whistles with all the holes closed. Cut the whistle in two, just above the top hole, and discard the bottom half. Next, take a piece of metal rod which will just go in the bottom (unfortunately these whistles are slightly tapered), and push it into the whistle, blowing gently and evenly through the whistle at the same time.

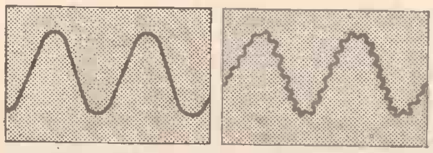


Fig. 2.—A single fundamental tone and the effect of harmonics.

It will be found that the note rises as the column of air is shortened.

Now construct a similar whistle, somewhat longer, out of tin, copying the whistling production part of it. The whistle must be the same bore its entire length, and you will now be able to push a close-fitting metal rod up it as far as the whistling aperture. You will now have a true Galton's whistle in its simplest form, more especially if the bore of the cylinder is not more than ¼in.—the less the better. Now fit a piece of rubber tube and two rubber balls, one of which should be enclosed in netting (see Fig. 3). Next fit on to the end through which the moving piston travels a screw piston and a micrometer gauge and you can measure the length of the column of air and the pitch of the note depending on it.

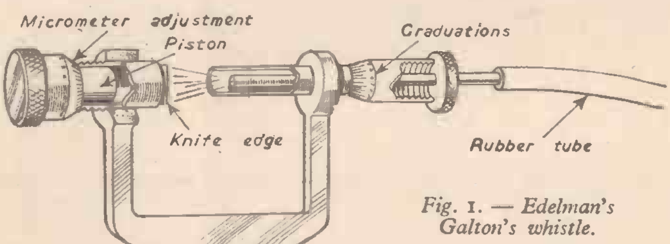


Fig. 1. — Edelman's Galton's whistle.

The instrument as thus described can be purchased from scientific instrument makers.

An improved instrument with a much finer tube and capable of going in a case which would fit in a waistcoat pocket and fitted with a scale, showing the pipe length and frequency, can also be purchased.

You can graduate your micrometer as you like, but it is usually graduated in centimetres (the distance between two consecutive threads of the piston screw) and millimetres, i.e., 10 divisions on the turning head.

The best way of calibrating a Galton's whistle is probably by means of what is known as the cathode-ray oscillograph. If the whistle be used with a standard air pressure you can obtain reproductibility in the pitch of the note emitted provided the temperature remains or is kept constant. Sounds above human audibility can be detected by means of the sensitive flame method.

Edelman's Galton's Whistle

This very scientific whistle is a type of small organ pipe, consisting of a very short cylindrical pipe with a sharp edge, upon which is directed a blast of air from an annular nozzle. The pitch of the note can be varied by moving a piston at the closed end of the pipe—by means of a micrometer screw shown on the left in Fig. 1. The distance of the nozzle from the pipe requires adjustment to suit sounds of varying pitches and the micrometer on the right is used for accurately setting this position. So far as human audibility is concerned only a few nozzle settings are necessary.

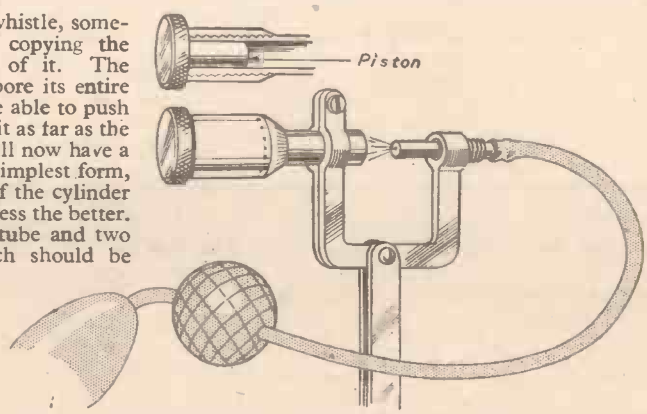


Fig. 3.—Galton's miniature organ pipe in the form of a whistle which was blown by means of a rubber bulb.

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Book Received

"Clock and Watch Escapements," by N. W. J. Gazeley, F.B.H.I. 294 pages. 192 illustrations. Price 40s. net. Published by Heywood and Co.

THIS is a companion work to the author's "Watch and Clock Making and Repairing," which was favourably reviewed in this journal some time ago, and it treats the subject of escapements in much greater detail than was possible in the earlier book. It deals with all clock and watch escapements, including the verge or crown wheel, the recoil, the dead beat, the gravity, the chronometer and platform clock escapement, and the verge, Mudge, Remontoire, cylinder, virgule, duplex, lever and chronometer watch escapement, with additional information on the use of the depth tool and polishing.

The book not only deals with the principles and troubles likely to occur with these escapements, but also with methods of repairing them. Although some of the escapements are not now manufactured, many of them are still in use, and the watch and clock maker is often called upon to repair them, since it is not possible to purchase interchangeable material as with modern watches.

All those interested in horology will find this well illustrated book fascinating, and to the repairer it will become a standard work on watch escapements. It is fully indexed.

WATCH REPAIRING for the Amateur

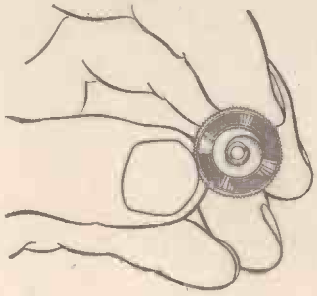
By F. J. CAMM

A New Series on the Repair and Adjustment of Wrist and Pocket Watches

NEXT replace the pallet bar and proceed to replace all of the other wheels in the train after cleaning and brushing.

The Top Plate or Bars and Reassembling

Clean the top plate or bars and peg out all the pivot holes, and then drop the plate or bars gently over the pillars. Using gentle finger pressure to hold the two plates together, with a pair of tweezers gradually place each pivot in its hole, starting from the spring barrel and working towards the escape wheel. Only the very lightest pressure should be used,



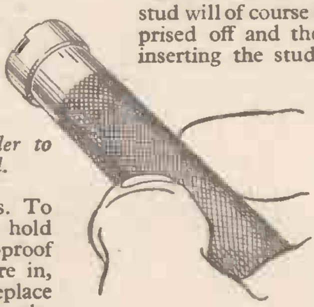


Fig. 15.—Use a mainspring winder to insert the spring in the barrel.

otherwise you will bend the pivots. To avoid finger-marking the plates hold them between a piece of acid-proof tissue paper. When all pivots are in, replace the pillar screws, and replace the cannon pinion by supporting the opposite pivot on a stake held in the vice, holding the cannon pinion in a pair of tweezers and gently pushing it on. It may be that it will need a hammer and punch gently to drive it home. If the centre holes are jewelled great care is necessary in this operation to avoid cracking them.

You may now apply oil to each pivot hole; do not use too much—just the slightest drop is necessary. The oil is held in place by capillary attraction and will remain fluid for at least a year. With Epilame oils, two oils are used; the pivot is first dipped in one oil and then in another and it is claimed that the oil remains viscous and fluid for a much longer period. All high-class watches are so oiled.

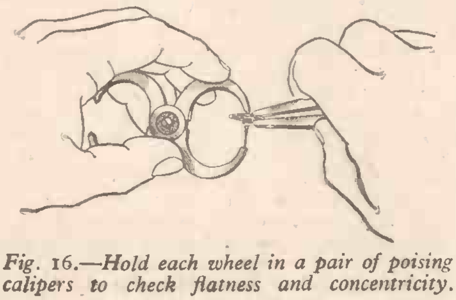


Fig. 16.—Hold each wheel in a pair of poising calipers to check flatness and concentricity.

The movement is now ready to receive the balance, and this again should be quickly dipped in the benzine, dried off and placed aside whilst attention is given to the balance cock and the bottom jewel hole in which the balance runs. It will be noted that these holes have end stones on them, fixed by a steel or brass cap, fastened by two screws. It is necessary to remove this cap on top and bottom holes, to peg them out and reassemble. In some very high-class watches end stones are also fitted to the pallet staff and to the escape wheel, and if so these end stones must also be removed and cleaned. Next place the balance in the watch, making quite sure that the impulse pin is in the fork of the lever. Place the cock over and gently lead the pivot into the hole, and refasten the hair spring. If the balance has been removed with the cock, as it must have been if it is one in which the hairspring is pinned to a stud riveted into the block, the stud will of course have first been prised off and the holes cleaned before re-inserting the stud into the cock. Under no circumstances remove the balance by unpinning the spring. It has been pinned up at the appropriate point for correct timekeeping. Indeed, the timekeeping of a watch depends upon this pinning point, and once it has been correctly rated the pinning should never be unfastened. Now insert the winding shaft and give the mainspring a few turns. The watch should immediately commence to tick. Observe that it is swinging full and that it has not a sluggish action.

The vertical play of the pinion shafts can, in watches fitted with jewelled bushes, be adjusted by pressing the bush a little farther into or out of its setting, and this is best done with the aid of a jewel-setting press (see Fig. 22). It is always wise to test the concentricity and flatness of the train in a pair of poising calipers (see Fig. 16). It is particularly important to ensure that the centre arbor carrying the cannon pinion is not bent, for it is upon the truth of this that the regular and even passage of the hands relative to the dial and to each other depends.

The Winding Shaft

One of the commonest repair jobs concerns the fitting of a new winding shaft and button. Buttons are made in a large number of shapes and sizes and it is important to obtain one to suit the character of the case. Some cases have a small pipe through which the winding shaft passes, and this means that a button must be chosen which will fit snugly but freely over this pipe. In others the button itself has a pipe, which projects into the case and acts as a bearing. In Lentil type cases with oval bows the button instead of being circular in form is conical to fit into the conical recess in the pendant, but these apply

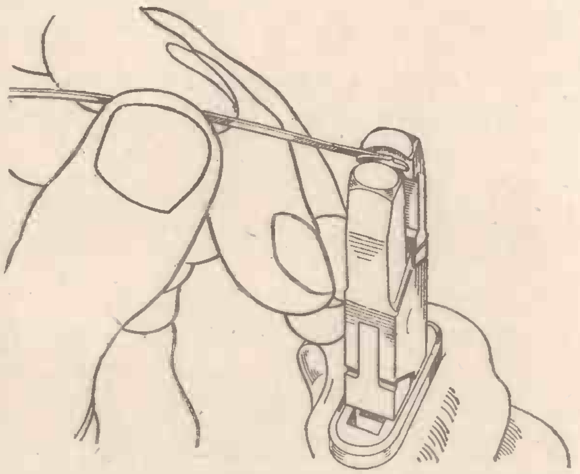


Fig. 14.—Shaping the mainspring end to form the catch piece to engage with the dog in the barrel.

only to pocket watches. The button should not be too large in diameter, so that it extends beyond the band of the case, where wrist watches are concerned otherwise it will chafe the wrist. Again, some buttons are intended to be driven on a tapered square end of the winding shaft, whilst others are screwed on.

Boxes of assorted buttons and winding shafts are available from the material dealers in chrome, silver and rolled gold finishes. The colour of the button must, of course, match the case. If the stump of the old winding shaft is still in the movement, unlock the bolt and pick it out with a pair of tweezers. This is a most useful guide for selecting a new shaft. The position of the groove for the set hands bolt which shifts the sliding part of the castle wheel to the set hands train is important, and so is the length of the square and of the pilot point at the end. When the stem is extended for setting the hands the pilot point should still remain in its hole to act as a guide. The screw end of the shaft can be cut off so that the button fits snugly down to the case or over the pendant as the case may be. If it is a drive-on shaft, careful cutting and filing will be necessary to ensure this.

If, however, the shaft is missing entirely you must first suspect that the hole in the plate is so worn that the bolt does not lock it effectively and it may therefore be necessary to bush the plate before fitting the new shaft. Bushes for this purpose are available.

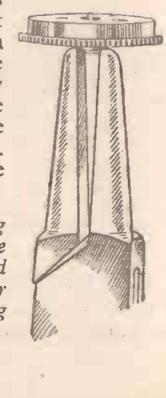


Fig. 17.—Grip the mainspring arbor with the pliers, hold the barrel in the left hand, and turn the pliers to check whether the two ends of the spring engage.

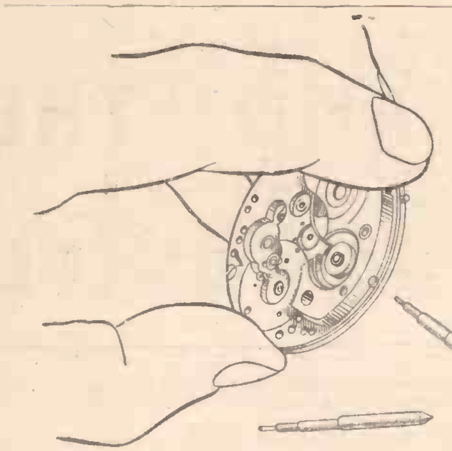


Fig. 18.—Hold the winding shaft in a hand vice and check it for wear in the movement.

Next select a shaft with a square which will fit the square hole in the castle wheel and test it to see that it winds the watch. Next remove it and lay it on top of the plate with the groove coincident with the stud in the bolt which fits into the groove. In this way you will be able to judge the length of the square and of the pivot point, and you may bring it to size and to length by means of a fine Swiss file. In the case of stop watches a small tube is inserted in the pendant and the plunger in the button which operates

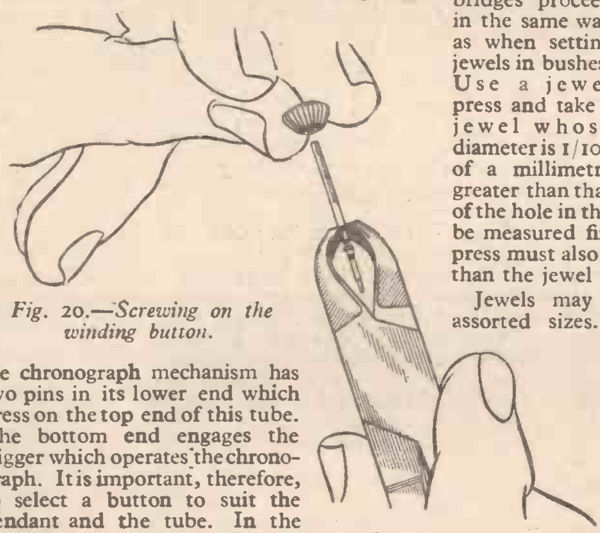


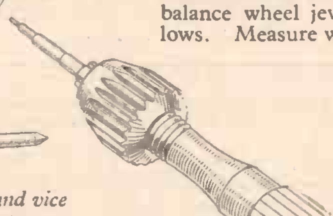
Fig. 20.—Screwing on the winding button.

the chronograph mechanism has two pins in its lower end which press on the top end of this tube. The bottom end engages the trigger which operates the chronograph. It is important, therefore, to select a button to suit the pendant and the tube. In the case of mass-produced watches it is sufficient to send to the material dealer giving the size of the movement and its number and interchangeable button and shaft will then be supplied, and save a great amount of hand fitting.

In some cases what are known as "repair stems" are supplied. These are oversized and are intended for use where the winding holes in the plates are worn. They are usually 5/100, 10/100 and 15/100 of a millimetre greater than normal.

Replacing Jewels

The replacement of jewels, whether set in bushes or not, is done with the help of a simple jewel setting press, an invaluable help to every watch repairer.



For bushes set in bridges and for balance wheel jewels proceed as follows. Measure with a pair of calipers the diameter of the bush hole in the bridge. Then turn a brass bush, whose interior diameter corresponds to the diameter of the jewel. See that the inner and outer diameters of the bush are perfectly centred. Once this is done, choose a jewel with an external diameter 1/100 of a millimetre larger than that of the bush hole. Set the jewel in the bush, taking care that the diameter of the pusher in the jewel press is 10/100 of a millimetre smaller than that of the jewel.

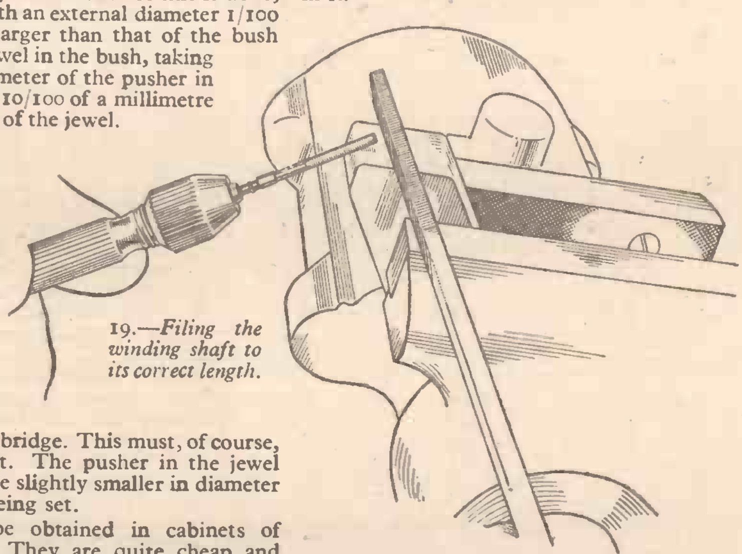
In the case of jewels set in bottom plate and jewelled bridges proceed in the same way as when setting jewels in bushes. Use a jewel press and take a jewel whose diameter is 1/100 of a millimetre greater than that of the hole in the bridge. This must, of course, be measured first. The pusher in the jewel press must also be slightly smaller in diameter than the jewel being set.

Jewels may be obtained in cabinets of assorted sizes. They are quite cheap and should destroy the popular illusion that certain watch repairers "steal the jewels out of watches." The jewels even in the best watches are valueless and useless for any other purpose. They have a hole which makes them unsuitable for jewellery and they are mostly synthetic. In some of the high-class hand-made watches of a few years ago real rubies were used for the jewel holes and diamonds for the end stones. Here again, however, they were of no great value, and could be purchased for a few pence.

Fitting a new jewel can be a troublesome business and watchmakers are not anxious to disturb them!

If you do not wish to purchase a stock of interchangeable jewels, you should strip the plate or bar and send it to one of the trade repairers with the wheel whose pivot runs in the jewel. They will select a jewel and fit it.

Occasionally, the repairer may encounter unjewelled watches, where the holes have worn so large that the gears on full wind jam and stop the watch. In such a case, it is necessary to bush the hole and, as already stated, bushes or bouchons are available. Broach open the hole in the plate until the bush is a tight fit, press it home, dress it off level with the plates, and then by means of a suitable broach, open up the centre hole until the pivot is a free, but not slack, running fit in it.



19.—*Filing the winding shaft to its correct length.*

In general, it can be stated that watches of this sort do not pay for repair, although interchangeable parts, such as hair springs, palets, hands, dials, winding shafts, buttons, mainsprings, etc., are available.

It is particularly important when ordering from the material dealers to state the make of the watch, usually printed on the dial, or its calibre in lignes.

(*To be continued*)

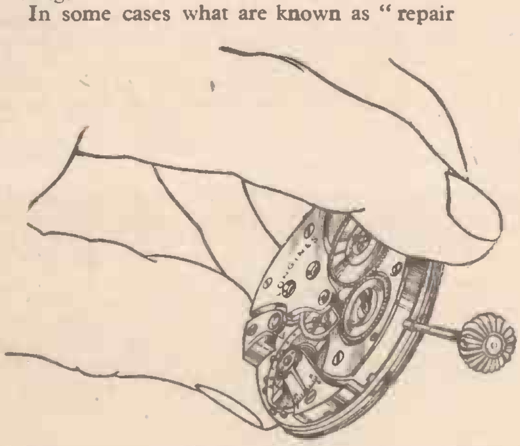


Fig. 21.—Insert the winding stem, lock the bolt down and check for wind and set hands.

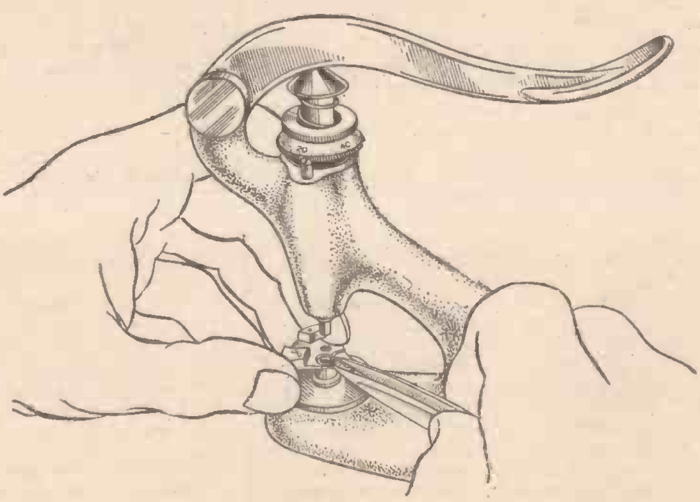


Fig. 22.—A press for jewel setting.

SCIENCE AND THE Coal Industry

A Brief Review of Some of the Research into Coal Mining Problems Carried Out by the National Coal Board

THE Mining Research Establishment was opened in 1952 to continue and extend research in mining previously undertaken on a small scale at the Board's first Central Research Establishment. The design of new machines and equipment is not the aim of the establishment, but it is rather intended to provide a background of knowledge to make this possible. The fields of research at the establishment are many and varied.

Coal Ploughing

Coal ploughs are one of the most attractive types of coal winning machine for thin seams. Their principle of operation is that a blade is drawn along the working face and in effect planes from it a slice of coal which falls to the floor so that it may be conveniently loaded on to the conveyor by a ramp following behind the blade. The plough is mounted on the face conveyor which it uses as a guide and which is advanced as each new cut is taken.

These machines have not been successfully applied to most British coal seams, because the coal is generally too hard. With existing machines in hard coals the haulage forces become too great and there is the complementary difficulty of maintaining the conveyor sufficiently rigidly to provide the large reactions necessary to steer the plough. The work at M.R.E. on ploughing has for its main object the development of a machine which will plough British coal and for a second object the obtaining of a fuller understanding of ploughing and the supplementing of the Establishment's work on coal breakage.

The work is carried on partly in the laboratory and partly underground and some of the recent investigations include a study of the effect of blade angle and cleat direction on the ploughing process. In this investigation wedge-shaped blades were used to take cuts from the prepared faces of blocks of coal. Four blade angles and four cleat directions were used. The force required was recorded for each set of conditions, and the mode of fracture and size distribution of the product was also studied. Fig. 1 shows the results of two of these experiments.

In another experiment, comparison is being made of the forces required to break blocks of various types of coal with a blade. The resistance of the coals to a wedge-shaped blade is to be compared, and the correlation with the impact strength index and other properties examined.

Fig. 1.—Effect of ploughing cleat on size of product. (Above) cleat at 45 deg. to face (measured in direction of travel). (Left) Cleat at 135 deg. to face (measured in direction of travel).

In addition to the component of force parallel to the coal face, which is required to drive the plough blade through the coal, there is also a force perpendicular to the face. The relative magnitude of these two forces plays a part in the steering of coal ploughs. A series of tests are in hand in which both these components of force are measured. The effects of the blade angle and the clearance angle are studied, along with depth of cut and speed of blade.

Percussive Ploughing

When a coal seam is ploughed, the tension in the haulage rope or chain fluctuates owing to variations in the resistance offered by the coal to the plough. Thus the peak forces may exceed permissible limits even though the mean force is well within the capacity of the haulage system. A recent development of the process to enable hard coals to be worked more easily is the introduction of a percussive action on the blade.

A basic study is being made of the relationship existing between triggering thrust, size of blow, and energy requirements. The coal specimen, mounted on a carriage, is brought forward so that the blade takes a cut from a prepared surface. The blade is mounted on a bar, and percussive action is obtained by striking the end of this bar with a heavy pendulum. The size of blow can be varied by changing the height to which the pendulum is lifted. A shoulder on the bar rests against a force-measuring system, so that a record of the force acting on the blade can be obtained.

In the auto-percussive plough large peak forces are obviated by arranging that a pneumatic hammer comes into action whenever the resistance to the blade exceeds a preset value. As soon as the coal is broken and the resistance has diminished the percussion ceases. In this way the haulage force is reduced and steering of the plough is facilitated.

Experimental auto-percussive ploughs have been tried out, and the results hold out good promise that it will be possible to develop a production machine which will be able to plough the hardest British coals at economic rates.

Rock Drilling

Drilling is basic to many mining operations such as shotfiring, exploration, methane drainage and roof bolting, and many millions of feet of hole are drilled annually in rock and coal.

The drilling rate is important, for it often results in quicker cycles of operations. For example, fast drilling has an important bearing on the rate at which tunnels can be driven and new workings opened up. A considerable amount of study has therefore been devoted to the subject.

In the past the percussive method of drilling has been used for rock work and the rotary method for coal winning, but it has been realised recently that rotary drilling can offer advantages in certain rocks which are not too hard or abrasive. The chief advantage of rotary drilling is that higher speeds of penetration can be achieved. Another feature is that dust production is somewhat less of a problem.

The most common method of reducing the amount of airborne dust resulting from drilling operations is to pass water along the drill rod to the drilling tool. Another method is to draw the dust by suction along the drill rod or hole and deposit it in a container. Some work has been done on a comparison of both methods when used with percussive drilling and it has been found the dry method is equally as efficient as wet drilling.

A comparatively new process of drilling, the rotary percussive method, is now being studied to determine to what extent the low bit wear of percussive drilling can be achieved in conjunction with the high penetration rates of rotary drilling. One advantage of the use of the rotary-percussive drill is that in medium hard rocks the rotary action can be used alone and the percussive action applied in conjunction with the rotary motion when the rock is too hard for pure rotary drilling.

It has been shown in earlier work that while penetration rate can be increased by means of an increase in thrust or pressure applied to the tool a limit is reached at which the drilling debris is generated more quickly than it can be evacuated. A complete study is being made of this "clogging" phenomenon and certain design factors have been determined which tend to reduce its gravity.

One improvement which has been made is the introduction of a streamlined joint between the rod and the bit to ensure unrestricted flow of cuttings from the bit to the scroll of the rod. Another fact which has emerged is that the amount of flushing water supplied to the tools governs the penetration speed attainable before the onset of "clogging." This is particularly important with smooth rods which do not have a scroll to assist in the ejection of debris. Three types of drill are shown in Fig. 2.

Other factors which are being studied include the effect of rotation speed, type of tool and disposition of cutting edges.

Metallurgical Investigations

The tools used for rotary or percussive drilling in coal or stone have to withstand very severe conditions of wear. They are for this reason tipped with "cemented carbides," first developed in their modern form in 1926, and now used for this purpose throughout the coal industry. These materials have to be produced by special sintering techniques from fine powdered carbides, notably tungsten carbide mixed with a softer bonding agent, chiefly cobalt metal. Many factors can influence their performance, in particular the size of the carbide grains and the proportion of cobalt.

A detailed metallurgical investigation is being carried out with a view to determining optimum grades of these hard metals for modern onerous conditions.

Strata Control

When coal is cut from a seam, the roof support goes with it and it is necessary to provide some other form of support while men are working in the neighbourhood. As the coal is removed and the face moves forward support must be given to the freshly exposed areas of roof whilst the props can be removed from the spaces no longer needed for the mining operations.

The aim of the work in strata control is in the first place to obtain an understanding of how the rocks are moved and stressed by mining operations, and conversely how the stresses affect the working of the coal, and in the second to devise methods of working and plant which will enable these movements and stresses to be controlled so as to improve the working conditions for the men and increase the output of coal.

Isleworth-Dowty Advancing Support

An example of this latter sphere is the development of the Isleworth-Dowty Walking Prop. The ordinary pit-prop must, of course, be erected and set manually on each occasion it is used and then taken down and removed when the time comes. The object of the "walking prop" project is to devise a unit which can be made under either local or remote control or perhaps later automatically to follow the progress of a face after the passage of a machine and maintain support of the roof all the time. Trials have already taken place of prototypes and six units are currently being manufactured by the Dowty Mining Equipment Company for an extended underground trial. The unit should be particularly well suited to the support of inferior roofs.

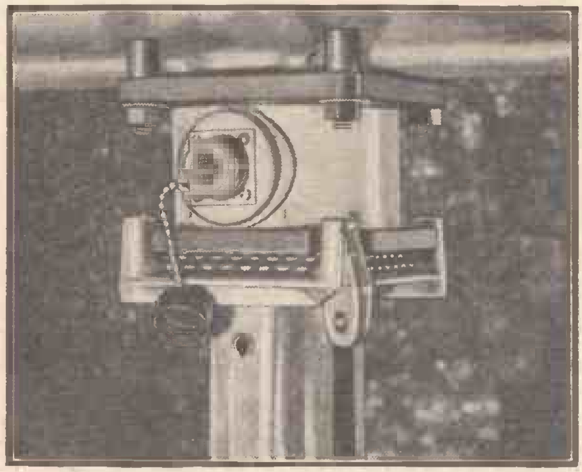


Fig. 3.—Load cell set between prop and roof bar.

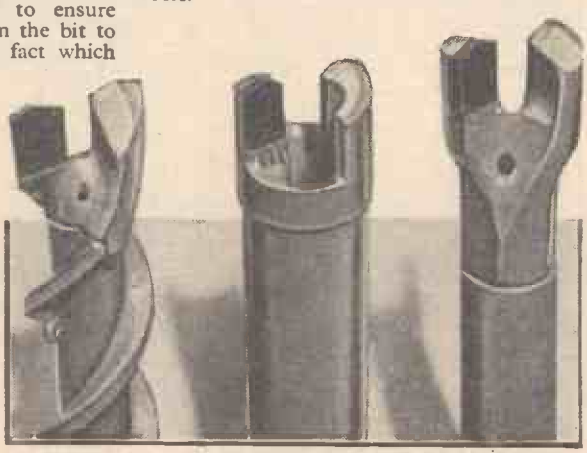


Fig. 2.—Scroll hollow and Continental rotary tools.

The Pit-prop Load Cell

Much of the work in strata control at the present time is concerned with the development of the instruments necessary to the basic measurements. The pit-prop load cell shown in Fig. 3 is an example of this and is intended to measure the load carried by conventional props. It is a steel cylinder held between two steel plates, and is inserted between the pit-prop and the roof bar. The strain on the inside of the cylinder, measured by electrical resistance strain gauges, gives a measure of the load. To reduce the errors caused by eccentric loading to a minimum, eight active gauges, evenly spaced around the circumference and eight temperature compensating gauges, are wired in a Wheatstone Bridge network. The galvanometer on which the load is read and the 6-volt supply battery are housed in a separate wooden box.

The Roof Bar Dynamometer

Roof bolting is a device for supporting the roof of a working by passing long, steel bolts through the surface rock and anchoring them in the overlying strata. An instrument for measuring the load carried by such bolts has been developed at M.R.E. Its principle is basically the same as that used in the pit-prop load cell, but in this instance the cylinder carrying the strain gauges is placed between the bearing plate or roof bar and the nut of the roof bolt.

The Strain Gauge Plug

For a proper understanding of the stresses and strain systems surrounding mine working, information must also be obtained on how the rocks behave ahead of the face and what happens in the pack and waste behind.

A technique for determining the variation in stress at some distance inside rock is being developed. The basis of the technique is the measurement of the strain in a metal tapered plug forced into a tapered socket at the end of a borehole, and the interpretation of this strain in terms of variation in stress in the rock. The strain in the plug is measured by electrical resistance strain gauges cemented internally into the fabricated plug.

The Pack Dynamometer

For the determination of the stresses in the pack, a dynamometer incorporating a hydraulic system has been designed. An 8in. diameter steel cylinder and piston buried in the pack will be connected by a thin tube to a pressure gauge in the nearest roadway. The readings on the gauge then provide a guide to the stress in the pack. The thin connecting tube is protected by a substantial steel pipe. The readings of the gauge are, however, affected by the modulus of elasticity of the dynamometer, the size of the pack material, the nature of the floor and the position of the dynamometer, relative to it and to assess the effects of these factors it has been necessary to make model experiments.

Coal Breakage Investigation

Coal Breakage Group is concerned with the properties of coal as an engineering material, and the way in which these properties enter into the mode of breakdown when coal is subjected to forces such as those produced by cutting and drilling tools.

The work has begun with a study of the behaviour of regularly shaped specimens of coal under the action of simple stress systems, e.g., simple compression and tension. A striking feature of the results obtained has been the variability in strength encountered among superficially identical specimens of coal. Half-inch cubes of coal cut from the same lump have shown crushing strengths varying over a range of 5 : 1 or more. The mean crushing stress also varies with size of specimen, being greater the smaller the specimen. The "strength" of a particular coal is, therefore, not unique, and statistical terms have to be employed to give an adequate description of strength. The physical picture of coal which emerges from our work is of a material ramified with cracks ranging from submicroscopic to macroscopic in size.

The elastic properties of coal are also studied, using both static and dynamic techniques. In the latter, small rods of coal can be made to vibrate at ultrasonic frequencies. Thus the velocity of sound in coal is determined, from which the elastic moduli can be calculated.

An interesting property which has been observed is that some coals "creep" under the action of loads which are less than the breaking load. This movement, although small, can be detected with sensitive apparatus, and is marked in bituminous coal. No such movement can be detected in anthracite. It can be speculated that phenomena like "coal-bursts," violent outbursts from the coal-face which are particularly marked in anthracite areas, may be related to the lack of ability of the coal to creep, and so adjust itself to dangerously high stresses.

Other work which is being carried on in the group includes a study of friction between coal and steel, and of the mechanics of wedge penetration into coal.

Instrument Section

In this section instrumentation problems of many aspects of mining are under consideration. In the field of dust detection, two dust samplers have been designed. One is a control instrument which is left in a working area to collect a dust sample covering up to eight hours. Dust-laden air is drawn in by a small clockwork-driven breathing pump and after passing through a filter (a type of artificial nose) it is exhaled again, leaving the respirable dust deposited on a microscope slide by a combination of gravity settlement and thermal precipitation. When this instrument records a dust concentration greater than the regulation maximum, further samples are taken by the second dust sampler. This works similarly to the long working sampler, but collects instead up to ten samples on a microscope slide, without reloading.

Among the other projects is a micromanometer specially designed for underground use; a multi-channel galvanometer recorder which has been developed as part of an instrumentation project which has as its objective the recording of forces exerted on and by a coal plough as it actually moves along the coal face; an alarm type of flame methanometer, which works on the principle of having a small sensitive bi-metal alarm which is actuated by an increase in the flame temperature as it burns a methane-air mixture.

Work is also being carried out on an acoustic strain gauge for measuring the stresses in rock, roofs, roof supports, etc. These have not been used underground hitherto because the associated electronic equipment cannot be operated in "safety lamp" pits. Transistor equipment is now being designed to replace existing valve circuits.

Environmental Research

Under this heading is included research work aimed at ensuring that the "environmental" conditions in the mines are not injurious to a man's health or working capacity.

Dust

Dust in the mine atmosphere constitutes an immediate danger to life through explosions of coal dust clouds and an insidious danger to health through the initiation of respiratory diseases by either coal or more particularly stone dust, fine enough to penetrate into and be retained in the lungs.

Study of this problem has been simplified by the improved dust samplers already mentioned. The formation of dust has also been studied in relation to rotary drilling techniques, and a definite falling off of fine dust production as penetration per drill revolutions is increased has been established.

Various researches have also been made into the effects of water sprays and wetting agents on the prevention of dust becoming airborne and elimination of dust already airborne.

Research on methane has so far been concerned with the provision of improved measuring instruments, capable of continuous operation, of recording dangerous gas concentration and providing warning of the latter.

Research planned for the near future will investigate the occurrence and distribution of methane underground, particularly making use of improved instrumentation.

Heat and Humidity

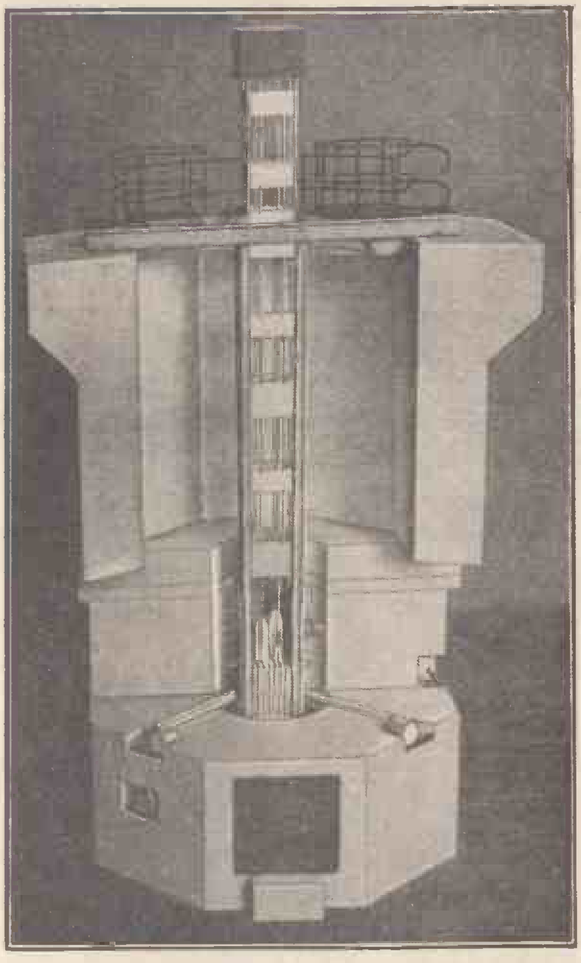
Deep mines are naturally hot and sometimes humid, both of which conditions reduce a man's capacity for work, although there is no long-term effect on health. An investigation as to how heat reaches and is taken up in working places in an actual pit is being followed by a programme of work on laboratory models of mine workings in which thermal effects can be studied more easily than underground.

Studies have been made of the behaviour of a local refrigerating unit providing conditioned air at a heading underground. Re-heating of the cooled air during passage to the working face in a duct has been shown to be largely due to heat radiated from the walls of the heading and the importance of careful distribution of the conditioned air at the face has been demonstrated.

Privately Owned Research Reactor

The First in Britain

BRITAIN'S first privately owned research reactor is to be constructed at the Associated Electrical Industries' Research Establishment at Aldermaston Court in Berkshire. The site for the reactor has been cleared and levelled and design work completed.



A cross-section of "Merlin." The actual fuel element—including Uranium 235—can be contained in a box only 3in. square and 2ft. long—little bigger than a lady's umbrella. But it must be shielded by 18ft. 6in. of water and 6ft. 3in. thick concrete, the total size of "Merlin" being 28 ft. high and 16ft. 6in. wide.

The reactor, which is of the water-moderated "swimming pool" type, is simple and versatile, suitable either for research and engineering investigation or for training purposes. It will be used not only by all the companies of the A.E.I. but will be available to universities, technical colleges and research institutions for undergraduate and post-graduate instruction. Similar reactors are likely to be exported to countries anxious to increase their knowledge of nuclear physics.

The reactor, known as "Merlin" (Medium Energy Research Light-Water-Moderated Industrial Nuclear Reactor) has been designed and will be constructed (subject to local planning permission) by the A.E.I./John Thompson Nuclear Energy Group. The uranium fuel is being provided by the United Kingdom Atomic Energy Authority.

The new reactor, although small, represents a new departure in the development of atomic energy; it is the first to be built and operated outside the authority and for use by industry.

Besides serving as a prototype, the new reactor will provide a powerful tool for A.E.I.'s research scientists and engineers to make their contribution to new inventions and ideas on nuclear power.

The basic nuclear physics research which started at Aldermaston Court nine years ago involves the use of two Van de Graaff accelerators which provide proton and deutron beams used to irradiate various light nuclei. By examining emitted particles and gamma rays from the induced nuclear reactions, important data is obtained on the fundamental properties of the nuclei and the forces which bind them together. Apart from its contribution to the knowledge of fundamental nuclear physics, this type of research has proved to be a valuable training ground where many of the members of the A.E.I. reactor team have gained experience in the techniques used in nuclear physics work.

cheaper power wheels having fixed speeds within this range the ideal arrangement is a friction drive giving a smooth variation of speed within these limits. The usual commercial wheel has an arrangement like Fig. 1, where the driver cone is tilted and a different point of contact gives a different speed ratio. This idea was discarded as the material for the cones would be difficult to obtain and too large to machine. Another commercial arrangement is shown in Fig. 2, where a friction wheel is moved across a large faceplate. This also leads to difficult construction, as the shaft has to be keyed to take the friction wheel, the faceplate is inconveniently large, and it has to be driven at a very low speed, as it always revolves more slowly than the head.

Finally came the idea of using two faceplates with a movable friction wheel between them. Fig. 3 shows the arrangement ; the faceplates are 6in. in diameter, the maximum size that the lathe would take, and are kept at

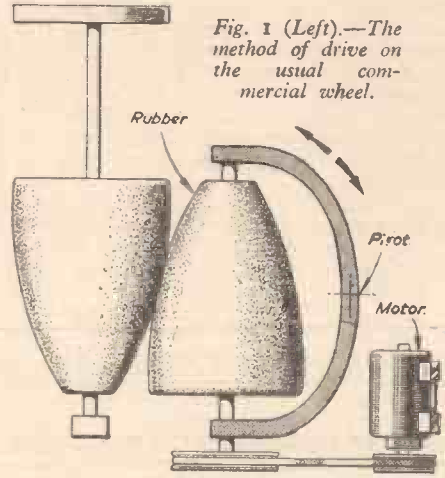


Fig. 1 (Left).—The method of drive on the usual commercial wheel.

pulley fixed to the lower end, runs in ballraces mounted in a standard 2in. pipe nipple. This is attached to the framework by two large

An ELECTRIC POT

A Variable Speed Unit Made from Ch

By R. W

constant pressure on an idler friction wheel running between them. If the faceplate centres are offset by 3¾in. a 1⅝in. movement of the friction wheel will give a speed variation of near enough 5 to 1 and this will conform with the original specification of a speed of 50 to 250 r.p.m. The mean speed in this range is $_{5}\times 50=112$ r.p.m. when both plates are revolving at the same speed ; the bottom plate will have to be driven at this speed and the top plate will go faster or more slowly according to the position of the friction wheel. A standard 1,450 r.p.m. ¼ h.p. motor is used and the ratio of speed reduction from this to the bottom plate is 13 to 1, which is rather high for one step. A compromise was reached by using a 12in. flywheel from an old sewing machine, since converted to power drive, and a 1in. pulley on the motor ; a ⅜in. M-section endless belt takes the drive very well and the resultant speed at the wheel is 54 to 270 r.p.m., which is very little different from the original estimate. If the large pulley is not available the speed reduction will have to be made in two steps, with the use of a countershaft.

A WHEEL and a kiln are expensive items and the handyman will obviously wish to save by making his own wheel. Some of the world's finest work has been fashioned on primitive kick wheels, but in this case ways and means were sought for the construction of the more desirable power-driven model. The specification was for an efficient variable-speed wheel made from cheap and easily available materials. Any machining required was to be within the capabilities of a 3in. lathe, the only machine tool available. Figs. 4 and 7 show the author's completed wheel.

Variable Speed

The first thing to be considered was the method of drive. The speed of the head requires to be varied within the limits of about 50 to 250 r.p.m., and while there are some

Fig. 4.—The completed electric potter's wheel.

Construction

The complete mechanism as shown in Fig. 8 is built in a framework of 5½in. × 1½in. deal. The top section is braced and the whole forms a very rigid structure round which the rest of the wheel can be built. The main shaft is a car half-shaft and the hub fits on to the splined end to form a base for the wheel head. The shaft runs in ballraces and a 6in. steel disc is screwed on to the lower end. The short bottom shaft, with another 6in. disc screwed to the top end and the 12in.

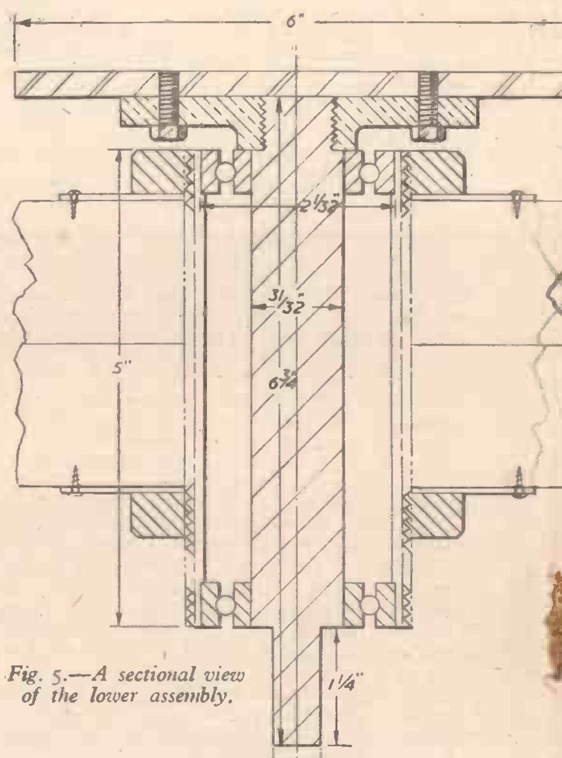


Fig. 5.—A sectional view of the lower assembly.

retaining nuts. The rubber friction roller, which is an ordinary rubber roller skate wheel, is held under slight pressure between the two discs. Pressure is adjusted by the two large nuts, which move the whole lower assembly up and down ; these also take up the wear on the friction wheel, which runs on the end of a shaft supported by two brackets, and is moved laterally by a conveniently placed foot pedal. Sizes may have to be altered slightly to suit the materials available ; the first place to look is a garage, and there find a discarded half-shaft

Fig. 6.— the

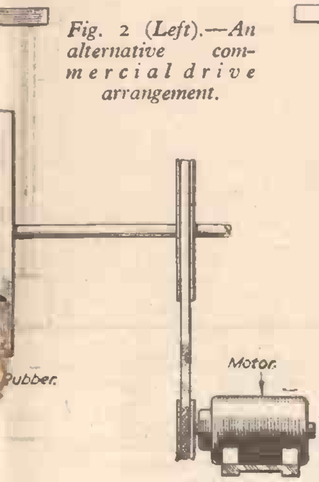


Fig. 2 (Left).—An alternative commercial drive arrangement.

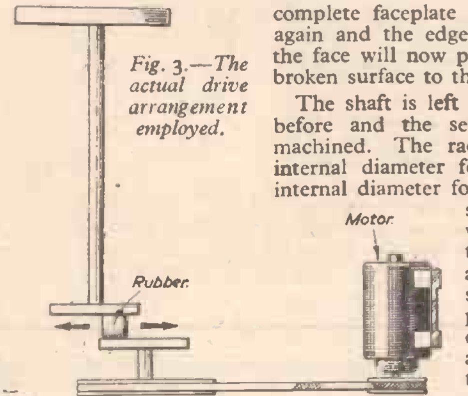


Fig. 3.—The actual drive arrangement employed.

with hub, together with a selection of ballraces in good condition. If the splined fitting is not too badly worn a little judicious work with a hammer and punch on the end of the shaft will make the hub a good

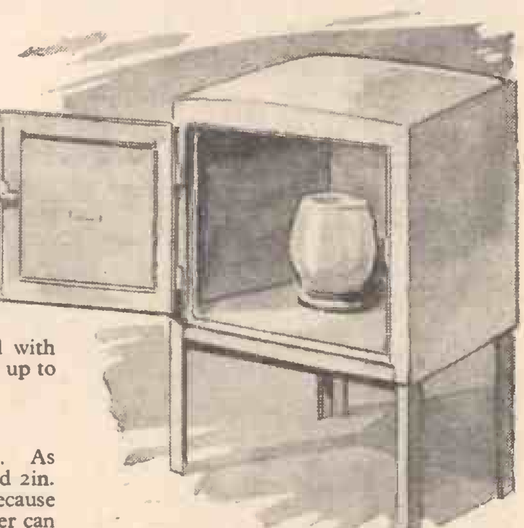
complete faceplate is mounted on the shaft again and the edge and face finish turned; the face will now present a smooth and unbroken surface to the friction wheel.

The shaft is left mounted on the lathe as before and the seatings for the ballraces machined. The races chosen were $1^{3}/_{16}$in. internal diameter for the top and 13/16in. internal diameter for the lower, and if these sizes can be found, then very little metal will have to be removed. The races are positioned so that the surface of the upper faceplate is 1¼in. below the cross-member when finally mounted. To mount the shaft in position, clearance holes are cut in the two top members and over these are fixed 4in. square plates of 1/16in. steel with holes cut to clear the moving parts of the races, which are then fixed in place by three ¼in. bolts through wood and plate, stout washers under the bolt heads clampdown on the outer ring of the race.

the disc as before. To ensure accuracy the disc is faced off while mounted on the shaft and running between centres.

The Variable Speed Control

The position of the control for varying the speed by means of a foot pedal is shown in Fig. 8, but Fig. 6 gives the dimensions in greater detail. The roller skate wheel has its own ballbearings and is simply held on to the shaft by means of two ¼in. Whit. locknuts. The holes in the supporting brackets are elongated in the vertical direction to allow for the adjustment of pressure and wear. The two collars on the shaft are stops and are adjusted to prevent the friction wheel from running over the edge of the discs at either end of its travel. The bearing rod for the foot pedal is clamped to the angle iron and runs between a bracket on the lower cross-member and a piece of iron strip fixed to the end of the side foot rest. The foot pedal is fixed to the angle iron and thus forms a conveniently



TER'S WHEEL

heap and Readily Available Materials

/. HILL

fit with no shake, and provide the boon of a wheel head which can be removed easily and replaced with the certainty that it will run truly.

Machining

Obtain a fairly large shaft, 1¼in. across flats if possible, and start by cutting this to a length of 14¼in. The hollow knurled portion of the hub is sawn off and cleaned up and this end mounted in the four-jaw chuck. The shaft is inserted to check that the hub is running truly, and the flange is then faced off; this is the surface on which the wheel head proper will rest. The flange of the hub is now bolted to the faceplate and the shaft inserted and supported by the back centre. The end is cut down to .825in. for a length of ½in. and threaded 14 T.P.I. to take a standard ½in. pipe flange, on which is mounted the upper faceplate. The easiest way to obtain the two faceplates is to have the local blacksmith flame-cut them from ¼in. steel plate. The faceplate is drilled and tapped ¼ Whit. to coincide with the existing holes in the flange, and the two securely bolted together. The

This is no doubt a very bad way of mounting ballraces, but these large races are only lightly loaded compared with their normal use and they seem to stand up to the strain very well.

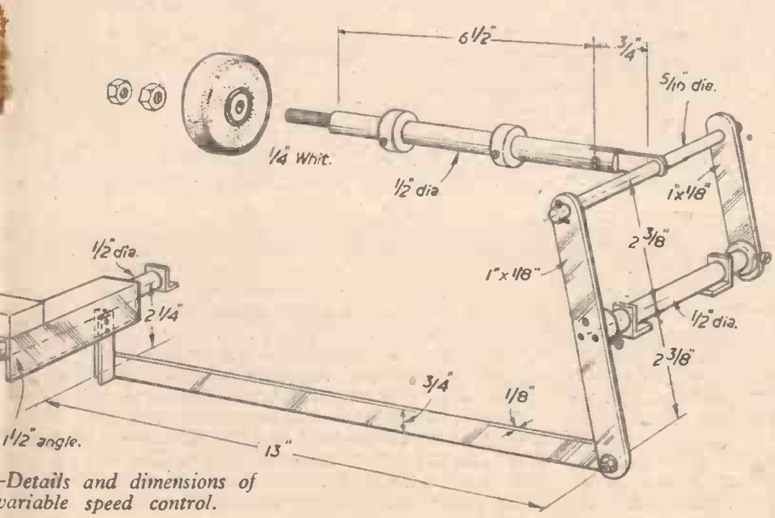
The Lower Assembly

This is shown in section in Fig. 5. As mentioned before, the basis is a standard 2in. pipe nipple, and this size was chosen because two ballraces of 2 1/32in. outer diameter can be fitted in each end very nicely. A nipple with the longest amount of thread is chosen and mounted on the lathe cross slide and the seatings machined with a between-centre boring bar; here again very little metal has to be removed. A hole is cut in the lower cross-member, and an additional piece of wood is added to give the assembly greater stability. The hole must be accurate, as the two discs must at all times lie exactly in the same plane. Two 5in. plates are fitted for the large nuts to bear on. The shaft is machined to a push fit for the ballraces, the lower end cut down to ½in. for the large pulley and the top end screwed to take

placed extension to the foot rest. The pedal should be horizontal at maximum speed; there is no need for a return spring as the friction wheel is slowly pulled over to the low speed position when the wheel is running, so that all that is needed is a gentle pressure on the pedal to maintain the required speed.

The Framework

The framework, shown in Fig. 9, is made of fairly light material as it serves for the



-Details and dimensions of variable speed control.

Fig. 7.—A further view of the completed wheel, showing foot pedal and control box.

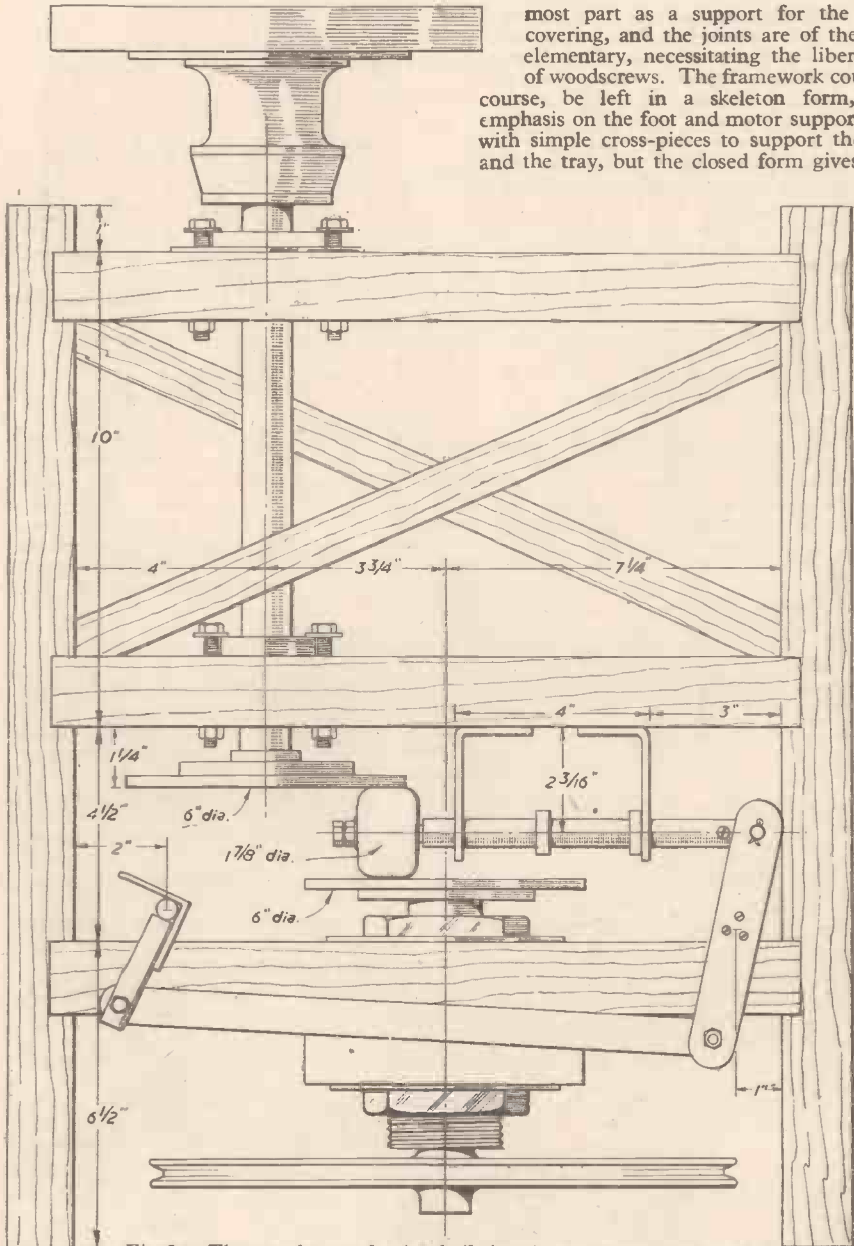


Fig. 8.—The complete mechanism built into its supporting framework.

most part as a support for the outer covering, and the joints are of the most elementary, necessitating the liberal use of woodscrews. The framework could, of course, be left in a skeleton form, with emphasis on the foot and motor supports and with simple cross-pieces to support the base and the tray, but the closed form gives a far better appearance for home use and is well worth the extra trouble. The finish is in ply or hardboard and the side panels have to be slotted to fit over the foot rests.

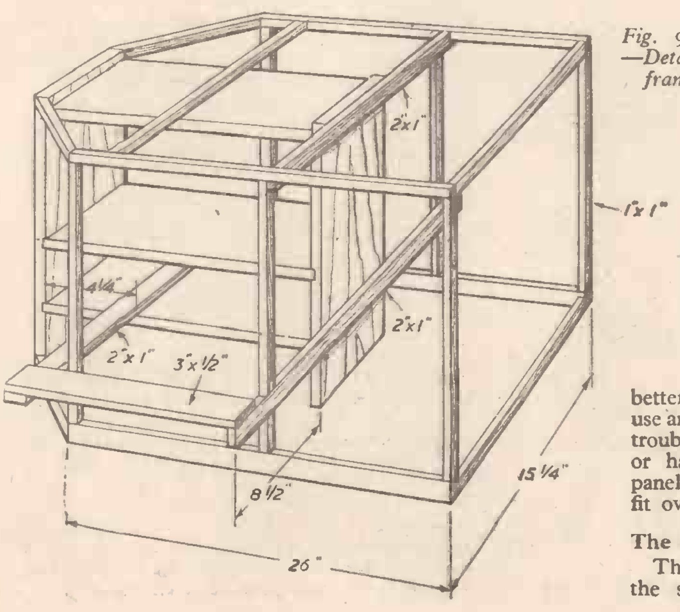


Fig. 9 (Left).—Details of the framework.

The Motor

The motor board is of the simple form shown in

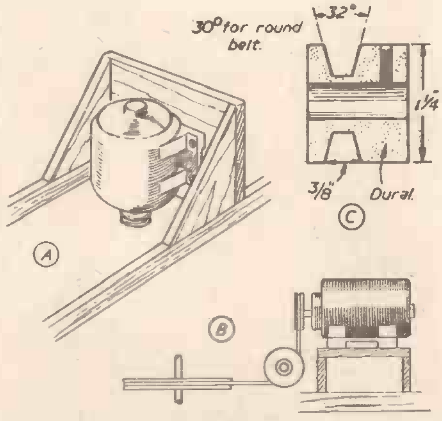


Fig. 10.—Methods of mounting motor and of making motor pulley.

Fig. 10A, the board is spaced away from the side pieces to adjust the belt tension. A $\frac{3}{8}$in. M-section belt 51in. long will just run clear of the end section of the basic framework. Only a ballbearing motor should be used in this position as a plain bearing motor is probably not designed to take the end load. If a plain bearing motor is the only type available the arrangement of Fig. 10B should be used, where the motor is mounted on a horizontal board and the drive goes via two jockey pulleys. The pulleys can be made from hardwood, the size is not critical and they can be made just large enough to hold ball-races. They are mounted on two short lengths of dowel which are screwed to the framework in the appropriate position. With this second arrangement the belt can be of $\frac{1}{4}$in. round leather and works best under slight tension. This can be achieved by mounting the motor on rubber and tilting it back slightly by clamping down the rear end.

The Tray

Fig. 11 shows how the tray is made. The base was a large 1in. board, from a tabletop, but it could also be made from Weyroc or narrower boards battened together. To make it waterproof the tray is lined with sheet zinc. This is cut and bent to size, pushed

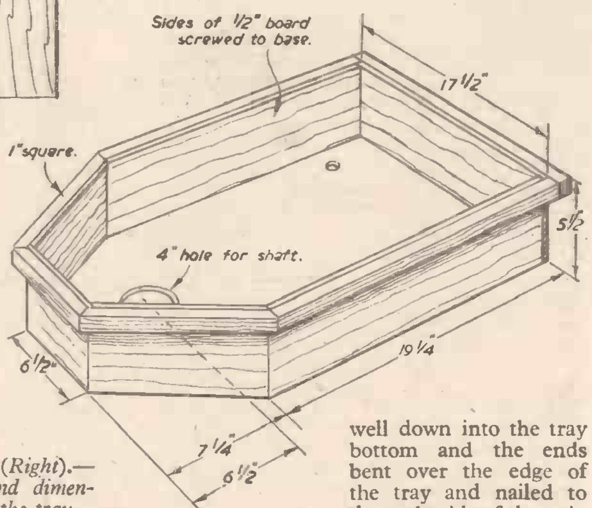


Fig. 11 (Right).—Details and dimensions of the tray.

well down into the tray bottom and the ends bent over the edge of the tray and nailed to the underside of the strip of wood edging the tray, where the sharp edges are out of harm's way. The bearing protector, Fig. 12, is first mounted over the shaft hole. A drain plug is made from a short length of screwed pipe and fixed by two nuts through a hole in the far corner of the tray. The top nut is recessed into the base of the tray to allow the water to drain away and a length of rubber hose is pushed on to the pipe and passed through the outer casing. The water is retained by a pointed bung pushed into the plug. All the joints are soldered up and the tray will hold a fair amount of water without endangering the mechanism. The finished tray is fixed to the framework by a few angle brackets and can be removed easily if required.

The Wheelhead

This is a 9in. disc of 1in. thick beech ; it does not have to be machined specially, for the top of the hub is true, and so long as the two sides of the wood are parallel, then the working surface will run accurately. The head is positioned on the hub and fixed with woodscrews inserted through the existing holes. A flange of zinc 7in. across and 1½in. deep is also screwed to the underside of the head and sealed with a little rubber sealing compound, to save water running off the edge of the head and down the shaft.

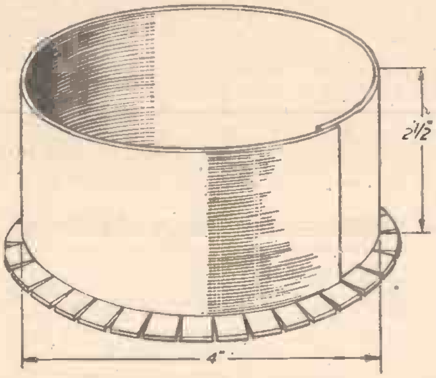


Fig. 12.—The bearing protector.

The Electrical Connections

A foot operated on-off switch is almost essential as the hands are usually covered in clay, and a small box to the rear of the right-hand foot rest houses an old electric iron switch, which is operated by a bracket fixed to the underside of a hinged wooden flap. A car type dip switch would also operate very well and probably be much easier to install. Two three-pin 5 amp. outlets are mounted on the end of the box, one for the motor and one for a lamp, if required ; the connections are shown in Fig. 13.

Due to the low construction the finished wheel presents a very neat appearance, and an ordinary household stool will give about the right working height with the feet on the side rests. The large ballraces employed will give a long and trouble-free life, the only point where attention is required being the rubber friction wheel. A fair amount of wear takes place here, but it lasts a considerable time before adjustment is needed, and even when it is worn out a replacement can be fitted in a few minutes.

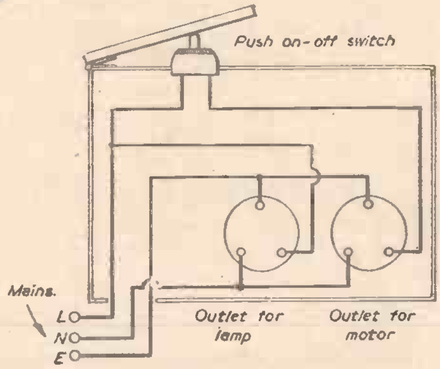


Fig. 13.—The electrical circuit.

BLACK LIGHT

How it is Produced and its Uses

By "SPECTUS"

BLACK light is a source of ultra-violet light filtered with special black glass, which absorbs all visible radiation or light from the discharge while transmitting the near ultra-violet radiation in the form of rays which are invisible to the human eye. These invisible waves if projected or focused on certain chemically treated articles will render the latter clearly visible in a dark room without any other source of light.

For instance a bright red pillar-box placed in a darkroom cannot be seen, but if chemically treated and a black light projected on it it will come to life in its complete form, colour and detail although no light will be visible. A close examination of the lamp, though, will reveal a dull violet glow, this being the radiation emitter beyond the violet end of the visible range.

Only carbon-arc or mercury vapour discharge lamps are rich enough in ultra violet to allow perfect filtration of the elimination of visible light rays, thus leaving only the invisible wavelengths to be transmitted for the purpose required, that being making the invisible visible.

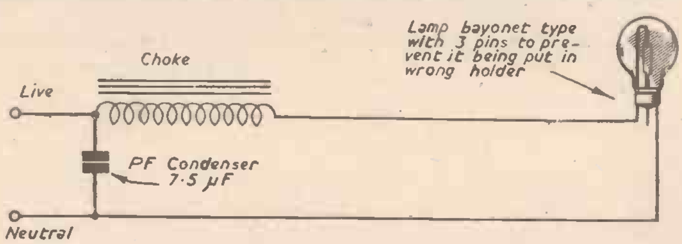
The only substance available to be used with these invisible rays to make that change is "Fluorescence," and black light will excite anything that has been treated with it so that it will glow visibly.

It is possible, therefore, to render visible a nearly complete colour range under black light and these colours will glow intensely all the time black light is projected on them.

The usual lamp for radiating black light is an ordinary 125-watt mercury vapour discharge lamp, identical to the street lighting lamps except that it is enveloped in black glass.

The spectrum of the mercury arc and the transmission properties of the black glass are such that the radiation from a 125-watt bulb is approximately 3,650 Ångström units, and, although not considered harmful, can cause annoyance and fatigue to the eyes if not shielded. *On no account must medical ultra-violet lamps be used for this purpose.*

A mercury vapour discharge lamp must be used with a choke or ballast resistor (the latter not recommended unless for D.C. operation) in a circuit which is given below. For carbon-arc spotlights or lamps special black filters may be used and also there is a range of U.V. tubes in 2ft., 3ft., 4ft. and 5ft. lengths which may be inserted in standard fluorescent lighting units.



Circuit when using a mercury vapour discharge lamp.

A good range of fluorescent paints, powders, paper, fabrics or flowers is available and for the experimenter it is suggested that the paper or fabrics be used as they need no special preparation like the paints and are cheaper. All colours are available. Powders for mixing with water for display fountains are unsuitable for anything else than the purpose for which supplied.

Fluorescent powder can be supplied with a suitable medium for making paints, but care must be taken when mixing so as not to crush the crystal-like particles of the powder or fluorescence will be lost.

Before using the paint articles for treatment must be smooth in surface and previously painted with a good stippled white undercoat.

The use of other undercoats of different colour will give the fluorescence a dull glow. Avoid vigorous brushing.

Painting of the fluorescent material must be done with a coarse or semi-coarse brush, keeping in one direction only.

Two coats are usually advisable, making sure that the first coat is perfectly dry before attempting the second coat. On no account rebrush over a wet surface.

After treatment the articles may be given a protective coat of good quality clear varnish. This will preserve the paint against possible damage or wear.

Main colours are as follow :

Colour of Paint	*Fluorescent Colour*
Deep yellow	Red
Yellow ochre	Orange
Light ivory	Green
Cream	Yellow
Dull white	Pale blue Violet

Other colours are available that fluoresce in their own colour.

For the best results complete darkness is necessary.

Black lights may be used by the magician as well as in the theatre and, of course, scientifically. Most aircraft have a small cockpit black light to fluoresce the various meters and gauges in flight. An ordinary 12-volt bulb is used, but there is sufficient ultra violet to serve the purpose, whereas visible light might cause annoyance to the pilot. Fluorescence is used now also in the aircraft and metal industries for crack detection in porous metals and fatigue after various treatments. No doubt, too, other valuable uses will be found in the future.

Radio-controlled Models

(*Concluded from page 407*)

star wheel on the first actuator can complete one revolution, i.e., about one second. With a little practice, however, any desired operation can be selected at will.

Fig. 6 gives an overall view of the fuselage of a model plane and illustrates the usual positioning of the various components of a control system to give rudder control only. The rubber band powering the rudder escapement is wound up by winding the crank which extends from the tail of the plane. It is important that the piano wire linkage between the actuator and the rudder crank is in line and very free to rotate as any tendency to stick will cause uneven operation of the mechanism.

MEASURING the TEMPERATURE of the MOON

By V. A. FIRSOFF, M.A., F.R.A.S.

How Scientists Have Discovered the Nature of the Lunar Climate

THE temperature of accessible objects can be taken, broadly speaking, in much the same way as that of a patient —by popping the thermometer into the mouth. Here heat from the tested body is allowed to flow by conduction into the mercury or alcohol column sealed in an evacuated glass tube (this is what an ordinary thermometer in fact is) until it reaches the same level in both. When, however, the temperature is too high or the object itself cannot be reached, this method of direct contact becomes impracticable.

The Method Simplified

Apart from conducted heat, any user of an electric fire, or for that matter any fire, to say nothing of sunshine, will be familiar with radiated heat. This is carried by electromagnetic vibrations of the same kind as light is, but the frequency of these vibrations is lower, or their wavelengths are longer, than in those responsible for optical sensations. They are not directly visible and are referred to as infra-red radiations, that is to say, the radiations found beyond the red end of the visual spectrum. The distinction between the " obscure " infra-red heat and ordinary light can be demonstrated by screening the fire with a glass container filled with water, known to astronomers as a water cell. We shall still see the fire but this will be a cold glow, for a water cell stops the infra-red more or less completely while allowing the light to pass through.

If we heat, say, a poker with a blowlamp at first we shall be able to feel its heat at a distance but there will be no glow. The poker radiates in the infra-red only. Then, as its temperature rises it will turn a dull red, which will gradually brighten up to cherry red and eventually to white. This means that with increasing temperature the poker emits more and more radiations of shorter and still shorter wavelengths. If we measure the amount of radiation emitted by a glowing body wavelength by wavelength, which can be done photo-electrically, we shall find that the point of most intense emission of energy will fall within the progressively shorter wavelengths as the temperature of emission rises. There exists a law relating the latter to the wavelength of maximum energy, and this is how the temperatures of remote stars can be gauged, though some practical difficulties arise from the transparent nature of the star surface.

The stars, however, are immensely hot; their temperatures run into thousands of degrees and their peak emission falls conveniently within the so-called " optical window " where our air is transparent to radiation. The planets and the Moon, on the other hand, are merely warm or cold. Yet, however cold a body may be, it will still be sending forth radiations, only less and less and their maximum energy will shift farther and farther into the region of longer wavelengths, beyond the red and the infra-red into the range of the short-wave radio, as the temperature falls. To most of these longer wavelengths our atmosphere is opaque, so that such radiations can be studied only within certain gaps where the air becomes sufficiently transparent to let them through.

We must, therefore, proceed differently from the case with the stars. Instead of looking for the peak of energy emission, we simply try to find how much heat the body radiates in the accessible wavelengths, either infra-red or radio, and make good the deficiencies from theory. Here the shorter distance is helpful, for these electro-magnetic waves spread uniformly through space, that is to say, they obey the " inverse square law "; if the distance increases twice, the amount of heat received by the same area exposed at right angles to the radiations will drop to one-fourth, if three times, to one-ninth, and so on. Due to this, the amount of heat coming from a body as cold as Jupiter (about —225 deg. F.) can still be measured, while that from hot stars tens of thousands of times as far away cannot. And, of course, if we know the distance of the body and the amount of heat received from it, say, per minute, we can easily get its temperature. Usually, however, we can obtain only part of this heat.

Part of the heat coming from the Moon, or planet, is merely reflected sunshine, and if we measured this we might learn something about the temperature of the Sun but not of the Moon. The lunar heat radiations must be isolated. The way to do this is the same as in screening out fire. The Moon radiates only in the longer wavelengths where the radiation from the Sun is practically nil. If, therefore, we interpose a water cell the heat of the Moon is cut off and only the solar heat comes through. The difference of the measurements with and without the cell will give us the lunar (or planetary) heat.

The Thermocouple

The amount of this heat is minute but it can be determined by means of a thermocouple, which is essentially a blackened wire made in three parts of two different metals welded together and sealed in a vacuum bubble, like an electric bulb. If the two welding points are at different temperatures, a current will flow through the wire. This current can be amplified and read off an ammeter. It is broadly proportional to the rise (or fall) in the temperature and depends also on the metals used. Ideally, in the absence of air, a zinc-and-bismuth thermocouple will register the heat of a candle at a distance of 3 miles; whilst a Cashman cell, which is not strictly a thermocouple, is 100 to 1,000 times as sensitive to certain parts of the infra-red.

The American investigators Nicholson and Pettit placed a zinc-and-bismuth thermocouple at the focus of the great 100in. Hooker Telescope at Mount Wilson and were able in this way to make accurate measurements of the temperatures of the Moon and planets.

Temperature Variation on the Moon

The temperature of the lunar ground where the Sun is directly overhead came out at +248 deg. F., considerably above the boiling point of water on the Earth (on the Moon, water is expected to sublime, or boil before melting, at about −60 deg. F. owing to the almost total absence of an atmosphere). When the Sun is not shining vertically down the temperature of the ground drops fairly rapidly and round about the lunar poles it will never rise above freezing point, whilst in the depth of the fortnight-long lunar night the thermometer will drop as low as −239 deg. F. Here, though, the Mount Wilson figures become unreliable, as at such low temperatures infra-red emission is very weak.

Pettit found that during a lunar eclipse the temperature of the surface of the Moon within one hour of entering the Earth's full shadow fell from 160 deg. F. to −110 deg. F. and rose as rapidly again with the returning sunshine. This is possible only if the lunar ground consists of far better heat-insulating materials than anything normally available on the Earth. In fact, the Dutch astronomer Wesselink tried to match the effect with various substances and obtained the best approximation with fine dust in vacuo—under terrestrial gravity. This was a point which he overlooked, for on the Moon every dust particle would have only a sixth of its terrestrial weight, so that the whole would be lying much more loosely and be an even worse conductor of heat.

Under-surface Temperatures

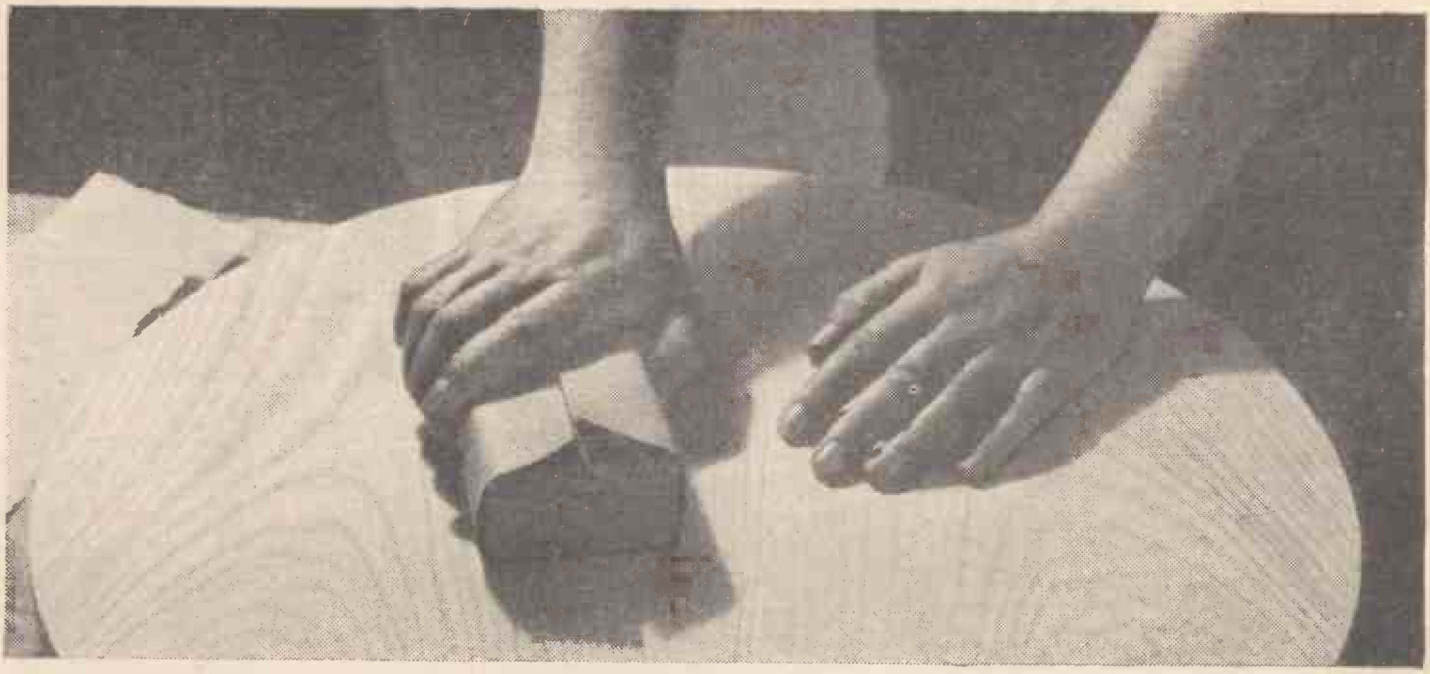
However, these results have since been supplemented by the investigations made in 1948 by Piddington and Minnett in Australia, who used a radio telescope and studied, instead of the infra-red, the short-wave radio emission from the Moon at 24,000 M/cs per sec. or 1.25 cm. wavelength. For the reasons stated above, this method is especially suitable for low temperatures and will, no doubt, in due course be extended to planets.

Whereas the surface of the Moon is opaque to infra-red radiations and the temperatures obtained by Nicholson and Pettit are those of the Moon's " skin," the short radio waves penetrate some way underground and the temperatures obtained by the Australian scientists refer to a layer about 3ft. deep.

As can be expected, it is much colder there, and indeed the lunar " subsoil " remains in a condition of permafrost, like the subsoil of Alaska or Siberia. Also, while it takes only a couple of hours of sunshine to bring the " skin " of the Moon from the frost of midnight to the scorching heat of the lunar noon, the layer examined with the radio telescope heats up but slowly, reaching its highest temperature 3½ days after the lunar noon and its lowest the same time after midnight. The range of variation is also less—about 145 deg. F. for the whole Moon and 190 deg. F. for the narrow equatorial belt. In

(*Concluded on page 421.*)

Craftsmanship deserves a triumphant finish



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the latter the maximum temperature attained 3ft. underground is only 85 deg. F. and the minimum −105 deg. F. Still deeper the temperature does not vary and stays permanently at about 40 deg. F. of frost. This is cold enough, yet the lunar rocks are such good heat insulators that if the future explorers build their shelters underground there should be no difficulty about keeping these at a genial temperature day and night. From Piddington and Minnett's data the night temperature of the lunar surface comes out some 40 deg. F. higher than as measured with a thermocouple.

These results are interesting also in another way. They permit us to estimate more correctly the rate at which heat flows in the lunar rocks. In fact, Wesselink's calculations require some revision and it now appears that the case is best met by an extremely bubbly type of rock, resembling pumice, overlaid by a thin skin of dusty material, probably of meteoric or volcanic origin, in the presence of gas. The skin may on the average be only a millimetre thick and it is this dust that gets so very hot in the day and so cold at night.

Such structure of the lunar surface is of considerable importance to the possible existence of some hardy type of vegetation, which might resemble our lichens.

Masking Frames for Enlarging

Making and Using a Handy Set of Cardboard Masks

By P. H. BRECKIN

THERE are many commercially made adjustable masking frames on the market for holding the sensitised paper on the baseboard when enlarging, but the prices are prohibitive to many amateur photographers, and in addition, they have a number of disadvantages such as :

(a) Difficulty in holding the paper whilst lowering the frame, without the paper moving slightly.

(b) Margins do not always become even and parallel with the edge of the print.

(c) It is not possible to raise the frame whilst in position, with the enlarger head low down, without moving the frame from its original position.

(d) The author has found that most difficulty is experienced in producing small prints such as quarter-plate size when the print is in the top left corner of the frame, and the majority of the wood base including the rubber foot is overhanging the enlarger baseboard, thereby giving an entirely unstable and sloping surface.

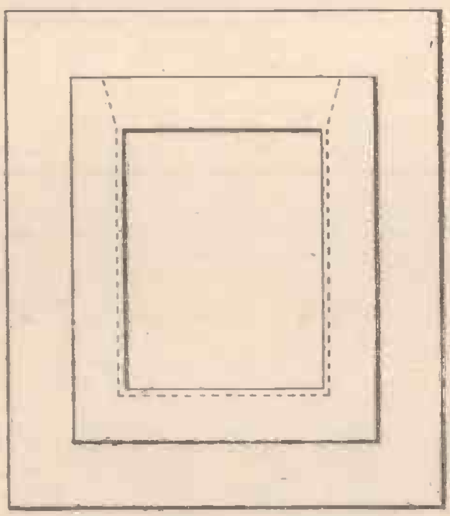


Fig. 1.—The completed mask.

My own adjustable masking frame was abandoned in favour of a series of frames made in 1942 and which are still in constant use.

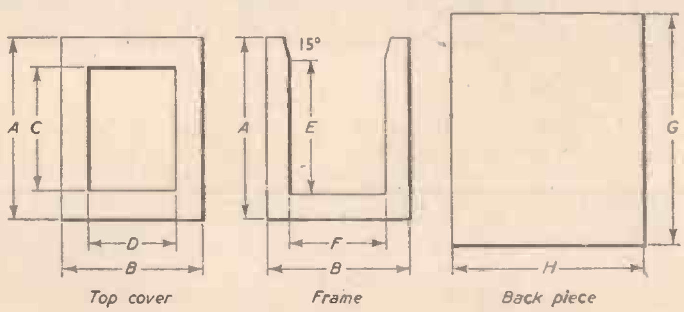
These have many advantages, which are especially noticeable when several identical enlargements have to be produced from one negative, or when single enlargements of the same size are required from a series of negatives, and even for single prints the masks are preferred to a metal masking frame.

The masks are made at negligible cost from three pieces of white card approximately 1/16in. thick, and the three sections are glued together, as shown in Figs. 1 and 2. No specific card thickness is essential, but for the larger sizes it is advisable to use a thicker card to prevent any floppiness.

First, determine the sizes of enlargement you are likely to require and make out a table similar to that shown in Fig. 3. The author made a series of frames covering all the standard sizes up to 12in. x 10 in., and intermediate sizes which are produced by cutting the standard sheets into two, four and eight pieces.

When the sizes you are likely to require have been decided, and also the width of margin desired, the table can be completed, and when all the sizes have been entered it will be apparent that several of the smaller pieces of card will be available from the offcuts from the larger masks.

Now a few remarks in connection with the table of sizes. A white margin of ⅛in. all round has been allowed on the three largest masks and 1/16in. all round on the two smaller ones. This margin can be varied to suit individual taste by adjusting the appropriate dimensions in the table. A clearance of 1/32in. or 1/16in. has been left above the paper size in the centre frame-piece, as different makes of paper have been found to vary slightly in size. It is essential that the cut-out in the top cover should be cleanly cut with a sharp knife or razor blade, as otherwise any wavy or rough edges will appear on the finished print.



Paper size	A	B	C	D	E	F	G	H
12 x 10	14	12	11¾	9¾	12 1/16	10 1/16	16½	14½
10 x 8	12	10	9¾	7¾	10 1/16	8 1/16	14½	12½
8½ x 6½	10½	8½	8¼	6¼	8 9/16	6 9/16	13	11
6½ x 4¾	8	6¼	6⅜	4⅝	6 17/32	4 25/32	10	8¼
4¼ x 3¼	5¾	4¾	4⅛	3⅛	4 9/32	3 9/32	7¾	6¾

Fig. 3.—Dimensions for making different sized masks.

Method of Use

The negative is placed in the carrier and the appropriate mask selected for the size of enlargement required. An old print is slid into the mask and the back used for focusing the negative ; this allows for the paper thickness to be used. The mask can be moved about until the composition is decided upon, or the portion required is selected, and it is then pinned down by drawing pins in each corner of the back piece. The sensitised paper is slid into place and the necessary exposure given. It is quite a simple and speedy operation to slide in and out subsequent prints, and each one is exactly the same area and size, with an even white border all round.

The entire front faces of the frame and inner area of the backpiece can be painted with indian ink to minimise any light reflections on the paper, and if objections are raised to pins being inserted in the baseboard, a cork bath mat can be purchased from a multiple store and this used on top of the baseboard.

A further refinement would be to make a list of the various sizes and give each a letter or number, which would also appear in large size on the border of the back piece. If the list is pinned adjacent to the enlarger, it is quite an easy matter to locate the particular size of mask required.

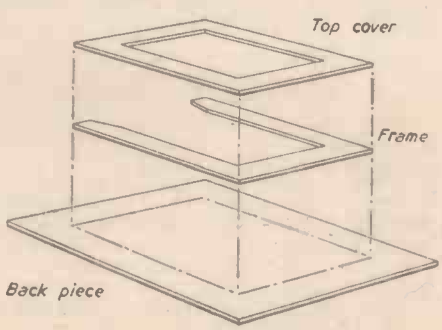
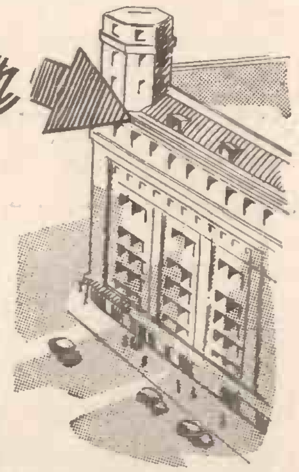


Fig. 2.—The separate parts.

Letters to the Editor



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

Drying Feathers

SIR,—Referring to "Feathers for a Sleeping Bag" in queries column of February issue, an old-style method of drying feathers, well-known in country districts, is to use the iron wash-house boiler of the type built into a corner and heated by a fire underneath. The method of cleaning and drying the feathers is to put them into the *dry* boiler, and light a *small* fire of sticks or paper, preferably paper, just large enough to warm the metal. Stir the feathers as they toast gently. When the feathers are dry and fluffy, lift them out and you will find all the foreign bodies, etc., at the foot of the boiler. No doubt insecticides and fumigants could be used at the same time but I have no experience of these as the heat is usually sufficient.—H. W. HOWIE (Selkirk).

Electric Imitation Coal Fire

SIR,—In reply to J. Wright, who seeks information in constructing an imitation electric fire, I offer the following. First build a fire on a board with either coal or logs exactly the shape required. Next, take a piece of buckram (obtainable from a milliner) and soak in warm water until soft. Then place it over the built-up logs or coal, press the buckram round all the shapes and allow to dry, which takes a few hours. You can then remove the logs or coal, disturbing the shape does not matter as the buckram will spring back again. Next mix paint, alabaster and a little melted scotch glue to a thick paintable consistency and paint over the effect where the light is not required to shine through. Put plenty on where the shapes join one another. Where the light is intended to shine through, just dab on a grey-white paint to imitate ash and sprinkle a little Xmas tree snow on the paint to sparkle a bit. Care should be taken when making the fire to deflect the heat away from the effect otherwise it might scorch. I made a 1½ kW log basket five years ago, and after constant use is still in good condition.—C. A. NORRIS (N.W.4).

Imitation Cotswold Stone and Dyes for Cement Paths

SIR,—Re the reply to the query for Imitation Cotswold stone and dyes for cement paths published in P.M. for February, Mr. Stannage is quoting very old-fashioned practices in the precast stone industry. Few, if any, of the firms who manufacture coloured concrete products use dyes of the type he suggests. These dyes are far from permanent and for good results require mixing in a mill.

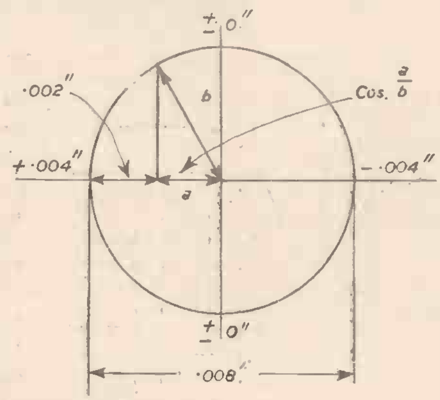
The modern method is to use pure white cement ("Snowcrete") and coloured cement ("Colourcrete") which can be obtained in a variety of colours. These can be used in the normal cement proportions with the aggregate, or toned down with "Snowcrete." This is the most common method, as they are usually too bright if used alone.—W. J. MORANS (Newbury).

Eliminating Taper on Long Shaft Turning

SIR,—In "Letters to the Editor" in your February issue, Mr. Groome, of Wellingborough, gives details of a very clever method of eliminating slight tapers in long turning on lathe. But, unfortunately, his last paragraph is not quite correct.

If the centre has been ground to an eccentric throw of .004in. the full travel across the diameter will be .008in. With the zero mark towards the lathe operator, the eccentricity is .004in. Turning the centre through 90 deg. in either direction, will give no eccentricity at all in a horizontal direction, but will give the full .004in. vertically either above or below the centre according to direction of rotation of the centre.

A further rotation of the centre by 90 deg., giving now 180 deg. total, will give the movement of the centre of twice the throw, in other words, .008in.



Mr. T. H. E. Marsh's eccentricity diagram.

With tapers between these two limits the centre must be rotated through an angle bearing direct relationship to the vertical distance from the chord to the centre. This can be calculated per .001in. or per .0005in., but would, I believe, be better checked in each case with the dial gauge. However, if +.002in. eccentricity is required then the angle of rotation can be found from the formula :

$$\text{Cos of } \angle = \frac{\text{radius—eccentricity}}{\text{radius}}$$

$$= \frac{.004 - .002}{.004} = .5 \qquad \angle = 60°.$$

—T. H. E. MARSH (Glasgow, W.5.).

Duplicating Photographs

SIR,—With reference to the letter from Mr. Johnston, of Chester, (May, 1956) referring to the query concerning duplicating photographs from Mr. Larson, of Sheffield.

Whilst the essence of Mr. Johnston's letter is an outline of the process involved, one important point has been missed.

A normal photograph, whether a negative or a positive, is a continuous tone subject and without further processing is incapable of being used in the production of a gelatine relief stencil or "silk screen" stencil.

A little reflection will show that this statement is correct. What is required is a stencil which will allow a flow of ink or pigment to be impressed on the duplicating paper in proportion to the density of the original subject. From this it follows that the stencil must be, as it were, "porous" in proportion to the original. Now, if an image is formed from an ordinary negative on to bichromated gelatine, the result will be a positive transparency, which will only be capable of passing pigment in the transparent areas when transferred to the screen. These transparent areas will consist solely of the shadow areas. The middle tones and highlights will be more or less solid gelatine.

In order to obtain a successful stencil it is first necessary to convert the continuous tone photograph into a "half-tone" by photographing the print through a half-tone screen. This results in a negative consisting of a series of dots. The area of each of these dots is proportional to the amount of light passing through the half-tone screen on to the negative and is, therefore, proportional to density of the image of the photograph. A careful study of photographs reproduced in PRACTICAL MECHANICS will explain this result rather better than words. Here a magnifying glass or a linen counter will be very useful.

If this half-tone negative is now used to produce the gelatine stencil we shall have a stencil consisting of dots which vary in size in proportion to the original density. Obviously, this stencil will be porous and is capable of giving a fairly truthful reproduction of the original.

The writer has made many of these stencils for the silk-screen process, both from line drawings or sketches and type matter, and also from continuous tone photographs, and would point out that there are snags attached to the process of making half-tone stencils which have taken a long time to iron out.—T. W. CLEMENTS (Eastbourne).

Making Match Head Material

SIR,—Re information sought May issue page 239, the booklet "The Manufacture and Uses of Phosphorus" published by Albright and Wilson, one of the leading manufacturers of compounds of this element, whose works are at Oldbury, gives this composition. The formula is due to the French chemists Sevene and Cahen, who first used it in 1898. The booklet is issued by Albright and Wilson at 2s. 6d.

I would strongly advise Mr. Murphy not to attempt to make this material at home. Certain mixtures of this nature are prohibited by Order in Council to be manufactured except by licensed firms. Serious accidents have taken place in schools where chlorate and phosphorous mixtures have been made. Similar regulations probably apply to Eire.—GEORGE C. BELL, (Colne, Lancs.)

Crackle Finish

SIR,—In reply to your "Information Sought" query of May, 1956, regarding "Crackle Finish," details of "Silkette" Ripple Finish are obtainable from Pinchin, Johnson and Co., 4, Carlton Gardens, London, S.W.1.—E. ROSENSTILL (London, S.W.15).

(Continued on page 425)

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SIR,—I am writing to you to answer Mr. C. Higginson's problem on a "crackle" finish. A special paint called "Panl" can be obtained in black which gives a very effective crackle finish on instruments. The paint is applied and the instrument is suspended over a luminous bunsen flame, or over a very low gas stove, the fumes from the flame cause the paint to "crackle."

The paint can be obtained at 3s. 6d. per tin from L. Miller, 8, Kenton Park Crescent, Kenton, Middlesex. Black, brown and green colours are available.—GRAHAM PEARSON (Burton-on-Trent).

Improved Record Indexing System

SIR,—Re "Making a Record Library," in the December issue of PRACTICAL MECHANICS, I think Mr. Haskell's indexing system could be improved. If new records were being continually added, I think the lists mentioned would become very confused, as the new records would, presumably, be added to the bottom of the list.

In my own system I index the records under the surname of the artiste or name of the orchestra, and record cases are numbered A1, A2, A3, etc. The following are examples taken from the index, which should explain it more fully.

The record R18A was added after the original list was made up. If any other records by Johnnie Ray are bought, their numbers will be R18B, R18C, R18D, etc. The sheets of the index are held in a loose-leaf holder and can be replaced or added to if required.

Little White Cloud that Cried Cry	R.18 Johnnie Ray	Space for other artistes who's names begin with "R"
Such a Night An Orchid for my Lady	R.18A	
Cuckoo in the Wood Old Vienna Yodelling Song	R.19 Mina Reverelli	

Red River Valley Ragtime Cowboy Joe	S.1	Dreams of Yesterday Coming Home	S.9 Dorothy Squires
Prisoner of Love Bibbiddi Bobbiddi Boo	S.2 Jo Stafford	Buttons and Bows All My Love	S.10 Dinah Shore

I had a cabinet specially made, but any cupboard or shelf would do, with the addition of partitions at equal distances of 6in. apart between the shelves.

White 1¼in. plastic letters were purchased from Woolworths and screwed on to the shelves in front of each space. I found that two spaces were needed for "C's" and "S's," while I could put E-F, G-H, N-O, P-Q, T-V and W-Z in spaces together without any mix-up. At the bottom of the cabinet is a space about 4in. deep in which I keep the L.P. discs and any special record albums. If, at some time in the future, I have sufficient L.P. discs to merit an index, I shall use the same system for a separate index, and will also store them separately. The photograph shows the cabinet and the records in place.

With tape-recordings I found that the strips of paper at the beginning of the reels were useless if a number of different items were recorded on one reel. I therefore made out slips of paper to number each reel and attached them by winding Sellotape round them and one of the spars on each reel. In addition to the numbers, "Side (a)" and "Side (b)" were put on the different sides of the reels. A double page of a notebook is used for each reel. Each page is headed with the reel number and on the left-hand sheet "Side (a)" is written, and the right-hand sheet "Side (b)." When anything is recorded which is worth keeping it is entered on the

Mr. E. T. S. Gray's gramophone record library.

appropriate page. Anything you wish played back which is about the middle of the page is sure to be found about the middle of the reel. If you wind forward and miss it you just have to listen to what is on that part of the tape where you've stopped, look at the notebook page, and you know whether to wind forward or back to find the item required. Another index could easily be used here, so that the items are in an alphabetical order, remembering to leave sufficient space between each letter of the alphabet for any other material recorded later. It is surprising, however, how quickly you come to know on what particular reel to look for a favourite item. The same goes for the records: if you are playing them quite frequently you can pick out most records without having to look up the index at all.—E. T. S. GRAY (Aberdeenshire).

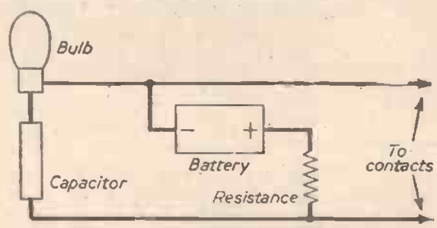
The "Golden Hind"

SIR,—In your December, 1955, issue of PRACTICAL MECHANICS, you published rough plans and an account of the "Golden Hind." I served in the Navy from 1937 to 1952 and can remember the miniature "Golden Hind" mentioned sailing down river to Plymouth Hoe firing salutes. It was a very impressive sight. Since than I have been sailing yachts and boats and can understand what team work was required to handle her, especially as she was a 16-oared sailing pinnace. I last saw her laid up in chocks in Devonport Dockyard.

I intend building a model of her 27in. long and using papier maché for the hull. I have built several models powered by electric motors and one or two yachts, using wood, but I find that papier maché is considerably cheaper and I think it possible that it is nearer the scale weight.—G. J. TILLEY (York).

"Capacitor Flashgun" and Smoothing Rectified Current Errors

SIR,—With reference to the circuit of the Capacitor Flash Gun on page 297 of the May PRACTICAL MECHANICS, the resistance should be as in my diagram below. In your circuit, the closing of the camera contacts would put a dead short on the battery causing the contacts to burn or arc together.

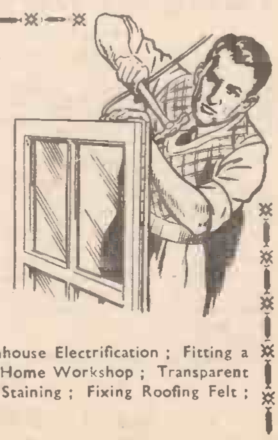


The corrected circuit.

I notice also in "Your Queries Answered," page 326, dealing with "Smoothing Rectified Current," you state that a capacitor of 50 pF should be connected across the putput of the the rectifier. As you are dealing with L.F. not R.F., should it not be 50 μF?—R. ASHLEY (Kettering).

(I regret that my Capacitor Flashgun circuit contained the above error, and the circuit should be as per my wiring diagram and Mr. Ashley's corrected diagram.—M. KATERS.)

[We regret the second mistake referred to by Mr. Ashley, but this was due to a typographical error.—ED.]

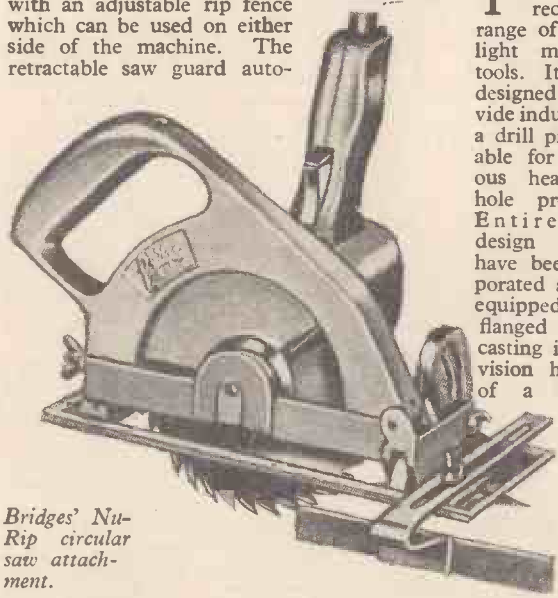


Trade Notes

Circular Saw Attachment

A NEW 6in. portable circular saw attachment, named the "Nu-Rip," has been introduced by S. N. Bridges and Co., Ltd., Parson's Green Lane, London, S.W.6, as an accessory to their Tool power range, powered by the Toolpower general purpose drill.

Of sturdy die-cast alloy construction the 6in. saw is capable of ripping or cross-cutting timber 1½in. thick. The mitring gauge is calibrated in single degrees up to 45 deg. It has a rise and fall table for depth of cut with an adjustable rip fence which can be used on either side of the machine. The retractable saw guard automatically covers the blade when the cut is completed.



Bridges' Nu-Rip circular saw attachment.

The Nu-Rip retails at £4 19s. 6d., inclusive of a 6in. combined rip and cross-cut blade, or at £4 3s. 6d., exclusive of blade. The Toolpower drill is extra at £7 19s. 6d.

McAllan Flame Guns

SEVERAL types are made and the one illustrated is the Mk. 12 hooded flame machine. A 30in. (2,000 deg.F.), scientifically applied flame is produced and concentrated by a heavy sheet steel hood. A simple adjustment raises or lowers the position of the flame gun on the wheeled chassis to achieve the most effective height. The flame gun may be removed from the chassis for use elsewhere, with or without the hood. Further details are available from C. B. McAllan (Engineers), Ltd., Hersham Factory Estate, Molesey Road, Walton-on-Thames, Surrey.

The McAllan Mk. 12 hooded flame machine.

A Cyclist's Compass

FOR those cyclists who like to know their direction of travel, John Clennell and Co., Ltd., 6, Ludgate Square, Ludgate Hill, London, E.C.4, have produced the "Pathfinder" compass which may be clamped to the handlebars of a cycle or motorcycle. The luminous metal dial is fitted in a swivel mounted case and the retail price is 13s. 6d.

Startrite Bantam Drilling Machine

THIS ½in. capacity sensitive driller has recently been added to the existing range of Startrite light machine tools. It has been designed to provide industry with a drill press suitable for continuous heavy duty hole production. Entirely new design features have been incorporated and it is equipped with a flanged fixing casting in place of the machine base. Provision has been made for the attachment of a mortising attachment and other accessories. The price is £29 18s. od. (motorised three-phase) and £2 extra for single-phase supply. Full details are available from the Startrite Engineering Co., Ltd., Waterside Works, Gads Hill, Gillingham, Kent.

World's Smallest Power Saw

MANUFACTURED by W. Kennedy, Ltd., Station Works, West Drayton, Middlesex, this saw is unique in that, to reduce machining, hexagonal bars were used in its construction. The saw comprises two fixed hexagonal bars, held by a cast aluminium block. It is fitted with a one-hand release which leaves the operator with one hand free to manipulate the workpiece. A feature of the saw, which can cut metal ½ mm. thick, is the shortness of the blades used. Measuring only 15 cm., these require no tension to keep them straight. Overall dimensions are 22in. × 7¼in. × 10in. and the price is £23 13s. od.

Wolf Cub Additions

A NEW attachment and a new accessory have been added to the range of Wolf Cub portable electric tools. They are a hedge trimmer, shown in the photograph, and an extension cable.

The precision built hedge trimmer is designed for light trimming or hard cutting back on long hedges or small shrubs. It has a blade length of 10in. and is of the oscillating type, incorporating a step-down gear reduction giving a speed of 850 strokes per minute. It is attached to the nose of the power unit and held rigidly in position by means of a simple screw clamp. The cutters are operated through a driving dog which is fixed into the power unit driving spindle in place of the ¾in. chuck. The retail price is £5 17s. 6d.

Of special interest to the hedge trimmer owners, the extension cable is 30ft. long and equipped with weatherproof plug and socket. Retail price is £1 19s. 6d.

The Wolf Cub hedge trimmer attachment.

New Myford Lathe

RECENTLY introduced is the High-speed Super Seven 3½in. centre lathe, which is a high-quality unit capable of producing work to fine limits and a high degree of surface finish. The lathe is shown in the photograph and possesses the following general features of interest: high maximum spindle speeds (14 speeds of 25-2,150 r.p.m.) quick change gearbox (48 threads and feeds).

The Myford Super Seven 3½in. centre lathe.

The cabinet includes isolator and electrical unit which is both compact and accessible. The unit provides overload protection and no volt release gear, and has switching for lathe and suds pump. The Super-7 is designed to utilise the extensive Myford range of attachments and accessories. Full details and price list are available from Myford Engineering Co., Ltd., Beeston, Nottingham.

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.

FOR SALE

COMPRESSORS for sale, 2½ CFM, 180lbs. sq. in., on metal base, with driving wheel and receiver, price £3; ¼ h.p. Heavy Duty Motors, price £3; carriage forward. Wheelhouse, 13, Bell Road, Hounslow. (Phone: Hounslow 8749.)

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

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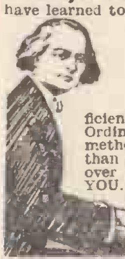

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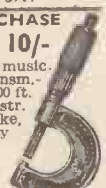

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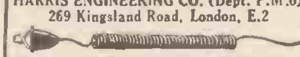

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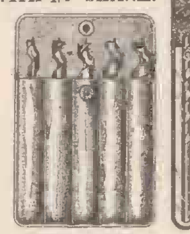

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Making Plastic Wood

I WOULD like to find out a method of making use of sawdust to produce some type of plastic wood.

I should like to use this plastic wood for two purposes :

1. To act as a filling between small tins glued to a tray of three-ply wood.

2. To make sheets of the material.—N. A. McKenzie (Midlothian).

I. Use sawdust flour and cellulose acetate flour. This latter can be made by cutting up and pulverising celanese fabric. When these two substances are intimately mixed, stir into a solution of methyl-iso-propyl ketone to desired consistency. This latter solvent can be obtained from the Shell Chemical Company.

2. To carry out this process you need to incorporate your sawdust flour with a thermal setting plastic. We suggest you write to Bakelite, Ltd., Grosvenor Gardens, S.W.1, and ask them for a brochure on this matter and get them to send you some phenol formaldehyde "syrup," which will set hard on heating. Mix this with your sawdust and roll out between rollers or press into sheets.

Testing Wind Generating Plant

I HAVE a plant supplied by an amateur constructor (not one of the proprietary plants). The dynamo is a Bosch, rewound for low speed (12 volt). The propeller is about 4ft. only. I am not getting any appreciable output, even in a gale, and I am wondering if there are any testing facilities open to me, such as a wind-tunnel test which would relate the output to definite wind speeds ?—A. J. Banwell (Chepstow).

WE think that it would be rather an expensive matter to test the set in a wind tunnel as might be available at the N.P.L. or an aircraft factory. In addition there would remain the problem of measuring the wind speeds at the point where the plant is installed.

It would appear that a better plan would be to drive the generator by mechanical means in order to find the speed at which it gives the required output. It is quite likely that the generator requires driving at an increased speed to generate the necessary voltage, which could perhaps be arranged by using a chain or gear drive. Alternatively, if necessary, you could rewind the generator to operate at a lower speed. In this case each coil should be rewound with more turns in inverse ratio to the speeds. Thus, if the dynamo required twice the normal speed at which it is being driven it could be rewound to operate at normal speeds by winding each coil with twice the present number of turns. The output of the machine would be reduced at the lower speed, however, since it would probably be necessary to use much thinner wire when more turns are fitted.

By driving the generator mechanically you could ascertain if the dynamo is at fault; an open circuit in the shunt field circuit or incorrect brush position would account for the trouble experienced.

Cleaning Stained Glass

I HAVE a large stained-glass window that has not been cleaned for several years. Consequently, it is robbing the hall of its light. Normal cleaning methods have no effect and I wonder if you would suggest anything ? I am told that hydrofluoric acid will clean it, but I am doubtful of its action on the lead and putty.—K. Unsworth (Lancs).

IF the window is really of stained and *painted* glass it must be on no account touched with hydrofluoric acid. It is not the lead and putty that this acid will injure, but the glasspainter's work, the glass and the skin if it is allowed to touch the hands. It will attack everything except pure rubber. Are you sure that it is dirt which is on the window ? Many or most glasspainters lay a very thin matt of pigment over the glass and this is fired on and so becomes part of the glass since it is a vitreous enamel. If you have reason to think, or if you know, that the disfigurement is dirt, then scrubbing with strong soda water should remove it. With the soda in warm water you could use soap or one of the modern detergents, but we do not recommend anything more drastic than this treatment.

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*An * denotes constructional details are available free with the blue-prints.*

Spirit Duplicating

CAN you provide me with details relevant to spirit duplicating—making and operating, the spirit used, etc. ?—A. M. Stuart (Watford).

THE lid of a square biscuit tin will serve as the container for the gelatine. You must experiment with the quantities which are given as a working basis. Start off with the following :

50 per cent. gelatine.

25 per cent. water.

25 per cent. glycerine plus 0.5 per cent. sod. salicylate to prevent mould.

Heat up the gelatine and mix with the 50-50 water-glycerine mixture to right consistency when cold.

For your ink mix up methyl violet crystals with water and about 5 per cent. glycerine. Use an ordinary steel pen and write your copy on greaseproof paper and allow to dry.

Place this direct and without smudging face downwards and gently but firmly impress with a smooth squeegee roller. Make your imprinted copies from this impression in the same way after peeling off the initial impress by using a smooth surface paper.

Making Liquid Soap

IS it possible to make a liquid soap from soft soap so as to have a clear liquid ? I have tried just boiling it with water and also just using hot water, but on cooling it settles out cloudy and thick with just a little clear liquid on top. Could ordinary hard household soap be made into a clear liquid soap ?—C. Smallwood (Edinburgh).

YOU must use *distilled* water when making a clear soap. A soft potash soap is the best. Some household soaps can be used, but many of them contain a "filler" and this would prevent a good liquid soap being made. The point of using distilled water is that you must avoid any possibility of calcium salts being present as they form a cloudy precipitate.

Hot Water Tank Corrosion

IN my hot water system I have a copper cylinder, 30 gallons (36in. by 19in.), and in the last few months there have been pinholes in the seams which develop into leaks and leave blue-greenish colour streaks. What is the cause ?—E. Jones (Cardiganshire).

THE cause of your trouble is corrosion through peat acids in your water.

There will be no cure other than to replace your system throughout with galvanised iron pipes and cylinder.

To have part copper and part iron in your system would increase the trouble.

Insolubilising Glue

WILL the use of formalin render glue insoluble ?—E. Howe (Sidcup).

GLUE should be soaked in a 10 per cent. solution of formalin to render it insoluble.

Casting Aquarium Ornaments

I HAVE cast a small ornamental wall, path and an arch in plaster of Paris for use in my aquarium. As this is porous, would you let me know the procedure for waterproofing and also what paint I should use, so that they will not be harmful to the fish ?—G. W. Smith (Canterbury).

WE suggest you dip your plaster of Paris devices in *just molten* paraffin wax. This is quite neutral. Any good bakelite lacquer can be used for colouring.

Power Cut Warning

I HAVE changed my nursery glasshouse boilers over to forced draught so that I can burn cheap fuel, which means that I am reliant on electric power for my motors. We recently had a power cut of 11½ hours, and this cut started at 12.40 a.m. If this cut had occurred in mid-March, when my tomato plants were part grown, my glasshouse temperature would have gone down to such a low point that the crop would have been completely ruined.

Is there any device (independent of the mains electric power) that could be connected to either glasshouse temperature or water temperature, and when the heat got below a certain point would come into operation and ring a bell in my house and warn me that trouble was afoot ?—A. Hallsworth (Pickering).

YOUR problem could be solved by using a thermostat which was fitted either on the boiler or inside the greenhouse, the thermostat being connected in series with a battery and bell in the house. The best arrangement would probably be to use a boiler thermostat so that the thermostat contacts would close to ring the bell as soon as the boiler temperature fell to a certain preset value.

Thermostats are supplied by:

Salford Electrical Instruments, Ltd., Silk Street, Salford, 3, Lancs.

Thermostatic Controls Co., Avenue Road, Hampton, Middx.

Robert Maclaren & Co., Ltd., Kilbirnie Street, Glasgow, C.5.

Waterproofing Methods

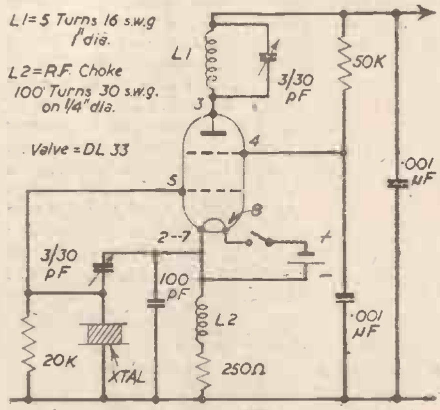
I HAVE recently purchased an ex-R.A.F. gaberdine flying suit to wear when motor-cycling. Can you suggest how I can successfully waterproof it ?—J. Morley (Hull).

WE rarely advise our inquirers to waterproof made-up garments for the waterproofing process necessitates immersion of the garment in warm liquids, a process which usually results in severe shrinkages. As an example, your garment could be waterproofed by 15 minutes' immersion in a warm strong soap solution and by an equal immersion in a strong alum solution. The waterproofing would be efficient, but, more likely than not, you would not be able to get the garment on afterwards owing to the shrinkage !

A better way is to dissolve 10 parts of ammonium stearate in 90 parts of white spirit. Dab the solution on to the material with a soft brush or with cotton wool and then, if necessary, repeat the process. Ammonium stearate is a tan-coloured waxy product. It melts at 75 deg. C. and does not contain any free alkali, so that it will not rot the cloth. It repels water well, and provided that the solution is not too concentrated it will not stiffen the cloth unduly. This material may be obtained from any laboratory chemical supplier.

A Crystal-controlled Oscillator

I HAVE made the model control items published by you, receiver, transmitter and wavemeter, but have failed to contact anyone who has a transmitter or a sufficiently accurate signal generator. I think the only thing I can do now is to make a crystal oscillator, using the transmitter valves and batteries. Could you give me a practical layout using a 6Y50 kc/s crystal and a DL33 valve which are available?—J. F. Brown (Cardiff).



Crystal-controlled oscillator circuit.

TO make up a crystal-controlled oscillator to calibrate your equipment we suggest a version of the tritet circuit as shown in the sketch above. The circuit is modified to use battery operated valves and it should be noted that the filament leads should be short and the battery placed away from earthed bodies.

The DL33 valve has a tapped filament and to use it on 1.5 volts pins 2 and 7 on the valveholder should be strapped together to form the negative filament lead whilst pin 8 goes to the positive connection. The anode circuit is tuned to the 27 Mc/s band, and in your case will extract the fourth harmonic of your crystal frequency. It is important that the coil is constructed as stated on the drawing otherwise you may tune to the wrong harmonic.

You should then be able to tune your wavemeter to the output from the oscillator and thereby "find" the band.

The numbers written on the drawing round the valve indicate pin connections viewed from under the chassis and counting clockwise starting from the spigot.

Fire Extinguishing Mixtures

HOW can I make a good fluid for a fire extinguisher and what are the most easily obtainable chemicals for same ?—J. G. Huggins (Enniskillen).

THERE is no universal type of fire-extinguishing mixture. You would not, for example, put water on to a petrol fire or on any type of oil fire. Nor, for that matter, would it be of much use to throw sand on to a burning hayrick.

An all-round "general" fire extinguisher for all types of fire is carbon tetrachloride. This is thrown or squirted on to the seat of the flames, and being incombustible itself it vaporises and chokes out the fire.

Methyl bromide is a recent and very excellent addition to the range of these fire-extinguishing liquids, but it will be rather too expensive, we think, for your use.

Carbon tetrachloride is easily obtainable and not too costly. You should be able to get it from Messrs. Harrington Bros., Ltd., Shandon Chemical Works, Cork.

For dealing with non-oil fires a very cheap fire-extinguishing liquid is made by dissolving a handful of common salt and a handful of sal ammoniac in a quart bottle of water. This bottle is thrown into or broken over the flames. The dissolved salts form a coating on everything which the water touches and renders it almost incombustible. Strong solutions of borax, alum and ammonium sulphate can all be used for the same purpose.

Information Sought

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

Making a Transfer

I WISH to make a transfer of the type sold for imprinting a design on material by smoothing a clothes-iron over the back of the transfer. Can you give me details ?—D. G. Brinjes (Maidenhead).

Garden Fountain

I WISH to construct a fountain for my outdoor pool (8ft. by 6ft.) to be run by electricity. Can you help me to obtain a diagram or drawing to construct same ?—F. Evans (Shirley).

A Small Sand-blasting Machine

PLEASE supply me with some information regarding the construction and operation of a small sand-blasting machine for cleaning sparking plugs.—R. J. France (Nottingham).

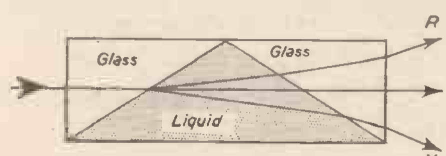
Photographic Prints on Metal

I REQUIRE some photographic prints on metal (brass and steel) for hand engraving purposes. The print must not be too hard or it will chip in the process.

Can you give me some formulæ for the emulsion with which to coat the metal and processing of the print ?—S. S. Sims (London, N.13).

The Wernicke Prism

I WISH to construct a direct-vision Wernicke prism as per sketch. Please will you tell me the liquid used, the cement or glue for



The Wernicke prism.

fixing together and also the kind of glass used ?—L. D. Saurin (Portsmouth).

Making Rubber Stamps

AN article in Practical Mechanics dealt with the making of rubber stamps, but only with moulding from positives such as printers' type, etc. Can you tell me of the method used when the only positive may be a print, drawing or writing in ink ?—E. Read (London, N.19).

Home-made Refrigerator

I REMEMBER hearing once of a refrigerator that was reputed to work on water alone. The name was something like "Kepcold." Could you tell me how they work ? Do you know some other cheap method of refrigeration that I could utilise ? —J. Laughton (H.M.S. *Diamond*).

Junior Section

A MODEL YACHT

Constructional Details of a "Sharpie," Sloop-rigged With a Six-plank Built-up Hull

The completed model yacht.

IN this design the method of hull construction eliminates arduous carving from the solid or the tricky orthodox rib and plank method. The hull is, instead, built up from six pieces of wood, the outlines of which are shown in Fig. 1.

Materials and Method of Building the Hull

The bottom and the transom are cut from ¼in. plywood and the sides and deck from ⅛in. plywood; two pieces of ¼in. scrap wood are also required to make the former shown in Fig. 1, and similar scrap wood will also furnish the material for the keel, cutwater, rudder, etc. If obtainable in small quantities, the plywood parts are best cut from resin-bonded ply.

Dimensions must be taken from the scale of inches in Fig. 1 and full size templates of paper or cardboard drawn before any sawing is started. Care should be taken in marking out these templates, especially the deck and the bottom curves. A good method is to make a half template, draw one side and turn it over to draw the other side, so making the curve the same both sides.

The building board and former should be made to the scale dimensions shown in Fig. 1, the former being screwed to the building board from the underside. After making parallel sawcuts, approximately where shown, down the length of the bottom, this is screwed, saw-

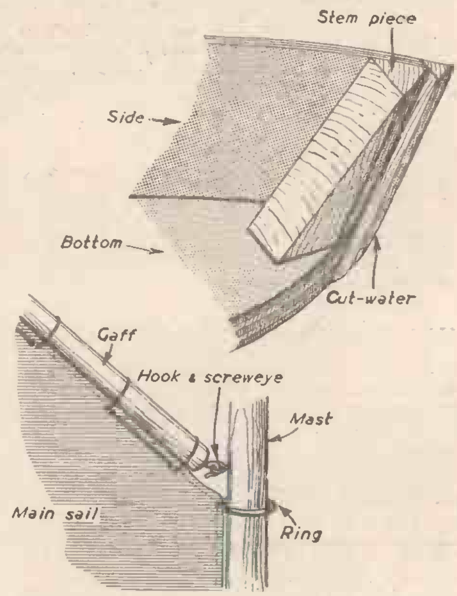


Fig. 2.—Positioning the stem piece and cutwater, and attaching the gaff to the mast.

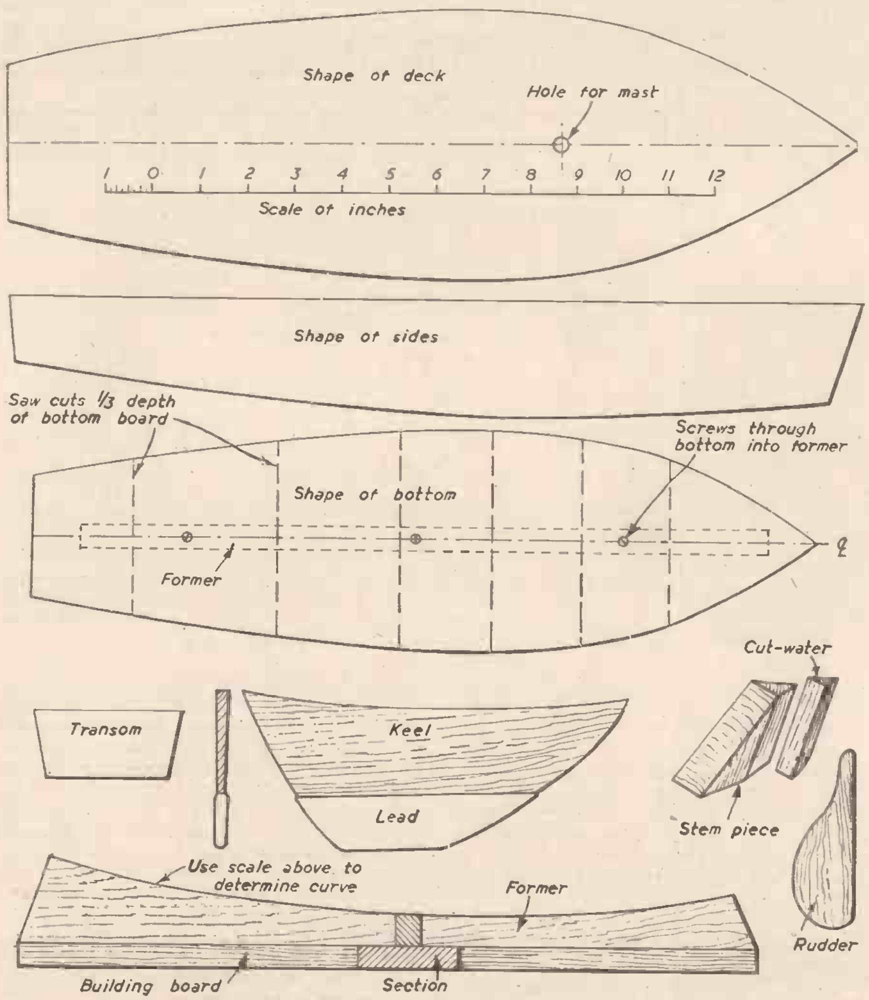


Fig. 1.—The various component parts of the hull and the building former.

cuts uppermost to the top edge of the former, as shown in Figs. 3 and 4. The transom is now pinned and glued to the back of the bottom as shown in Fig. 4, and the stem piece fixed in place in the bows. The sides are glued in place next, any overlap being trimmed away. Finally the cutwater is glued on, as shown in Fig. 2, and the whole sandpapered to a smooth outline. A waterproof glue should be used and the one made under the name "Casco" is recommended. At least 12 hours should be allowed for the glue to set and then the hull can be removed from the former ready for the fitting of the keel.

The keel is carved to the shape and dimensions shown and sheet lead is beaten into position round the bottom edge and pinned in place. The complete keel is then screwed and glued into place on the hull. See Fig. 1 for details. The holes in the hull, originally for fixing to the former, may be used if conveniently placed. Holes not covered by the keel should be plugged with a mixture of Casco and sawdust.

The deck is fitted next and this should be panel pinned as well as glued to ensure greater strength. To make a firmer job, it may be found better to glue in some ¼in. square battens across the deck, these being cut to fit inside the two sides. When hammering in the panel pins, the hull should be supported underneath by two blocks, one each side of the keel.

Painting the Hull

Allow the glue to set and sandpaper smooth again. Apply a coat of red lead first and when this is dry, sandpaper down and give two coats of the required finish. If a two-coloured

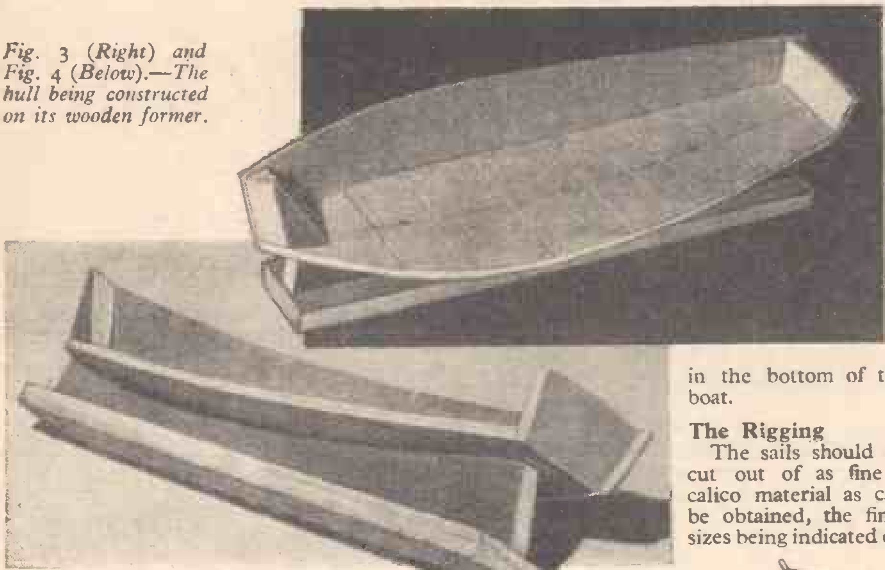


Fig. 3 (Right) and Fig. 4 (Below).—The hull being constructed on its wooden former.

finish, divided by the waterline, is required, the hull should be floated and the waterline carefully marked.

The Rudder

The rudder is made from ¼in. wood to the size and shape shown in Fig. 1, all the edges being smoothly rounded off. The method of attachment to the transom is shown in Fig. 5. Four small screweyes are required, two for the rudder and two for the transom. The rudder pivots on a pintle rod. For the tiller, a piece of firm brass wire is forced into a hole in the top of the rudder stock and a hook formed, as shown in Fig. 5.

The Spars

A round 5/16in. dowel is required for the mast and it should be carefully tapered off from the deck line to the masthead by planing or scraping and then sandpapering smooth. The 5½in. long bowsprit is made in a similar manner and glued and pinned down to the forward end of the deck so that it projects over the bows some 2¾in. Again a similar technique is employed to make the boom and gaff, dimensions being taken by means of the scale from Fig. 6. These are attached to the mast, as shown in Fig. 2, by means of a hook and screweye.

Stepping the Mast

A hole should be bored in the deck in the position shown in Fig. 1 and its diameter should be such that it is a tight fit round the foot of the mast. In the bottom end of the mast drive in half-way a 1in. long brass nail, nip off the head and file a sharp point. When the mast is pressed home firmly, this nail point serves to locate the bottom of the mast in the bottom of the boat.

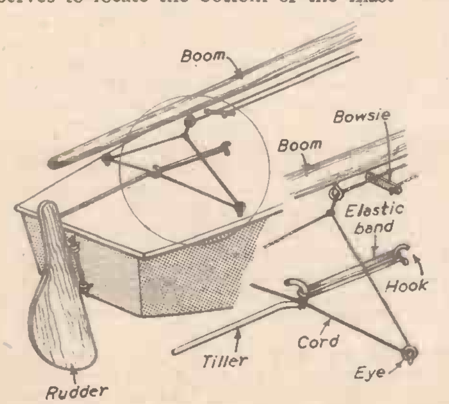


Fig. 5.—The automatic tiller and the rudder.

The Rigging

The sails should be cut out of as fine a calico material as can be obtained, the final sizes being indicated on the sail plan, Fig. 7. The cutting sizes should be ¼in. larger all round than the dimensions given, to allow double hemming.

The mainsail is laced to the boom and gaff by the method shown in Fig. 2: fine quality white twine is used. Four rings are made up from brass wire to attach the mainsail to the mast. Their positions are shown in Fig. 6. The method of attachment to the sail is by passing one end of the wire through the seam of the sail before the ring is finally closed up round the mast. The rings should be of such a size as to slide easily up and down the mast. The gaff is held erect by means of a halyard passing through a screweye at the masthead and thence to a cleat at its foot.

The foresail is fitted with an endless cord starting from a screweye just above the waterline on the bows, passing through a hole bored in the end of the bowsprit, up through the seam on the forward edge of the foresail, continuing through a screweye up near the mast head and down to a cleat in convenient position on the foot of the mast. The bottom corner of the foresail nearest the mast has a short cord attached, which passes through a screweye on the deck and is adjustable by means of a bowsie.

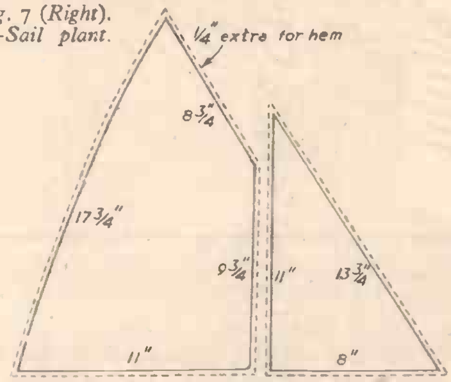


Fig. 7 (Right).—Sail plant.

Two shrouds should now be added as additional supports for the mast. These should be attached to the mast at a point near the top of the foresail fixing and run down to eyes one on either side of the deck as shown in Fig. 6. Each one of these should be adjustable by means of a bowsie.

The Automatic Steering Device

The arrangement of this is as shown in Fig. 5, and no further explanation as to construction is necessary. The purpose is to keep the boat's head in the set direction and ensure a straight course. The principle is that as the wind tends to slew the stern of the boat round, the cord attachment to the tiller causes the tiller to steer the boat and maintain even wind pressure on the sails. Adjustment to this device should be made by varying the strengths of the elastic band.

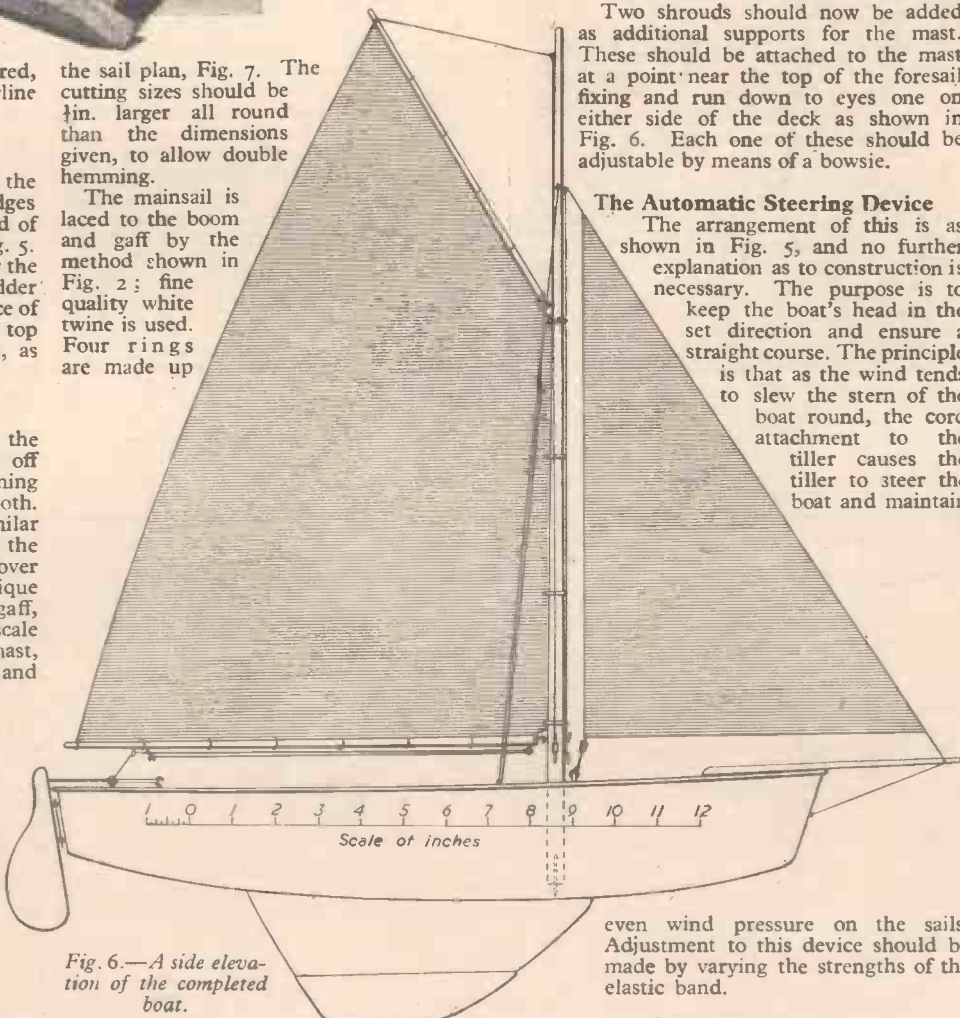


Fig. 6.—A side elevation of the completed boat.

Carrying the Boat

A fully rigged model is an unwieldy object to carry and it is suggested that the mast and rigging be dismantled to prevent damage. The rigging has been designed with this object in view, and it is accomplished by running down the bowsies on the shrouds, then uncleating the halyards on the mainsail and foresail, allowing the sails to be lowered. The mast can now be eased out of the hull and the whole rigging laid along the deck and secured for carrying with elastic bands.

A Simple Galvanometer

Constructional Details for Making a Sensitive Instrument for Detecting Very Small Currents

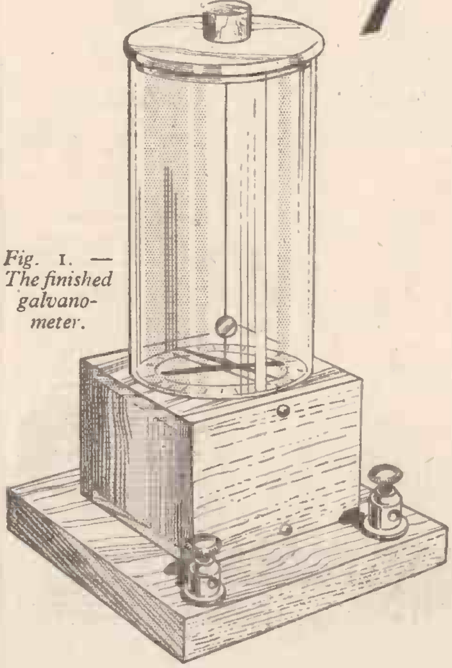


Fig. 1. — The finished galvanometer.

MANY experiments involve the detecting of very small currents, and this is impossible without a sensitive galvanometer (see Fig. 1). These are expensive instruments, but with a little care one can be made to give a very good result. Fig. 2 shows a sectional view of the completed instrument. Fixed to a heavy base is a little cabinet, 2in. by 2$\frac{3}{4}$in. by 1$\frac{7}{8}$in., composed of two sides, a top and a back, with a small drawer, which can be pushed in and out at the front. On the drawer is wound a coil. On top of the cabinet a glass-lamp chimney is fixed, covered at the top with a cardboard lid. From the centre of this lid hangs a hair, supporting a little system of two magnetic needles. The lower needle hangs in the centre of the coil, while the upper one hangs above it, both eyeing across the coil. When a current passes through the coil, the needles are deflected. Just above the needles a tiny mirror of polished tinplate is fixed, which reflects a spot of light on to a wall, the movement of this spot shows the slightest deflection of the needles.

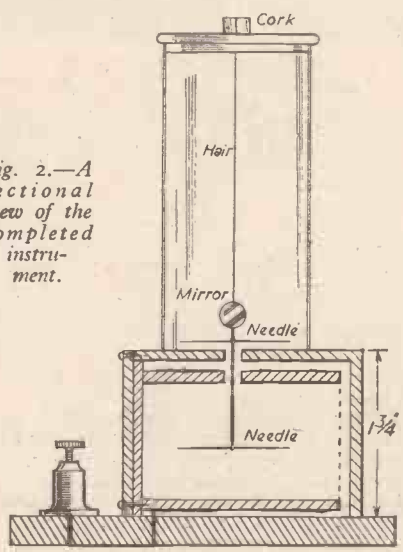


Fig. 2.—A sectional view of the completed instrument.

The Base

This should be at least 1in. thick and as heavy as possible. A sheet of lead on the bottom is useful. The sides of the cabinet should be about $\frac{1}{4}$in. thick, but the top and back can be of fretwood. Use glue and brass screws or pins to fix together. No iron must on any account be used. The front should be made of two pieces of fretwood, one large enough to cover the entire front of the cabinet; the other a little smaller so that it just fits between the two sides, the top and the base. Glue these together. To the back of this glue four pieces of wood, as shown in

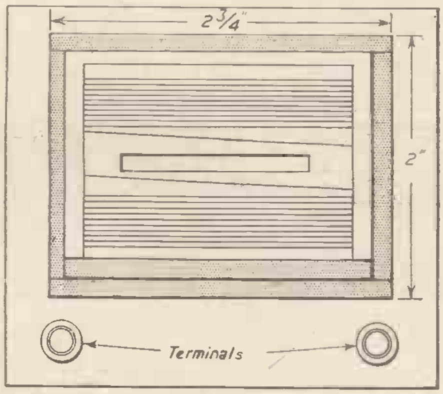


Fig. 3.—A plan view of the cabinet with the top removed.

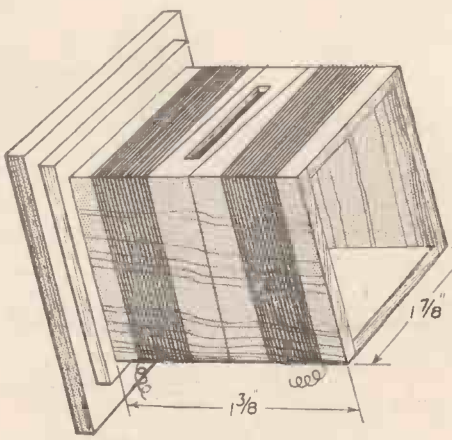


Fig. 4.—The former for winding the coil.

Fig. 4, to make the former for winding the coil. The lower needle swings inside the former, which is wound with a dozen yards of No. 26 double silk-covered wire. Wind this on closely and evenly, being careful to leave the slot in the top clear. Through this slot the needle is passed when assembling the instrument.

Assembling the Parts

When wound, it is advisable to give a coat of shellac varnish. Push this little drawer into place and fasten by two brass screws. Bring out the ends of the coil to the two terminals fixed on the base.

Fig. 3 is a plan of the cabinet with the top removed. Obtain two magnetic needles about 1in. long or make them from pieces of sewing needle. Fasten them firmly with glue to a vertical wire, so that the north pole of one is over the south pole of the other (see Fig. 5). Glue the upper end of the vertical wire to a hair, the other end of which is fastened to the cover of the lamp chimney.

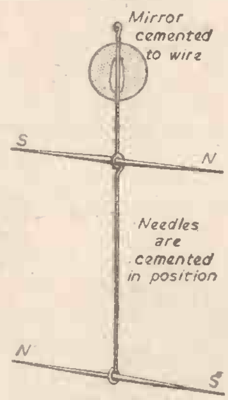


Fig. 5.—Details of the hair magnetic needles and mirror.

Glue the chimney firmly to the top of the cabinet. Lower the needles into place, the bottom one passing through slits in the cabinet top and former.

The mirror is a tiny disc of polished tinplate about 3/16in. diameter, glued to the top of the vertical wire just above the upper needle. It should be made slightly concave to give a sharper spot of light. A narrow beam of light from a shaded lamp should be thrown upon the mirror and reflected on to the wall. For less delicate readings, a graduated circle can be fixed to the top of the cabinet, inside the chimney, readings being indicated by the upper needle.

A galvanometer, of course, is an instrument for *detecting* small currents—it does not *measure* them. These devices can be made also from a small 1$\frac{1}{2}$in. diameter compass, which is attached to an electromagnet. This latter may be made from two or three punchings or stampings from an old wireless transformer. Cut them $\frac{3}{8}$in. wide and of a length equal to the diameter of the compass, that is 1$\frac{1}{2}$in. Put them together and wind two turns of paper round them. Wind this core with about 80 turns of fairly fine wire (say, 30 d.c.c.) in an anti-clockwise direction. Mount the magnet so that the magnetic needle of the compass when pointing to north is at right-angles to it, and bring the two leads from the electromagnet to two terminals.

To test an instrument made in this way, connect the left-hand terminal of the galvanometer to the shorter strip of an ordinary pocket-lamp battery and adjust it so that the needle of the compass points north. Connect the longer strip of the battery to the other terminal and the needle should immediately take up another position between north and east, and the new position will depend on the current flowing through the instrument; the stronger the current, the nearer will the compass needle point to east. A very weak current will only cause the needle to move very slightly. To use for polarity testing, the needle will move in the direction towards the positive terminal.

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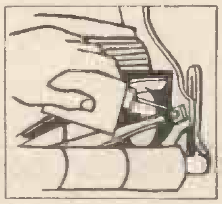

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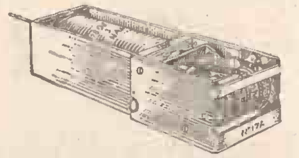

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THE Cyclist

Editor : F. J. CAMM

VOL. XXIV JULY, 1956 No. 408

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

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WHAT I THINK By F. J. C.

The L Plan for Cyclists

A PLAN to make cycling safer for children has been evolved by The Committee on Road Safety, and it is outlined in a report to the Ministry of Transport. The Committee suggests that the test for children should require a level of skill and knowledge to be expected within the ages of 11 to 15. The children would be tested orally or by a written paper in addition to having practical tests. Children under 11 who could not be expected to pass the test would have to show a white disc, children who pass the test would be given a badge to display on their cycles and those who have not passed would carry white discs on the front and back mudguards. It is noted that the plan is not recommended for immediate use. It is also noted that it would be an offence for any child to cycle without badge or disc, and any court proceedings would be against the parents. Blithely, the report says " the obvious loophole that more than one child often rides the same bicycle need cause little concern. Emphasis of the scheme should be directed towards making people conscious that theirs is the responsibility for allowing children to cycle." It is further suggested that local authorities should have power to forbid cycling to school by children who have not passed the test and goes on to reject compulsory tests because of administrative difficulties and the burden on the police. Reliance is to be placed on voluntary training and testing, in extension of the present voluntary scheme run by a variety of organisations.

The Cycling Proficiency Scheme, sponsored by the Royal Society for the Prevention of Accidents, which is carried out in about 500 localities throughout the country has so far resulted in 100,000 children passing the test in eight years. These figures, however, are meaningless unless they are related to the accidents to children which have occurred in that period, and those statistics do not suggest that the granting of 100,000 pieces of paper have lessened the number of accidents to children.

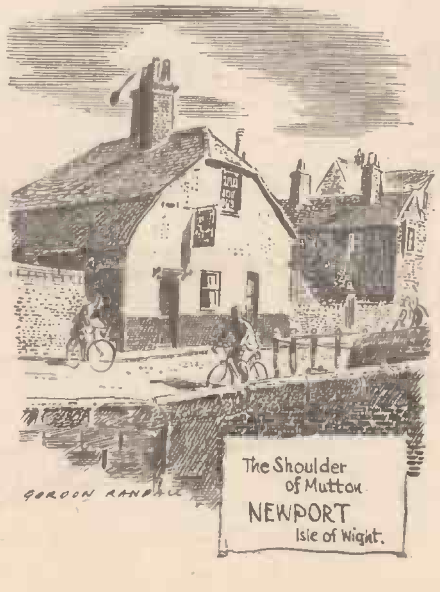
The certificate, as a fact, is practically worthless. It is awarded not only by R.O.S.P.A. but by the Cyclists' Touring Club and the National Cyclists' Union. It is estimated that the juvenile cycling population between the ages of seven and fifteen is nearly 3,000,000 and the Committee think that considerable financial support should be provided by the Government and cycling associations for a major effort to reduce accidents to child cyclists.

The statistics quoted show the ineffectualness and ineffectiveness of the test for cycling proficiency. In the first of the two years encompassed by the test, there were 10,715 accidents to cyclists under 15 and in 1955 the figures rose to 12,615. The report, therefore, is largely an ambiguous and unctuous waste of time and with many of the recommendations made in the report we profoundly disagree. It is curious that the C.T.C. and the N.C.U. have consistently opposed one measure which was calculated to make cycling safe—cycle paths. Their attitude has been that the roads are free for all and that cycle paths are an attempt at segregation. Many of the cycle paths such as those along the Great West Road can hardly be calculated to make roads safe, since they cross the drive—in to various works and, of course, are non-existent where there is a crossing road.

Another safety measure which has been consistently opposed has been the fitting of rear lights and reflectors. Can it be that these two organisations with their tiny membership as compared with the total number of cyclists are eating their own words ? It would not be the first time that they have had to do so. The Committee recommends, for example, that cycle tracks should be improved, implying that they now agree with them. They now apparently agree with the regular inspection of children's bicycles. The two associations vigorously opposed this when schoolmasters introduced it some years ago.

It would seem that the Committee failed to investigate whether children should be allowed to cycle at the age of seven to the danger not only to themselves but other road users, except on enclosed circuits where they could not interfere with ordinary traffic. The suggestion of the age at which children can commence to cycle would, of course, be unpalatable to the manufacturers of juvenile cycles and it may be that the two associations concerned were not anxious to tread on the corns of the manufacturers. We agree with the final conclusion : " it seems ridiculous to devote large sums to the upbringing and education of our children if through parsimony in another direction we neglect to keep them alive and unmaimed." The chairman of the Committee was Mr. Hugh Molson, Joint Parliamentary Secretary to the Ministry of Transport. Perhaps he will, therefore, persuade his minister to obtain sanction from Parliament for the spending of this extra money.

A quaint recommendation is that research should be carried out to develop a satisfactory rear-view mirror for cyclists. No such research is necessary. A simple mirror clipped to the handlebar would do the trick. The report does not reflect two years' work. It deliberately evades the issue, and seems afraid to make the recommendations which are really necessary.



Old Bicycles

I AM glad to know that so many clubs are now interested in the history of bicycles, and that Veteran Bicycle Clubs are being formed with the object of collecting some of the early machines with which history was made. I doubt very much, however, whether many of these early machines still exist outside museums. What is really wanted is a committee of authorities to categorise, label and authenticate these old bicycles. The late H. W. Bartleet (I am so popular, call me Sammy) professed to have collected a number of old bicycles but he did not object to being careless with the truth when he labelled them. I have mentioned before his spurious claim to have possessed Hume's bicycle on which was won the first bicycle race on pneumatics. Hume wrote to me not so many years ago and stated unequivocally that the machine was destroyed. Yet in Bartleet's so-called museum, there was Hume's machine ! This is how he did it. He wrote to Hume asking for the specification of the bicycle. Bartleet then found a machine which somewhere near fitted the description and, voila ! Hume's bicycle was recreated.

There are a number of old boneshakers still in existence but, alas, no one knows where Macmillan's bicycle is. The machine in the Science Museum is an acknowledged replica.

I expect if there were a nation-wide search amongst lofts, attics and outhouses in country districts some old machines would come to light, but it would be difficult to identify many of them because they were of purely local make and sometimes only one of a particular design was built. I have prepared and presented to the Centenary Club a set of scale drawings of Macmillan's bicycle, of which I have made a ⅛in. scale working model. I noticed that a larger model obviously constructed from my drawings was exhibited at a model engineering exhibition in London last year without the slightest acknowledgment. The Science Museum has no drawings of this machine. Incidentally, whilst speaking of old machines, it is odd that the motor car came before the motor cycle. I have made a scale model of the original Werner motor cycle (1895) and of the Benz car (1888). I now have three " firsts," and readers who would like to see them may do so by appointment. In passing, the collection of old cycling books from 1860 onwards is a fascinating hobby and it is well worth while hunting round second-hand bookshops and stalls for a " find."

Future Cycle and Motor-Cycle Shows

After very full and careful consideration of the views of its members, the Bicycle Manufacturers Association announces that the Council has taken the decision to adopt a biennial policy for future shows, and accordingly the next Cycle and Motor-cycle Show after the 1956 Exhibition now in course of preparation, will be held in November, 1958. —F. J. C.

Adjusting Bearings

By "CYCLE MECHANIC"

Some Tips to Help Make Your Cycle Run Smoothly and Silently

A BEARING running on steel balls should be absolutely free; it must not be so tight that the bearing becomes permanently loaded and at the same time it must not be so slack that centrifugal force throws the balls out of their proper track. Protection from atmospheric conditions must be given, for the finest bearing can be ruined in a few days by the action of dirt and water. The free use of a good and suitable lubricant not only prevents excessive friction but assists in preserving the bearing from detrimental moisture.

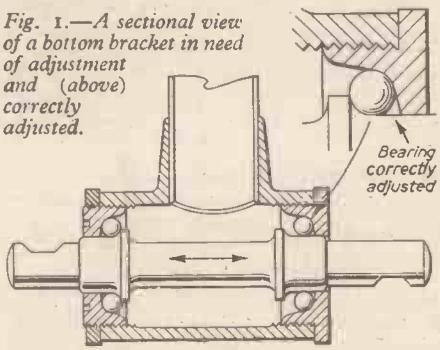


Fig. 1.—A sectional view of a bottom bracket in need of adjustment and (above) correctly adjusted.

The Bottom Bracket

The bottom bracket, shown in section in Fig. 1, is, perhaps, the hardest point to bring into proper adjustment, for although the bracket axle may be free and minus "shake" before tightening the locking ring, by so doing, the cup is forced outward just a fraction, but sufficient to cause a slackness which must be avoided. Patience is needed to obtain that essential accuracy. Bracket adjustment should always be made from the left-hand cup, which has a right-hand thread; the right-hand cup with a left-hand thread being the fixed one. In the case of cottered brackets (not now in general use) it is necessary to loosen the cotter pin in the bracket shell and tighten it after making adjustments.

If the threads in the bracket shell of the frame should be worn, thus making the cups a loose fit; if the threads have not been turned in parallel, or the cup axle races have not been ground accurately, it will be impossible to obtain the desired precision setting. A bearing must be at right angles to the axis of rotation. There is, however, small chance of any of these troubles on a good machine. A oilbath bracket is shown in Fig. 2.

Heavy Duty

It is the bottom bracket that is called upon to endure very heavy duty, and the continually varying loads imposed at this point, by the one-sided and uneven thrusts transmitted through the cranks, add considerably to the wear on the bearing. I often wonder why some manufacturer does not incorporate in his designs a roller bracket bearing (although I have a faint recollection that a maker once did) or even larger balls and races, for the greater the load the larger the bearing should be. Standard brackets house ¼in. balls, but tandems and Chater-Lea singles have 5/16in.

Pedals might give some trouble, for when tightening the lock nut the cone which you have so carefully adjusted may become screwed up a little, although usually a toothed washer which fits over the grooved spindle is made to prevent this occurrence—if the washer is a tight fit it probably will. One-eighth-inch balls in pedals are nowadays being replaced by most makers with 5/32in., while many are using larger diameter at the crank end, this end of the bearing taking the greatest load.

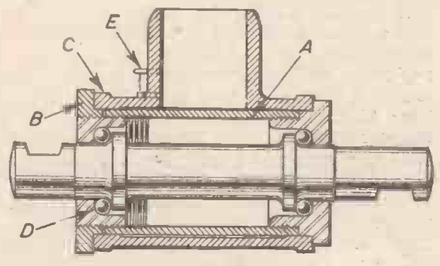


Fig. 2.—The oilbath bracket. A—sleeve, B—locking ring, C—body, D—cup, E—oil lubricator.

Wheel Hub Adjustment

Little can be said about wheel hub adjustment, except that a slackness might be due to the hub cups being loose inside the shell. Adjustment should be made from the cone A (Fig. 3) with the spanner flats on it. This cone should be on the left-hand side of the machine, the right-hand cone B is usually screwed up tightly on the spindle and should remain fixed.

The adjusting cone is locked, when adjusted by the end nuts C, C, which hold the fork ends D, D, together. In cases where the end of the cone beds up against the fork-ends, the cone sometimes has shoulders E, E, provided to fit in the fork slots and the outside washers F, F, have similar shoulders, as shown, to fit the slot. This prevents the threads on the spindle touching the fork slots and ensures true positioning of the hub spindle. Never interfere, as far as normal adjustments are concerned, with the right-hand side of a three-speed gear. When a wheel is in correct adjustment the weight of the valve should be sufficient to turn the wheel and the valve will settle at the bottom.

Most people use petroleum jelly when assembling balls in bearings, but oil should be injected afterwards, grease being unsuitable for bicycle lubrication.

The Steering Head

Steering head adjustment is a simple matter in most cases. However, it may be found that the steering is tight in one position and loose in another. This uneveness can usually be put down to the fork crown ballrace not sitting squarely on the crown, or rather, not being parallel with the bottom head lug race, and a cycle mechanic's assistance is needed to put the fault right. Sometimes the steering may be found to have a shake in it, and yet not be free enough for comfortable steerage, this trouble can be, more often than not, traced to one of the races being a slack fit in the frame. Removing the offending race and tapping the lug round with a light hammer will usually remedy this complaint. Should the fork crown race be found to be loose it can be packed with a strip of metal foil, or the shoulder on which the race fits might be marked all round with a centre punch, a tighter fit thus being obtained. One-eighth inch, 5/32in. and 3/16in. balls are used in the head, and at least one maker uses taper roller bearings.

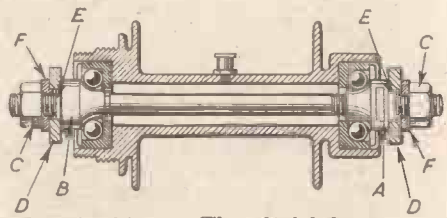


Fig. 3.—The wheel hub.

The top ballrace is adjusted by the ball ring A (Fig. 4) which screws down the thread on the column tube B and is locked by the lock ring C. This is independent of the handlebar fixing. The latter is by a cone D which fits the taper inside the split end of the handlebar stem E and is pulled up expanding the split end and jamming it in the column tube B of the fork, by the long bolt F whose head rests on the top lug of the handlebar and whose screwed end pulls up the cone wedge at the bottom. This long bolt should be kept greased at the head and the thread. The bottom bearing of the ball-head is the one which gets neglected, runs dry and wears. Often the makers provide no lubricator or oil-hole for this. Turn the bicycle upside down and squirt oil in from the bottom with an oil can; but keep this bearing oiled as it is important. G is the adjustment for rake of handlebar and the lug H clamps round the bar by the bolt and nut J.

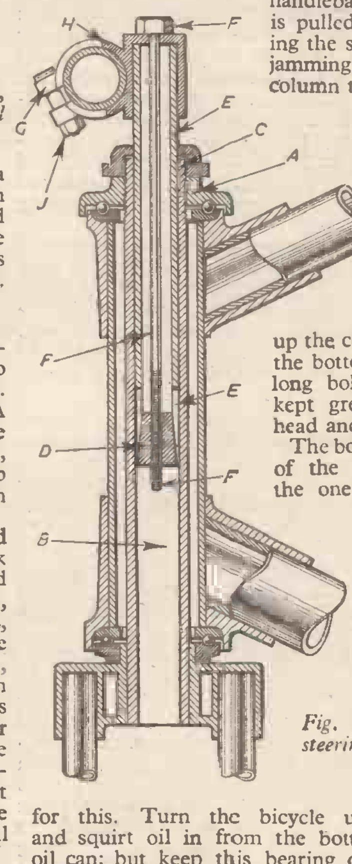


Fig. 4.—The steering head.

Never insert a few new balls in a bearing, they are cheap enough to fit a complete set. If you are not quite certain as to how many balls should be in a race, remember that it is better to have one short, than one too many. Even wear in a ballrace is not detrimental, but periodical examination should be made in order to ascertain if the surfaces are becoming marked or pitted, although when this is the case, the damaged part usually voices its injury with a series of irregular cracklings.

Published about the 30th of each month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by W. Speaight & Sons, Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia), Ltd. Sole Agents for South Africa—Central News Agency, Ltd. Subscription Rate (including postage): For one year, Inland 18s. 6d. Overseas 17s., Canada 17s.

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Practical Mechanics. July, 1956.