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AUGUST 1960

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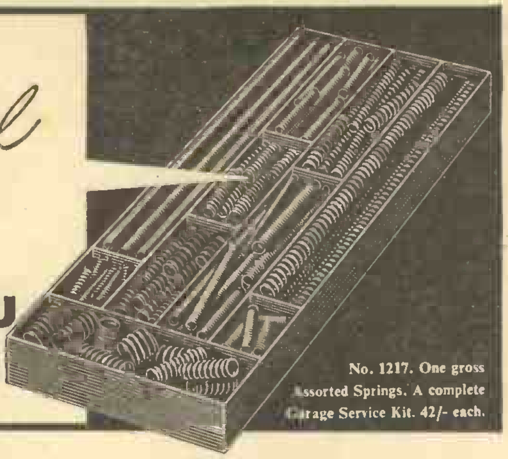

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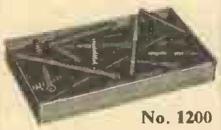

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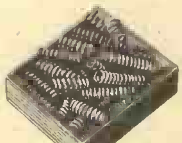

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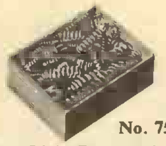

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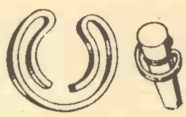

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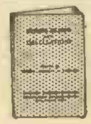

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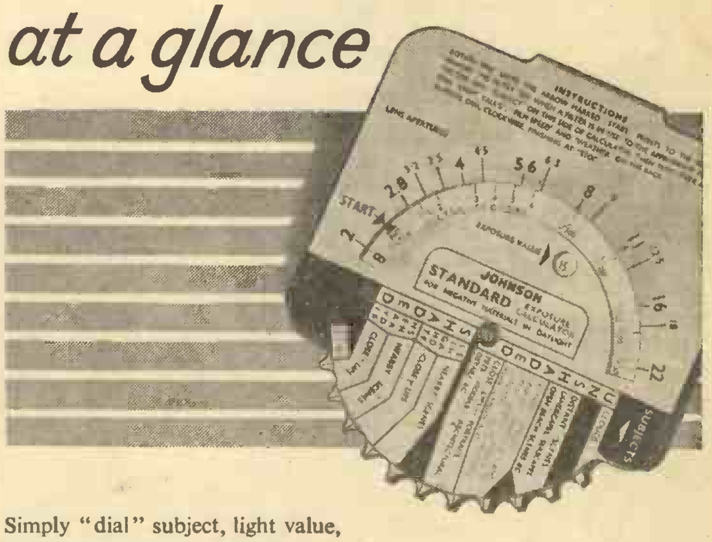

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Practical Mechanics

AUGUST, 1960

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CONTRIBUTIONS

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

FAIR COMMENT

D.I.Y. LINK WITH THE PAST

MODERN mass production has been instrumental in killing true craftsmanship. This is undoubtedly true but for most of us any disadvantages in this are outweighed by the tremendous benefits this progress has brought. The chief of these, of course, is cheapness; the mass-produced item is but a fraction of the cost of its hand-made counterpart. Another advantage is interchangeability of parts and the facility with which spare parts may be obtained and fitted, due entirely to the fact that every individual item of a batch of thousands mass produced is identical with all its fellows.

In addition to the " no more craftsmen " angle one also hears the complaint that, " they don't make things to last as they used to." This too is true. Things aren't made to last a life-time as they were in the past. There is no need for them to last so long. As soon as they are worn out they can be replaced by a more modern and improved version and, thanks to modern production methods, the buyer is still not out of pocket.

Indirectly, however, mass production is responsible not only for eliminating the old-time craftsman but also for introducing what may be the forerunner of his modern counterpart.

Modern production methods are largely responsible for the high standard of living which we enjoy today and, in the same way, for the increasing amount of leisure time available. It is the ordinary man's efforts to occupy his newly available leisure time constructively that have resulted in what has now become universally known as D.I.Y.

The link with the past is more direct than might at first be supposed. It is not merely that the same mass production methods which put the old craftsman out of work started the new trend but also many of the new hobbies are the same as the old crafts. Things like baskets, hand-made leather goods, pottery, wood carvings, toys, embroidery, woven work, turnery and furniture were all products of the old-time craftsman and they are all gaining popularity as modern hobbies.

There is no doubt that the new hobby workers take a pride in their work; for most of them this is the only motive for doing the work at all. Does this mean that the new craftsman will be an amateur instead of a professional?

THIN END OF THE WEDGE?

In " Fair Comment " in our issue dated April, 1959, we wrote, " This is the space age and with all the exciting new discoveries being made, we are extremely disappointed that Great Britain, the country that discovered, explored and colonised much of the world's surface, is not taking a prominent part." The subject was, of course, the exploration of space and thus it was with great interest that we read the remarks of Mr. Duncan Sandys, the Minister of Aviation in a recent speech to the Press Gallery at the House of Commons.

After mentioning that the Government were actively considering the adaptation of " Blue Streak " as a launcher for space satellites, he went on to say that the difficulty was in weighing up the possible advantages against the cost and the demands on scientific skill. This weighing up process is made considerably more difficult because the possible advantages are largely unknown. Those things which show definite promise, such as vastly improved world-wide radio telephone communication and television, much more reliable weather forecasting, improved astronomical observation, military intelligence and the acquisition of knowledge about space with a view to future interplanetary travel may be only minor benefits compared to other things as yet undiscovered and undreamed of. Mr. Duncan Sandys concluded by saying, " The fact that we really have no idea where it might ultimately lead us, may perhaps be the best of all arguments for going ahead and finding out." It is this statement which we hope is a broad hint that perhaps at long last we shall ourselves be joining the conquest of space.

The September, 1960, issue will be published on August 31st. Order it now!

Process your own

A money-saving procedure

G. A. T. Burdett

IT is the purpose of this article to show how simple colour processing really is, how it can be successfully accomplished by the amateur photographer, and without the aid of elaborate equipment or even a proper dark room.

There are two principal 35mm. colour processing outfits available in Britain. One is the Kodak Ektachrome Processing E2 improved kit, which is for processing Ektachrome reversal colour films, including the new high speed Ektachrome; the second is Johnson's Ferraniacolor Processing Kit, for processing Ferraniacolor reversal films, shown in Fig. 1.

Equipment Required

Some of the equipment required for processing Ferraniacolor films is shown in Fig. 2, but below is given the full list.

(1) A development tank. This should preferably have a transparent spiral reel which makes the colour reversal process less arduous. Reels of various sizes are available and one accommodating four 20-exposure or two 36-exposure 35mm. films, enabling them to be processed simultaneously, will save considerable time and trouble.

(2) A good thermometer with clear scale. These are available to fit development tanks.

(3) One timer. The Smith 60-minute timer/ringer is particularly suitable.

(4) Two or more 600cc. glass or plastic measures.

(5) One or more 20oz. glass or plastic jugs.

(6) One No. 1 photoflood lamp, plus shade (2s. 6d.).

(7) One holder for the lamp, e.g. an adjustable desk lamp is particularly suitable.

(8) Seven (maximum) brown bottles (600ccs.). Empty sherry bottles are suitable, but brown glass bottles can be purchased from photographic dealers.

(9) Two (or more) film clips for suspending the films during drying.

(10) Plastic washing bowl or similar kitchen utensils for providing rinsing water and for the storage of bottles at specific temperatures during processing. (See Table I.)

Preliminary Steps

Processing can be conducted anywhere, but preferably in the kitchen or bathroom where adequate water and mixing facilities are available. Substantial quantities of bulk water at specific temperatures are necessary for bringing the solution to the correct temperature, as specified by the makers, and for maintaining it at a given temperature; also for rinsing and washing the films during processing.

For the rinsing water a baby's plastic bath can be used, and for housing the bottles of processing solutions at the correct temperature a wash-boiler, which can be switched on as necessary. If this is metal-lined it must not be used for rinsing water.

Having prepared the kitchen and utensils, mix the solutions in accordance with the maker's instructions, supplied with the processing outfits (Fig. 3).

These solutions are mixed at temperatures ranging from lukewarm to 90 deg. F. The solutions are bottled in turn and placed in the wash-boiler, in which the water temperature is just above the processing temperature. It is important that the solutions should be main-

TABLE I.—*Processing Steps of Ektachrome and Ferraniacolor.*

No. Steps	Process	Temperature °F.	Time Mins.	Temperature °F.	Time Mins.
Ektachrome				*Ferraniacolour*	
STAGE 1					
1	Develop	75 ± ½	10	65 can raise to 70	14
2	Wash (or rinse)	73–77	1	65 approx.	5
3	Harden	73–77	3	65 ,,	5–8
4	Wash	73–77	3	65 ,,	5
		TOTAL	17 mins.	TOTAL	29–32 min.
STAGE II.	Reversal exposure under Photoflood Lamp.				
5.	(30 secs. to 1½ mins.).				
STAGE III					
6	Colour development	73–77	15	65 approx. Magnesium sulphate bath in soft water districts (see maker's instructions).	8
7	Wash	73–77	5	65 approx.	15
8	Clearing bath	73–77	5	No separate process	
9	Wash (or rinse)	73–77	1	See Process 7 above	
10	Bleach or bleach hardening	73–77	8	65 approx.	10
11	Wash (or rinse)	73–77	1	65 ,,	5
12	Fixing	73–77	6	65 ,,	8–10
13	Wash	73–77	8	65 ,,	15
14	Stabiliser	73–77	1	No comparable process	
15	Drying	110 max.	—	Similar	
			50 min.		61–63 min.
		TOTALS	67 min.		90–95 min.

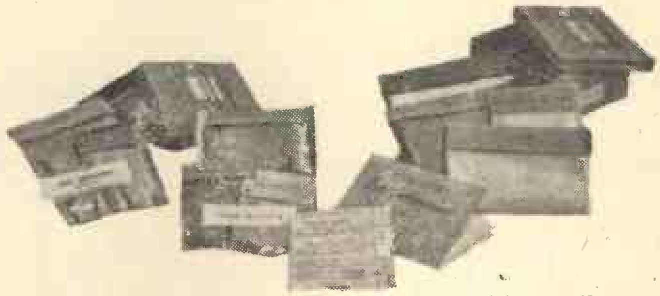


Fig. 1 (Above).—The nine ingredients of Johnson's Ferraniacolor processing outfit and labels for fixing to bottles.

Fig. 2 (Left). — Principal equipment required; developing tank, accurate thermometer, measure, funnel, stirrer, timer, film clips and five bottles. Two extra bottles are required for Ektachrome.

Fig. 3.—Preparing the solution for colour processing. Bottles must be lined up in correct order as shown.

Fig. 4.—Pouring the first developer into the tank (now loaded with film).

Fig. 5.—Standing the tank in a bowl of water to maintain solution inside at correct temperature.

COLOUR FILM

described step by step by


Fig. 6.—Second exposure using a 100W. lamp. Do not let film dry out.

Fig. 7 (Left).—A 35mm. film can be handled best during the second exposure by keeping it in the transparent reel. Expose one end first and then the other.

Fig. 8 (Above). — Returning the colour developer to the bottle. Solutions still to be used are lined up on the left, the used being on the right.

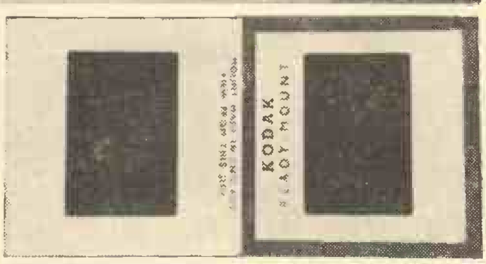


Fig. 9 (Above).—Typical 2in. × 2in. card ready-mount for a standard 35mm. colour slide.

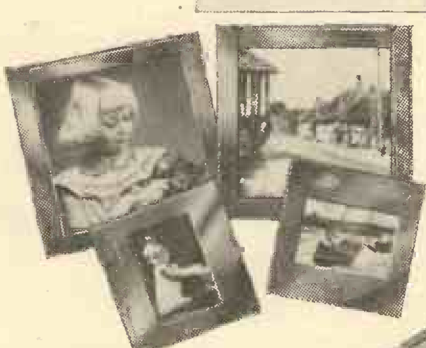


Fig. 10 (Above).—Typical 2¼in. sq. colour slides (top) and at the bottom 2in. × 2in. (35mm.).

Fig. 11 (Right).—Typical slide box.

tained at the correct temperature for about 30 minutes before using.

Incidentally, the bottles are numbered and labelled, labels being supplied with the processing kits. To ensure that they remain affixed when the bottles are placed in the bulk water, it is preferable to stick them to a tie-on label tied to the neck of the bottle.

During the time the temperature of the solutions is being "stabilised," thread the film or films in the developing tank spiral. This must be carried out in complete darkness. The cupboard under the stairs or room blacked out are equally suitable. The lid is replaced and the tank can now be brought into the light.

By now, we should have the bottles in solution in the storage water at the processing temperature (75 deg. F. for Ektachrome and 65 deg. F. for Ferraniacolor) and a bath or other vessel of bulk rinsing water at the same temperature. The timer should be on a convenient table, the loaded development tank on the draining board, the photoflood in the desk lamp, and this connected to its plug and socket.

The temperature of the processing room (kitchen) should be at normal room temperature to assist in the maintenance of the solution temperature.

First Development

It will be seen from Table I that to obtain the best results the temperature of the first developer during processing is critical. Kodak Ektachrome allows only ± ½ deg. F. variation from 75 deg. F., and although Johnson's Ferraniacolor gives a margin of 5 deg. F. from 65 deg. F. to 70 deg. F., it is advisable to keep to the 65 deg. F. if possible.

To ensure that the temperature is maintained during the 10 minutes of first development for Ektachrome and the 14 minutes for Ferraniacolor, it is as well to bring the developing tank to the correct temperature immediately prior to processing. This is simply done by standing the tank in bulk water. The jugs and measures should be similarly treated.

The first developer can now be poured into the jug or measure and the temperature taken. If a temperature correction is required, stand the jug of solution in a bowl of water, and keep it there for at least 15 minutes after the solution has reached the correct temperature.

Now set the timer for the whole of the first stage—first development, rinse, harden and wash—17 minutes for Ektachrome and 29–32 minutes for Ferraniacolor. Pour the solution into the tank (Fig. 4), tap the tank on the table to release air bubbles on the film, and then stand the tank in the bowl of water which is at the correct temperature (Fig. 5); agitate for 20 seconds, or as instructed by the makers, then agitate at intervals as recommended.

WATCH THE THERMOMETER and also the timer.

The times given by the makers include pouring in the solution, emptying the tank and draining. At the end of the specified time—10 or 14 minutes, less emptying and draining time—pour the solution into the water, rinse or wash as instructed, but do not remove the lid of the tank; pour in the hardener direct from the bottle, agitate and then replace the first developer in its *original bottle.*

The agitation and washing processes are repeated, and the spiral is removed from the tank and is placed on the draining board for draining off the water.

All remaining work is carried out in the normal room lighting. The tank lid need not be replaced again.

Reversal Exposure

For the reversal exposure, the photoflood lamp is brought into operation.

The lamp is switched on and the film is placed underneath. If you are using a transparent spiral it is necessary only to place the spiral under the lamp at a specified distance for a given time, exposing first one end and then the other (Fig. 7). But if your spiral is opaque, it is necessary to remove the film from the spiral and expose the film by moving it backwards and forwards under the lamp (Fig. 6).

Adequate exposure is necessary. You cannot over-expose. You must not let the film dry out. Place the film (and its reel) in water between exposures, or place the reel in a white bowl of water during exposure. Ensure that the water does not splash on to the lamp, or it may shatter. A sheet of dry glass may be used for this.

(Concluded on page 494)

TABLE II.—*Costs Compared.*

EKTACHROME	£	s.	d.	*FERRANIACOLOR*	£	s.	d.
Eight 20-exposure films (unmounted) at retailer at 9/- each	3	12	0	Four 20-exposure films (unmounted) and processed at retailer at 9/- each	1	16	0
Home processing kit, parts 1 and 2	1	2	6	Home processing outfit (parts 1 and 2)		11	0
Saving	2	9	6	Saving	1	5	0
Cost per 20-exposure film when home processed		2	10	Cost per 20-exposure film when home processed		2	9
Saving per 20-exposure film		6	2	Saving per 20-exposure film		6	3

The above costs will vary, depending on the number of films being processed at one time.

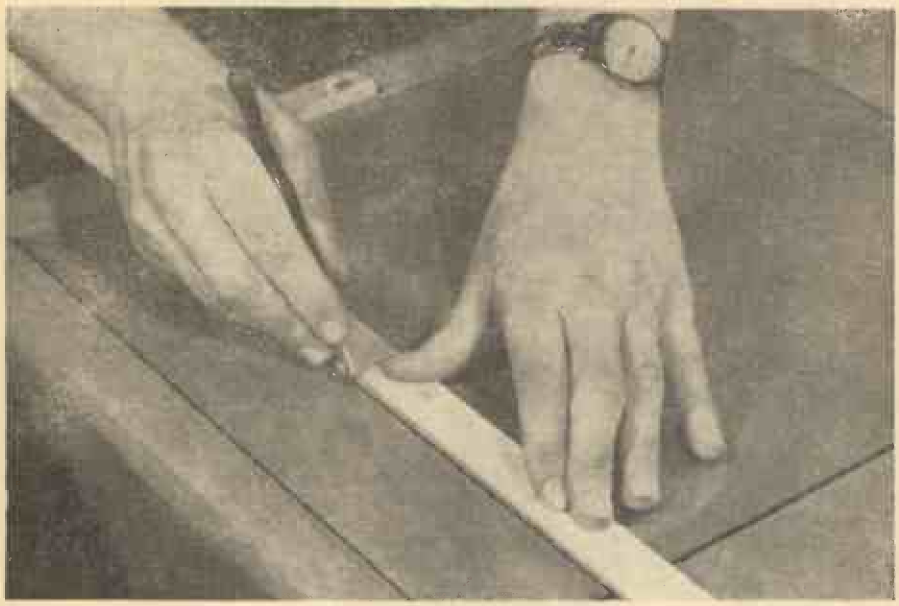


Fig. 1.—The set-up for making a straight cut.

HANDLING
THE STRAIGHT CUT — THE CUTTING OF CURVES

Some of the techniques are described in the first of a short series

by S. M. Charlett

ALTHOUGH it can be developed into a fine art, the cutting of sheet glass is no more difficult than the cutting of glass tube or rod. Success depends upon practice and the observance of a few simple rules.

The beginner always makes the mistake of thinking that the glass cutting tool is a means of hacking through the sheet, rather than a mere marking tool, and consequently he makes a deep score mark, hoping to produce a good break. All that usually happens is that at best the effort produces no better results than would a gentle scratch, and at the worst a heavy score mark induces slight splintering along the edges of the cut, and a resultant jagged break. The rule when marking a line for parting sheet glass is to use a very light pressure, sufficient to produce a barely visible *hairline scratch*, and it will be found that the break, when made, will have a clean edge. The best scratch is produced by drawing the cutter, or diamond, across the surface to be marked without any pressure other than that of the actual weight of the cutter.

Never try and mark the same line twice, or try to deepen a scratch. More often than not the second scratch will wander from the first, and in any case it will only make a deep coarse mark instead of a thin hairline. Once a mark has been made, leave it, and if it has spoiled a piece of work make it again elsewhere rather than waste time trying to correct the error by further scratching.

Cutting Tools

In the writer's opinion the glazier's diamond is the most valuable tool for glass cutting, as far as the amateur is concerned. Many experienced readers may use other tools, but the diamond is better for the beginner.

Diamond cutters may be bought from most laboratory suppliers, and are supplied mounted in a pen-type holder. They are capable of marking the hardest glass, producing a hairline scratch. In general they cost about £1 1s. each.

The wheel cutter consists of a specially hardened steel wheel, mounted on a pen-type holder. While not quite as efficient as the diamond, the wheel is quite useful. When fairly new it will produce a fine hairline scratch, but it does tend to deteriorate very rapidly, particularly if used on very hard glass. The tendency with this type of cutter is to press rather too hard and to produce a very crunched and ragged mark. Prices vary from dealer to dealer, but a good wheel costs about 7s. 6d.

The glass cutting knife is a blade of steel carrying a tempered edge ground very sharp and somewhat resembling a 1in. chisel. This is used primarily for the marking of the softer types of glass, and once again the tendency is to press too hard with one corner, and thus produce a ragged scratch. The correct way to use the tool is to keep the edge parallel to the surface of the glass, and to press lightly, resulting in a fine mark.

A patent glass cutting tool can also be used. This consists of a 2½in. blade of fine tool steel with an extremely sharp and durable cutting edge, mounted in a plastic handle of convenient size. Such a tool is manufactured by Gallenkamp & Co., of London. It is used by holding the edge in complete contact with the surface to be marked and then drawing along with sufficient pressure to produce a fine scratch.

Additional Tools

A straight edge will be required. This may be of wood, plastic, or other material. Bar tool steel can be recommended as being less liable to wear or to distort under usage. It is preferable to have two of these tools, one for small pieces of work, the other for larger pieces. The writer uses a tool steel bar 12in. × 1in. × ⅛in. for smaller work, and a bar 36in. × 1in. × ⅛in. for larger operations. The straight edges may be graduated if so desired, but this is not essential as any measurements may be made with an ordinary rule.

The square consists of a straight edge set at right-angles to a rigid handle, and is used for laying off lines at a right-angle to a given edge. The ordinary type of carpenter's square can be used (Fig. 2), but the writer prefers the all-steel engineer's square.

The cutting table may be merely a section of bench, or it may be a table made and reserved for glass work. A rectangular space 3ft. × 6ft. will usually suffice for most sheet glass work. At the centre front and rear of the table or bench should be screwed two small blocks of wood; these will allow the longer straight edge to be held without slipping while cuts are made with one of the tools mentioned above.

Several lengths of wooden batten 1in. × ½in. should be available; the purpose of these will be noted later.

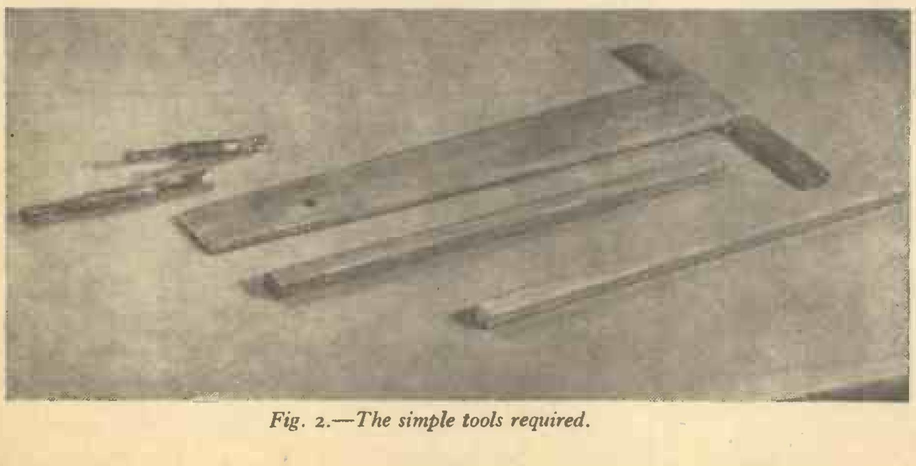


Fig. 2.—The simple tools required.

The Straight Cut

Assuming that we have a piece of glass 12in. wide and 15in. long, and that from this we wish to obtain a piece 12in. × 12in., we proceed as follows: using an ordinary rule and a finely pointed grease pencil a mark is made on each of the longer edges of the sheet 12in. from one end. The sheet is then laid on the cutting table between the two small wooden blocks noted earlier. The long straight edge is then placed over the sheet and held against the two blocks, the sheet being adjusted until the two pencil marks are against the straight edge. The latter may now be held firmly in place with one hand while a fine scratch is made with one of the cutting tools described above, care being taken to avoid any of the cutting faults previously mentioned (Fig. 1).

If the glass is of the normal soft variety this mark will suffice; if, however, the glass is a hard variety the sheet should be turned over

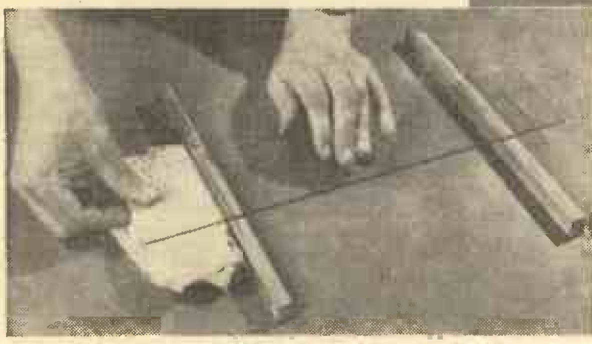


Fig. 3 (Left).—Breaking off the waste glass.

Fig. 4 (Above).—Using a template to cut a curve.

from the curve to leave a smooth edge, any irregularities being removed by grinding (to be described later).

Cutting Discs

The method is similar to that used for curves, although there is available an additional tool which renders a template unnecessary. This consists of a central pivot which carries an arm to which is attached a diamond. The arm may be adjusted to various radii, but generally only discs of 2in. dia. and upward may be marked, and below this we must resort to the template. With the circle marked tangential lines are inscribed in the waste glass (Fig. 5), in the same way as described under curve cutting, again taking care not to bring these right up to the main circle. Once again the waste should be tapped with the end of the marking tool until the waste pieces split away. The edge of the disc may be subsequently smoothed by grinding.

Cutting Holes

This requires more care than the preceding operations. The technique given below is usually only employed for holes greater than 2in. dia.; for smaller holes a method is given under the section on drilling glass.

SHEET GLASS

CUTTING DISCS — CUTTING HOLES

Assuming we wish to cut a 3in. hole in a sheet of glass then the first step is to mark out the hole, either by special tool or with a template. This done, a second circle about 1in. dia. is inscribed within the first and roughly at its centre. The operation of cutting waste lines is now performed, but instead of making them outside the circle they must be made within it (Fig. 6). The lines should start a fraction of an inch from the outer circle and can be taken into the inner circle without worry. Six or eight waste lines will suffice for the smaller circle, but when dealing with diameters of 6in. or more the number of waste lines should be increased. The marking completed, the segments should be tapped in the same way as for a curve, it generally being better to try and tap out individual segments if possible. A slightly ragged edge usually results from this operation, and this may be smoothed by grinding.

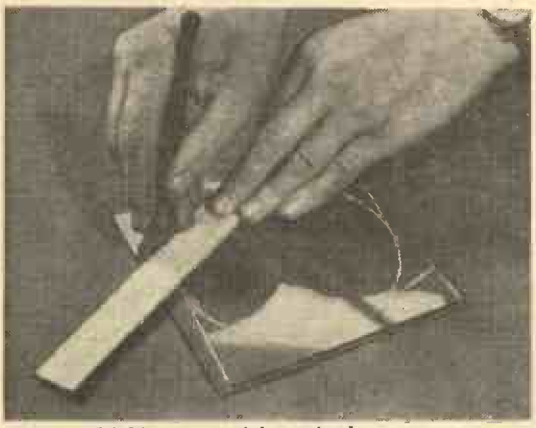


Fig. 5.—Making tangential cuts in the waste round a disc.

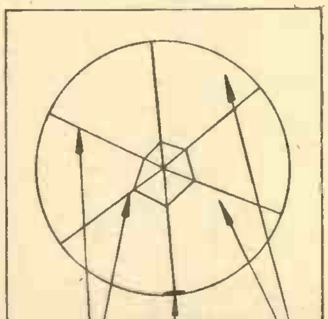


Fig. 6.—Cutting a large hole, shown diagrammatically.

and a second scratch made on the reverse side, taking care that this corresponds to the first mark. A perfectly satisfactory break will be obtained if the sheet is laid flat on the bench. Beneath the scratch marks is inserted one of the lengths of batten mentioned earlier. This should be long enough to project either side of the sheet, and should be arranged so that it lies a little to one side of the scratches allowing the 3in. piece to be removed to overhang. The opposite end of the sheet should be supported by a similar batten so that it lies parallel to the surface of the cutting table. A folded duster should then be placed on the piece of waste glass, the main sheet held gently but firmly with one hand, and the waste glass given a firm, sharp, downward thrust with the other hand (Fig. 3). It will be found that the glass will part and leave a clean straight edge. If the first thrust does not produce a break the pressure should be increased, in which case it may be advisable to hold the main sheet with a duster, in case of a mishap.

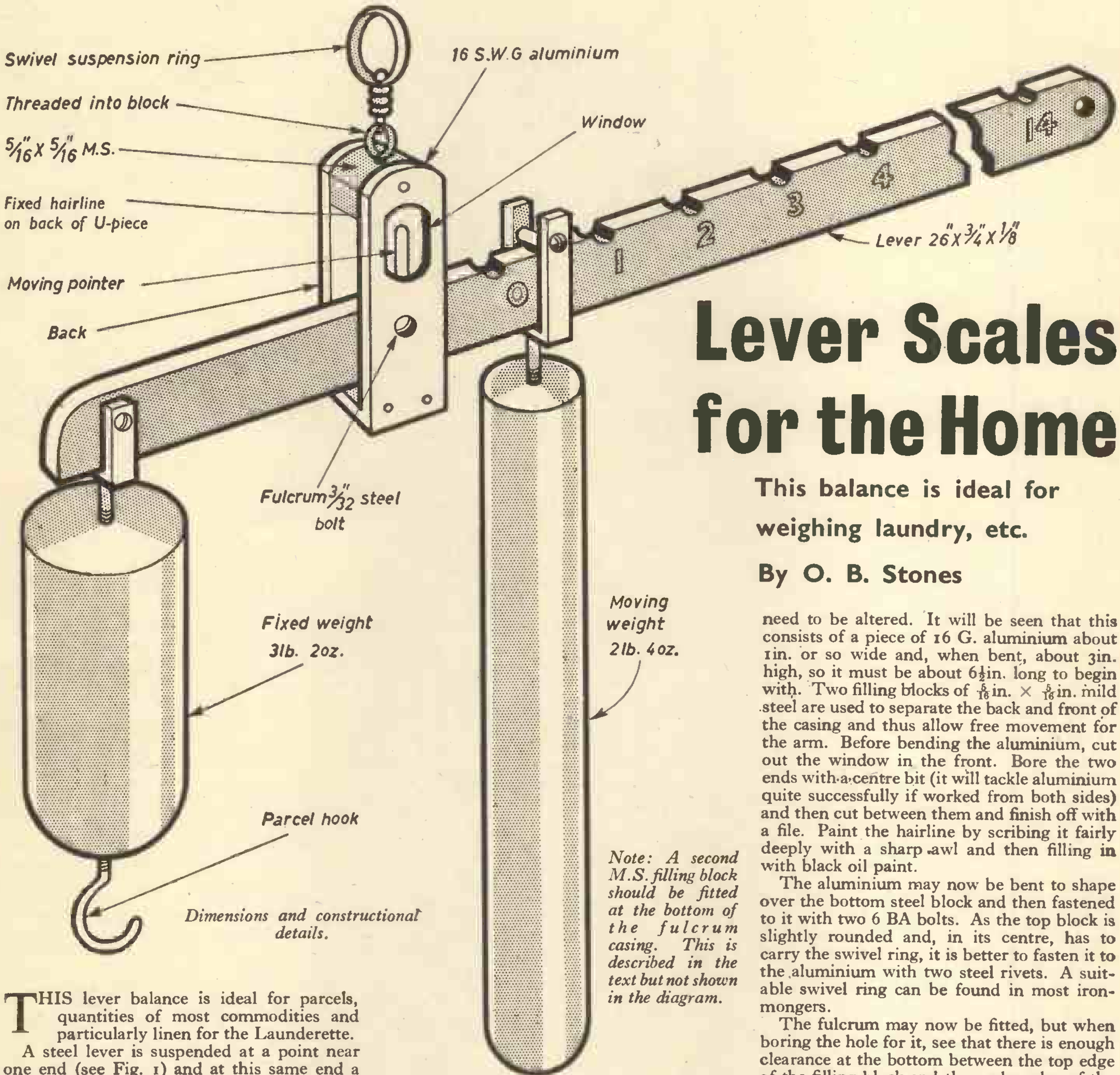
The Cutting of Curves

This is a most wasteful operation and should always be conducted with an eye to economy. Assuming we have a strip of glass 12in. × 3in., and that we wish to put a semicircular curve on one end, the first step is to make a template of the curve in thick cardboard to act as a marking guide. The glass strip is then laid upon the bench and the template held firmly in place as near the end of the strip as possible (Fig. 4). The best tool for marking is a diamond, and the curve should be firmly inscribed. Using a straight edge a number of further lines are inscribed on the waste glass, which is to be removed. These should be tangential to the curve, but should not quite touch it; if they are allowed to meet the curve there is a risk of a crack subsequently crossing it into the sheet. The lines having been inscribed, the marked section is tapped gently but firmly from beneath with the end of the cutting tool. The tapping should persist until the inscribed lines develop into cracks, when further gentle tapping and pressure will enable the pieces to be separated

An Alternative Cutting Method

Where the glass is exceptionally thick or tough it may be found very difficult or even impossible to get results with the above cutting methods. In this case the following alternatives are useful, if a little tedious. For a straight cut, or a curve of large radius, an ordinary hacksaw well lubricated with coarse carborundum paste can be used to saw along the markings. In the case of a sharp curve or a hole the hacksaw blade should be replaced with a length of piano wire. This is similarly lubricated with coarse carborundum paste. For the cutting of discs a start may be made at the edge of the glass, but for the cutting of holes it will be necessary to drill a start hole as described in the section on the drilling of glass.

Further techniques, including drilling, will be described next month.



Dimensions and constructional details.

Note: A second M.S. filling block should be fitted at the bottom of the fulcrum casing. This is described in the text but not shown in the diagram.

Lever Scales for the Home

This balance is ideal for weighing laundry, etc.

By O. B. Stones

THIS lever balance is ideal for parcels, quantities of most commodities and particularly linen for the Launderette.

A steel lever is suspended at a point near one end (see Fig. 1) and at this same end a weight is fixed. Along the remaining length of lever a sliding weight operates which, according to its distance along the arm when the latter assumes the horizontal, indicates the weight which has been applied to the short end.

General Details

The fixed weight, to which the parcel or goods to be weighed is attached, consists of a 2in. dia. brass tube 4in. long; this is filled with molten lead and, when complete with parcels hook and forked suspension device, weighs approximately 3lb. 2oz. The moving weight is a 7¾in. length of 1in. dia. iron piping, also filled with molten lead, and weighs 2 lb. 4 oz. The lever, or arm, is of mild steel 26in. long × ¾in. × ⅛in. and weighs 14oz. The fixed weight requires to be hung at about 1⅜in. from the fulcrum to bring the scales at "balance" and then the moving weight moved along approximately the same distance for each pound to be weighed.

Forked Suspension

The forked suspension pieces shown in Fig. 1 can be of mild steel or brass. Any form of suspension may be adopted, particularly with the fixed weight. It must be borne in mind that the moving weight has to be lifted slightly from slot to slot, and that it must slide easily along the arm yet without too much play. The fixed weight will be suspended at a point ⅝in. from the end of the arm, and a hole may be bored to accommodate a 2 BA bolt used for the purpose. The hole for the fulcrum may also be drilled, and this is fixed at a point 3¾in. from the same end of the arm. Since the fulcrum consists of a 3/32in. steel bolt or pin, drill a hole that will permit it to rotate freely but without wobble.

After cutting the tubing and filling with lead, the two weights may now be completed by having their suspension pieces screwed in and the parcel hook added to the fixed weight. Drill the lead slowly and clean the drill frequently. Tap if possible. The parcels hook is of ¼in. dia. material with a Whitworth shank and is obtainable at most ironmongers.

The Fulcrum

The fulcrum and its casing is shown in Fig. 1. The round fulcrum has been used, but if it is considered worth the extra trouble a triangular fulcrum may be made and fitted. The general construction of the casing will not need to be altered. It will be seen that this consists of a piece of 16 G. aluminium about 1in. or so wide and, when bent, about 3in. high, so it must be about 6½in. long to begin with. Two filling blocks of 5/16in. × 5/16in. mild steel are used to separate the back and front of the casing and thus allow free movement for the arm. Before bending the aluminium, cut out the window in the front. Bore the two ends with a centre bit (it will tackle aluminium quite successfully if worked from both sides) and then cut between them and finish off with a file. Paint the hairline by scribing it fairly deeply with a sharp awl and then filling in with black oil paint.

The aluminium may now be bent to shape over the bottom steel block and then fastened to it with two 6 BA bolts. As the top block is slightly rounded and, in its centre, has to carry the swivel ring, it is better to fasten it to the aluminium with two steel rivets. A suitable swivel ring can be found in most ironmongers.

The fulcrum may now be fitted, but when boring the hole for it, see that there is enough clearance at the bottom between the top edge of the filling block and the under edge of the arm to allow the latter to swing freely and find its own level. The fixed pointer may consist of a piece of steel or brass about 1in. long × 3/16in. wide and not more than 1/16in. thick. It is pointed at the top end by filing and is fixed at right-angles on the arm with its centre immediately over the centre of the hole bored for the fulcrum. It can be fixed to the arm with 10 BA c'sk. bolts or very fine rivets. The apparatus may now be assembled and suspended from any convenient point.

Calibration

Carry the moving weight away from the fulcrum and, at a point roughly 1⅜in. from it, it will be found that the arm assumes the horizontal and that the pointer and hairline are in perfect alignment. Where the bolt holding the suspension piece rests on the arm, file a semi-circle with a round file as shown in Fig. 1. This will be marked zero, as it represents the point at which the scales are in perfect balance. Use a set of shop weights, 1lb., 2lb., 4lb., 7lb. to calibrate up to 14lb.

Paint in the numbers "0" to "14" and, at the end of the arm, drill a hole and run through a bolt or stud to prevent the moving weight from accidentally sliding off the end.

I. Trethewey tells —

How I made my Kart

Fig. 1.—The completed Kart in use.

ANYONE can drive it in comparative safety—a racing car made from one giant size roller skate and lawn mower engine. Add a few simple modifications and you are in the Go-Kart business.

Most drivers want to make and race a car of their own—and I'm no exception. The idea of making a Kart began when I was looking through American magazines about six months ago and ended with the machine shown in Fig. 1.

The first problem was to find suitable wheels, about 10in. in diameter and with pneumatic tyres. I finally settled for Dunlop castor wheels 9in. in diameter each costing £2. For the chassis, a local tube bender supplied six pieces of 1in. O.D. 18 gauge tube which were to be the front and back axles, side members and two bends for the seat and the steering column support.

From the magazine which gave me the idea in the first place I found the correct dimensions. The track was to be 34in.; the wheel base 42in.; ground clearance about 2in.—mine with a load-up is just over 1in. but needless to say the seat has a stout steel bottom!

The Frame

To begin with the side members were shaped and welded to the front and back axles 13in. apart (Fig. 5). Then the back rest and steering supports were fitted. To keep the frame square the 18 gauge mild steel floor which extends from the front axle to the back rest was tack welded into place. A 20 gauge back rest was fitted in a similar manner.

Wheels

Roller bearings were a standard fitting but I considered them much too flimsy for the task ahead and replaced them with phosphor bronze bushes to run on 6in. bolts, ¾in. dia. The wheels were retained with a spacer and large nut. These bearings may seem primitive but proved most successful after many hours of driving, and never give any trouble. At all the meetings I've attended, wheels have collapsed, but, so far, mine are as sound as when they were first constructed.

Steering

The next step to consider was the steering. To ensure hands-off steering, the wheels needed castor and camber. I finally settled for 6in. castor and 8in. camber. For the back axle the bolt heads were turned down so they could be forced into the tube then brazed into position. The heads of the bolts acting as front stub axles were grooved and tubes 4in. long were welded in place, and in these were fitted the king pins, which are merely well-fitting bolts. All that remained was to weld U-shaped pieces of mild steel into the ends of the front axles, with suitable holes bored to take the ends of the king pins. This forms the complete front axle.

I welded a piece of ¼in. × ½in. steel 4in. long to the heads of the stub axle bolt, projecting forwards. These were linked by two short track rods joining at a drag link fixed to the base of the steering column. Although successful, this system caused heavy tyre wear, due to the lack of Ackerman correction. To turn correctly the inside wheel must pivot further than the outside. Normally this is achieved with the track rod behind the wheels. This was not possible on my Kart; to turn the wheels in this manner, the track rod must be lengthened as the turn gets more acute. After much experimenting I made up a T-shaped drag link which does that (see Fig. 3).

The steering column was a piece of ½in. tube, 18in. long, anchored at one end by the drag link and at the other by the steering wheel. The rim of the steering wheel was made of ½in. conduit, using only a large pulley wheel and a vice. The three spokes were short pieces of conduit, hammered flat at one end to fit the centre boss, which is a 2in. dia. piece of ¼in. steel plate welded to a short tube fitting over the end of the steering column. At this stage the machine was mobile, so a friend pushed it round the yard to get an idea of how it would finally handle.

Engine

After a considerable search I decided on a 125 c.c. Royal Enfield two stroke engine which I obtained for £3. It had a gear box but I thought they were "out" for Karts so I removed it. To do this I split the crank case and gear box and cut off unnecessary pieces of the casting. The engine was then put back together without a clutch or gear box. The final drive is therefore straight from the engine to the rear wheel. The original engine sprocket and primary chain are used and these drive a Cyclemaster sprocket which happened to be the correct diameter and pitch. Cutting off the gear box meant losing the rear engine mounting so the engine was now tilted to a horizontal position and mounted solely on the original front bearer (Fig. 4).

Clutch

A piece of tube 4in. dia., 1in. long was welded on to the driven rear wheel. To this was fixed the back clutch plate. The friction plate which is also the drive was welded to the Cyclemaster sprocket; the pressure plate was withdrawn, not by the usual push rod, but by a short tube which is fitted with bearings and a cable-actuated toggle. The complete gadget fixes over the end of the axle. The engine plates were just two pieces of mild steel 4in. × 6in. slipped over the rear axle

Fig. 2.—The rear brake.

Fig. 3.—The steering linkage.

Fig. 4.—The engine mounting.

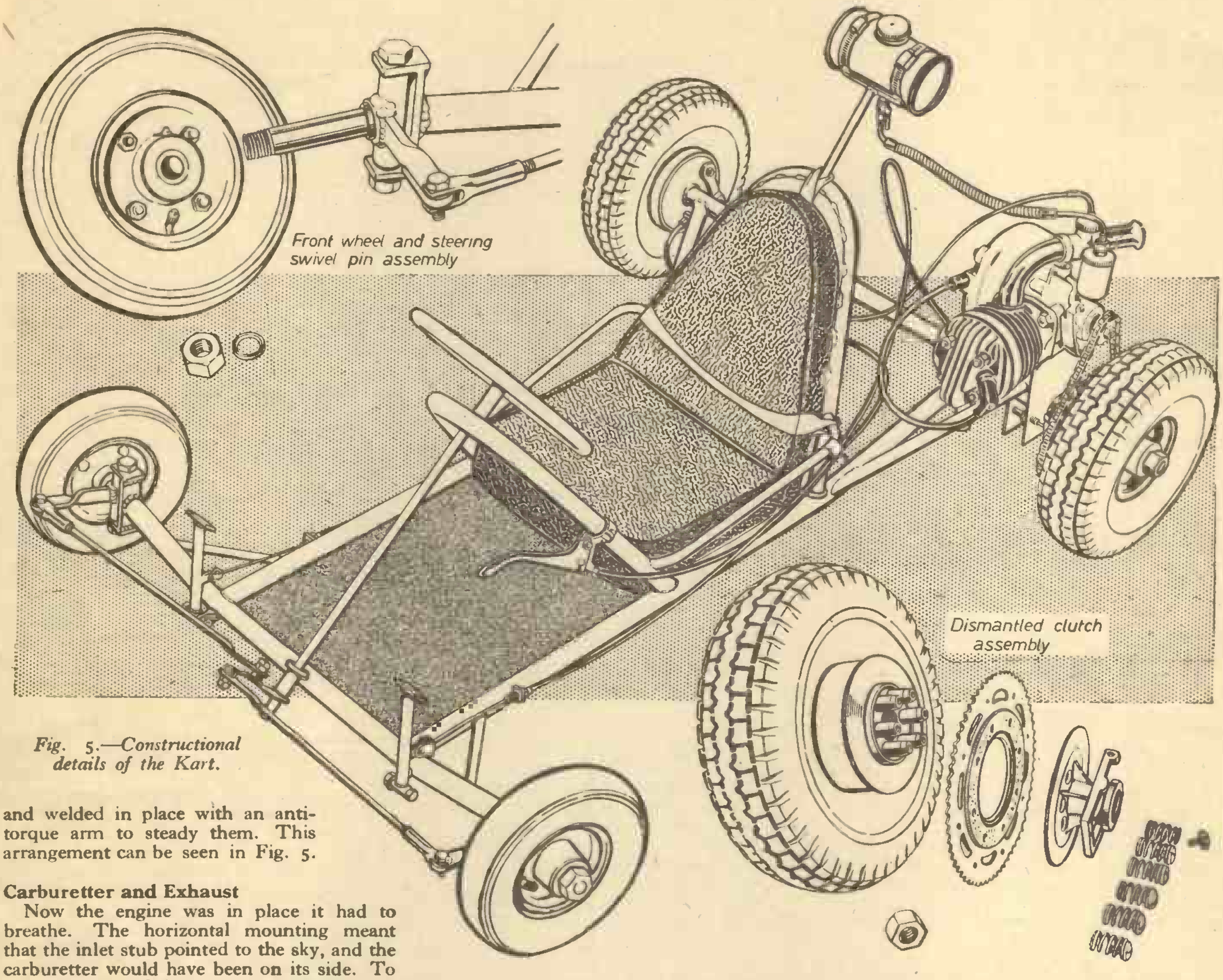


Fig. 5.—Constructional details of the Kart.

and welded in place with an anti-torque arm to steady them. This arrangement can be seen in Fig. 5.

Carburetter and Exhaust

Now the engine was in place it had to breathe. The horizontal mounting meant that the inlet stub pointed to the sky, and the carburetter would have been on its side. To overcome this, I bent a 5in. long piece of 1in. dia. tubing with a flange on one end, to fit over the inlet stub on the cylinder barrel. The carburetter fitted neatly over the other end. The exhaust pipe was merely an 8in. piece of straight copper tube with a suitable flange. While I was playing with the copper tube I thought I might as well make a ram tube, the bell of which was easily made with a ballpein hammer after the copper had been annealed. The tube is held in place by a jubilee clip.

The petrol tank is a cylindrical 1 pint oilcan on its side, with filler soldered on. It is held by two jubilee clips to a short piece of flat strip welded to a 6in. tube mounted on the top of the back rest. This allowed just enough fall for the petrol and was not hindered by centrifugal force when cornering violently.

The Kart theoretically was now ready for a trial run. The throttle was bravely fixed open (there being no throttle control as yet). The carburetter was flooded, the petrol turned off, and with one big shove the engine fired and I had torn the tread off the driving tyre. A few modifications were obviously necessary. I fitted some rugged tyres. These were nearly 1ft. in diameter but fitted my original wheels. So far I have had one replacement—the old one is being re-treaded as a slip tyre with a plain flat surface.

At this stage the R.A.C. decided to bring out a set of rules, many of which I thought unreasonable. I found my Kart did not comply with three of them; I had no brakes, no magneto cut-out switch, and solid wheel bearings.

The magneto cut-out switch was easily fitted; it is merely a switch to earth the low tension lead in the magneto. The solid wheel bearings I left as I think they are as good or better than the roller bearing type. The brake problem was easily solved; from an invalid chair manufacturer I obtained a brake back plate, including shoes. The hole in the centre of the plate was opened out to 1in. and slid over the right hand rear axle and brazed in place. The brake drum was a piece of tube fitted in a similar manner to the tube supporting the clutch (Figs. 2 and 5).

Controls

The throttle is controlled by the right foot, the brake by the left, and the clutch by the left hand. This means that they can be worked simultaneously. I drilled and tapped two pieces of 2in. long strip and brazed them on the front of the chassis where I wanted the foot pedals to be. The pedals were 6in. tubes with 1in. long pieces welded on to the bottoms of each to form T's. Small strips were fitted to the other ends. Bolts pass through the T-pieces and screw into the brackets with lock nuts to ensure that they stay in position.

The pedals were connected to ordinary Bowden cables, anchored to the chassis itself. The clutch is worked by a motor cycle handle-bar lever, fixed to the steering wheel support. I find that these controls are most conveniently placed.

At this stage the Kart went for its first real test at the first Brands Hatch meeting. Although the machine gave little trouble, its performance convinced me that several modifications were needed including a more robust clutch, and front axle bracing. The clutch was easily altered. I removed the corks from the centre friction plate and fitted instead two Mintex rings. These cost 18s. The clutch slipped a little but this is an advantage as it allows the gearless engine to pick up revs easily.

At Brands Hatch I also found I needed something to stop me sliding off the seat. This was taken care of by tubes welded from the base of the steering column support to the back rest. Although this looks most uncomfortable, it is very effective.

To form front axle supports, tubes were welded from the ends of the axle to the chassis, to form an equilateral triangle.

The Kart's speed was about 40 m.p.h. with poor acceleration, a few modifications were needed. The compression ratio was slightly modified, the ports were filed and cleaned, and a 100 jet was fitted. There is little difference in top speed, but the acceleration is much better. One hundred octane petrol is now used with just over ¼ pint of oil to each gallon.

A foam rubber seat and backrest have just been added, the cart is freshly painted British Racing Green and the exhaust pipe, ram tube, manifold and track rod ends are chromed.

The finished Kart is good to look at and a pleasure to own.

A MOVING ARBOR CIRCULAR SAW

Add this piece of equipment to your workshop

By Jameson Erroll

THE machine is suitable for a 6in. or 7in. saw, the table being of generous size for either. Also, it is constructed with a view to using the same ½ h.p. motor to drive other machines, so it has not been built-in as it may well be if machine and motor are to remain permanently connected. In deciding the size of saw in relation to the work most likely to be undertaken, it should be borne in mind that, with a ⅜in. thick plywood table, depth of cut will be limited to about 1½in. with a 6in. saw, 2in. with a 7in. saw, and so on. But thicker cuts can quite well be made by reversing the wood after the first cut. With a larger table a larger saw can be incorporated. Use a ½ h.p. motor to drive a 7in. saw and ¾ h.p. for 9-10in.

The Unit

The actual circular saw is an "Empire" unit manufactured by Messrs. S. & G. Sergent of Costessey, Norwich, Norfolk, and costs £3 6s. without a chuck and £4 with one. The chuck will be useful if the constructor intends to incorporate a side drilling or routing device. The unit is sturdy yet compact and will take up to 12in. dia. saw. It is fitted with high speed ball-bearings (grease nipples fitted) and a standard type 2¼in. vee pulley of "A" section for ½in. belt. Since, however, there are accepted speeds at which varying sized saws will work most efficiently, the author asked for a 2in. pulley to be fitted. This is run direct from a 5in. pulley on the motor which makes 1,425 r.p.m., thus giving to the saw a spherical speed of about 5,600ft. per minute which is reasonable for so small a saw. As saws get larger, a spherical speed in the region of 10,000 f.p.m. is aimed at. If the constructor's motor runs at 3,000 r.p.m.—as many do—the 2¼in. vee pulley can be used running off a 3in. pulley on the motor for a 6in. saw or off a 2½in. pulley for a 7in. saw. Work out the size of pulley you will need and ask Messrs. Sergent to supply that size when you order the unit.

Reference to Fig. 1 and photographs Figs. 3 and 4 show that the unit is mounted on a hinged baseboard of oak to which is attached a mild steel guide strip the movement of

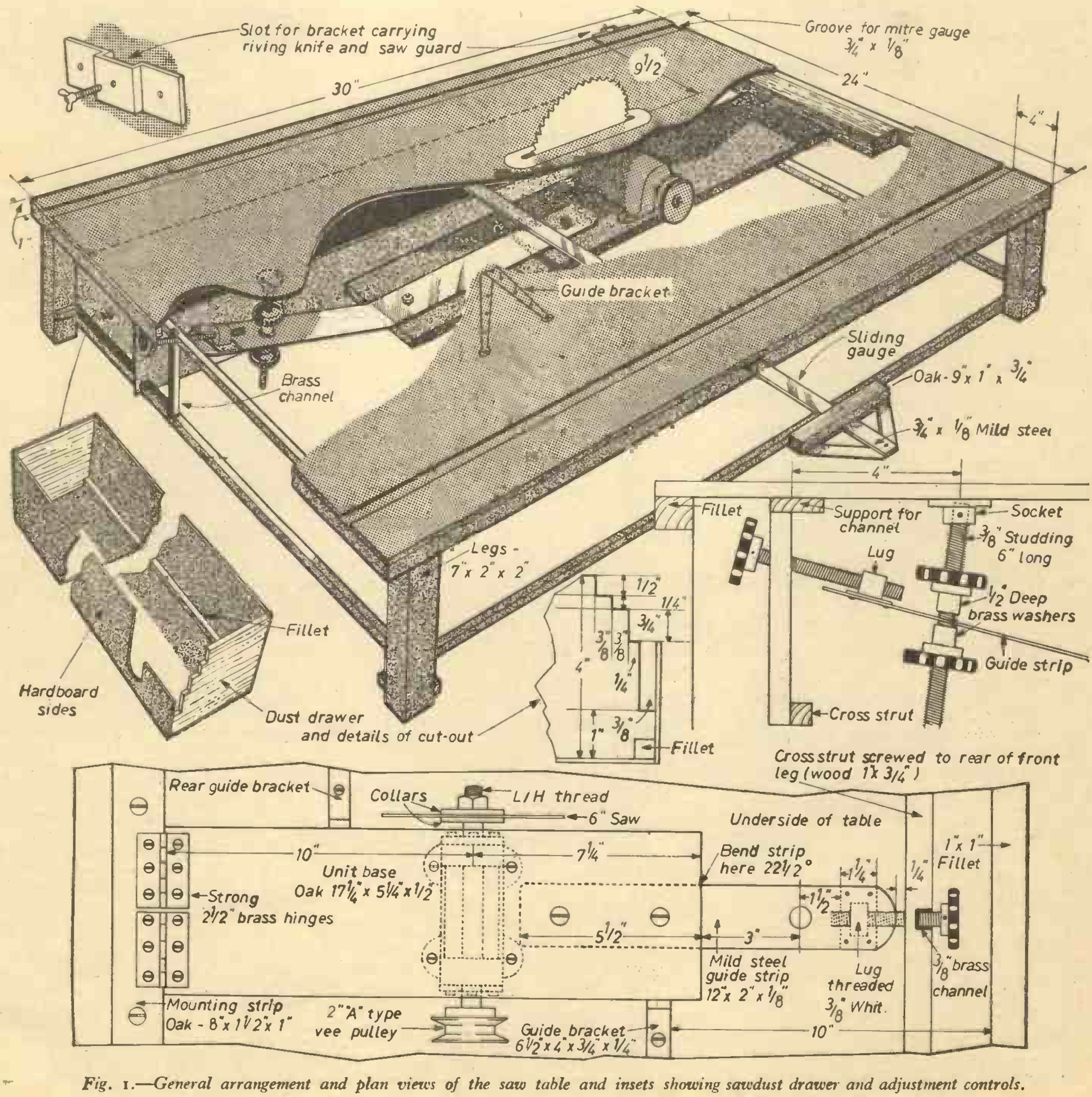


Fig. 1.—General arrangement and plan views of the saw table and insets showing sawdust drawer and adjustment controls.

which is controlled and locked in position by threaded knobs running along rods. Lateral movement is prevented by two guide brackets and, when locked at the desired height, the saw is perfectly rigid.

Constructing the Mechanism

The table is of ⅜in. plywood 30in. × 24in. and is stiffened by 1in. × 1in. fillets which run around the outside edges; where they meet at the corners, they are mitred for the sake of appearance. These are screwed through the top of the table, the screws being neatly countersunk; a screw about every 6in. is adequate.

The unit is mounted on the oak base as shown plainly in Fig. 1 which also furnishes all necessary measurements. This base is hinged to a mounting strip and it is essential that really strong, tight hinges be used. Brass ones ⅛in. thick will be suitable, and if they are bronze-bushed so much the better. Economy on these is not recommended; the hinges must be entirely free from "wobble."

The mounting strip of mild steel 12in. × 2in. × ⅛in. may be drilled and bent and the lug fitted before being mounted on the oak base. The lug shown in the photographs happened to be in stock, but one can quite easily be made by centre boring and tapping,

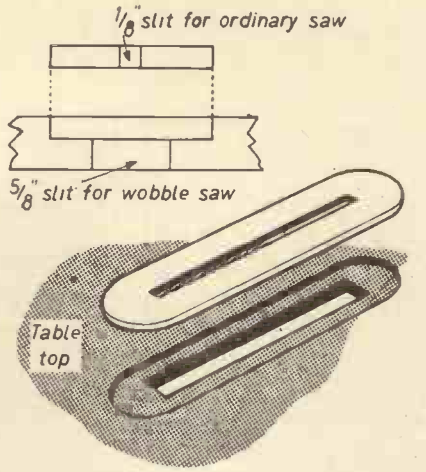


Fig. 2.—Details of inset for accommodating wobble saw.

strip—may now be assembled. At its base it rests loosely in a ½in. socket in which it is pinned; this gives just sufficient play to counteract the to-and-fro movement of the rod as the guide strip moves up and down. Two bakelite wheels, drilled and tapped right through, control the height of the guide strip and, together, lock it firmly. In order to give a better bearing on the strip, two ½in. deep washers are used as shown; they can be cut from $\frac{1}{16}$in. thick brass or copper tubing having an internal diameter of ⅜in.

A further locking and stiffening device is employed at the front and consists of a 4in. length of ⅜in. rod which runs between the flanges of a length of brass channel and screws into the lug. The channel is 6¾in. long and the back is cut away for about 5in., i.e. ⅞in. from each end. This is quite easily done by drilling a hole ⅞in. in from each end and cutting away the remainder with a hacksaw. Free the frame from the blade in order to pass the latter through the drilled holes and re-assemble for cutting. The edges of the cut are

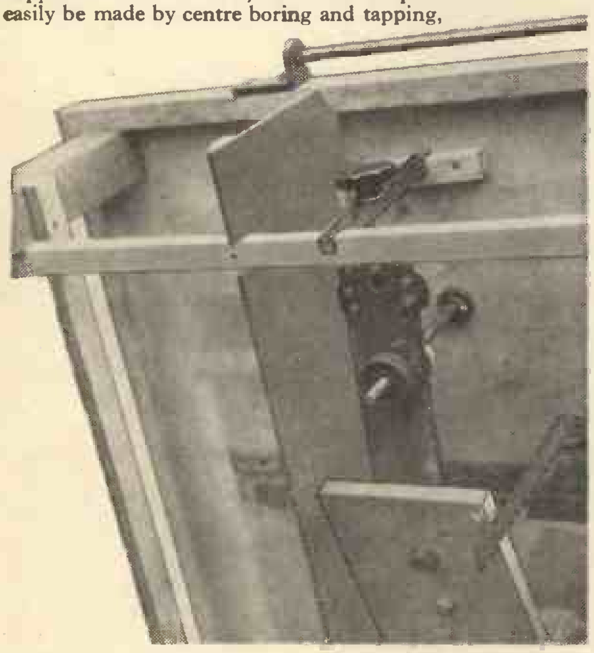


Fig. 3 (Left).—An underside view of the saw table showing particularly the adjustment mechanism.

Fig. 4 (Right).—A further underside view showing the whole of the rise and fall mechanism.

⅜in. Whit., a ¾in. cube of steel and mounting this on a 2in. × 1¼in. × ⅛in. plate. Drill the plate for mounting.

The ½in. dia. hole, with centre 3¼in. from the front of the strip, is for easy clearance of the length of ⅜in. rod which slides through it at slightly varying angles when height adjustment is made. Bore the holes for the lug plate but do not fit it until the guide strip is bent. It will be found that this can be done cold, although, of course, if a forge is available it is easier to do when heated. It is bent at a point 6½in. from the front to 22½ deg. out of horizontal (see Fig. 1). Use ⅜in. Whit. bolts to secure the strip to the oak base and be sure, when mounting, that it aligns perfectly. Now attach the base to the oak mounting strip, taking care to see that the edges are parallel with the sides of the table. Its lateral position should be such that the saw itself is 9½in. from the extreme left-hand edge of the table. See Fig. 1. This should be done with bolts passing through the table, not screws. It is also a good plan to substitute for two of the screws in the back hinge flaps two 2 BA bolts, also passing through the table with their c'sk heads let into the face.

Adjustment Mechanism

The vertical adjustment—the ⅜in. rod which runs through the ½in. hole in the guide

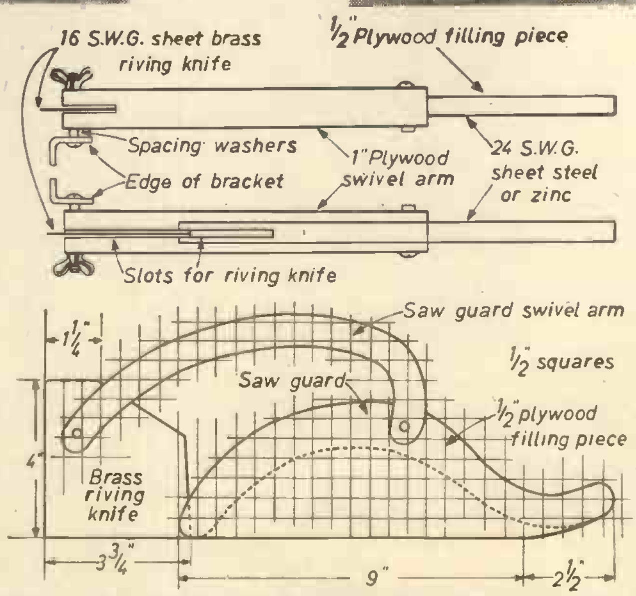


Fig. 5.—Saw guard and riving knife. (Top) View looking down. (Centre) Underside view. (Bottom) Side view. The curved dotted line shows how plywood filling between the two pieces of sheet zinc is cut away to clear the saw.

then filed perfectly smooth. A notch is cut in the 1in. × 1in. cross-strut to take the channel brass which is secured in position with a No. 4 c'sk wood screw. At its foot it is similarly fastened to a short length of 1¼in. × ½in. wood which is screwed to the underside of the table. The wheel or knob for turning the rod is not bored right through as were the other two, but to ensure it does not turn anti-clockwise and thus unthread itself from the rod it is pinned with a short length of ⅛in. silver steel or a small taper pin.

This completes the rise-and-fall mechanism and the two guide brackets may now be fitted. Their size and position are shown in Fig. 1.

They further preclude any possibility of lateral movement of the baseboard carrying the unit, and may well be bolted through the table for added strength using c'sk 2 BA or 3/16in. Whit. bolts.

The four wooden legs are 7in. × 2in. × 2in. They rest on the underside of the table inside the fillets to which they are secured with 2in. c'sk No. 8 wood screws. They are strengthened near the foot by cross-struts as shown. It is not advisable, however, to fix a strut at the rear until experiments have been made as to the position the motor is to occupy. Also, the legs may have to be made longer if the motor is to be placed partly under the rear of the table.

In the various photographs there can be seen odd pieces of hardboard but to aid clarity these are not shown in the line drawings. For the most part they form a further preventive against lateral movement of the unit base, but they also serve to enclose the unit to a certain extent and thus help to keep it reasonably free from sawdust. They are fixed to the underside of the table with ¾in. × ¾in. fillets and similarly attached to any cross-strut they happen to contact. Note that where they pass alongside the spindle they are cut away so that the unit can be swung clear of the table for changing the saw. Also, on that piece of hardboard which runs between the unit base and the saw a fillet is fixed which not only stiffens the board but acts as a runner for the sawdust drawer, the strut from front to back legs on the left acting as the other.

Sawdust Drawer

Insets in Fig. 1 show how this is made and how it is cut away on the saw side in order to clear the mechanism. The front and back are of ½in. plywood and the sides and bottom of hardboard joined by wood fillets. At that point where the saw, when lowered, would come in contact with the wood fillet and the hardboard bottom, a slit will have to be cut to accommodate it. This, however, is best done by the saw itself when the machine is completely assembled. The saw is raised, the drawer pushed in, the motor switched on and the saw gently lowered and allowed to cut its own way through. Note that the drawer can only be removed or replaced when the saw is at its maximum height. The drawer can be seen in position in Fig. 1.

The Guard and Riving Knife

Fig. 5 gives scaled layouts of this assembly. This design is in almost universal use now and possesses many advantages over the earlier types of guards. The joints are loose fits and the guard and its swivel self-adjusting. The wood lifts the nose of the guard as it is pushed forward and the wood passes smoothly along without undue friction. As the cut nears completion the nose begins to fall and the guard eventually comes to rest in direct contact with the table.

The function of the riving knife is to prevent the cut ends of timber tending to close together and thus bind on the saw; this would certainly happen when long timber is being cut. The riving knife should, therefore, be a shade less thick than the saw-cut is wide; 16 s.w.g. brass which will be found a suitable thickness for most saws. When the wobble saw is in use, as for groove cutting, both guard and knife must be removed, but since only a small portion of the saw is above table level and the wood being cut covers it as it passes along, no accident will happen if liberties are not taken.

The swivel arm is of 1in. plywood hollowed out at the ends as necessary to allow it to swing over the riving knife at the back and to permit the guard to swing freely at the front end. The guard is composed of two pieces of 22 or 24 s.w.g. sheet zinc separated by a suitably curved piece of ½in. plywood the inner edge of which rides about ¼in. above the saw when at its full height. It is much better to use zinc than sheet iron since it is so much softer than the saw and will not cause damage should it be pushed into contact while the saw is running. Note that the design is for a 6in. saw; if a larger one is used, the inside curve must be altered accordingly.

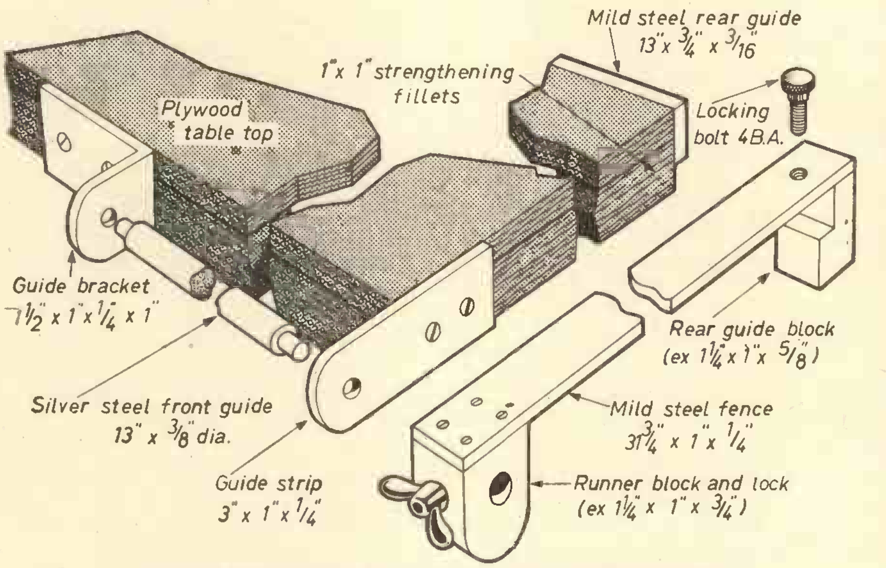


Fig. 6.—Details of the fence. Wooden parts are shown shaded.

The Fence

This is shown in detail in Fig. 6, which is almost self-explanatory. The runner block rides along the front length of silver steel held between two brackets, and the rear guide block runs along a length of mild steel screwed to the back of the table. Both blocks can be clamped in position, the front one by means of a fly-headed bolt and the rear one by a 4 BA bolt with a milled head—a wireless terminal is excellent. If the front length of silver steel cannot be conveniently turned down to ¼in. at the ends, make the holes in the brackets ⅜in. and stop them on the outside with a piece of thin metal screwed on.

A Useful Gauge

Shown also in Fig. 1 is a gauge for regulating length or width when a number of pieces have to be cut to identical measurements. This is made up of ¾in. × ⅛in. mild steel and a piece of oak. The steel bar runs along the underside of the table and is guided by two fillets. Actually, it is a good idea to make one of these fillets of ¼in. mild steel screwed to the table at 4in. intervals; this gives rigidity to the centre of the table. The second fillet may well be of wood.

Saw Slot

The outlet for the saw calls for some comment since it may at times be called upon to function with a wobble saw. This necessitates a much wider mouth than is normally necessary or desirable. The use of an inset (shown in Fig. 2) overcomes this difficulty. To cut this outlet and the inset proceed as follows: With the wobble saw on the machine and with the unit at its lowest position, i.e. the saw blade just clear of the underside of the table, set the saw in motion and slowly raise the unit and let the saw cut its own way through the table. Now gouge out part of the face of the table around the mouth to a depth of ⅛in. as shown. Shape a piece of good quality oak ⅛in. thick so that it is a press fit. Substitute an ordinary saw for the wobble saw and repeat the above movement so that the saw cuts its way through the oak inset. When doing this it will be advisable to hold down the inset with a thick piece of scrap timber (2in. stuff for preference) as the action of the saw will tend to throw the inset from the table.

The metal slot which will carry the bracket for the riving knife and saw guard is shown in Fig. 1 in its approximate position at the rear of the left side of the table. Details are shown inset top left but measurements will, of course, vary according to the type of bracket used.

Mitre Gauge

Details for construction of the mitre gauge are given in Fig. 7. Normally it is used on the left of the saw but when long planks are being dealt with and, possibly, being cut into a number of equal lengths, it may be used on the right of the saw in conjunction with the sliding gauge. The base is of 5/16in. good quality plywood, the upright fence of 1½in. × ¾in. plywood, and the guide rod of ¾in. × ⅛in. mild steel. The curved slot in the base through which the flybolt passes should first be drilled out with a 5/16in. drill and then carefully finished with a file and glasspaper. The reason for making the gauge with only 90 deg. of arc instead of the usual 180 deg. is that in practice it was found that the extra weight, being unsupported by the table when used on the left of the saw, tended to make it tilt. Since mitres can be cut either way by using the gauge on the left or the right of the saw as occasion demands, it was decided to limit the arc to 90 deg. but to retain the full length of the upright fence.

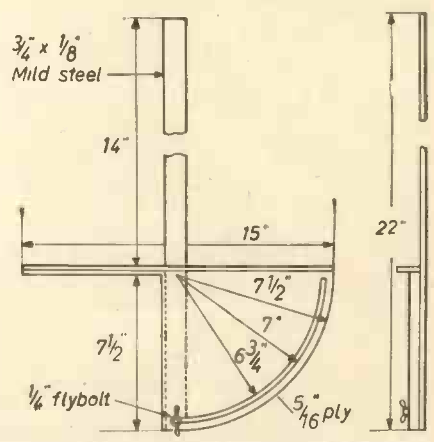


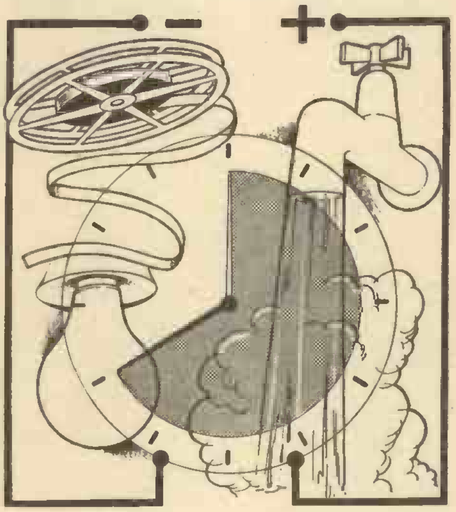
Fig. 7.—Plan and side elevation of mitre gauge.

THE AUTOMATIC HOUSE
PART 6

HOME-MADE TIME SWITCHES

Method of construction and some of the many uses to which they may be put are described here

by E. V. King



IT is possible to modify ordinary clocks for use as time switches and one method is the latching relay system. This is suitable for switching on a circuit at a preset time. An ordinary alarm clock is fitted at the rear with a small piece of springy metal mounted on an insulator on the back of the clock. The position of the spring is such that it just touches the alarm winder but does not prevent it being wound up or unwinding. A contact is taken from the metal clock frame and from the spring.

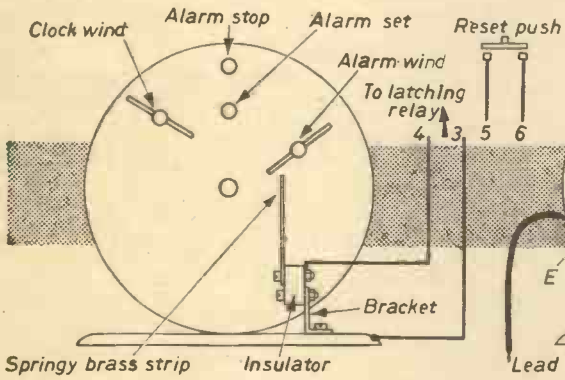


Fig. 43.—Simple alarm clock time switch.

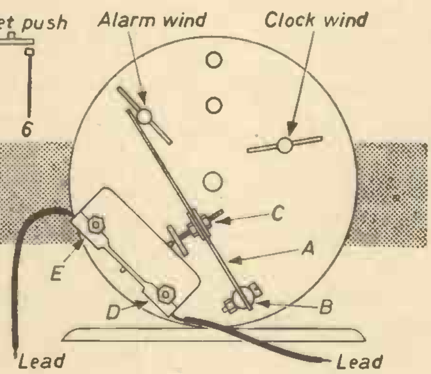


Fig. 44.—Locking micro-switch system.

The connections go to a normal latching relay working on 24V. or less such as is shown in Figs. 11 and 15 (May issue). When the alarm goes off, contact is made and the armature of the relay wired as shown in Fig. 43 is primed. The lamp, etc., comes on and will stay on until the latch is lifted either by a small mechanical plunger or electrically as in Fig. 43.

Locking Micro Switch System

Fig. 44 shows a very successful time switch made for under 30s. The clock was purchased from a walk-round store for 18s. with a guarantee, and it is fitted with a *special type* of micro switch made by Bulgin. This should be carefully ordered as "S502 RE-SET." Other types may be suitable, but they *must* lock-on when pressed.

For an alarm clock about 5in. dia. the spring actuating arm "A" (Fig. 44) should be about 3½ to 4in. in length. It must be fully flexible yet of light-gauge metal. The metal "bones" of a lady's corset are ideal, but heavy clock springs would do.

The arm is pivoted two ways at "B" and has an adjustable tappet at "C." The micro switch is fixed in position by the screw "D" which could be a self-tapper, but the author took the mechanism out of the case to drill the hole to obviate filings fouling the mechanism. The alarm should be tried to make sure that when the alarm goes the plunger of the micro switch is pushed in and that the alarm continues to unwind, flexing the spring to do so.

If all is well the other hole for screw "D" is drilled, and the nut and bolt fitted. If used on a low-voltage circuit nothing else is required; if used on mains the terminals must be covered either with a suitable Perspex cover or with Faraday Wax.

The switch fitted is a single-pole changeover and it can be arranged to switch off a circuit if desired. By using two clocks it is possible to put a device on for a certain period. An arrangement for switching a radio and tape recorder on for a certain period is given in Fig. 45.

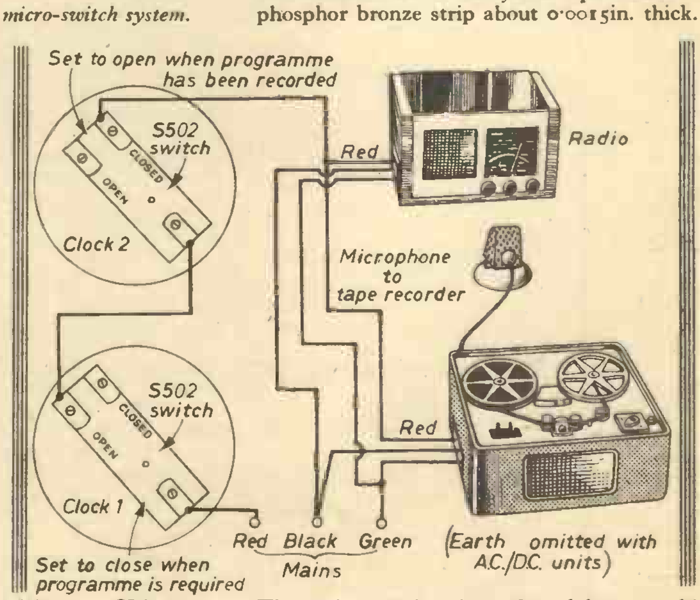


Fig. 45.—Using two home-made micro time switches to record a radio programme.

Contacting Hour Hand Devices

The torque on the hour hand of a clock is quite great due to the internal low gearing and this means that the hand may be made to make light contact on a strip of phosphor bronze or similar non-corrosive metal. Only a few milliamps could be passed through or the hand itself would fuse so it is usually necessary to make the hand contact work a relay; this is shown diagrammatically in Fig. 46.

Motor car secondhand spare depots and breakers' yards will supply surplus car clocks with 14-day movements in good condition for a few shillings, these are ideal for conversion into time clocks. The one used in the prototype was a Smiths type from a 1936 Austin 10, it kept time within one minute per week. No doubt most robust clocks would also be suitable for the conversion explained.

Where ordinary clocks are modified to make time switches they will work every 12-hour cycle, most commercial clocks do so on a 24-hour cycle. This can be avoided if additional 2 to 1 gearing is used on the hour hand spindle, suitable gears are obtainable from model engineering shops, but the work requires great skill. If 24-hour time clocks are to be made a 24-hour dial clock or synchronous motor units should be used. Almost any of the surplus units of this type can be used with the time clocks to be described. A suitable unit is currently available from Messrs. H. W. English at 17s. 6d.

Drilling the Glass

A small hole about $\frac{1}{16}$in. is required exactly in the centre of the glass. The set-up for drilling is shown in Fig. 48.

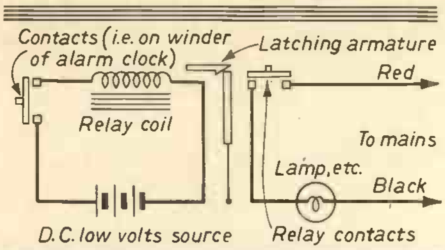
Now using a small electric drill or a hand brace put small amounts of motor valve grinding paste or carborundum and water into the hole, let the drill rotate freely without pressure. After about three minutes a hole will have been bored through the glass. Be very careful to wash all paste off and keep it well away from the clock mechanism.

The contact assembly is made and fitted to the glass and minute hand removed before putting the glass back in the clock.

The Contact Assembly No. 1

The parts required are a small BA bolt about 1¼in. long with a few washers, a light spring from an old ballpoint pen, a strip of brass from a torch battery and a piece of fine phosphor bronze strip about 0·0015in. thick. The author used a piece of steel from an old feeler gauge with good results.

A washer is soldered to the head of the bolt as shown in Fig. 50B. Make sure that when the clock is offered to the glass with this bolt in position that the minute hand shaft (with



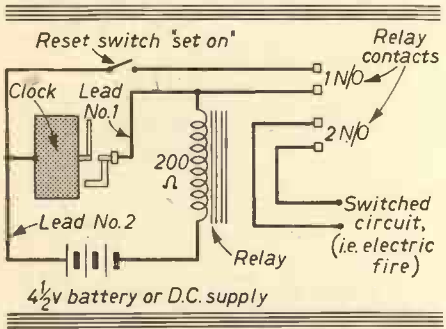


Fig. 46 (Top).—Time switch relay system.

Fig. 47 (Above).—Wiring for " on " only.

Fig. 49 (Below).—Photograph of complete on/off time switch (using motor 14-day movement).

the hand removed as it is not required) will just clear the bolt and washer. If necessary file away part of the head and washer. Solder a small piece of brass strip about ½in. × $\frac{3}{16}$in. marked " A " in Fig. 50 to the washer. Now take a similar piece of shim and round one end as " B " in Fig. 50. This is soldered in position (use Baker's Fluid flux if steel).

Holding the bolt and contact as so far made in a vertical position with the bolt head down, bend the strip " A " (not " B ") to the approx. angle of Fig. 50B. When then offered to the clock face it should miss the surface, but the hour hand should just foul it as it moves round. For clarity " C " has been shown completely clear of " B " but in fact they may just overlap.

A wire is soldered to one of the washers not yet used. The assembly is then fixed up as also shown in Fig. 50. The nut and terminal head are locked tight with the setting pointer carefully set between them. The setting pointer " C " must be arranged to show the time when the contact strip " B " first touches the hour hand as the latter moves round.

Make sure the hour hand is clean and that the contacts have been put on so that the hand lifts " B," otherwise a ratchet action will bend up the contact and hour hand.

Using the Time Clock

The " on " set hand is rotated ANTI-CLOCKWISE until it shows the time at which it is required to put on a circuit.

The clock is wired up as shown in Fig. 47 using a small 4½V. battery and any suitable relay. Two N.O. contacts are required together with any ordinary toggle switch or

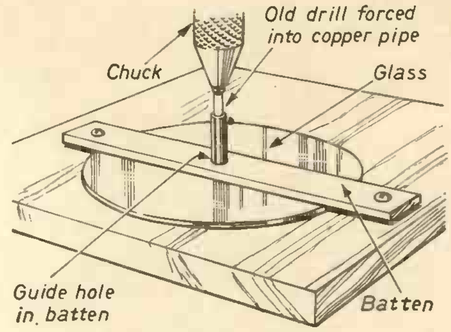
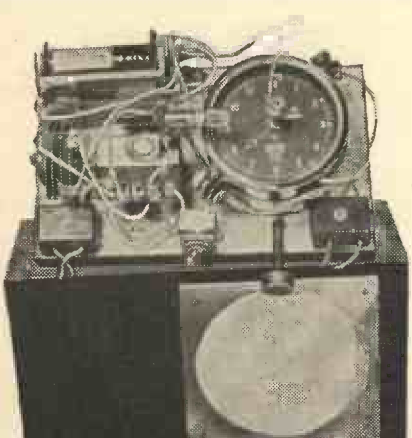


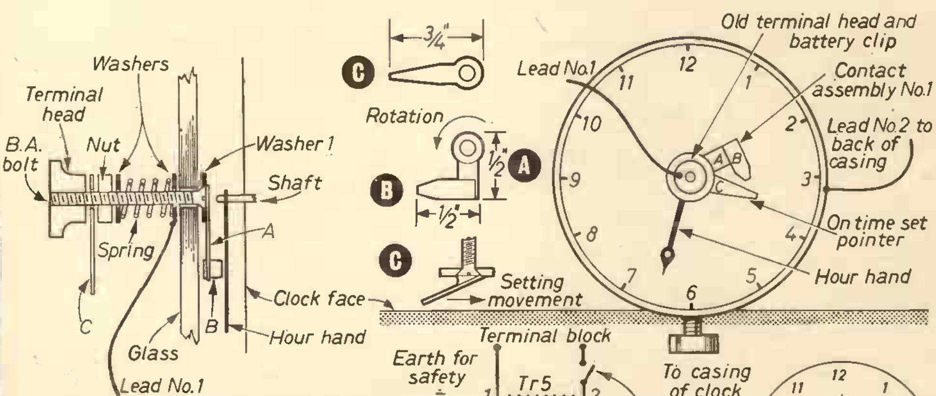
Fig. 48.—Drilling the glass.

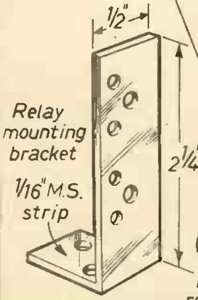
micro type (N.O.) which opens circuit when pushed.

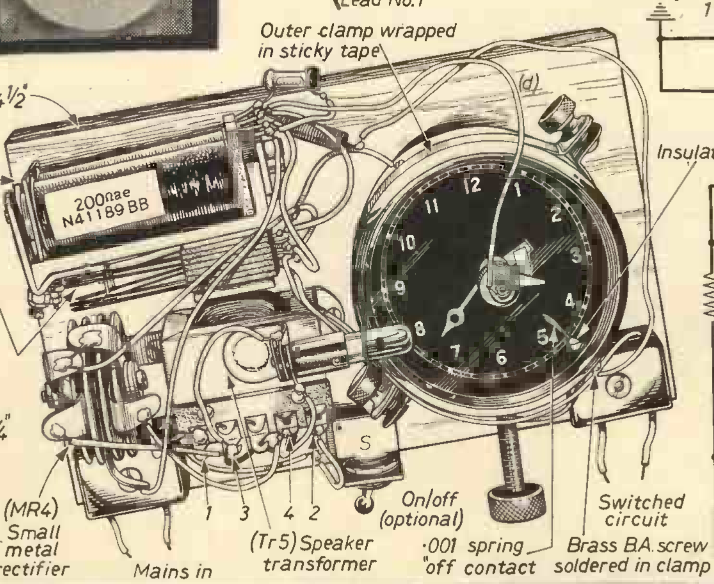
There is no drain on the battery until the " ON " position is reached because the wiring goes through the N.O. contacts numbered 1 (Fig. 47). When the contact " B " (Fig. 50) touches the hand a few milliamps of current flow through the clock casing, energise the relay core and " 1 " points close (the core then stays energised until the re-set switch is momentarily put off). The N.O. contacts " 2 " close at the same time and may be made to control some external device, mains or otherwise. If mains switching is used, earth the clock for safety, although no danger is involved unless the relay insulation breaks down. P.O. relays will switch 3A. easily and up to 5A. without undue arcing. For larger currents a second " contactor " type relay is required.

Fig. 50 (Below).—Details of the contact assembly.









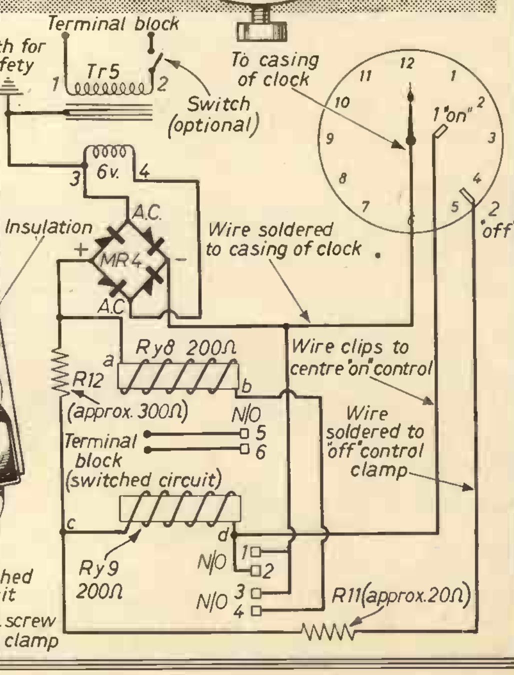


Fig. 51.—Main dimensions of the relay mounting bracket.

Fig. 52.—Complete layout and wiring of the on/off time switch using 14-day movement.

Fig. 53.—On/off time switch circuit.

Readers should not attempt to work a circuit directly from the contacts on the clockface, the current has to pass through the hour hand and must be limited to 100mA. or damage may result.

Further Conversion for ON/OFF Switching

If a latching relay such as in Fig. 10 is used with this clock, the ON position will not draw any current after the hand has moved past contact " B." If using this system, wire leads 1 and 2 of the time clock to terminals 3 and 4. The reset button (release) will be as shown in Figs. 10, 11 and 15.

Making Contact No. 2

It is possible to fit another contact so that, as the hour hand moves round, contact is made, releasing the latch. This second contact is shown in Figs. 49 and 52 and can be fitted to car type clocks allowing the contact stay to project through the windows originally fitted to allow the dash light to illuminate the clock face. The clamping ring is made of valence curtain rod fitted with a wing nut and bolt for tightening. It is insulated from the clock proper by a strip of insulating material.

Two semi-circular strips of metal (headphone bands will do) are bent so that they are a tight fit round the rim of the clock and are held in place by using two bolts fitted with terminal heads or wing nuts. A ¼in. BA bolt is soldered in any position round the circumference of the band and a piece of thin (0·001in.) shim metal soldered to the end. The size is not important, but could be roughly ½in. × ¼in.

The clamp can be rotated through just under 90 deg. If more movement is desired, the clamp is removed and refitted with the contact projecting in the next window of the clock.

It is also possible to drill another hole in the glass near the end of the hour hand and to fit the No. 2 contact through it. Adjustment would then be by rotating the glass in the rim of the clock.

The contacts do not carry more than a few mA. at any time and good permanent contact is not required.

The photograph of Fig. 49 shows the complete conversion with the associated control gear. The author used a plain wooden box cover and simply wound the motor every two weeks and checked the time every three months. A glass window and a small dial lamp could be fitted and the time read at a glance.

Mounting the Components

It does not matter at all how they are mounted as long as the relays are free and air can circulate round the plates of the rectifier.

Tr5 (Figs. 52 and 53) is any normal speaker or filament transformer fitted near the mains terminal block. M.R.4 is a small ½A bridge rectifier as used for battery chargers, it should be rated for 12V. and mounted in free air. Do not alter the tension on the plates by taking any of it apart. Relays 8 and 9 are normal P.O. 3000 types (200Ω), though others will do if experiment is made with R.12 and R.11 (300Ω and 20Ω ¼W.). Relay 8 requires one pair of N/O contacts and Relay 9 two pairs of N/O contacts. Other contacts may be removed or left *in situ*.

The relays should be tested as previously described and No. 9 should pull in with a current of only 10mA. Test using a 4½V. torch battery and a 300 or 330Ω resistor. Adjust as necessary. Relay No. 8 is not critical, but should be set to give a good contact when on. Mount the relays in any suitable fashion, Fig. 52 shows a method used by the author in the prototype. The top relay is Ry. 8 of Fig. 53. Bracket required is shown in Fig. 51.

The clock may be mounted in any position, although made for vertical operation this does not appear to be necessary. Make sure the clamp can be fully rotated without fouling the relays, etc.

Wiring

Wire the mains to the high impedance side of the transformer; a switch may be fitted in the red wire, but is not necessary.

Also optional is a 6V. dial lamp fitted to illuminate the dial and connected to terminals 3 and 4 in Fig. 52 and also visible in the photograph, Fig. 49.

Wire the output of the transformer to the green tags of the metal rectifier. Switch on and verify that a slight hum can be heard. Switch off. Wire the red tag through R.12 (300 or 330Ω) to coil of Relay 9. Wire negative side of rectifier (two black tags are joined first) to the metal CASING of the clock, *not* to the moving centre contact (see Figs. 52 and 53). The centre moving contact is wired to the coil of Relay 9. Switch on, and turn the hand of the clock so that contact is made. The relay should pull in.

Now pick out any pair of N/O contacts on the relay and wire one to negative of rectifier and one to the coil end already connected to centre clock contact. Switch on. Adjust the clock for contact; the relay should pull in. Adjust the clock so that contact is lost; the relay should *remain in* as long as the mains are connected. Switch off. Switch on again; the relay should not pull in until the hand contacts centre adjuster again.

Wire Relay coil No. 8 to the positive of the rectifier and the other side of the coil to another pair of N/O contacts on the relay just tested, taking one lead to rectifier negative. Switch on. Nothing should happen until hand contact is made. Both relays then pull in. Adjust the hand to past contact position; both relays still stay in. Switch off. Both relays fall out. Switch on again and both relays should stay normal until hand contact is again made.

Where the 300Ω resistor, R.12, contacts on the coil tag of Relay 9 solder on a 20Ω resistor (R11). Connect a long lead from it to the clamp holding No. 2 contact round the rim of the clock. It is as well to check first that the clamp is insulated properly from the clock, a small rubber tube (valve rubber) over the BA contact holder and transparent adhesive tape round the clamp will help. Switch on and turn hand to " contact." Relays both pull in. Turn hand to " no contact " position; both relays remain in. Turn hand to touch No. 2 contact. Both relays fall out. Repeat, noting that between the ON contact and the OFF contact, the relays both remain in, and between the OFF and the ON they both remain normal.

Brief Explanation of the Working

Transformer Tr5 gives a low voltage source of 4V. to 6V. A.C. which is rectified to D.C. by M.R.4. This will pull in Relay No. 9 by passing current through the 300Ω resistor, the relay coil, clock contact No. 1 to the frame of the clock and thus to the other side of the D.C source.

When pulled in, one pair of contacts bridge the hand contact and keep the relay in, even when the hand has passed the contact. At the same time another pair of contacts take current through the other relay, pulling it in very strongly (no resistor is in circuit) and completing any external circuit desired.

When the hand of the clock touches No. 2 contact on the clamp, a comparatively heavy current (relative to 10mA flowing in No. 9 coil) is drawn through the safety resistor R.11 causing a large voltage drop across R.12. The resultant voltage on Relay 9 is very small and it falls out. Once out, the hand bridging contacts open and at the same time Relay 8 circuit is interrupted and it also falls out. The external circuit is thus interrupted.

Use of the Switch

This switch will function well with no trouble for many years. In all cases fix it out of the way of infants and keep it covered both electrically and mechanically as the side windows in the clock will let dirt enter. Attach an earth to any convenient point and do not use in a circuit drawing more current than for which the contacts are designed. For very heavy switching another much heavier relay must be inserted in addition to Relay No. 8, or in place of it, provided relay No. 9 pulls in sufficiently well to give a good contact on the points operating the second relay.

Anti-spark devices should not be necessary as only one contact is made every 12 hours, but conventional means of quenching may be used. No quench is required on A.C. switching. If humming develops (this did not trouble the author) a large-value electrolytic condenser may be placed across the red and black sides of the rectifier (1000 to 3000μF., 12V.) would be suitable wired the correct way round.

Warning

Do not try using mains circuit switching wired directly to the clock hands, etc. This is dangerous and in any case will damage the hand and working parts of the clock.

(To be continued)

Here is another article on musical instrument construction, this one dating back to the eighth century.

Make and Play a REBEC FIDDLE

By A. B. Orr

STILL played in parts of Spain and Africa, the Rebec, or Rebab fiddle, is the forerunner of the violin as we know it today. It was introduced to Spain from North Africa in the eighth century and was played by strolling minstrels throughout Europe. The name Rebec is derived from the Persian and means " the melancholy one," an apt description of the nostalgic tone of this instrument.

The design has remained the same with very little variation from the early days. The instrument to be described has been arrived at from studying old records and historic carvings and follows closely the traditional pattern.

Extremely simple to make, the finished instrument produces a beautiful tone and is also extremely attractive looking. Before making a start on construction, carefully study the drawings and photographs until every stage in construction is clearly understood. There is no need to be deterred by the carving and general ornamentation as this can be left out if so desired. Many Rebecs were extremely simple and completely devoid of elaboration.

Fig. 1 shows an exploded view of the fiddle. Construction can begin on the body.

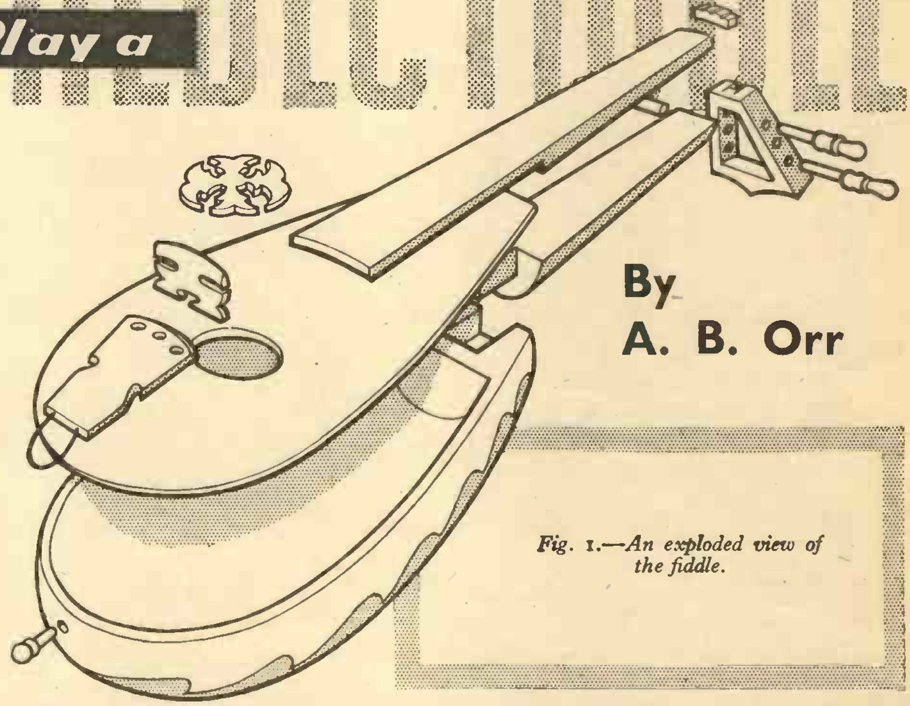


Fig. 1.—An exploded view of the fiddle.

The Body

This is made from a block of well-seasoned pine or walnut measuring 14in. × 5½in. × 3in. Scale up the body lines given in Fig. 3 and transfer the plan on to the block using carbon paper. The block should now be cut to the plan shape. Mark in the inside line as shown, leaving a block at the neck end to take the neck. Firmly secure the block to the bench or table using G-clamps and, using a ½in. or ¾in. gouge, hollow out the block until it conforms to the inside shape shown in Fig. 4. The hollowing process is not as difficult as it might appear. See that the tools are razor-sharp and work from either end towards the middle. A wooden mallet is useful for the first stages, finishing off with small cuts by hand. Once the body is nearly at the desired inside shape use a piece of broken glass with a suitable curve to scrape the inside smooth and free from tool marks. Fine sand-paper can now be used to finish off the inside. Before turning over the block, cut out the socket to take the neck. Ideally this should be dove-tailed but the simple joint shown does the job admirably.

Turn the block over and start shaping the outside. The wall should be left between ⅛in. and 3/16in. thick except where the carving is to be done. A ledge should be left around the top. This ledge should be ¼in. wide by ¼in. deep. This is to give a good gluing surface for the sound-board or table.

When carving the outside shape, take care to let the shape develop as a whole. Do not spend too much time on any one area. Once the desired shape has been achieved mark the carved elaboration on the wood. Using a knife of the X-Acto type, cut along this line, ensuring that the blade is at right-angles to the body at all times. This cut should be about 1/16in. deep. This done it only remains to cut up to this line from below. The carving should now be standing proud of the surrounding body by about 1/16in. Using various grades of sand-paper, smooth the body down, carefully cleaning out the details of the carving. The body can be laid to one side now, while a start is made on the neck.

Neck

This is made from a block of mahogany measuring 8in. × 1¾in. × 1½in. Transfer the measurements given in Fig. 5 to the block and cut out. Once in the square the neck should be temporarily fitted into its socket in the body. Drill a hole in the neck in the socket end and screw it to the body. Using a spokeshave, shape the neck until the body flows into it without any bumps or irregularities. Once again use various grades of sandpaper to obtain a perfectly smooth finish. The neck can now be removed from the body and placed to one side (Fig. 6) while the head is made.

Head

Fig. 2 gives details of the head. The measurements should be transferred to a suitable piece of mahogany. After sawing to the outside shape, the string slot should be

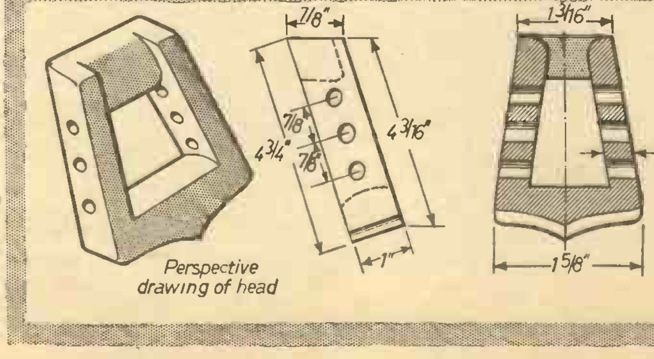


Fig. 2.—Details of the head.

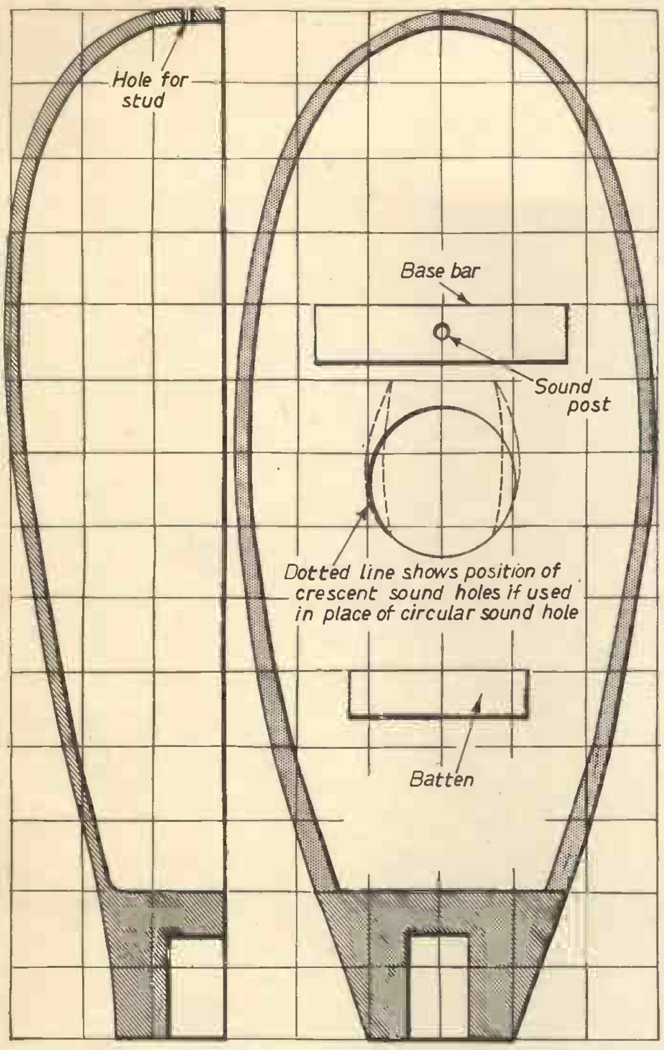


Fig. 3.—Plan of the body. The squares each represent 1in. full size

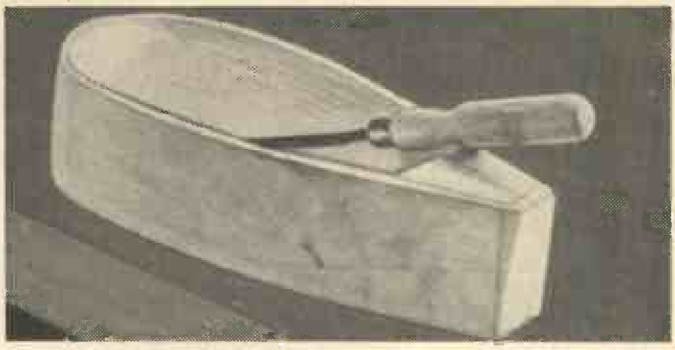


Fig. 4.—The hollowed-out body.

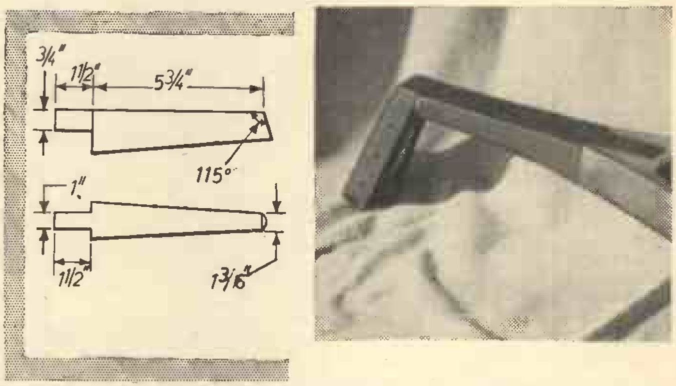


Fig. 5.—Dimensions of the neck and photograph of the neck and head temporarily fixed to the body.

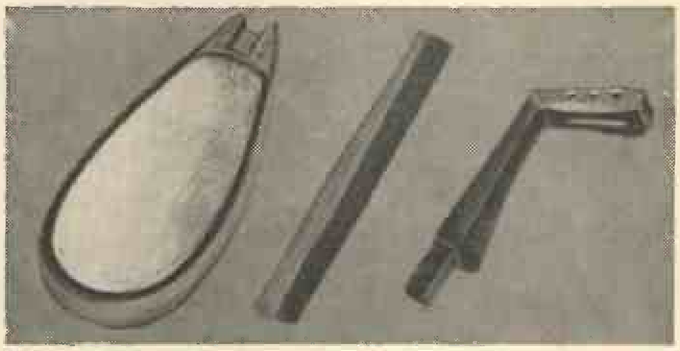


Fig. 6.—The finished body and neck with head attached.

cut out. Use a $\frac{1}{4}$in. chisel for this and make a clean slot, sloping from either end. At the neck end a channel is cut out to take the strings. Now drill three $\frac{1}{4}$in. holes for the pegs.

The head can be left plain or can be carved. A simple way of improving the head is to bevel the edges. If carving is desired then there are a number of simple designs that should give no trouble. These can be found by looking at carved furniture.

The head is now ready for gluing to the neck. Aerolite 306 was used in the original and proved excellent. Not only does it give an extremely strong joint but it is also space-filling and helps to mask any slight errors in construction. When the glue is dry trim away any excess and see that the top of the head is in line with the top of the neck.

The neck can now be glued to the body (Fig. 7). Take great care here to ensure that the neck is accurately located. Lay a straight-edge along the neck and check that it meets the end of the body accurately. Any adjustments can be made by inserting small slivers of wood at the appropriate place in the socket.

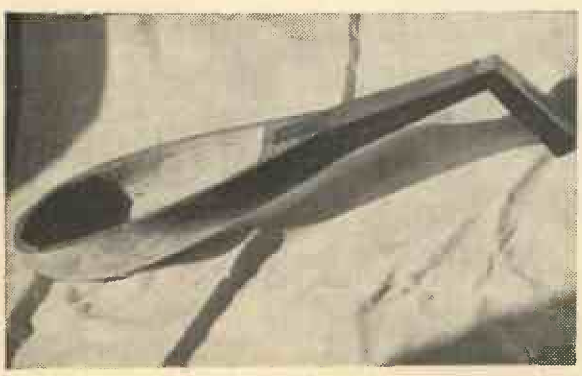
The body and neck can now be left to dry while the finger-board is made.

Finger-Board

Fig. 7 gives details of this important part. Make the finger-board from a piece of mahogany measuring $11\frac{1}{2}$in. × $1\frac{3}{4}$in. × 1in. As will be seen from the drawings, there is a step where the neck joins the body. At the head end it will be noticed that the finger-board overlaps the join between neck and body by about $\frac{1}{4}$in. The underside of the finger-board is curved to the same shape as the top. This under-curve need only be taken back 3 or 4in.

Table

Lay the finished body of the fiddle on a piece of $\frac{1}{16}$in. plywood and with a pencil mark round the outline. Select the plywood to be used with an eye to the finished instrument and choose a piece with attractive grain. Using a fret-saw, cut round the outline, leaving the pencil line showing. Next cut out the $2\frac{1}{4}$in. dia. sound-hole and clean the edges with fine sand-paper. It should be noted at this stage that the sound-hole can be dispensed



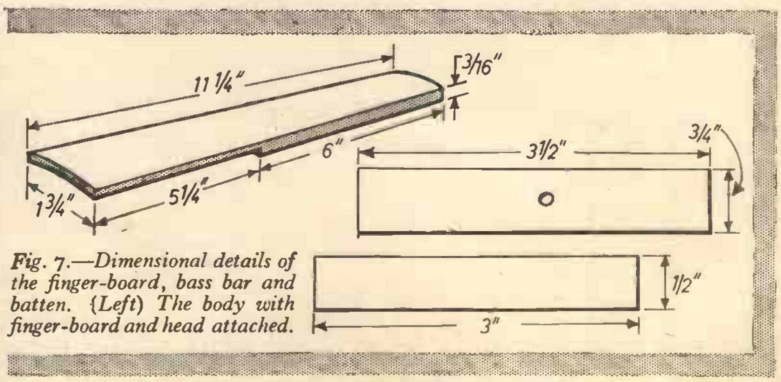


Fig. 7.—Dimensional details of the finger-board, bass bar and batten. (Left) The body with finger-board and head attached.

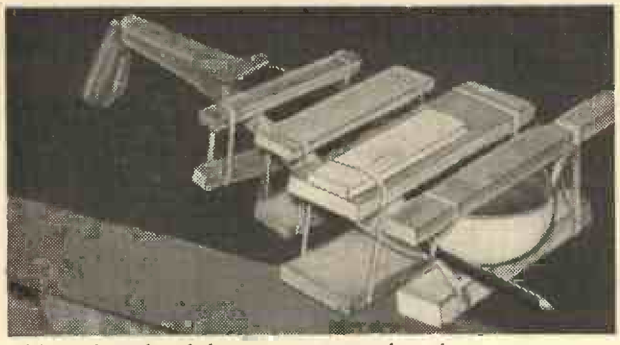


Fig. 8.—Clamping the table to the body.

with and replaced by two crescent-shaped openings. These openings appeared on many early instruments and were the forerunners of the f-holes in the violin as we know it today.

Now make and glue in place the bass bar. Fig. 7 gives details of this part. It is glued in place in the position shown in Fig. 3. Also glue in place the batten shown in Fig. 7. When gluing these parts it is a good idea to clamp the table on to a flat piece of wood to ensure that the table is absolutely flat.

It only remains to locate the sound-post. This is a short length of ¼in. dowel a fraction longer than the height from the floor of the belly to a straight-edge laid across the top of the body. This is to make it a tight fit when the table is glued in place. It is a help in locating the sound-post if it is glued to the bass bar on the table.

The table can now be glued in position. Use the glue liberally. Once in position the table can be held in place using simple clamps (Fig. 8) or by wrapping around with model aeroplane elastic. This last method ensures even tension over the entire glued area.

The Rebec is really beginning to look like a musical instrument now. While the table is drying make the tail-piece, bridge, pegs and nut.

When the table is dry, glue the finger-board in position on the neck.

Tail-Piece

Make this from a piece of hardwood (ebony would be ideal but is rather hard to get) measuring 3¼in. × 1½in. × ⅜in. It is shaped as shown in Fig. 9 and has three holes drilled in it to take the strings. It is held to the body of the fiddle by a loop of gut that fits over the tail-piece stud. The gut is held as follows. Drill two $\frac{1}{16}$in. holes in the end of the tail-piece, to a depth of about 1¼in. Using a sharp knife, cut through to the end of these holes from below. Insert a short length of gut into one of these holes until it emerges at the end. Tie a knot in this end. Later, when the tail-piece stud is located, the free end of gut is taken round it and back up the second hole. A second knot holds the loop in place.

Bridge

Fig. 10 shows this detail. It should be made from straight-grained pine. Use either a fine fret-saw, or, better still, a jeweller's saw, to cut the shape.

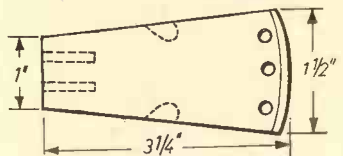
The Pegs

Although violin pegs can be bought in most music shops, they are not in keeping with the rest of the fiddle. Fig. 11 shows suitable design for the pegs. These can be made quite easily from dowel. If a lathe is available no trouble at all will be encountered. Without a lathe, however, very good pegs can be hand made. They should be slightly tapered to ensure a tight fit in the peg holes.

Sound-Hole Inlay

Fig. 12 gives a simple pattern. Transfer the design to a piece of ⅛in. plywood and carefully cut out with a fret-saw. Make it a tight fit in the sound-hole. Sand smooth and place to one side to await assembly.

Fig. 9 (below).—The tail-piece.



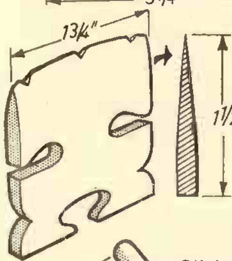


Fig. 10. (left).—The bridge.

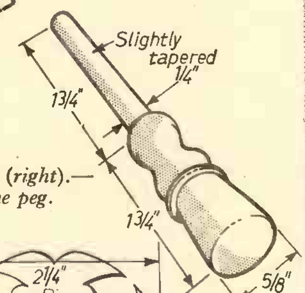


Fig. 11 (right).—The peg.

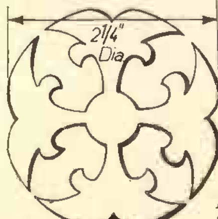


Fig. 12 (left).—The sound-hole inlay.

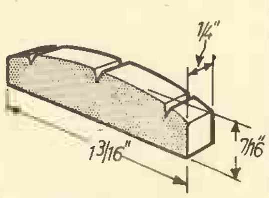


Fig. 13 (above).—The nut.

Fig. 14 (left).—Details of the bow.

The Nut

The nut is made from either scrap hardwood or bone. Fig. 13 gives details.

Tail-Piece Stud

Carve this from a short length of dowel. Drill a hole to take the stud in the body.

The Bow

Although the fiddle can be played with an ordinary violin bow, that shown in the photographs is more in keeping with the period of the instrument. It is made from a 2ft. 2in. length of straight-grained pine, $\frac{5}{16}$in. square. Fig. 14 gives details. A further 6in. length of $\frac{5}{16}$in. square pine is glued to one end as shown. A ⅛in. hole is drilled in the bow where the two pieces join and a vee is cut in the top. Bind the end of the bow for about ½in. below this vee to prevent splitting. The bow-hair, which can be bought in most music shops, is held in place by two knots, 2ft. 1in. apart. After tying the first knot, insert the untied end through the hole in the lower end. Now tie the second knot and, bending the bow carefully, slip the hair through the vee. The bow can be left strung in this manner for long periods without damage. Apply rosin liberally before playing.

Finishing

It was decided to finish the instrument in such a way that it looked mellow with age. This was achieved by using a spirit stain and friction polish. A number of very weak coats of stain were applied. The original was made from pine and a walnut stain was used. Before staining the fiddle itself carry out tests on pieces of scrap until the desired effect is obtained. The grain should next be filled and rubbed down smooth. Now for the friction polish. That used on the original was bought made up in a woodworkers supply shop. It should be used very sparingly. A high, piano finish, is not required but instead a dull glow to enhance the character of the wood. A very light mahogany stain was used on all mahogany parts before filling the grain and rubbing down. The bridge and nut are left unfinished. The tail-piece stud should be stained black and polished.

Assembly

Locate the tail-piece stud in the body and glue the sound-hole inlay in place. The fiddle can now be strung and the tail-piece loop finally knotted.

General

The photographs show where embellishment can be added. The lower end of the finger-board can be cut to the shape shown with a fret-saw. It is up to the reader to add whatever decoration he feels will enhance the finished instrument. If slipping pegs give trouble, drill a small hole up the centre of each peg and force home small wedges.

If reasonable care has been taken over the various stages the finished fiddle shown in Fig. 15 will not only be a very good-looking instrument but will have a tone that will amply reward the amateur *luthier*.

The fiddle should be strung with three violin strings. Either the top or bottom three, according to individual choice. The fiddle is tuned in the same way as an ordinary fiddle.

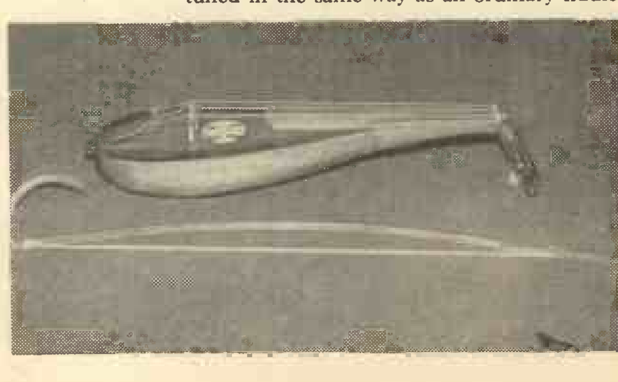
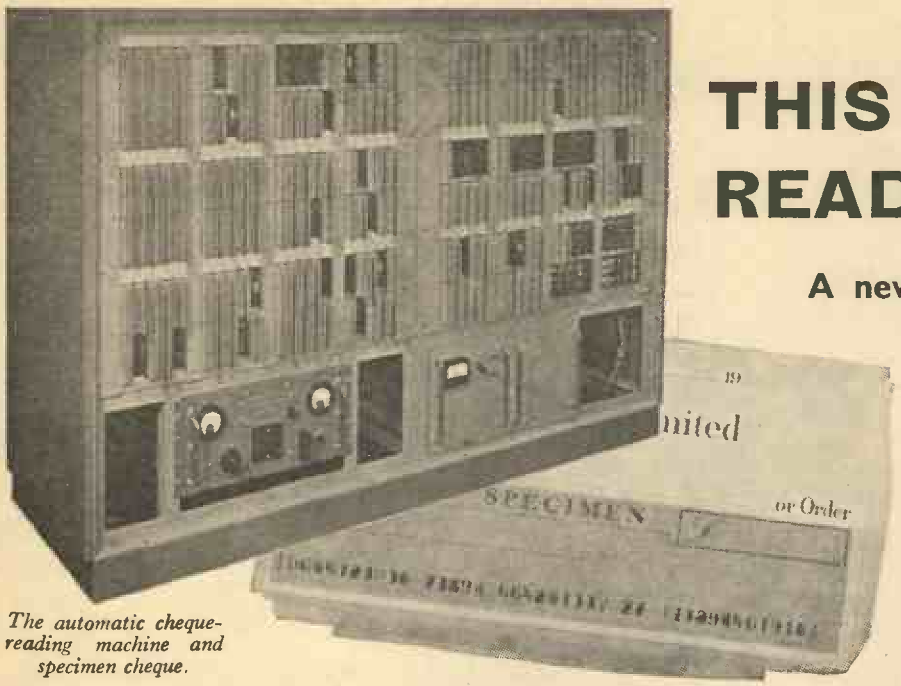


Fig. 15 (right).—The finished fiddle and bow.



The automatic cheque-reading machine and specimen cheque.

THIS COMPUTOR READS FIGURES

A new development in the electronic field

THE first demonstration of automatic cheque handling using E.M.I.'s new Figure Reading Electronic Device—FRED—in conjunction with the Pitney-Bowes/National high-speed document sorter, was given recently at the Hayes headquarters of E.M.I. Electronics Ltd. Cheques of various sizes from many different cheque printing houses were shown being automatically sorted into their paying branches.

In a typical day's voucher clearing in the United Kingdom over 2,000,000 cheques are sorted for return to about 10,000 branches. Manual sorting methods are finding it difficult to keep up with the increasing numbers of cheques being used, so the banking industry is studying the advisability of installing electronic figure-reading and sorting equipment.

FRED has been developed as a numeral-reading machine specifically for use with bank cheques and for other similar business purposes.

All the data normally found on a cheque—such as serial number, branch number, customer's identity and amount—can be coded along the bottom edge using the FRED numerals.

Cheques in sizes ranging from 6in. × 3in. to 8in. × 4in. can be sorted indiscriminately and other special sizes can be handled if required. Punched card cheques, when printed with FRED characters, can be read simultaneously with normal paper cheques.

Accurate spacing of the characters along a line or the precise positioning of any character relative to the leading edge of a cheque in the sorter is not necessary, and normal printing tolerances are sufficient.

Low Printing Costs

The FRED system makes very few demands on the cheque printing industry, so its adoption would result in keeping cheque printing charges down to a minimum. Extensive tests have been carried out with hundreds of thousands of cheques from all the leading British cheque printing houses to confirm FRED's practicability.

Some of the data—such as customer's account number and amount—has to be imprinted on the cheques in the banks, so tests have also been carried out in collaboration with the leading manufacturers of imprinting machines.

Bar Code Numerals

A reading machine intended for use in business offices should be very reliable, fast, compact and of low cost. Whilst it is relatively easy to meet these requirements with a bar code reader, since the detection of such a simple " pattern " is a comparatively straightforward problem, it is much more difficult with complex shapes such as conventional Arabic numerals.

This difficulty has been overcome in the FRED system by building a five-element bar code into the design of the numerals. The resulting typefaces are visually similar to conventional designs—they are in fact based on an existing fount called Broadway—and are therefore easily recognised by the human eye. Furthermore, the machine is presented with what amounts to a simple five-unit bar code, which, with magnetic ink printing, leads to very reliable machine recognition.

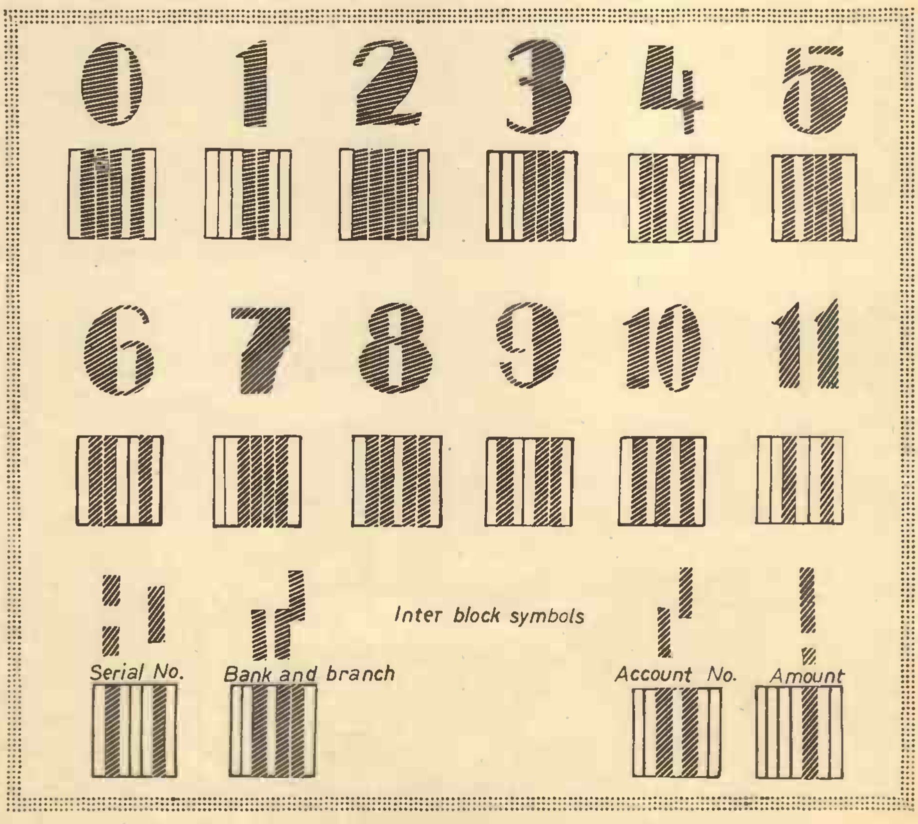
The FRED numerals and inter-block symbols are shown in the diagram below, the corresponding bar code being drawn under each numeral for comparison purposes.

Consider, for example, the numeral " zero." Referring to the bar code beneath this numeral and reading from right to left the columns are black, white, black, black, black. If the numeral is also imagined to be divided into five equal vertical columns, it is clear that these too (reading in the same direction) are:

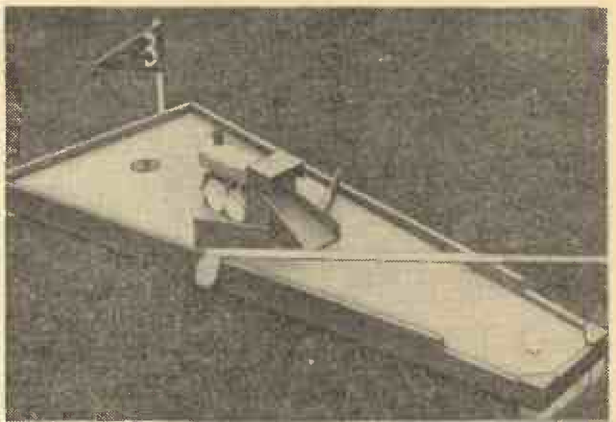
(1) mainly black
(2) mainly white
(3) mainly black
(4) mainly black
(5) mainly black

If a " mainly black " column is represented by 1 and a " mainly white " column by 0, the code for zero is 10111, as for the bar code. Each numeral is coded in this way.

As the first digit in each code is always " 1 "—the right-hand column of each character is always black—this form of the code gives four variable digits, with 16 possible combinations.



A five-element bar code has been built into the design of the numerals.



You Can Make It Yourself At Home By Eric Hawkesworth

DESIGNED for either indoor or outside use, the Krazy Train miniature golf course can be put down in quite a small area to give a most interesting game. Some putting skill is required to negotiate the hazards, which are all associated with railways. Painted in the suggested colours, the miniature greens and hazards present an attractive appearance and the total cost of the complete set—under £5—could be easily recouped, if the owner desired, by siting the outfit in—say —a local park and letting the public play round for a small fee.

Constructing the Platforms

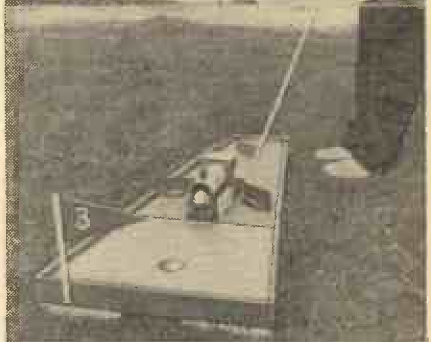
Outer frames for the eight platforms are all identical in size and shape and are built up using planed 3in. × $\frac{3}{4}$in. timber. Side pieces measure 4ft. $7\frac{1}{2}$in. while the ends are 2ft. and 8in. respectively (Fig. 1). Joint the frames with glue and screws after first cutting away the tee-off end of the frame pieces as shown.

The actual greens are built up in two pieces to each frame—a 3ft. long portion with slight incline to return mis-hit balls and a flat section with the hole in the middle. Either hardboard or thin plywood may be used. Fig. 2 shows how five inclined greens may be cut from a 6ft. × 3ft. sheet and three such sheets would be required for the whole set of large and small greens.

Extra strips of wood as shown are nailed inside the main frames to carry the greens, the plywood or hardboard pieces being nailed down on to these carrying strips. The ball hole is fretsawn 3in. dia. and a plywood box is fastened below. A $\frac{1}{2}$in. hole is drilled at the tee-off end to hold the ball each time it is hit (Fig. 2).

Other items needed for the platforms are ball fences made from strips of hardboard and 1in. square pieces of wood to direct the ball to the hazard and the hole number pennants. The pennants should not be too high (Fig. 2) so that putting from the broad end is convenient. Screw the pennant post to the outside of each frame.

Paint the frames red and the boards green to complete the platforms.



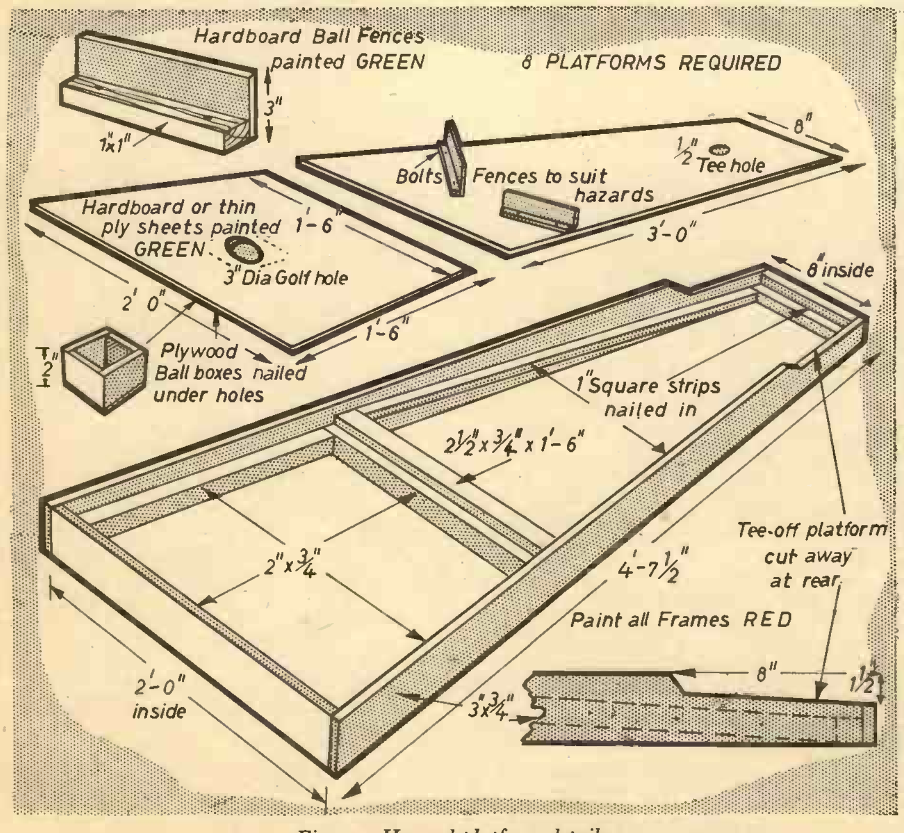
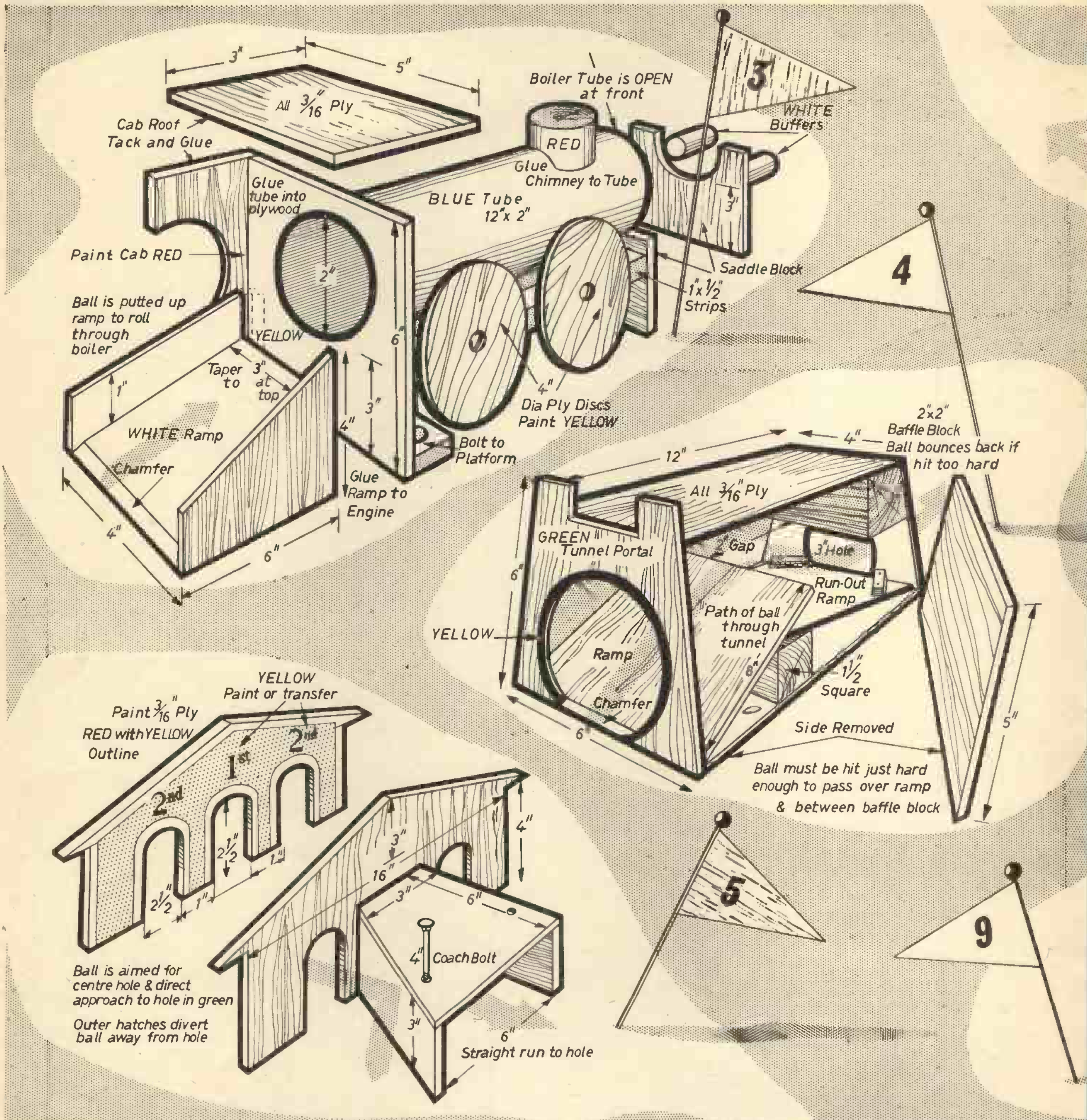


Fig. 1.—Hazard platform details.
The photographs on the right show some views of the author's Krazy Train golf course.



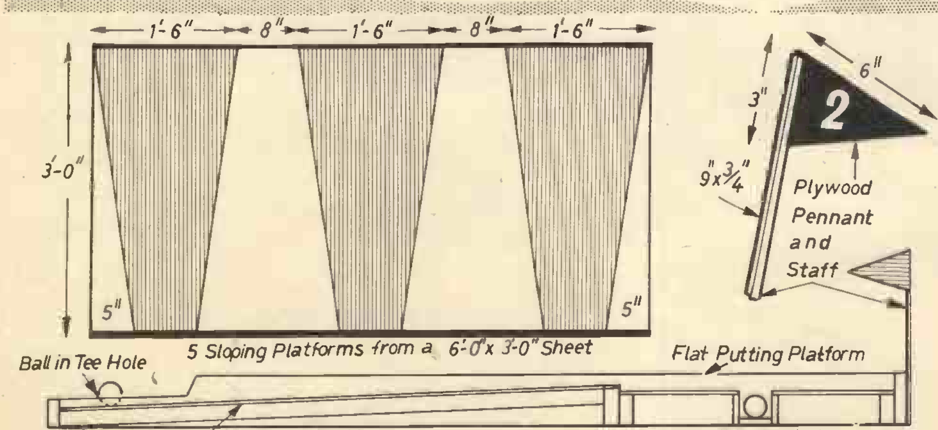


Fig. 2.—*Further details of the hazard platform and the plywood pennant.*

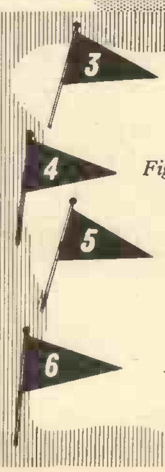


Fig. 3.—*The engine hazard.*

Fig. 4.—*The tunnel hazard.*

Fig. 5.—*The booking office hazard.*

Fig. 6.—*The girder bridge hazard.*

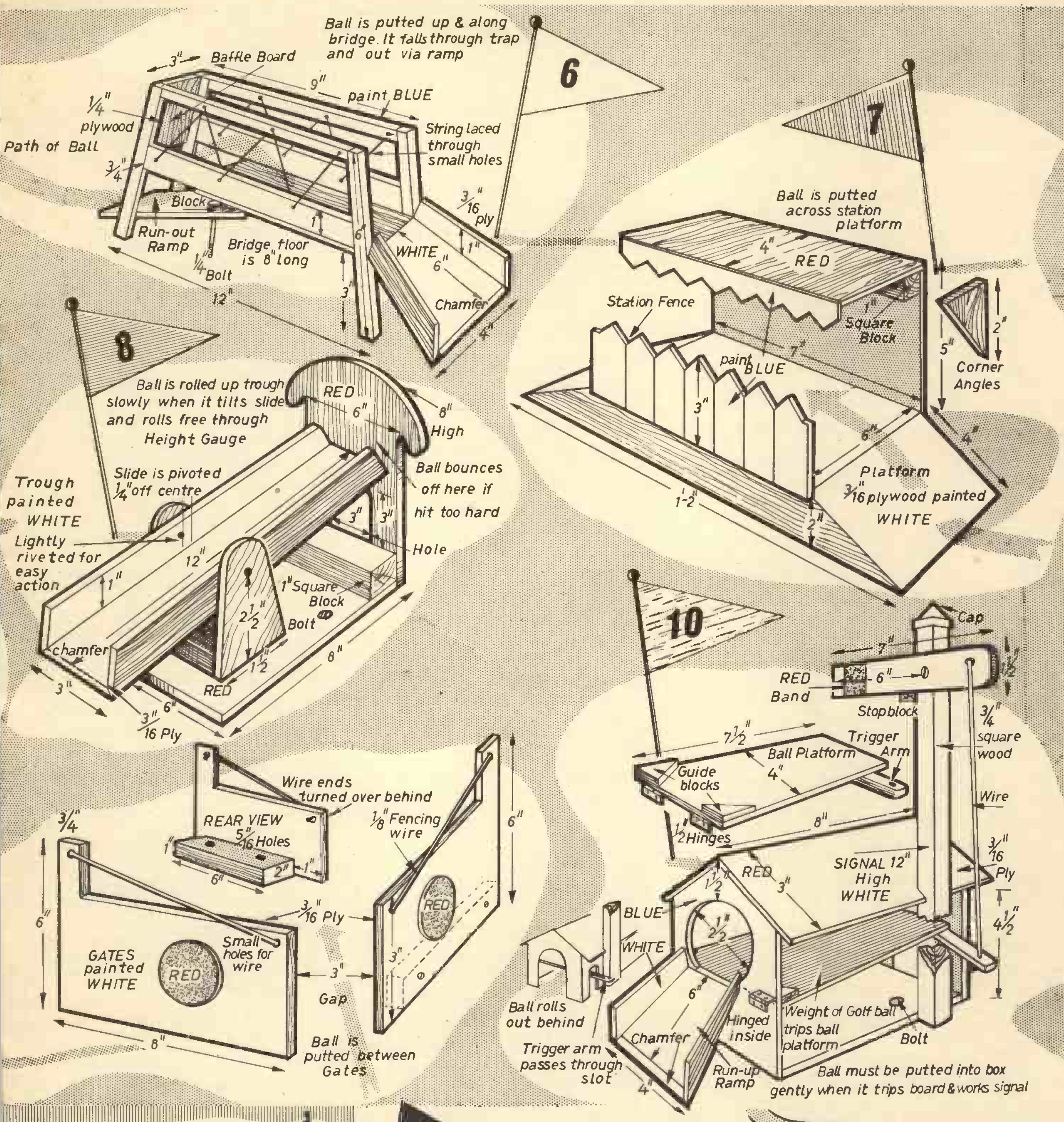
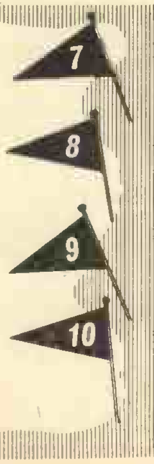


Fig. 7.—The station hazard.

Fig. 8.—The height gauge hazard.

Fig. 9.—The level crossing hazard.

Fig. 10.—The signal hazard.



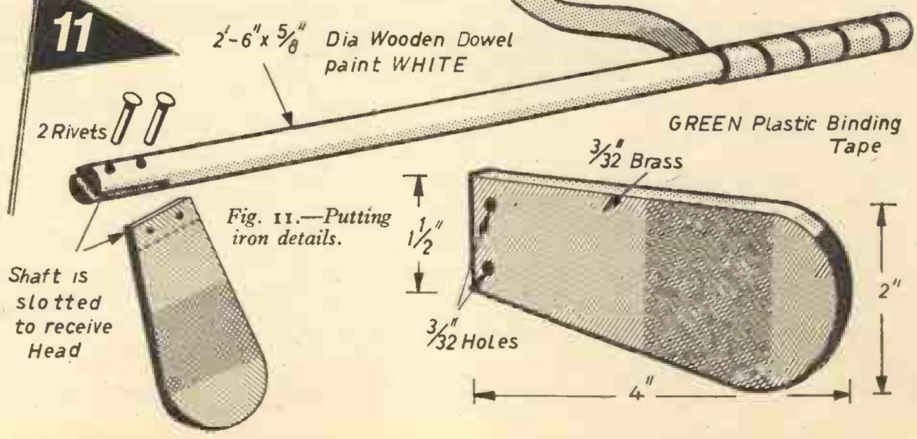


Fig. 11.—Putting iron details.

The Engine Hazard

A 12in. length of 2in. internal diameter pipe forms the boiler of the engine hazard (Fig. 3). This pipe is mounted into a plywood cab at the back end and sits on a plywood saddle up front. Wooden side strips join cab to saddle and the plywood wheel discs are screwed and glued to these strips. Plywood $\frac{3}{16}$in. thick should be the minimum used and this applies to all the hazards.

The run-up ramp is built to the given dimensions which give a slight taper from front to back and provide 1in. high side walls to guide the ball into the tube. Notice how the leading edge of the ramp is chamfered to give a smooth lead-in. A chimney and front buffers are cut from 1in. dia. dowel and glued in place. Colours for the engine—and all the other seven hazards—are included in each sketch. The enamel should be painted over at least two wood undercoats.

Mount the engine on a platform with the nose just projecting over the flat green. Use coachbolts with wing nuts underneath the green for easy winter packing and secure two suitable ball fences each side of the run-up ramp, also with small $\frac{1}{4}$in. coachbolts. The hazards should be directly in line with the holes so that a straight putt has every chance of holing in one.

The Tunnel Hazard

A drive through the tunnel hazard is not quite so easy as might at first seem. Fig. 4 shows the internal construction of two ramps and a baffle block. The ball must be hit with just sufficient force to lift it over the run-up ramp. Too hard a drive will bounce the ball off the baffle block and back out of the tunnel!

Plywood corner pieces must be located on the lead-in and lead-out edges of the ramps so that balls run smoothly through the openings. This applies to the other hazards with internal ramps. Secure the tunnel to the green with ball fences either side the mouth.

The Booking Office

This hazard runs the full width of the green so that no extra ball fences are required (Fig. 5). It is cut from a strip of plywood measuring 18in × 7in. and has three ball openings as shown.

The tunnel deflector is built up from more plywood and is fastened immediately behind the centre hole. Balls passing through this opening have a direct run to the hole but balls going through the " 2nd Class " openings are directed to left and right of the flat green. A second putt is thus required to sink these shots.

Girder Bridge Hazard

Make the sides of the bridge from $\frac{1}{4}$in. plywood and lace white string through small drilled holes as shown. The ramps are of the thinner plywood as is the baffle board at the rear end of the girders. The ball must be hit up on to the bridge platform via the run-up ramp with just enough pace to roll it through the trap. It will rebound if hit too hard. Two more ball fences prevent shots going straight to the flat green (Fig. 6).

The Station

The platform with canopy-top and fence is easily assembled from pieces of suitable plywood. Blocks 1in. square can be used to strengthen the structure. As shown in Fig. 7, they are tacked and glued into the angles. Ball fences direct the balls into the hazard.

The Height Gauge

Built up off a base of ply, the height gauge hazard is a kind of see-saw (Fig. 8). The trough of the see-saw is pivoted $\frac{1}{4}$in. behind its rocking point so that its angle of inclination always lies toward the tee-off green. A backboard is fastened to the rear of the baseboard and this acts as a re-bounce baffle if the ball travels up the trough too fast. The ball must overbalance the trough, when it can run through the hole in the baffle.

Bolt to a platform with fences aligned each side of the mouth of the trough.

Level Crossing Gates

Fig. 9 shows the pair of level crossing gates through which the golf balls must be driven. They are simply cut from plywood with wire stays added to resemble brace bars. The gates are supported with blocks attached behind. These are drilled for the holding-down coachbolts.

The gates are painted white and have red ply discs tacked to their centres. Leave a gap of 3in. between to make this very sporting hazard.

The Signal Hazard

The weight of the golf ball rolling through the signal box is employed to press down a platform which is counter-balanced—via a wire arm—against a signal arm. Thus, a successful drive through the hazard flicks the signal arm to " all clear " (Fig. 10).

Notice how the rear view of the signal box shows the hole at floor level through which the ball rolls after depressing the platform. The run-up ramp has a chamfered edge to lead the ball into the box and two ball fences are required.

The signal arm is fastened to the post by a single woodscrew and must be an easy—but not loose—fit. A length of $\frac{1}{8}$in. bronze welding wire is ideal for the connection to the platform that tilts.

The Putting Irons

Suitable putting irons for the miniature golf set are made from lengths of smooth $\frac{5}{8}$in. dia. dowels and sheet brass pieces (Fig. 11). Each shaft is 2ft. 6in. long and is slotted at the base to accommodate the putting head. Depth of slot is $1\frac{1}{2}$in.

Use $\frac{3}{32}$in. thick brass for the heads and saw them to the shape given. Notice how the head makes an angle with the shaft. Drill a couple of small holes at inch centres through shaft and head and rivet a pair of copper pins through the lot.

Paint the shafts white then bind a length of green plastic adhesive tape round the handle end to give a good grip.

Process your own Colour Film

(*Concluded from page 475*)

Remaining Steps

When the reversal exposure is completed, the film and its reel are returned to the development tank and the next solution—the colour developer—is poured in, having first reset the timer. If you have had to remove the film from its reel during the reversal exposure, re-threading is easily done by placing film and reel in a bowl of water.

At the colour development stage it is possible to relax. The step is a comparatively long one, and all that is necessary is an occasional agitation.

This is now an opportunity to check the temperatures of the rinsing water and the bottle storage water, also check that the labels on the bottles are still intact and that the first developer and hardener have been restored to their bottles. At the end of this stage the colour developer is returned to its bottle (Fig. 8) and the succeeding washing and clearing stages carried out.

Appearance of Image

So far, the film shows no sign of any image, the base is grey upon removal from the tank prior to the reversal exposure, and it remains so until half-way through the bleaching stage; during bleaching the base turns green and about half-way through the process a cream image appears at last.

After bleaching, the film is washed and then fixed. During fixing the outside surface of the film looks very dark and black and resembles a black and white negative.

The last wash is now made, taking 8 to 15 minutes.

There is one extra process for the Ektachrome film, the most important one of stabilising. The stated time must not be exceeded.

Now, after the long period of processing, you can hold the film up to the light to assess your work, both with regards the subject taken and the success of the processing.

Finally the film is attached to clips and hung to dry in a dust-free atmosphere and at a temperature not exceeding 110 deg. F. Correct drying is of primary importance.

Re-use and Storing of Solution

If you are processing further films at once, place the bottles in the bulk water tank and check that the temperature is correct. Clean all measures, jugs and other vessels, also clean the developing tank and dry the spiral-reel thoroughly before threading in the new film. Also clean the agitator and thermometer. Then process as before.

When you wish to store the solution for use on subsequent days, the bottles should be full or almost full and stoppered and be placed away from the light.

The storage life of the various solutions comprising Ektachrome Process E2-Improved Type is—First and Coloured Developers (unused and partially used) 2 weeks; other solutions (unused and partially used) 8 weeks. The life of Johnson's Ferraniacolor Processing chemicals is—First and Colour Developers, unused 1 week, partially used 48 hours; other solutions at least 6 weeks.

When solutions have been stored for any length of time they should be filtered before use to remove any deposit.

Care is Essential

By following the maker's instructions completely and ensuring that the equipment is clean; that one solution does not contaminate another, that the second exposure is adequate and that the temperature and timing are as recommended, every transparency should be a good one.

Making Colour Slides

Having processed your film you will now wish to make your own slides, either for direct viewing through one of the many slide magnifiers or project them on to a screen.

The simplest and least costly method is to purchase cardboard ready mounts (Fig. 9). These cost 5s. 6d. for 50 from Kodak and 2s. 3d. for 20 from Ferraniacolor. They have self-sealing adhesive, it being only necessary to cut up the film, place the sections in the mounts, fold over, and seal.

Plastic, metal and glass slides can be used and these are particularly suitable for projector work, when the cardboard mounts tend to distort temporarily in the projector because of the heat and " jump " out of focus. A selection of slides is shown in Fig. 10.

Finally, care of slides is essential. There are a number of special boxes and cases available (Fig. 11), the most important thing being to keep them away from the light or the colours will tend to fade.

The P.M. 2-Berth Cabin Cruiser

The Concluding Article of the Series by F. Hook

IT is better to commence work on the cabin of the boat at the main cabin bulkhead at frame 4 and work forward to the windscreen. This bulkhead is framed up with four vertical members and a cabin roof beam (Figs. 25 and 28). The two outer vertical members are secured first of all to the ends of the coamings around which they are notched. Ensure that the inwards slope of these members is identical. The two members which form the door frame must be exactly vertical when the boat is precisely horizontal across the beam and also should be checked to ensure they are parallel. The cabin beam rests on top of these four members to which it is secured by four plywood gussets screwed on the inside of the bulkhead across the joints. The door frame members are screwed at their lower ends to the lower members of frame 4.

At frames 3 and 2 vertical members are secured to the knees and carlin and sloping in at the same angle as those of frame 4 (Figs. 26 and 27). This can be judged by sighting from the cockpit along the edges of the bulkhead. These members are 1¾in. × ¾in. and the vertical length is better left a little full at first. The roof beams should be clamped to their top ends and adjusted into position by sighting along the top of the cabin beams.

The curvature of all the roof beams should be the same. Consequently when the curve has been set out on the bulkhead beam the other beams can be marked out from this one.

Another point of importance concerning the vertical members at frames 3, 2 and windscreen position is that they should also be parallel to the bulkhead frame when viewed from the sides of the boat. That is to say they should all be parallel to one another.

The vertical member at the windscreen position is screwed only to the carlin, which is perhaps a weakness, consequently a strengthening piece of 1½in. × ¾in. is fixed across from the carlin to the sheer batten at this point to give additional support.

The sloping windscreen side members do not rest upon the carlins (Figs. 29 and 31), but upon a 9in. piece of carlin timber screwed against the carlin. For the time being do not proceed with the windscreen.

Check the alignment of the roof beams and then scribe their positions on the side members at frames 2, 3 and 4 and cut out a notch upon which the beams can rest (Fig. 28). Screw the beams into position.

The Cabin Carlins

The two cabin roof carlins should now be fitted. At first cramp a light piece of timber (1½in. × ½in.) along the ends of the beams to get the slope required to the top ends of the vertical members. Then trim off these waste pieces. Now mark and cut notches in the ends of the deck beams to take the carlins, 1¼in. × ¾in. These carlins are screwed into the ends of the beams. The forward ends of the carlins will mark the height and slope of the top ends of the forward side supports. Saw off waste and screw the carlins into the top of the supports.

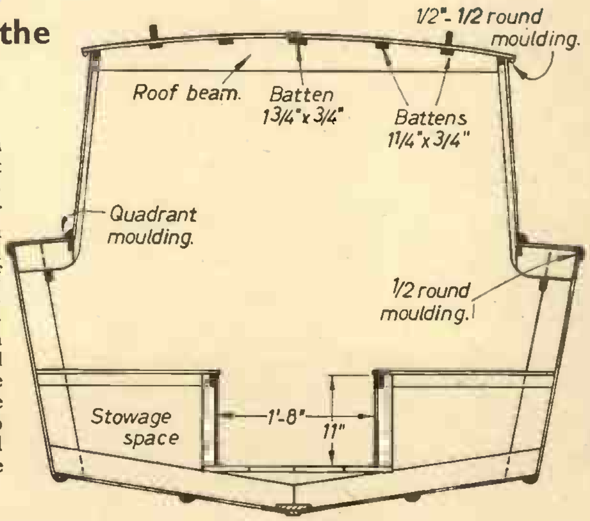


Fig. 26 (Above).—Sectional view at frame 3, looking forward.

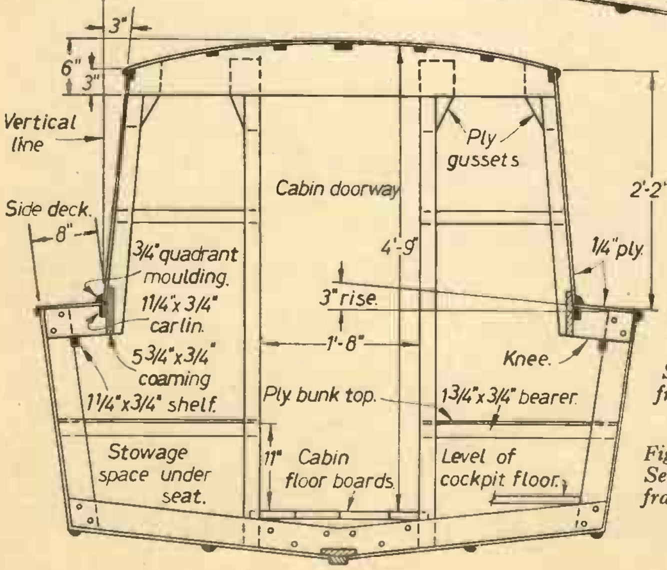


Fig. 25 (Left).—Sectional view at frame 4, looking forward.

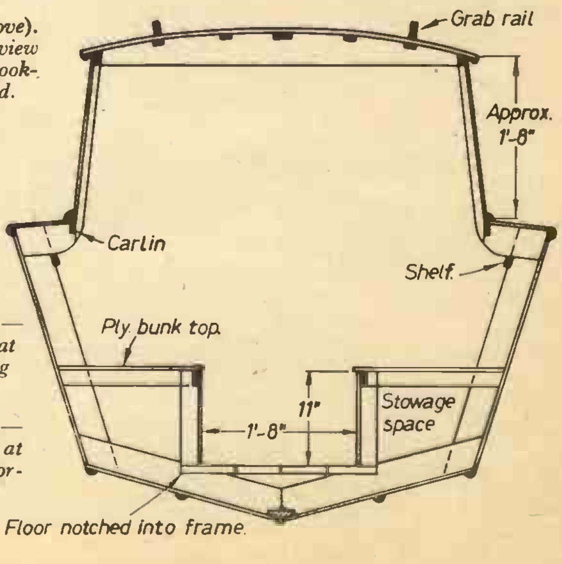


Fig. 27 (Right).—Sectional view at frame 2, looking forward.

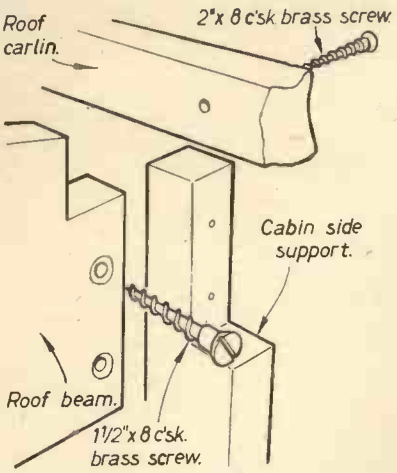


Fig. 28.—Details of junction of roof beam, roof carlins, and cabin side supports.

The windscreen (Fig. 31) can now be completed by screwing the sloping members in position and then fitting the top rail with a curvature to correspond with that of the other deck beams. All this work may be done with neatly made butt joints provided they are well glued with Aerolite glue and screwed up tightly. It is important to keep an eye on any likely points at which rain may penetrate and to be sure that they are well sealed with either glue or Seelastic.

Fig. 30.—A photograph taken during cabin construction.

Roof Battens

The roof has five battens. The central one is 1¾in. × ¾in. and the others are 1¼in. × ¾in. The central one is wider to make a good jointing surface for the two pieces of plywood with which the roof is covered.

These battens are notched into the roof beams and screwed into position (Fig. 26).

Now fairing off the roof members can be undertaken with a smoothing plane. Make sure all screw heads are well countersunk to save any damage to the plane blade.

Carlin Filler Pieces

Applied to the side-deck carlins in between the vertical members of the cabin framework are some pieces of 2in. × $\frac{5}{16}$in. thickness plywood. These pieces form a ledge against which the lower edges of the side panels of the cabin can be screwed. They also provide a bearing surface upon which to put the Seelastic sealing compound.

The Side Decks

The upper structure of the cruiser is now ready for covering in with ¼in. thick plywood. The lay-out of the various panels is given in Fig. 32, but it is to be noted that these sizes are only approximate.

Commence by fitting the fore-deck (Fig. 31) which consists of two triangular panels. The top of the stem should be trimmed away flush with the sheer battens. The top of the false stem may be left for the time being and later it may be rounded or shaped to suit the constructor. It is essential to get a good fit of the foredeck against the lower windscreen rail. It is helpful if the panels are held in place with just one or two screws at first to ensure a good fit before using sealing compound. When all is ready Seelastic is thinly spread upon the edges of the deck beams, battens, sheer battens, etc., and then the panels are put into position again and screwed down with screws at every 4in. Use ¾in. × No. 6 c'sk brass screws. If the decks are to be left natural colour and varnished then the screw heads are best driven in just flush with the surface. If the decks are to be painted then the screws may be sunk in a little and the holes stopped.

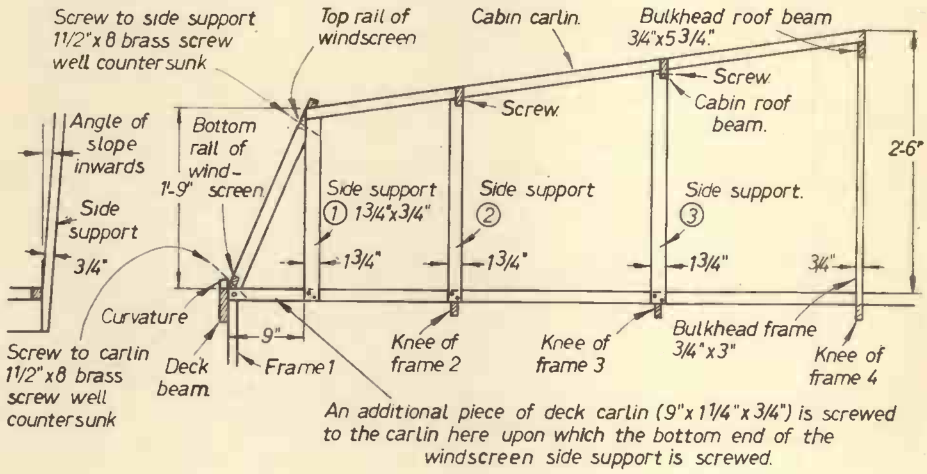


Fig. 29.—Details of cabin side structures.

Each side-deck comprises two panels. The shorter forward pair of pieces must butt neatly against the ends of the foredeck and against the carlin filler pieces. The aft ends of these panels reach to frame 3. In order to provide a wider bearing surface at this point for the joint of the two panels it is advisable to screw on an extra bearer to the knees at frame 3 as well as at frame 1.

The two stern-side deck panels butt against the forward two and against the cockpit coamings. Trim off any overhang at the transom and along the gunwale line. The outer edge of the side-deck panels can finally

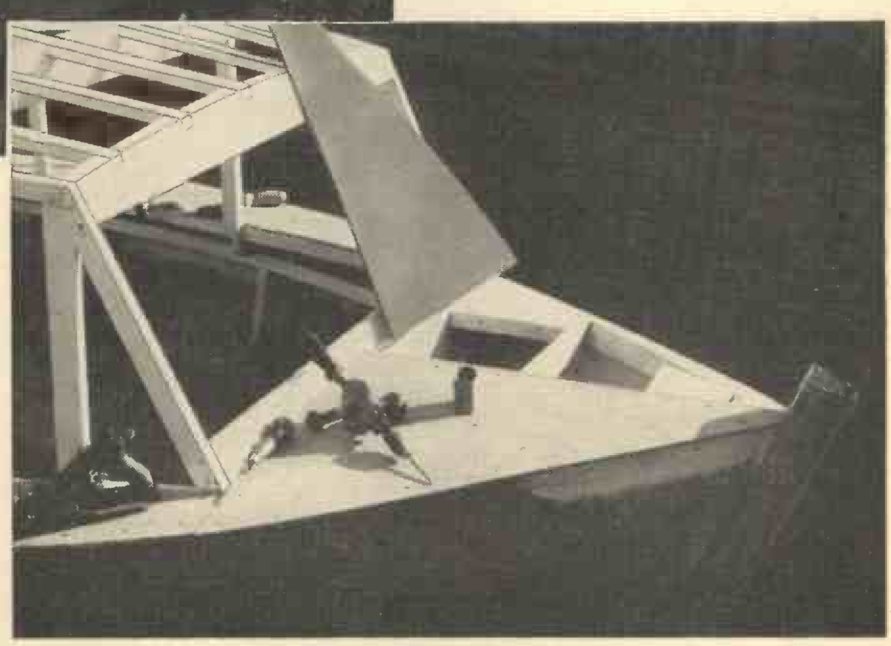


Fig. 31.—Fitting the fore-deck.

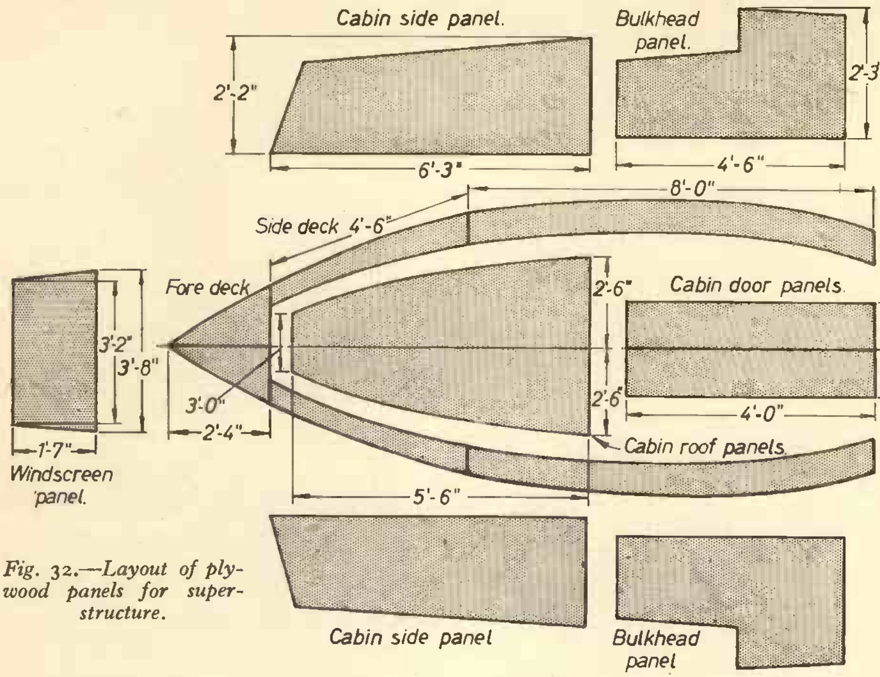


Fig. 32.—Layout of plywood panels for superstructure.

be sealed over with a length of $1\frac{1}{2}$in. half-round moulding screwed and sealed from bow to transom.

The Windscreen and Cabin Side Panels

Roughly trim these panels to size and mark in lightly any members of the cabin framework and then give consideration to the arrangement of the openings for the windows.

These windows are of $\frac{1}{8}$in. Perspex and are held in place with rubber mouldings similar to those used for car van windows. It is necessary to get the correct moulding for the thicknesses of materials being used. A typical cross section of rubber moulding is shown in Fig. 35. Remember to avoid sharp curves in window openings when using such mouldings as it is difficult to fit them to very sharp curves. A minimum curve of $2\frac{1}{2}$in. radius is suggested.

In passing it is of interest to note that instead of a fixed windscreen window panel the constructor may wish to contrive a window which hinges outwards as on an old-type car windscreen. In fact it is possible to use a salvaged car windscreen for this purpose.

Another reason for such an opening window is that it provides an emergency exit forward should the cabin door get jammed or in the case of fire in the after well. A grim thought but at least one for which it is as well to make provision. Needless to say, one or two small car-type fire extinguishers should form a part of the gear in the boat when it is in use.

Assuming then that a fixed windscreen panel is to be used, fit it in place making a good fit against the fore-deck on the bottom edge.

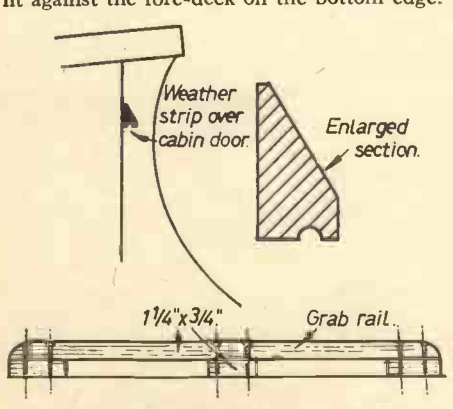


Fig. 33.—Weather strip over cabin door.
Fig. 34.—Grab rail.

Trim off level at the roof beam and the side uprights.

Fit next the two bulkhead panels. A small filler piece will be needed over the top of the door. In addition, at that point, it is advisable to fit a strip which will protrude over the top of the door to keep rain from running in (Fig. 33.)

The side panels are now fitted. They must make a good fit against the side decks. Final trimming off of the two ends may be delayed until the panels are screwed in place. Sealing compound is used again under all surfaces which butt together to give a watertight joint. The rear ends of these panels must be left overhanging about an inch in order to screw against a jointing strip of $1\frac{3}{4}$in. $\times$ $\frac{3}{4}$in. to which is also screwed the side screen of the cockpit (Fig. 35).

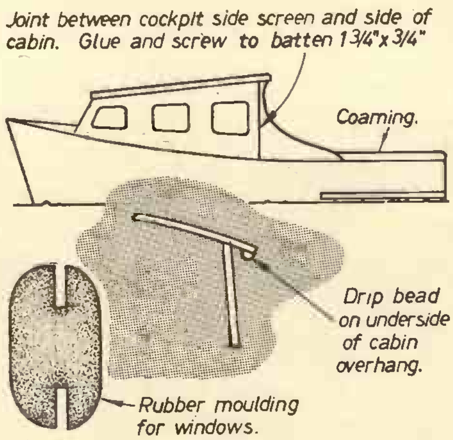


Fig. 35.—Cockpit side screen and rubber moulding for windows.

Finally the roof panels are secured in place. The edges may be trimmed back flush with the sides and ends and a moulding be screwed over the joint to make a waterproof seal. Alternatively an even more weatherproof arrangement can be made by having small overhanging eaves all round, rather more overhang should be provided at the bow end for effect. The underside of the overhang can be reinforced with some $\frac{3}{4}$in. half-round moulding which will also act as a drip beading (Fig. 35).

A length of $\frac{3}{4}$in. quarter round moulding is screwed and sealed along the side decks against the cabin sides, the coaming and the windscreen. This sealing strip must be put on very carefully and sealed so that there is no possible chance of water penetrating below decks in the worst of weather. This is the most vulnerable point for leaks in any craft such as this.

The Grab Rails

These are essential fitments for the roof of the cabin. They are to provide hand holds when walking along the side decks and are useful to prevent such articles as mops and boat hooks from rolling off the roof of the cabin.

The rails (Fig. 34) are in two parts and are of $1\frac{1}{4}$in. $\times$ $\frac{3}{4}$in. material, neatly rounded to be comfortable to hold, screwed to the cabin roof battens with a spacer or similar material.

The Cabin Door

The cabin door (Fig. 36) is made of two 10in. wide doors which are arranged to fold in half and thus take up less room in the cockpit when opened.

The frames are constructed with the use of half-lap or mortise and tenon joints. The plywood covering is held in place with brass nails or screws as well as glue.

Brass backflap hinges are used. They are better than butt hinges as they may be laid flat on the frames and thus give a wider bearing surface.

A small bolt top and bottom on the inside of one half of the door will secure it, and a handle and lock of a suitable kind can be fixed to the other half of the door.

Cabin Seats

The interior of the cabin can be fitted up to any requirements of the reader. In the present design the author kept a parallel gangway of 20in. width down the centre of the cabin. This makes the seats taper off at the bow, but nevertheless wide enough to sit on. See Figs. 25, 26 and 27.

Supports for the seats are of $1\frac{3}{4}$in. $\times$ $\frac{3}{4}$in. timber and the seat tops can be offcuts from the panels used for the skin of the boat. These will have to be shaped to the curvature of the boat and slots cut to fit around the frame members. To provide more bed space it may be necessary to carry pieces of plywood to fit across from one side to the other of the gangway. The seats can be covered with foam rubber cushions which are excellent in that

(*Concluded on page* 500)

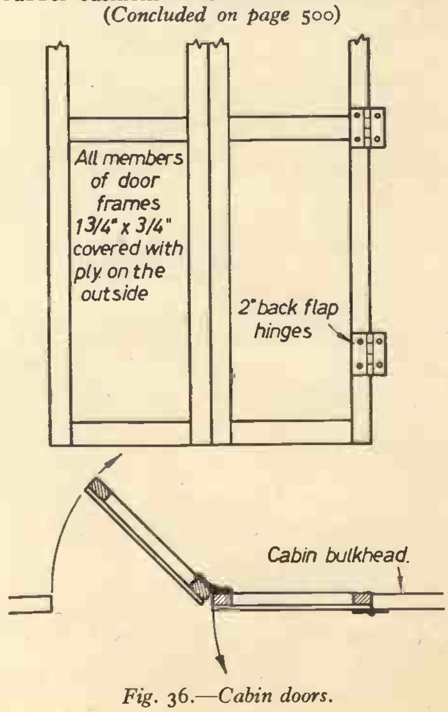
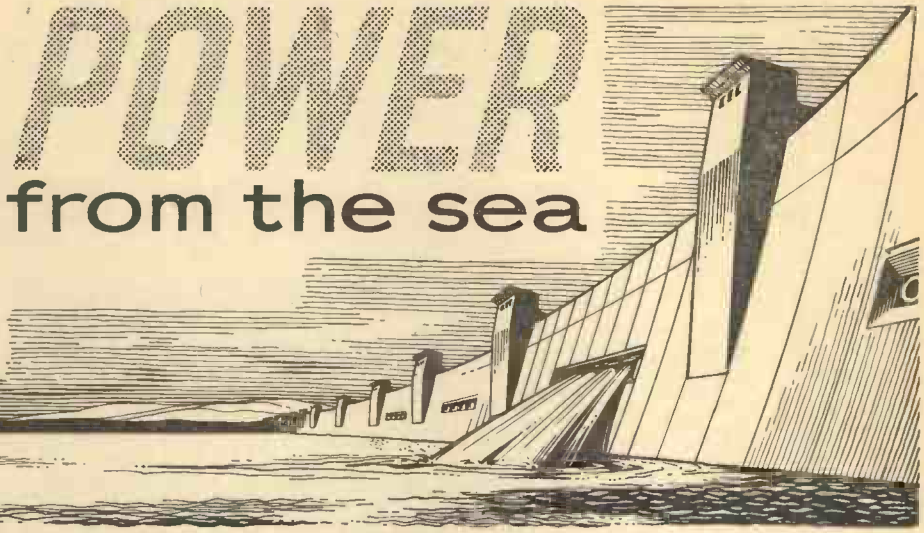


Fig. 36.—Cabin doors.

POWER from the sea



IN the world today abundant electric power is of the first importance, and this is seen by the fact that the building of new generating stations can hardly keep pace with the increasing demand. As the years go by the requirements will grow still bigger. Looking ahead it may well be that even the growth of atomic power will not be sufficient for the world's demands. Where then will the engineers look for the power which they must have? The answer is that they will look to the sea.

There are many ways to obtain power from the sea, but one of the least known is to use it as a giant absorber of the sun's energy. Every day the sun shines on the earth, and the amount of energy received is stupendous. It has been calculated that when the sun is directly overhead each acre receives the power equivalent of 5,000 horse-power. Think then how much power could be generated from an area the size of the Indian Ocean, if only it could all be gathered up.

R. N. Hadden describes the latest ideas for making use of the sea

Red Sea Dam

Of course, it is one thing to say that so much of the sun's energy falls on a given area, but it is quite another thing to try to harness it. However there is one way in which the sea can be made to give up some of the energy which it has absorbed from the sun, and that is by evaporation. One scheme has been put forward by a Frenchman named Rene Bigarre for harnessing the energy of the sun which falls on the Red Sea.

Bigarre's scheme was to build a giant dam across the mouth of the Red Sea near Aden, to stop any water from flowing in from the Indian Ocean, and to fit locks to the Suez Canal so that no water could flow in from the Mediterranean (Fig. 1). He claimed that when he had isolated the Red Sea in this manner the level would start to drop very rapidly due to evaporation. The figure given for the drop in level was 23ft. per year. There would be nothing to prevent this drop in level as no rivers flow into the Red Sea.

Bigarre then went on to describe the second part of his scheme, which was to install giant turbines in the dam. When the level had fallen about 30ft. he would start the turbines up, thus allowing water from the Indian Ocean to flow into the Red Sea once again. In flowing through the turbines the water would generate tremendous power. The rate of flow would be carefully controlled so that the level in the Red Sea would be maintained at its new reduced level. In other words the flow would exactly equal the rate of evaporation. When it is considered that the Red Sea is about 1,200 miles long and about 200 miles wide it can be seen what a tremendous flow of water would be required to maintain the level. In fact it has been calculated that the output of the turbines would be equivalent to burning 200,000 tons of coal per day!

There is however one snag to this scheme at the moment and that is that nobody wants such huge powers at this point, as the surrounding lands are all desert. Nevertheless it may well be that an efficient means may be discovered to use electric power to convert sea water to fresh water. If this could be done then all the surrounding deserts could be turned into fertile land, bringing prosperity to countries which are now poor.

A Mediterranean Dam

Another scheme similar to the Red Sea dam, but more attractive in that the power generated would be nearer to the great industrial centres of Europe, is the Mediterranean dam. This scheme was put forward in 1928 by a man named Sorgel. His idea was to build a dam across the Straits of Gibraltar (Fig. 2), again with the object of lowering the level of the sea by evaporation. This scheme was designed not only to produce power but also to increase the land areas of the Mediterranean countries.

This scheme although very similar to the Red Sea dam would be a much longer-term project, as the rate of evaporation is lower. This was fully realised by Sorgel when he proposed the scheme, and in fact he laid down the various stages for doing the work. The first step would be the building of the main dam across the Straits of Gibraltar and a smaller one across the Bosporus. When the dams had been completed the level of the sea would begin to drop. While the level was being lowered the power stations would be built, one in North Africa, one in Southern Spain, and a smaller one in Turkey on the Bosporus.

Sorgel reckoned that by the time the power stations had been finished the level of the sea would have dropped enough to start power

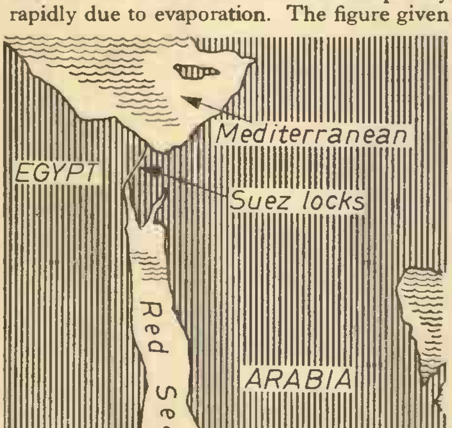
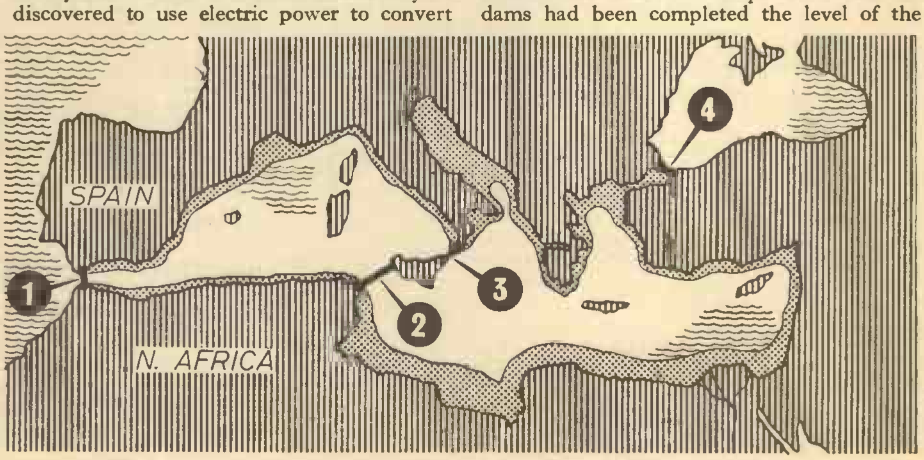


Fig. 1.—The Red Sea dam.



Extra land due to lower level.

1 *Gibraltar Dam.*

2 *Tunis Dam.*

3 *Sicily Dam.*

4 *Bosporus Dam.*

Fig. 2.—Positions of Mediterranean dams.

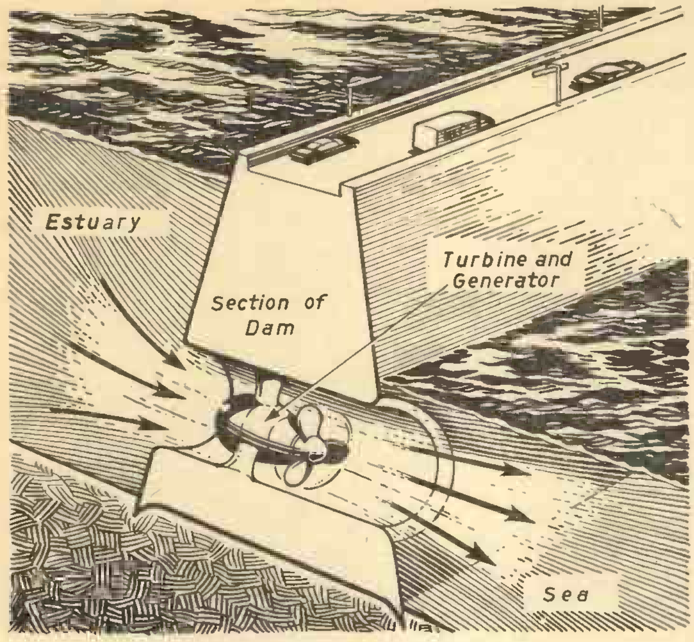


Fig. 3.—Tidal power station.

generation. The actual rate at which the level would sink would be very much less than in the case of the Red Sea. It has been calculated that the evaporation is about 5½ft. per year, but this is partly cancelled out by the large rivers which flow into the sea. In effect the final rate of dropping the level would be about 40in. per year, or 33ft. in 10 years. In the scheme as put forward power generation would begin when the level had fallen 33ft., or 10 years after the dams had been completed.

Second Stage

The next step in the scheme would occur nearly 100 years later. By this time the level in the Mediterranean would have dropped nearly 300ft., provided too much water had not been let in through the turbines. With this lowering of the level vast new tracts of land would have become available to the surrounding countries. It has been calculated that at least 90,000 square miles of extra land would be available.

At this stage Sorgel decided that no further benefit would be realised by lowering the level of the western end of the sea any more, as the gain in extra land would be small due to steeply shelving shores. However he believed that a useful purpose could be served if the eastern end were even further reduced in level, as quite a lot more land would be exposed.

To reduce the level of the eastern end of the sea still further dams would be built from Italy to Sicily, and from Sicily to Tunisia (Fig. 2). The level of the eastern end of the Mediterranean would then be lowered a further 300ft. Power stations would again be built to generate electricity by allowing a controlled flow of water from the higher level in the western section into the lower eastern section.

At this point Sorgel proposed stabilising the system, about 200 years after the first dam had been built. There is no doubt that the power generated by this scheme would be really fantastic, and would probably be able to supply most of Europe. There is no doubt either that the extra land exposed would be very useful to the various countries concerned.

The Snags

There are also a number of drawbacks. The first is that although the sea level would be reduced in the Mediterranean, it would be increased throughout the rest of the world by about 3ft. This would be very serious for low-lying countries like Holland. The second disadvantage is that all the existing ports on the Mediterranean would become useless. As the level dropped the ports would have to be moved farther and farther away from their original sites. This would mean a move at least every 10 years, which would be very costly.

Because of the disadvantages of carrying the Sorgel scheme to its ultimate conclusion it has been proposed by some experts that a modified version should be adopted. In this modified version the level would only be reduced 50 to 70ft. This lowering of the level would be sufficient to enable a large amount of power to be generated and still retain the usefulness of the existing ports.

Tidal Power

So far the schemes described have depended on evaporation for the production of power. However there are other methods whereby electricity can be obtained from the sea, and one such way is to use the power of the tides. In actual fact such a scheme is being built in France at the moment, where the very great rise and fall of the tides is being harnessed.

As a tidal power scheme is actually being built by the French a brief description of it is given. However similar schemes could be built in the Severn Estuary in this country, or the Bay of Fundy in Canada. The French project is being built in the estuary of the River Rance, where the tidal rise is over 40ft. Across the mouth of the estuary a dam is being built, which will house the turbines and sluice gates (Fig. 3).

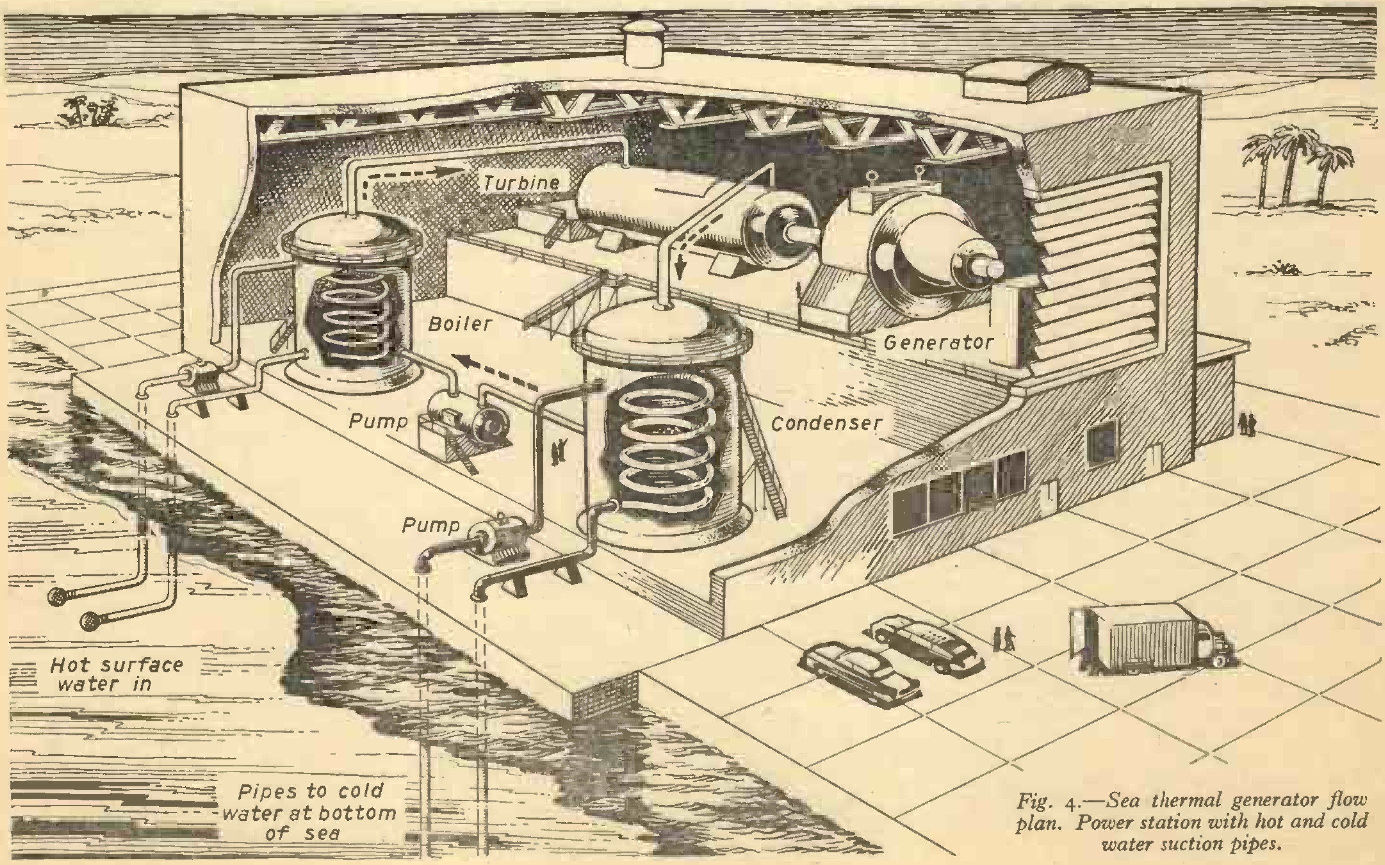


Fig. 4.—Sea thermal generator flow plan. Power station with hot and cold water suction pipes.

Method of Operation

In operation the sluice gates will be opened when the tide is rising, allowing the water to rush into the basin behind the dam. At high tide the sluices will be shut and the turbines will be run in reverse to act as pumps to push even more water into the basin. It may seem strange at first sight to use electric power to pump more water into the basin, when the whole object of the scheme is to produce power and not to use it. However it has been proved that a small expenditure of power to pump more water into the basin at high tide is more than offset by the extra power generated when the level of the tide has fallen and the water is flowing out through the turbines.

When the basin is full to capacity the pumping is stopped. A period of waiting then occurs until the level of the water outside the dam has fallen to about 14ft. below the level inside the dam. The turbines are then started up and are run until the tide again begins to rise. The sluices are then opened and the whole cycle is repeated.

It may be wondered why power generation does not occur while the tide is flowing into the basin as well as when it is flowing out. The answer to this is that it has been proved by experiment that it is more efficient to generate in the way described. It may also be wondered if the cyclic nature of the power generation will not be a disadvantage. However the answer to this is that the tidal power scheme will run in conjunction with a hydro electric station. When the tidal station is generating the hydro electric station will be stationary, when the tidal station is stopped the hydro electric station will be generating.

Heat Pump Principle

There is still another method whereby power can be generated from the sea, and this is by using the difference of temperature between the water on the sea bed and on the surface. This method depends on the fact that warm water will boil if its pressure is reduced sufficiently. The steam thus generated can be used to drive a turbo-generator.

Fig. 4 illustrates how this type of power station would work. Hot sea water is drawn up from the surface of the sea, and is circulated in coils in the low pressure boiler where steam is generated. The steam then drives the turbine, and is exhausted to the condenser. The condenser is kept cold by circulating cold sea water through the coils. It is possible to make a power station of this type work with a temperature differential between the hot and cold water of only 40 deg. F. There are many places in the world where this temperature differential could be obtained.

Ideas Wanted

There is still one other way in which power could be generated from the sea, and this is from the waves. Waves are produced by the action of the wind on the surface of the water, and so in fact they represent the power which has been absorbed over vast tracts of sea. This power is really tremendous if only it could be harnessed, but it is a big IF, as nobody has yet thought of a really good way of doing it. However there is little doubt that some day somebody will devise an efficient way of harnessing this power. When this way is found it will probably be some simple solution, and will probably be thought of by some quite ordinary person who is not afraid of new ideas. It might even be YOU!

The P.M. Cabin Cruiser

(*Concluded from page 497*)

they do not retain moisture in the same way as other types of mattress.

The spaces under the seats are valuable for storage purposes and they can be made more use of if the front of the seat is covered in to prevent articles from falling forward. The floor should also be lined to prevent small articles from falling down into the bilges.

Timber for Seat Fitments

2 seat longitudinal members	6ft. × ¾in. × 1¾in.
1 cross member at frame 1	3ft. × ¾in. × 1¾in.
2 cross members at frame 2	2ft. × ¾in. × 1¾in.
2 cross members at frame 3	2ft. × ¾in. × 1¾in.
2 cross members at frame 4	2ft. × ¾in. × 1¾in.
6 leg supports.	1ft. × ¾in. × ¾in.
2 plywood tops 6ft. × 2ft. × $\frac{5}{16}$ from offcuts	

Rubbing Strips at Stern

These were shown in Fig. 1 at the beginning of the series and are necessary to protect the side of the boat at moorings, in locks, etc. They are made from pieces of timber 4ft. × 1¼in. × 3in. The width of the timber tapers to 1in. at the forward ends. The strips are strongly screwed into position at the transom and frames 5 and 6.

Finishing

The final finishing of the craft can be to the constructor's own taste. Preliminary work is the same whatever finish is desired. All woodwork must be well glasspapered down with various grades of paper. Three thin coats of pink primer should be applied with a light rubbing down between each coat. All holes should be filled and smoothed off level. Two coats of undercoat should next be applied with a final coat of top coat.

If mahogany timber is to be left in a natural colour, the preliminary coats should be of yacht varnish well thinned down with turpentine and lightly glasspapered between coats. The final finish can be of two coats of varnish at full strength.

Mooring Cleats

Some provision must be made to moor the cruiser and four brass or galvanised cleats are needed. The size can be about 4in. to 6in. Four are needed, two at the bows and two at the transom. They are bolted on to the side decks at the points where the reinforcing pieces were screwed prior to the fitting of the side decks.

Engines and Steering

Most outboard engines of horsepower from 4 to 20 can be used to propel this boat. The Seagull Century or Anzani Super Single 5 are suitable for quiet inland waters where speed is in any case prohibited.

The engine is used to steer the boat as well as to propel it and this is achieved by swivelling the engine on a pivot by a tiller. The Anzani engine can be completely turned round so that it will in fact act as a reversing action to the drive. The Seagull will not do this.

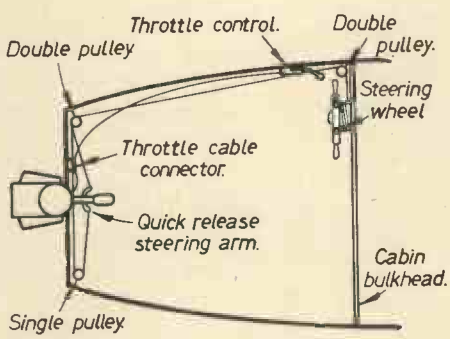


Fig. 37.—Steering and throttle remote control.

It is unlikely that the skipper will want to stand by the tiller the whole time and a remote control steering wheel can be quite easily rigged up on the outside of the bulkhead panel on the port side. The various accessories for this remote control can be rigged up by the inventive amateur but on the other hand parts may be bought quite inexpensively. Messrs. J. White Ltd., 247 Camberwell New Road, London, S.E.5, will be pleased to send a list of current prices upon request. From the current list the following items would be needed.

	£	s.	d.
1 No. 3 Steering Wheel ..	3	10	0
1 No. 6 Quick Release Steering Arm		17	6
1 No. 13 Flat Mounted Single Pulley		3	6
2 No. 15 Double Pulleys ..		9	0
1 No. 17 Throttle Lever control		17	6
1 No. 18 Throttle Connector ..		10	0
10ft. Bronze Throttle Cable ..	1	0	0
2 No. 11 Cable Clips		2	0
2 No. 12 Thimbles			6
	£7	10	0

Fig. 37 shows the disposition of the various parts with their names.

A ROLLING BALL CLOCK

A novelty described by A. B. ORR

THE clock to be described is a smaller version of an early eighteenth century Chinese clock. At the hours and half-hours a small ball is released and rolls down a series of ramps. At the end of its run the ball drops into a lift which carries it up to await the next hour.

Choice of Clock

The most suitable clock for conversion is one of the old glass-fronted American type which can usually be picked up extremely cheaply in auctions. Choose a clock that is mechanically sound and check that it has a striking movement and that it is working. Remember that the taller the clock the longer the ball can roll. The one shown in Fig. 1 has its decorative work removed.

Conversion

First of all remove the glass panel. This is usually held in by small pins or glued block. Then, using the removed glass as a template, make a panel of ⅛in. plywood to fit into the frame. Cut away the area covering the face with a fret saw. This panel is the base for the mechanism, the ramps being attached to the front and the lift gear behind. See Fig. 2.

Ramp

The ramps are made from bicycle spokes, fitted into holes drilled in the side members. The angle of the ramps will depend on the size and weight of the ball used and will have to be found by trial and error. Note the dropping section on each ramp. Fig. 3 shows how this is formed. Position the spoke between the vice-jaws as shown, using three centre punches to form the curve. The ball should drop cleanly through the section on to the lower ramp. The ramp unit should be secured to the panel by wood screws from behind.

Two holes, slightly larger than the diameter of the ball to be used, should be drilled in the panel, one at the beginning of the ramp and the other at the end. The upper hole should be offset to the left a distance equal to the diameter of the ball. This is to ensure that the ball remains in the lift until the upper hole is reached.

Lifting Gear

As can be seen from Fig. 2 this is a small box that travels on two rails, driven by a screwed rod. (The other rail is hidden by the screwed rod.) The rod has a pulley on the lower end and is driven, through a counter-shaft, by a "Mighty Midget," or similar motor. No definite dimensions can be given as the final measurements will depend on the clock used in the conversion. The general layout will, however, be the same whatever size of clock is chosen.

The lift-box is made from ¼in. wood and $\frac{1}{16}$in. plywood. The sides should be drilled to take the guide rails which are about 1in. apart. Make the bottom of the box sloping slightly from right to left. This will cause the ball, on entering the lift, to roll to the left thus clearing the lower hole when the lift moves up. It is also an aid to smooth operation if the floor is also slightly sloped towards the front so that the ball will roll out smartly when the upper hole is reached. A stud projects from the back of the box. This can be either a nail or a $\frac{1}{16}$in. bolt. This stud fits into the hole drilled in the traveller.

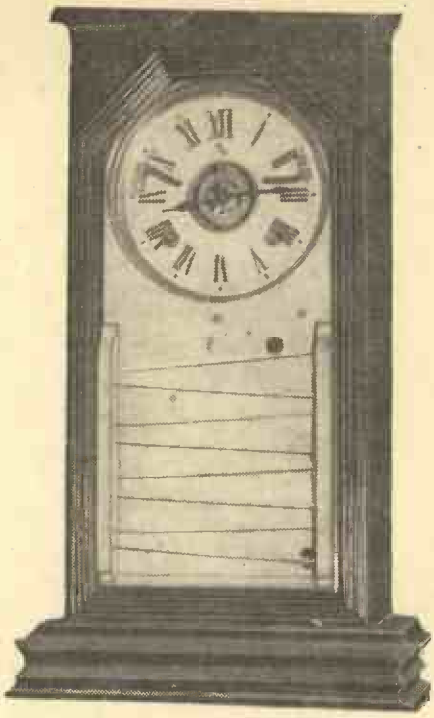


Fig. 1.—A converted clock.

The screwed rod is supported at each end by brackets made of tinplate or pieces of scrap brass. These are secured to the panel by folding under the guide rail supporting pieces (see Fig. 2). The pulley on the screwed rod is made from an empty cotton reel. A piece about ½in. long is sawn off and a vee is filed in it to take the rubber-band pulley belt. A short piece of pencil, with the lead removed, is pushed into the centre of the reel. The rod is made a force fit in the hole down the centre and a nut is screwed up tight against the face of the pulley. The pulley can be fitted on the inside or outside of the bracket, depending on the space available.

The traveller on the screwed rod is made by soldering a piece of tinplate on to two nuts, about ½in. apart as shown in Fig. 4. The tinplate is bent at right-angles and is soldered to two sides of each nut. One end is bent underneath and drilled to fit the stud on the lift-box. Ensure that the traveller can run smoothly from top to bottom without jamming. Any tendency to jam will probably be due to a slight bend in the screwed rod.

The drive from the motor is taken to a counter-shaft. The pulley on this is also made from a cotton reel with a pencil as a bearing. Fig. 5 shows a sectional view. If a lathe is available no trouble will be entailed turning up the pulley. If not, then it can easily be carved and rounded in the chuck of a hand drill held in a vice. A length of knitting needle serves as an axle. The bearings at each end are made from scraps of wood screwed to the panel.

On completion, check that the motor, counter-shaft and screw pulleys are in line as any errors will result in belts slipping off in use.

Limit Switches

These are simply made and Fig. 6 gives details. Note that the bolt securing the leaves of the switch is insulated from them by using paxolin washers. If an ex-W.D. relay is stripped down, many useful parts will be obtained that can be used. The switches are secured to the panel by one woodscrew each. This enables them to be swung around the securing screws, allowing adjustments to be made to the position in which the lift is stopped.

Trigger Movement

The ball, on emerging from the lift at the height of its travel, drops on to the top ramp and rolls about 2in. before being stopped by the trigger. Fig. 7 shows how this is made. When the clock strikes, contact is made through a simple switch (see Fig. 8) and the electro-magnet is energised. This draws the trigger plate sharply to its core and the ball is released. Trial and error will provide the correct setting so that the action is smooth and consistent.

The switch is very simply made by soldering a springy strip of tinplate or brass to the hammer on the striking arm of the clock. A second contact is made and is secured to the clock case in such a position that, when the clock strikes, and the hammer on the striking arm is raised, the two make brief contact.

Dial Contacts

Between the nine and ten and two and three divisions, two small brass contact plates are glued to the dial. Leads from these are taken behind the face through two small holes. Note that if the face is metal some sort of insulation will have to be placed between the contacts and the face. However, nearly all clocks of the American type have metal faces covered with thin card.

The minute hand of the clock should be sprung in slightly so that the tip bears on the plates in passing. Clean the tip of the hand well to ensure a good contact being made with the plates.

Wire the clock as shown in the circuit diagram (Fig. 9). Bell wire should be used and care should be taken to make the wiring as neat as possible. Make sure that nothing is allowed to foul the free swing of the pendulum. A lead is taken from the contact on the clock case to the electro-magnet on the trigger unit. the other side of which is taken to a battery. The second battery lead is taken to the frame of the clock.

Adjusting

Drop the ball on to the ramp and let it roll down to the trigger. It may be found that the ball does not roll freely. This can be remedied by increasing the slope of the ramp at this section. Make contact through the trigger switch on the striking hammer. The trigger on the panel should click back sharply releasing the ball. If it does not, check the wiring and make sure that the trigger unit operates freely. Once released, the ball should progress at an even speed along the ramps. Any tendency to slow or stop should be cured by slightly bending the ramp at the offending section. On dropping into the lift the ball should drop to the left. This can be helped by making the end of the ramp actually curve into the hole, guiding the ball into the lift.

Now place the minute hand just in front of one of the pairs of dial plates. When the hand touches the contact it may not ride smoothly over it. Bevel the leading edge of the contact. On making contact the lift should be driven smoothly up until the stud on the lift opens the limit switch and stops the motor. The ball should drop out easily. Increasing the slope of the floor of the lift will cure any tendency to hesitate.

Once the movement is working well all the parts should be checked and then the batteries can be stowed in the pedestal of the clock.

A Perspex panel could be used in place of the plywood. The mechanism would then be visible from the front. If Perspex is chosen, it is a wise plan to make a plywood panel first and then transfer switch positions, etc., to it. This will avoid vacant holes being left after experimenting with positions of various components.

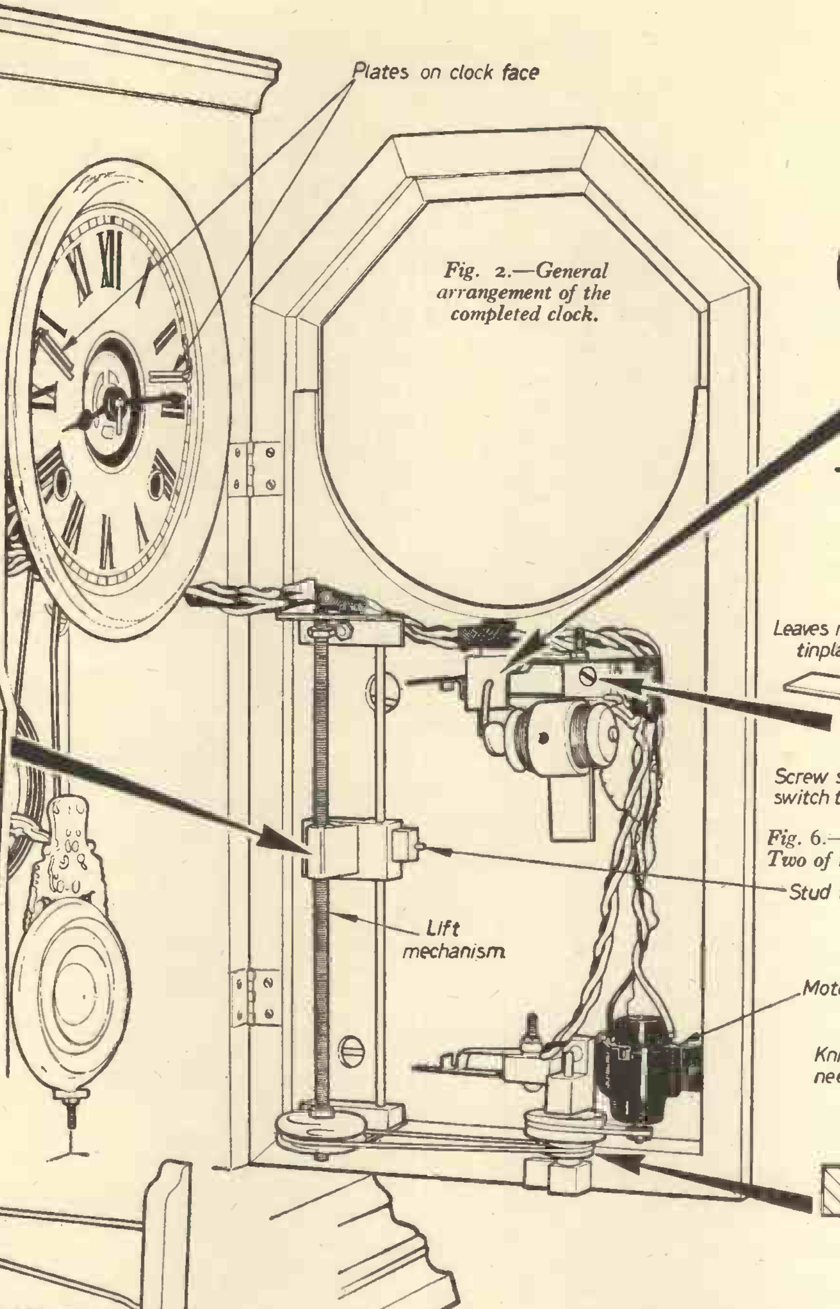


Fig. 2.—General arrangement of the completed clock.

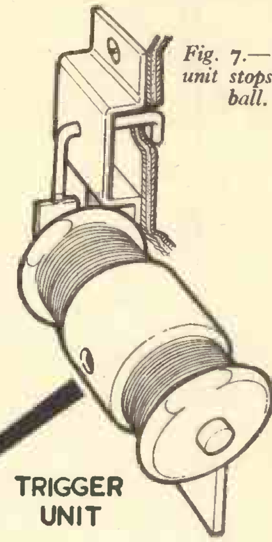


Fig. 7.—This unit stops the ball.

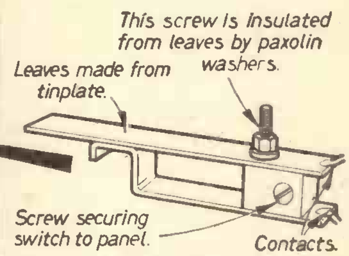
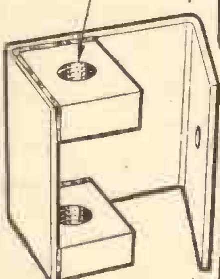
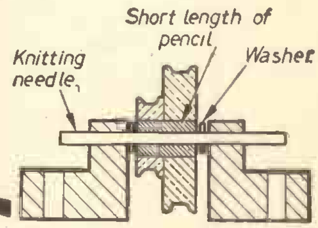


Fig. 6.— **LIMIT SWITCH**
Two of these switches are required.



TRAVELLER

Fig. 4. — The nuts should be ½in. apart.



COUNTERSHAFT

Fig. 5.—A sectional view.

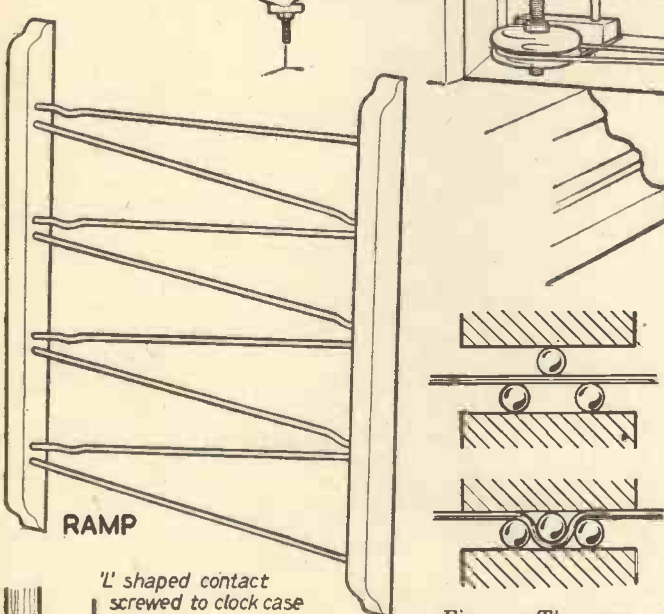


Fig. 3.—The ramp and (above) the dropping sections.

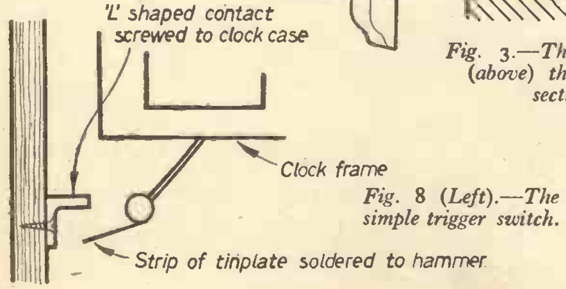


Fig. 8 (Left).—The simple trigger switch.

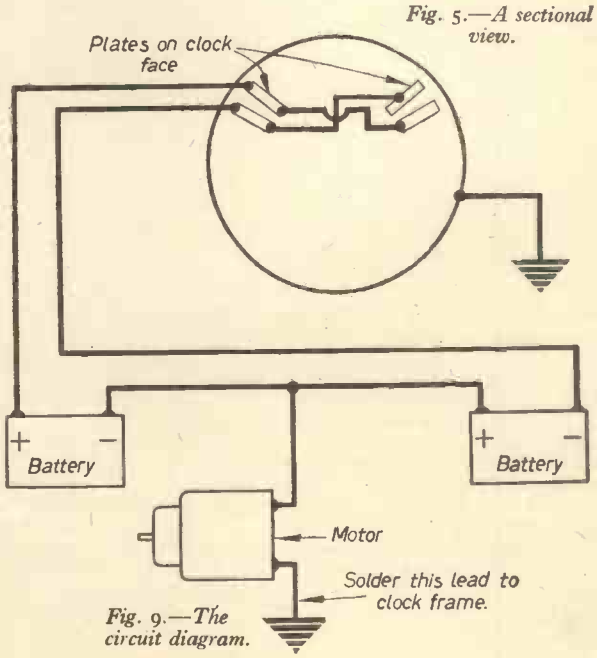


Fig. 9.—The circuit diagram.

COSMIC WEATHER

Is our weather affected by the planets?

By V. A. FIRSOFF

Fig. 1.—The Arran hills under snow. A drop in the air temperature due to solar flares may bring a fall of snow.

PRIMITIVE man lived exposed to Nature. His animistic outlook was unitary. He felt himself part and parcel of his surroundings. The Sun and the Moon, the stars and planets of his skies, personified and deified, were directly involved in his personal drama. In the Middle Ages celestial portents and astrological prognostics preserved the link, but the development of city life, the revival of learning and the rise of science brought about the break-up of the ancient order of things, leading to particularization and fragmentation of life, thought and eventually of science itself.

In the aftermath of this great upheaval these trends no longer appear so reasonable as they once seemed to be. In fact, the ancient beliefs seem to be creeping in in disguise by the back door. The relationships once dimly sensed are becoming re-established in scientific terms. Isolation is impossible; in the tangled web of interdependences, heavenly bodies—the Cosmos—do affect human lives, if only through the medium of the weather.

Our Weather and the Sun's Corona

English weather there may be, but it is not made in England, nor even wholly in the Icelandic Low and the warm currents of the Gulf Stream. The Earth itself is no independent unit, insulated by empty space from other worlds that once seemed so unattainably remote.

It was noticed some years ago that the global weather situation on Mars showed general resemblance to that of our home planet. This is due to the fact that weather is not so much a Martian or a terrestrial as a solar entity. The outer atmosphere of the Sun—the corona—extends far out into space and envelops the whole of the Solar System as though in a thin cocoon of gas and dust. At our distance from the Sun the corona has a not inappreciable density of about 1,000 particles to the cubic centimetre, not counting the dust, which forms local clouds and is derived, at least in part, from the interstellar space.

The coronal gas consists predominantly of a mixture of protons and electrons in roughly equal numbers—in other words, it is live electricity. It is not still but in rapid movement and has a mean kinetic temperature of some 10,000 deg. C. When the surface of the Sun is disturbed powerful jets of similar electrified particles are emitted, as well as short-wave radiations, which agitate the outer corona and the upper atmospheres of the planets, whose magnetic fields capture the electrified particles.

Sunspots and their Effect

Such solar emissions are associated with the appearance of bright flares on the Sun and these in turn with sunspots. This is how sunspot numbers acquire their great meteorological importance.

The amount of energy of unobstructed sunlight at the mean distance of the Earth from the Sun passing through a cross-section of one square centimetre per minute is called the solar constant. As the name indicates, it is substantially invariable, at least within the range of visual wavelengths, and would appear, moreover, to have remained the same throughout decipherable geological time. The Sun was no hotter when life first began to stir in the primeval oceanic slime.

It may be that the ice ages, of which at least four are known to have occurred at intervals of some 250 million years, have been due to a temporary change in the solar constant, but this has not been proved and other explanations exist. On the other hand, it has already been intimated that the emission of corpuscular radiations, as well as of rays of shorter wavelengths and ultraviolet rays in particular increases appreciably with rising sunspot numbers.

This has but little effect on the solar constant as such, but it results in an intense heating of our stratosphere, due among other causes to the absorption of the ultraviolet by ozone. As a result of this the upper air tends to flow to the polar zones and the permanent high pressure systems at the expense of the tropics and the low-pressure areas. The net effect, both long- and short-term, is intensified circulation and storminess. More particularly in our latitudes increased solar activity, not so much at a sunspot maximum itself, as immediately before and after, tends to produce cold winters and hot summers.

The main sunspot period has an average duration of 11½ years, but it may vary from about 8 to 14 years in particular cases. There exist longer fluctuations of 23, 50 and 80 years respectively of established meteorological importance. Their effects can be traced well back into historical and geological past. Fig. 2 shows a group of large sunspots.

Planetary Influence

The lesser bodies of the Solar System also influence our weather. Some of this influence appears to be indirect and due to the tides raised by the planets in the Sun. In fact, it has been observed that there are more sunspots when the large and/or the near planets are on the opposite side of the Sun from the Earth. Since an increase in sunspots indicates an increased heating in the upper atmosphere, which entails, oddly, a drop in the temperature at ground level, it follows that the mean monthly temperature may be expected to be somewhat higher when the bright planets are conspicuous in the night sky. (See Fig. 1.) This is precisely what has been found by statistical investigations extended over a number of years.

The mass of Jupiter, the largest of the planets, is less than a thousandth of the Sun's mass. The other planets are negligibly small by comparison. Yet tidal action depends not just on the attracting mass, but on the drop in the gravitational potential over the diameter of the attracted body. The latter appears in the formula by its square and the diameter of the Sun is 864,000 miles, which enables planets, after all, to raise appreciable tides in the Sun, even in the case of so small a body as Mercury.

Magnetic Effects

The effect of planetary attraction—and this need not be gravitational only—on the outer corona is direct, as the planet is actually immersed in it.

If gravitation intervened alone the action of Jupiter on our weather should be about 7½ times as strong as that of Venus, but the reverse is true and Venus appears to be a more potent factor. Even more surprisingly, Mercury, whose mass is barely about $\frac{1}{15}$ that of Venus, would seem to affect the mean monthly temperatures more than any other planet. This is most probably due to magnetic forces.

Venus and Mercury have this in common that they circle the Sun inside the Earth's orbit, so that they periodically pass between us and the Sun. Fig. 3 shows an observational drawing of Venus. A planetary configuration of this kind is known as inferior conjunction.

Dr. Houtgast, of the Sonnerborgh Observatory, Utrecht, has investigated the meteorological records of 44 inferior conjunctions of Venus and found a marked decrease at such times in the amount of corpuscular radiations reaching the Earth from the Sun. This can be accounted for by the screening effect of the magnetic field of Venus, if the latter is about five times as strong as that of the Earth.

These results agree with those obtained by the American meteorologist C. A. Mills, who has found among others that with Venus on the same side of the Sun as the Earth " unseasonable warmth " occurred with a frequency 8 per cent above " normal expec-

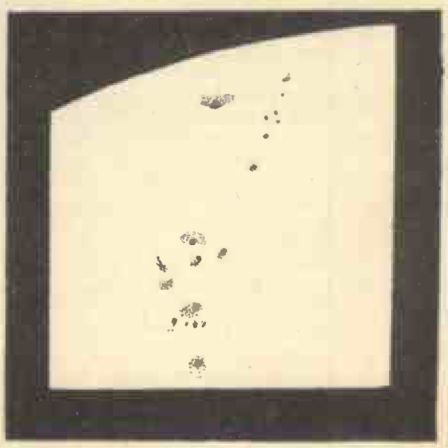


Fig. 2.—A group of large sunspots, 1956.

tancy " and with Venus on the other side " the occurrence of warm periods was 20 per cent below normal."

Mercury may be an even more powerful magnet. Not only does the position of Mercury in relation to the Sun and the Earth appear to be noticeably reflected in the terrestrial meteorological records; but even the varying distance of Mercury from the Sun can be traced in them, the influence decreasing as Mercury moves away from the Sun.

These investigations are still *sub judice*. They are very difficult, as planetary configurations are many and varied and the effects are generally small and not easy to disentangle, but when long series of observations are considered there is a significant excess over chance fluctuations, which is attributable to planetary action.

Effect of the Moon

Closer at hand the Moon, too, has some effect on the weather. It is reported that Lunik III has registered no detectable magnetic field in the vicinity of the Moon. This is very odd, for there exists a well-established magnetic variation coincident with the lunar month and the Moon has a powerful effect on the ionized layers of the stratosphere and on the cosmic rays at lower levels, which would be very difficult to account for in the absence of lunar magnetism.

According to Sydney Chapman, at Huancayo, Peru, the total tidal variation of the Appleton (F) ionized layer " amounts to some 60 km. (say, 35 miles) in height and 20 per cent in electron density." The amplitude of this tide depends on magnetic latitude, being largest on the magnetic equator. Martyn in Australia has found that the tidal oscillation of the Kennelly–Heaviside (E) layer was opposite in sign to that observed in England by Appleton and Weeks, which again indicates a magnetic origin.

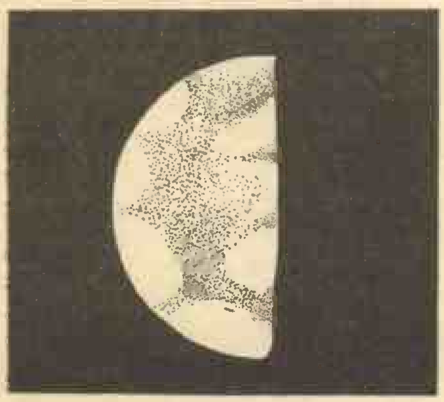


Fig. 3.—An observational drawing of Venus.

The intensity of cosmic radiation shows a marked fall at lunar high tide. This, too, is of some meteorological importance, as cosmic rays ionize the air and thus provide condensation nuclei for atmospheric water vapour. Reference to the influence of the stratospheric conditions on the troposphere, which is the proper seat of weather, has already been made.

The tide produced in the atmosphere of the Earth by lunar gravitational attraction is insignificant and in terms of barometric pressure at Greenwich barely reaches 1/100 mm. of mercury. It has been elicited with difficulty by prolonged series of observations. Thus such correlations between the phases of the Moon and meteorological data as have been discovered cannot arise from the gravitational tide and are clearly related to the stratospheric effects.

The correlations between lunar phases and weather are mainly twofold; they involve rainfall and temperature.

Earth's Rainfall and the Moon

The possible relationship between rainfall and the phase of the Moon has been investigated all over the world. In Britain no clear connection between the two has been discovered, but in some countries, notably in Spain and France, there was a slight increase in rainfall when the Moon was close to the point of its nearest approach to the Earth (perigee) and within two or three days after the new Moon. L. N. Carapiperis has found that in Greece thunderstorms increased in frequency with the Moon's approach to the perigee during the years 1901-40. This would corroborate the Spanish rainfall data.

In 1952 the Hungarian Meteorological Institute published a paper on the apparent influence of the Moon on the formation of Mediterranean cyclones during the periods 1931-34 and 1946-50. The dates of formation of these cyclones were shown to cluster about those of the full and new Moon respectively. The advance of Icelandic cyclones and Azores anticyclones towards the Bay of Biscay was found to show a similar preference within a margin of about 2½ days either way. (See Fig. 4.)

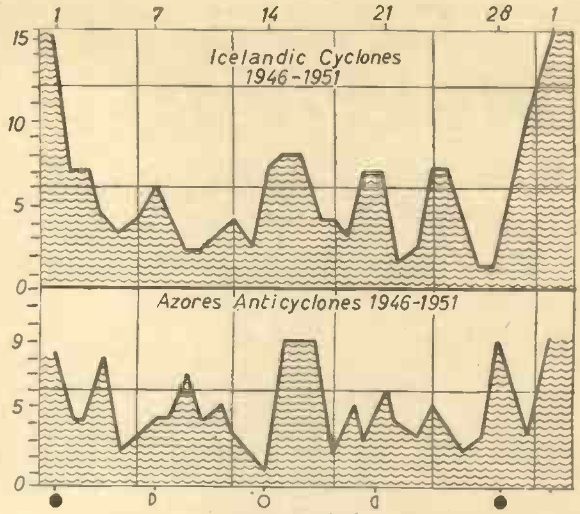


Fig. 4.—A graph of Icelandic cyclones and Azores anticyclones.

It is fair to add that these tendencies are comparatively weak and, whilst probably real, cannot be regarded as fully established. The main difficulty is that statistical investigations require an immense number of observations before incidental factors can be eliminated with certainty.

Earth's Temperature and the Moon

This difficulty did not arise in the investigation of minimum night temperatures by Herbert Henstock in North Wales, where effects were stronger and clearly marked.

When the monthly temperature curves for the years 1947, 1948 and 1949 were examined there appeared a regular drop in the minimum night temperature close to the full-Moon date in *every* single lunation. These results were confirmed in 1950 and 1951.

Spurred on by this discovery, Henstock extended his researches to 13 meteorological stations scattered all over the world, from Canada to Australia. The drop in the minimum night temperature at or about full Moon was present in every case and sometimes amounted to as much as 40 deg. F. It was more marked in winter than in summer and was generally the greater the wider the annual range of temperature variation, but not otherwise related either to latitude or altitude above sea-level.

Thus there can be no doubt that the Moon's phase has a tangible effect on the minimum night temperature, and, since clear nights are usually colder than cloudy ones, it seems that the ancient belief that clouds disperse at full Moon has some basis in fact. If so, however, then the Moon may be expected to affect rainfall as well.

This is not the end of our cosmic dependence.

Effect of Meteoric Dust

Now and again the Earth encounters in its path clouds of meteoric dust, and Dr. E. G. Bowen, of Australia, noticed that such encounters were followed within about a month by a world-wide increase in rainfall. The presence of fine dust in the air is important, as it provides nuclei round which the vapour can condense into drops. Smog is formed by a similar process. Dr. Bowen's ideas have been largely confirmed in recent years and he claims that a shower of meteoric dust may cause a rise of as much as 20 per cent above the global rainfall average.

These findings have further implications. It is generally agreed that the prerequisite of an ice age is increased precipitation. Cold by itself would not produce glaciers thousands of feet thick and it was shown by Sir W. Simpson that a decrease in the value of the solar constant would not initiate an ice age, but an increase might, by intensifying evaporation and, consequently, precipitation.

Now, the Sun with its array of planets pursues an orbit round the centre of the Galaxy. The Galaxy contains a number of dark nebulae, which are in essence extensive clouds of meteoric dust. Thus if the Solar System ran into a dark nebula this could easily cause ice ages on such planets as the Earth and Venus, as well as other disturbances.

As mentioned at the beginning of this article, ice ages tend to recur at intervals of about 250 million years, which corresponds very closely to the period of galactic revolution of the Sun. The dark nebulae participate in the rotation of the Galaxy, but the orbit of the Sun may be eccentric—its precise shape is not known—and certain levels in the Galaxy abound in nebular matter. The region of Orion, through which the Solar System passed about 8 million years ago, is rich in nebulae. The passage must have taken some time. And the dates fit.

The preceding geological period was the time of intense earth movements, which saw the upheaval of all our great mountain ranges. It was followed—the usual geological sequence—by the Pleistocene Ice Age, which is not over yet and may recur in full severity. There have been interglacial periods warmer and longer than the present historic spell of barely 10,000 years.

So we had better keep our fingers crossed. There is terror as well as promise in the skies.

PUZZLE CORNER

Stumped?

WHEN the ninth man of a cricket eleven goes in to bat, how many wickets are there left to fall?

Answer

Three. The eighth man's, the ninth's and the tenth's.

Building the 'Luton Minor'

Part 12 is the Concluding Article in This Series

Flying and Operation

IF the aircraft flies in a pronounced nose down—or tail down attitude—requiring firm pressure on the controls to maintain level flight, land immediately and adjust as follows:

Nose down. Check the centre of gravity location. If within limits, remove the tailplane and fit new front spar brackets to lower the leading edge of the tailplane by up to $\frac{1}{8}$in. If the C.G. position is found to be too far forward, adjust the seat position and/or fit ballast to the stern post. (Fig. 84, last month's issue.) Expert advice should be sought before adding any ballast.

Nose up. Check the centre of gravity location. If within limits, remove the tailplane and fit new front spar brackets to raise the leading edge by up to $\frac{5}{16}$in. Do not lower the rear brackets—these must remain the same. If the C.G. position is found to be too far aft, adjust the seat position and/or remove ballast (if fitted).

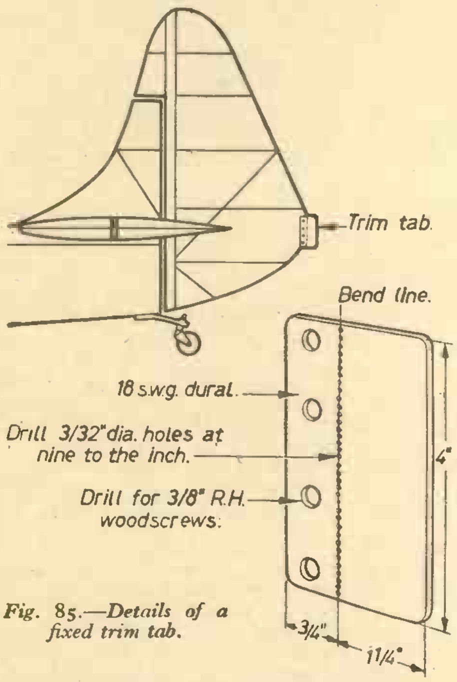


Fig. 85.—Details of a fixed trim tab.

If the aircraft persists in tending to turn one way or the other, check first that the rudder bar is in the neutral position when the rudder is neutral—if one rudder cable is longer than the other then the effect of centralising the rudder bar will be the unintentional application of rudder.

If this is not the cause, the rudder must be induced to "fly" to one side, and this is achieved by screwing a small aluminium trim-tab to the rudder trailing edge. If the aircraft turns to port, fit the tab to the port side of the rudder; for a starboard correction, fit it to the starboard side. The tab and its fixing are detailed in Fig. 85. One of two trial flights may be necessary to determine the correct amount of bend required on the tab to maintain straight flight with the feet off the rudder bar.

Should the aircraft fly one wing low, check that the incidence of both wings is the same both at the root end and outboard of the lift struts. Adjust, if necessary, to the limits on the rigging diagram. If this fails to reveal the cause of the trouble, examine the positions of the ailerons in the free position (hands off) in level flight relative to the control column. If the aileron flies high on the low wing (aileron trailing edge above the wing trailing edge), adjust the rigging of the control cables to lower it, remembering the correct cable tension must be maintained and also that there must be no more than $\frac{3}{8}$in. droop on each aileron on the ground (Fig. 86).

Flight Characteristics

The Minor is extremely easy to fly and the stick forces are very light throughout the full range of normal manœuvres and airspeeds. Control at the stall is exceptionally good when the aircraft is correctly rigged and there is no tendency to spin. The aileron drag with this type of aircraft makes it possible to perform an incipient spin if the stick is held over at the stall. Recovery is immediate upon centralising the stick and lowering the nose.

There is no definite stall warning other than the general sloppiness of the controls as the speed lowers. The machine will settle in a nose-up attitude with the throttle closed and the stick held back.

The Minor sideslips very easily both to port and to starboard, although the slip to port is somewhat greater. Its extreme manœuvrability enables the owner-constructor to experience the true joys of flying.

The high rate of sink enables a very short landing run and it is normally advisable to approach with a small amount of power on. For a power-off approach, come in high as if to over-shoot and, once the threshold has been crossed, surplus height and speed may be quickly lost by a series of short sideslips to either side.

Complete information on flying is available in the Pilot's Notes for the Minor which cost 7s. 6d. per copy post free from Phoenix Aircraft Ltd.

Landing Grounds

Many constructors will wish to use fields other than licensed aerodromes for their flying. Assuming that the field is suitable and is smooth with good approaches and ample room, the only requirement is that the pilot shall have the permission of the landowner to use the field. Additionally, the pilot must ensure that his flying may not create a hazard or nuisance to nearby homesteads or populous areas. Never indulge in unnecessary low flying or stunting and the regulations state that, except for the purposes of landing and taking off, no aircraft may be operated below 500ft. over open country or below 1,500ft. near any town or populous area. This is as much for the safety of the pilot and the preservation of his aircraft as for the safety of the general public.

If use is to be made of private land as a landing site, it is sound practice, wherever possible, to advise the local police beforehand. They cannot stop you flying so long as you have the consent of the landowner, but by warning them of your intentions you can avoid the embarrassment of a full-scale turnout of the emergency services brought about by a member of the public who, upon seeing an aeroplane descending in a field, may assume the worst! Additionally, the police

Fig. 86.—Both of the ailerons must have the same amount of droop with the control column central.

are very co-operative and in many instances can prove of invaluable assistance in deterring the endeavours of " souvenir-hunters."

Never leave your aeroplane unattended in an open field without picketing it down and never leave an aeroplane in a field with cattle—the smell of dope acts as an aperitive to cows and many cases are on record where cows have actually eaten tail-units and ailerons.

Licensed Aerodromes

There are many private aerodromes dotted around the countryside and any flying club will provide information as to airfield locations. Most airfields are free to light, private aircraft, although some (municipal airports in particular) charge a nominal landing fee of between 2s. 6d. and 5s. The extortion of exorbitant sums of money from the pilots of ultra-light aircraft for landing fees is one of the few banes of ultra-light flying. If the amateur is asked for more than half-a-crown, then he should ask the landing fee for an Auster and tender one-third of that sum since his aircraft weighs less than one-third the weight of an Auster. Fortunately, aerodromes where such practices exist are very few and far between—and they have a reputation.

A large number of operational Royal Air Force airfields are also available to the amateur pilot by prior permission—normally only a telephone call beforehand is necessary to secure landing clearance.

Maintenance

The Minor requires very little maintenance and a weekly general check and lubrication of the moving parts of the controls are normally all that is required for the airframe. The engine oil should be changed every 25 hours by draining and cleaning the filter in petrol. Every 10 hours or so check the tappet settings with the data shown in the engine log-book and also check the propeller for security together with the engine mounting bolts.

If the engine begins to run roughly, to vibrate more than usual or to develop a sporadic " knock," the fault can almost always be traced to loose mounting bolts or a loose propeller.

Always keep your aeroplane clean. A well-groomed aeroplane is a handsome tribute to its constructor and, furthermore, by thorough and regular cleaning any minor damage or defect is much more likely to be detected.

Full details as to maintenance and periodic overhauls are contained in the Luton Minor Servicing Manual available from Phoenix Aircraft Ltd. at 7s. 6d. post free.

Never jeopardise the future prospects of the amateur flying movement by indulging in unimaginative or stupid flying and, when operating at a licensed aerodrome, observe meticulously the airfield discipline which applies to everybody in the common interests of safety.

Do not be tempted to take chances. If something " isn't quite right " do not trust to luck that it will " sort itself out." Such action could cost you your aeroplane—if not worse. If the weather looks doubtful it is better not to fly and fly another day than to risk your Minor. Listen to and consider advice given you by more experienced flyers.

The " Major "

For the amateur who wishes to construct a practical two-seat light aeroplane, the Luton Major is a thoroughly proven machine which features folding wings and full dual control in cabin comfort. Embodying many design features of the Minor, the Major is simple to construct and was originally designed to fulfil a stringent Air Ministry specification for a training aircraft.

Materials

Every part and all materials necessary for constructing the Minor are available from Phoenix Aircraft Ltd. The constructor must bear in mind, however, that should he decide to purchase his metal fittings ready made, his aeroplane will cost more than if he were to purchase the raw material and fabricate everything himself. In this manner, the Minor airframe may be built for between £150 and £175, depending on the wheels and instruments used and the finish desired.

For the convenience of constructors, materials have been grouped together into kits and the following are available:

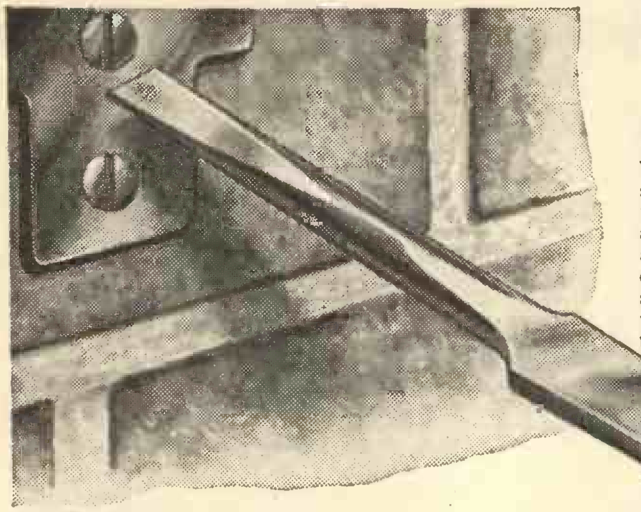
A pilot entering a Minor.

	£	s.	d.
Kit A Spruce for the tail assembly	7	10	0
Kit B Spruce for the two wings	19	0	0
Kit C Spruce for the fuselage ..	19	10	0
Kit D Complete kit of plywood	30	6	6
Kit E Complete kit of spruce (contents of Kits A, B & C)	45	0	0
Kit F Complete kit of nuts, bolts, A.G.S. parts and etc. ..	12	0	0
Kit G Complete kit of sheet metal	4	0	0
Kit H Complete kit of steel tubing *Available shortly.*			
Kit I Complete kit of fabric, etc.	15	15	0
Sundries			
Synthetic resin glue	3	0	0
Mainwheels (depending on type) Pair £10 to	£18	0	0
Phoenix tailwheel	1	17	6
Set of Phoenix undercarriage shock absorbers	2	0	0
Brass aircraft gimp pins ($\frac{3}{8}$in. & $\frac{1}{2}$in. × 20 s.w.g.) per lb. ..		10	6
10 cwt. extra flexible control cable per 150ft. coil	3	12	0
Streamlined steel tubing for lift struts	10	14	0
Lift strut adjustable end fittings (4 pairs)	3	0	0
Shoulder harness, nylon, quick release type	5	0	0
Instruments			
Airspeed indicator (calibrated in knots)	2	15	0
Airspeed indicator (calibrated in m.p.h.)	3	0	0
Altimeter (sensitive)	1	12	6
Oil Pressure gauge	2	0	0
Oil Temperature gauge ..	2	17	6
Tachometer	5	10	0
Phoenix Key Ignition Switch set	2	0	0

If at any time the amateur constructor should experience any difficulty in the construction or operation of his Minor, the designers will be pleased to advise.

This series of articles has been specially prepared for *Practical Mechanics* by A. W. J. G. Ord-Hume of Phoenix Aircraft.

A view of the completed Minor.



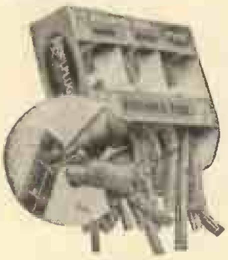
When you use a Screw use a Rawlplug too!

With Rawlplugs you get a stronghold for every size of screw in any masonry—brick, concrete, stone, slate, tile, etc., etc. It is so simple to drill the hole with the appropriate Rawltool or Metalide drill, insert the Rawlplug and drive home the screw, that you will soon become an enthusiastic Rawlplug user—and all your fixtures will be safe. You can start with the simple POPULAR OUTFIT which costs only 3s. 0d. and when you become proficient the larger outfits are available for your skill.

1/-

HANDY BOXES

Handy shilling boxes of Rawlplugs. Assorted sizes of Nos. 8, 10, 12 and 14 are packed for easy storage and selection.



50 RAWLPLUGS FOR 2/3

This divided window box holds 50 Rawlplugs assorted over Nos. 8, 10 and 12 gauges in three different lengths of each size. Incorporated in the lid of the box is a useful gauge to help you to select the right size screw for the Rawlplug.

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

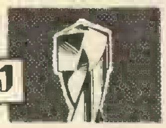
RAWLPLUG METALIDE for masonry drilling *the easy way*

REGISTERED TRADE MARK

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

No. 8 (3/16") Green Wallet	No. 10 (7/32") Blue Wallet	No. 12 (1/4") Brown Wallet	No. 14 (9/32") Grey Wallet
5/6	6/-	6/6	7/-

RAWLPLUG DURIUM Registered Trade Mark



FREE RE-SHARPENING

The most efficient, precision made, long lasting masonry drill is the Rawlplug DURIUM (with the free re-sharpening service). We strongly advise this drill for continuous drilling (such as industrial operation) 17 Sizes from No. 6 ($\frac{5}{32}$") to No. 30 (1") and a long series for drilling right through walls. Prices are from 9/6 each. For drilling glass use the special DURIUM GLASS DRILL. Made in nine sizes from $\frac{1}{8}$" to $\frac{1}{2}$" at 6/6 to 10/6 each. Free Re-sharpening Voucher with each drill.

1/- & 1/6

All Purpose Adhesive. Clear. Waterproof. Heat-proof. Insulating. Handy tube 1/-, Large tubes 1/6d. DUROFIX is undoubtedly the finest value for money today. It has such a wide range of applications from simple woodwork repairs to fine china, porcelain and glassware that no home should be without a tube. **Commercial tubes 5/-; ½-lb. tins 2/9; 1-lb. tins 10/6.**

1/-

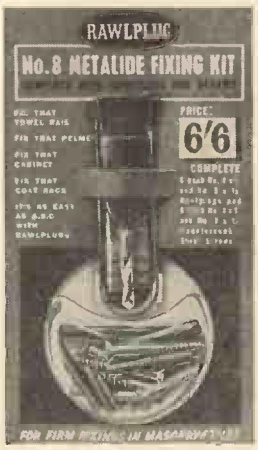
Real Wood in Putty Form. In dexterous fingers surprising things can be done with Rawlplug PLASTIC WOOD. Models can be made and coloured, intricate mouldings rebuilt, splits in wood made good and, what is more it will stick firmly to any non greasy surface—metal, glass, vulcanite, plastic, earthenware,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

1/-

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

10½D

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



METALIDE No. 8 FIXING KIT 6/6

Contents:—One No. 8 Metalide Masonry Drill, Six each No. 8 x ¾" and No. 8 x 1¼" Rawlplugs and six each No. 8 x 1" and No. 8 x 1½" countersunk steel screws. Full instructions for use are printed on the back of the card.

The Rawlplugs and Screws are housed in a transparent bubble which can be turned to release the contents as required from the reverse side. This kit will simplify all household fixing jobs. Ask to see one at your local dealer.

DUROFAST 1/9

Durofast is the new contact adhesive by Rawlplug. It has absolutely amazing strength yet is so flexible you can even fix rubber soles to shoes with it. Durofast is ideal for fixing laminated plastics to cabinet tops and can also be used for fixing metal to metal or glass to metal, rubber and felt to wood, etc.

RAWLPLUGS WALL PLUGS

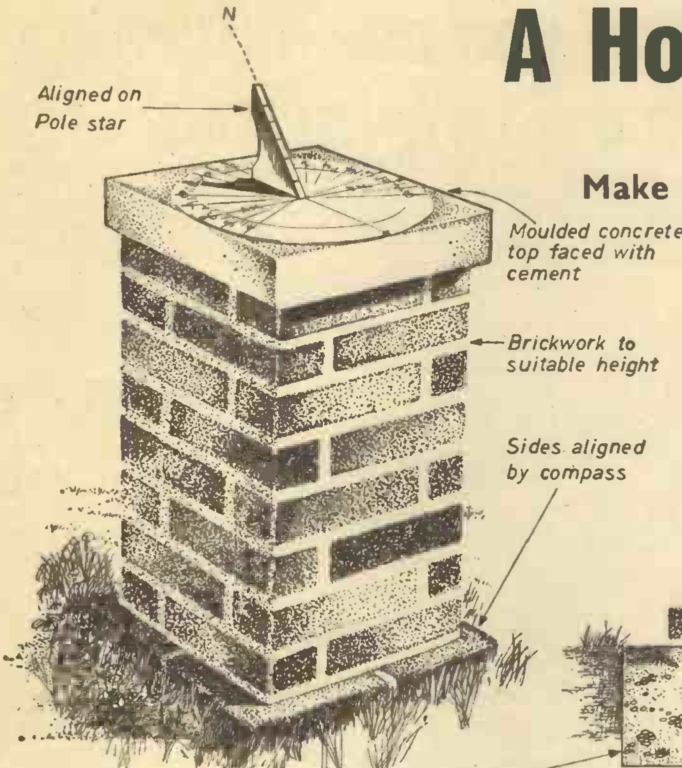
B658A

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

A Horizontal Sundial

Make this for your garden

By E. Rolfe Hunter



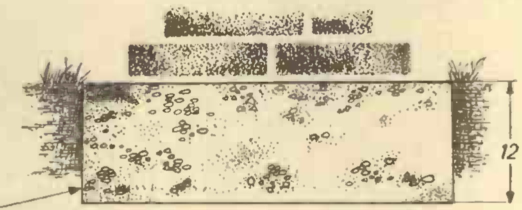


Fig. 1.—Details of the pedestal and concrete foundation.

SUNDIALS have in the past taken many forms, ranging from the huge stone structures of northern India and South America to the exquisitely made pocket-dials of the 18th century which are now collector's pieces. Basically, however, all sundials are the same; that is to say, all show projections on to a plane—the dial plate—of angles of 15 deg. or less subtended by the shadow casting edge of the gnomon or pointer.

Here the construction of the more usual "pedestal" type is described. (See Fig. 1.) Soft engraving brass is used for both the gnomon and the dial plate, the latter in its final shape being a disc cut from a sheet of $\frac{1}{8}$in. material 12½in. square, whilst the gnomon is formed from a suitably sized portion ¼in. thick. The dial plate should not be shaped until after the hour-lines and the other "furniture" have been engraved, in order to leave sufficient room for the preliminary drawing.

The Gnomon

This is shown in Fig. 3. It is drilled with three $\frac{1}{8}$in. holes in the base, through which countersunk bolts secure it to the dial plate in an exactly vertical position. The angle formed at the base of the gnomon must be made exactly equal to the geographical latitude of the sundial site, and the perpendicular side is cut and shaped with a file to the conventional curve. In the drawings given, the latitude used is 50 deg.

The Dial Plate

This is drilled as shown in Fig. 2 to admit the bolts which secure the gnomon, the lines shown in the drawing being first added. Having done this and marked the 6 o'clock and double noon lines, the hour lines can be either geometrically constructed or calculated according to the formula: Tan Shadow Angle = Sin Latitude × Tan Hour Angle, the hour angles being 15 deg, 30 deg., 45 deg., 60 deg., 75 deg., 90 deg., etc., up to 120 deg. For the benefit of readers unfamiliar with the use of trigonometrical tables, the required angles for latitudes between 50 and 60 deg. are given in Table 1. These shadow angles are measured from the noon lines. The preliminary drawing should be done in pencil, or better still, with Talbot Blue layout ink, before incising the essential ones with a tool such as a broken hacksaw blade or other steel pointed instrument. The circles which enclose the hour lines can be cut with the aid of an engineer's scriber. Fig. 4 shows the method used for subdividing the hours into quarters. Five-minute intervals may be marked by further sub-division in a way that will be apparent from the sketch.

The finished dial shown in Fig. 5 should have engraved on it the number of minutes—in this case 7 minutes—difference between "local apparent" (sundial) time and the "apparent time" at Greenwich. This difference depends upon the longitude of the sundial, and is in the proportion of four minutes for every degree of longitude between it and the Greenwich meridian. This difference is *added* to the sundial time if the sundial is *west*; and *subtracted* if it is *east* of Greenwich. Thus a sundial in a position 1 deg. 40 minutes east would be 6⅔ minutes ahead of Greenwich time and therefore that amount would have to be deducted from the time shown to give the "apparent" time at Greenwich. Similarly, if G.M.T. is

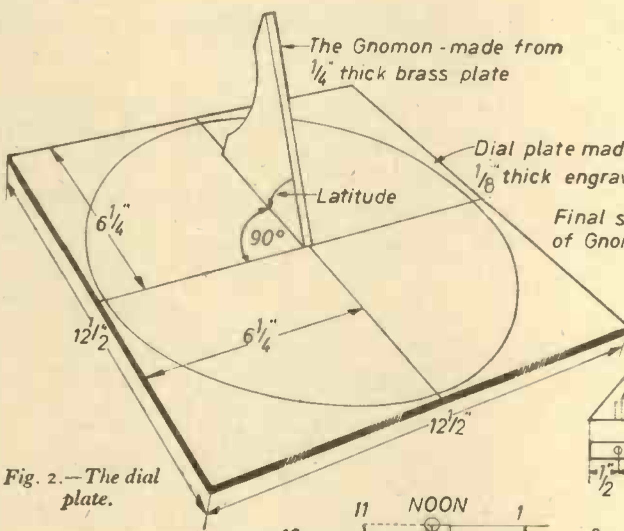
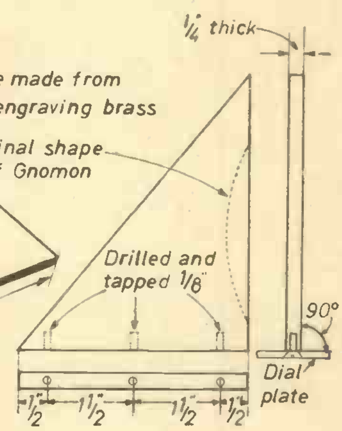


Fig. 2.—The dial plate.

Fig. 3.—The gnomon.



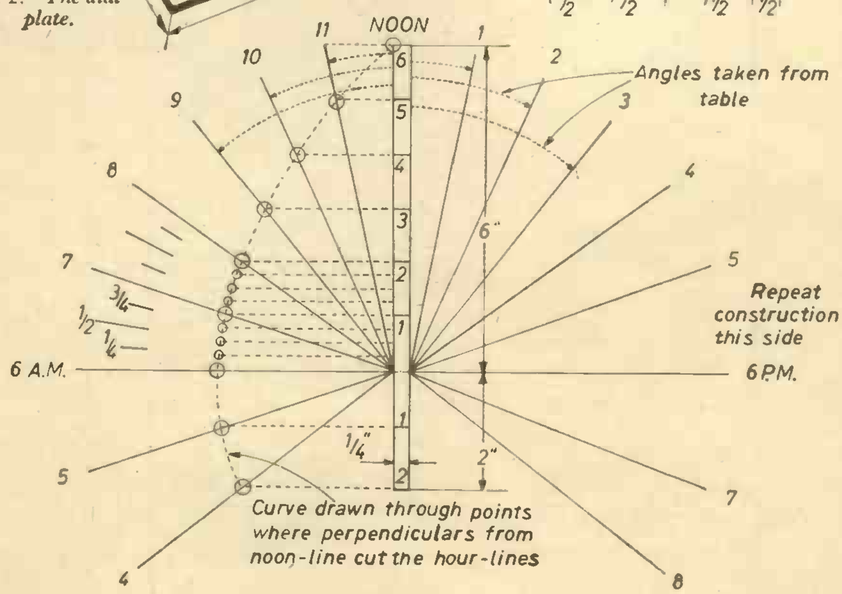


Fig. 4.—The method used for sub-dividing the hours into quarters, etc.

Sundial Times:		A.M. 11	10	9	8	7	6	5	4	P.M. 1	2	3	4	5	6	7	8
Latitude North.	50°	12°	24°	38°	54°	70°	90°	110°	126°	12°	24°	38°	54°	70°	90°	110°	126°
	51°	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
	52°	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
	53°	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
	54°	12°	25°	39°	55°	71°	90°	109°	125°	12°	25°	39°	55°	71°	90°	109°	125°
	55°	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
	56°	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
	57°	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
	58°	13°	26°	40°	56°	72°	90°	108°	124°	13°	26°	40°	56°	72°	90°	108°	124°
	59°	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
	60°	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,

The figures given ignore fractions of a degree, but are sufficiently accurate for practical purposes.

Table 1.—Shadow angles, measured right or left from the noon lines.

required, a further correction must be made. This correction is called the "equation of time" and can be obtained from a Nautical Almanac in your local library. The equation of time varies from day to day throughout the year and is often, in the case of well-made sundials, included on or near the dial plate in a tabulated form.

The Sundial Pedestal

A sketch of a brick pedestal built by the writer is shown in Fig. 1. The sides of the structure were aligned approximately North and South with the aid of an ordinary compass, the finished sundial was then placed on top and aligned so that the Pole star could be sighted exactly along the sloping edge of the gnomon on a night when the stars were particularly bright in a cloudless sky. The plate was then marked for position and later permanently screwed down to Rawlplugged holes in the top of the pedestal.

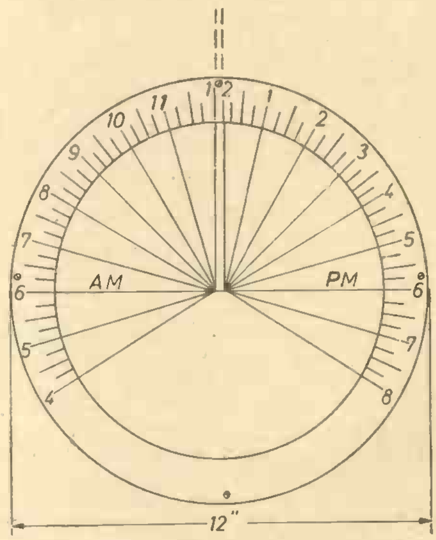


Fig. 5.—The completed sundial. The words "Add 7 min. for apparent time at Greenwich" should be engraved on the dial.

New Pipeline

A 24in. pipeline carrying crude oil from the port of Rotterdam in the Netherlands over a total distance of some 185 miles to refineries at Gelsenkirchen, Godorf and Wesseling in Western Germany, initially at a rate of 8½ million tons a year, came into operation in late June. This pipeline, which cost over £10 million to build, is the first international crude oil pipeline in Western Europe. With the installation of more pumping stations, its capacity may eventually be increased to 20 million tons a year.

The Medway Bridge

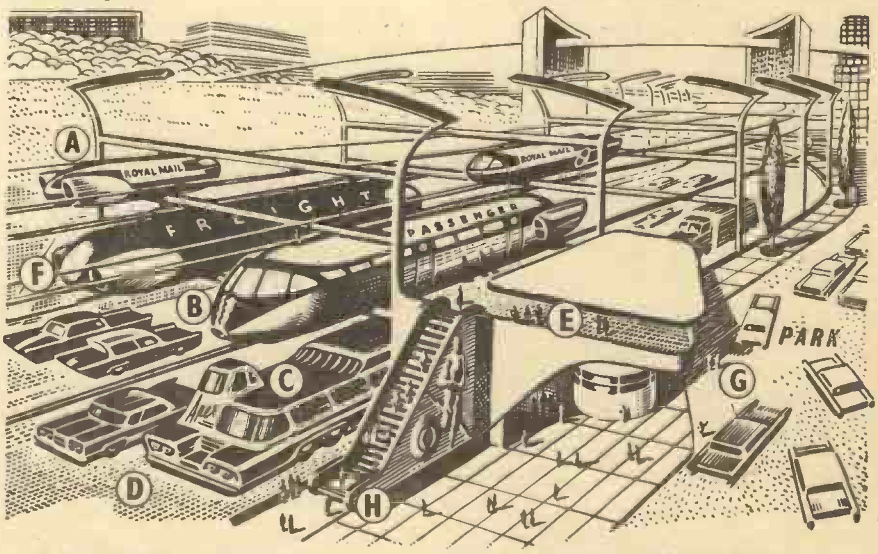
WORK is to start shortly on a concrete bridge with the largest pre-stressed clear span in the world. It will carry the Medway Towns Motor Road over the River Medway. Built to a design accepted by the Royal Fine Art Commission, the bridge will be of light and graceful appearance. Construction will take about two and a half years. Work on the Motorway itself, which will take less time to complete, will begin later. The bridge, with its approach viaducts and their abutments, will be nearly two-thirds of a mile long, with a central span of 500ft. The span will be 100ft. above the water. Two additional river spans—one on each side of the centre span—give the bridge itself a total length of 1,125ft. The western approach viaduct will have 11 spans and the eastern viaduct seven, making 21 spans in all. In addition to the Motorway's two carriageways, the bridge will also carry separate cycle tracks and footways.

New Life for Polluted Waters

IN Sweden polluted lakes are causing considerable concern to the public health authorities. Fish and plant life which once thrived in the lakes is gradually dying out due to sewage systems emptying into them. In an attempt to cleanse the lakes, the authorities called in experts who experimented with compressed air in a lake called Långsjbro. With the aid of Atlas Copco, international compressed air engineers, after a short trial period, surprisingly good results were obtained. Compressed air was introduced into the lake water through a perforated plastic hose, which was laid at full length on the lake bottom from a rowing boat. A small air compressor consuming 8-10 h.p. supplied the air. After less than three weeks the dissolved oxygen content of the water had risen to 57 per cent. and new plant life was beginning to establish itself. While emphasising that the case for compressed air should not be over-estimated, it was stated that this method is most useful in solving acute problems of pollution, especially if it precedes the construction of an efficient purification plant.

Elevated Railways for Britain?

PLANS are being made for an elevated railway for Britain on the monorail principle. This could be the answer to the country's passenger and light freight transport problem. In construction this system could be built over any and all existing conventional railway systems or main roads, and where the system supersedes the railway space beneath the monorail is left for conversion to high-speed roadways. At the major national termini themselves railway sidings and shunting yards could be cleared to provide extremely large car-parking centres. In mid-air 15 to 20ft. above ground level the running rail is designed to be supported on the lower member of rectangular steel and concrete reinforced frames which are placed at right angles to the direction of travel, the guide rail is suspended from the top cross members.



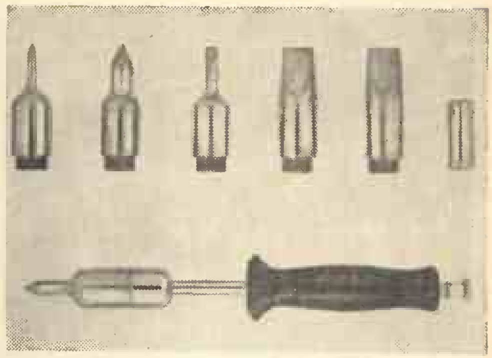
A *Royal Mail, monorail continuous loops—225 m.p.h.* B *Passenger, continuous loops—200-225 m.p.h.* C *Road transport, converted existing rail system to all towns—60-70 m.p.h.* D *Road, old lines converted to road transport using existing platforms "C."* E *Passengers' platforms, entry to passenger monorail by escalator.* F *Freight—five tons and luggage, controlled weight (otherwise road use)—70-100 m.p.h.* G *Car parks, all freight yards and sidings—2,000/7,000 cars per station.* H *Escalators to passenger platforms.*

TRADE NOTES

A Review of New Tools, Equipment, Etc.

NEW CARTRIDGE HEATED SOLDERING IRON

JENOLITE Ltd. (Engineering Supplies Division) are now marketing a soldering iron called the Quik-Shot. Unlike other soldering irons, the Quik-Shot does not require electricity, flame, blowtorch or external heat of any kind. The heat is provided by the patented cartridge which has been developed as a result of advanced chemical research. It contains 10,000 calories of heat energy supplied by a thermic mixture sealed in a steel shell. In cases of emergency, where electricity is not available, the Quik-Shot is indispensable. It has a detachable tip construction which permits the use of five interchangeable tip sizes. The retail price is £7 10s. A box of 12 tips costs £2 8s. The manufacturers are Jenolite Ltd., 13-17 Rathbone Street, London, W.1.



The Jenolite Quik-Shot cartridge heated soldering iron and five interchangeable tips.

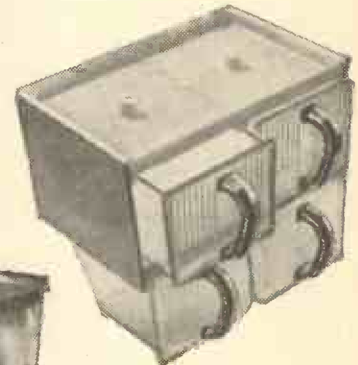
DRAPER'S TOOL BOX

THE handy steel tool box shown is now being distributed by B. Draper & Son Ltd., of Kingston Hall Road, Kingston-on-Thames, Surrey. The box measures 14in. by 8in. and is divided into two compartments. It has well-positioned handles and is finished in blue. Costing 19s. 3d., the tool box is obtainable from most tool shops. It is called the BDS No. 140 tool box.

The Draper BDS No. 140 steel tool box.

SPACE-SAVER DRAWERS

PLYSU HOUSEWARES Ltd., of Woburn Sands, Bletchley, Bucks, have on the market the Supermaid space-saver drawers, as shown in the photographs. Supplied complete with screws for fixing under shelves, they are made in transparent plastic with white handles. The retail price is 9s. 6d. for the small four-drawer unit, 17s. 11d. for the large three-drawer version and 14s. 11d. for a two-drawer model, not shown.



Two versions of "Supermaid" space-saver drawers.

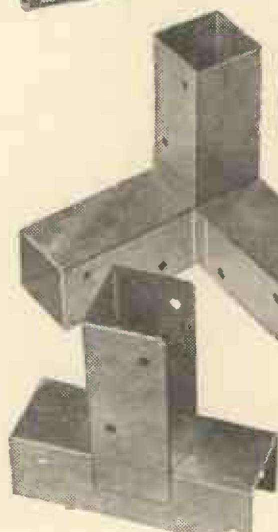
GIBJOINTS

THE most difficult and lengthy task in any timber-framed structure is the cutting and making of the joints. Gibjoints Ltd. have just placed on the market a "ready-made joint." Known as Gibjoints, these are precision-made metal units of 20 gauge sheet steel, welded for strength and hot dipped galvanised for life-long freedom from rust. Sets of Gibjoints for building work-benches, lean-to's, sheds and garages are available, including special nuts and bolts. Prices range from £3 10s. 6d. to £8 15s. They can also be bought individually in two, three and four-way joints. Readers requiring further details and price list should write for a free brochure direct to Gibjoints Ltd., 44 High Street, Harrow-on-the-Hill, Middx.

BRIDGES STRIPPADISC AND THE SANDSCREEN

S. N. BRIDGES & Co. Ltd., makers of the Neonic drill, have produced a remarkably efficient new accessory for paint-stripping, shaping, de-rusting and sanding. It is called the Strippadisc and is a 6in. paper-backed disc which gives an exceptionally fast cutting action which will not clog. This hard-wearing new accessory costs 9½d. and is available in coarse and medium grades.

Also new from Bridges is the Sandscreen, an open-texture sheet which gives a perfect finish on any surface with the Bridges Nu-sander attachment. Sandscreen cannot clog on paint or plaster and removes surface rust quickly. It is perfect for sanding wood. More versatile than the ordinary sanding sheets, Sandscreen lasts much longer and can be washed to clean the mesh. The Sandscreen comes in three grades, the fine and medium cost 2s. 3d. per sheet and the coarse costs 2s. 6d. per sheet. The address of the manufacturers is York Road, Battersea, London, S.W.11.



(Right) The Bridges "Strippadisc" fitted to a Bridges drill.

(Left) Two examples of Gibjoints.

TWIST DRILL SHARPENER

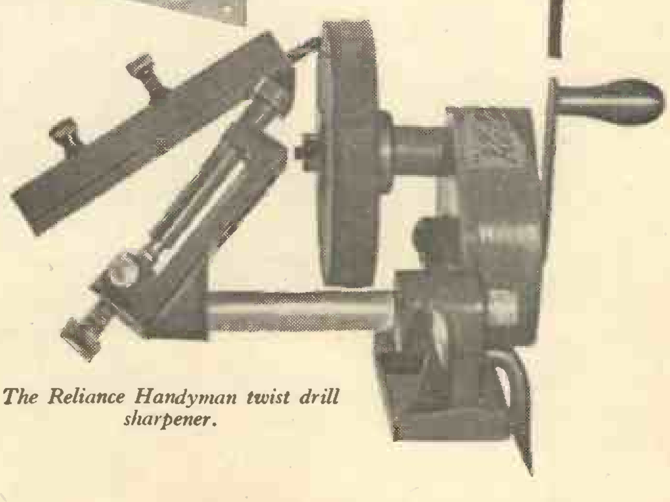
THE Reliance Handyman twist drill sharpener can be screwed to bench or door post with ordinary wood screws or clamped to a table with G-clamp provided. It has a maximum capacity of $\frac{7}{16}$in. dia. and costs £2 5s. The manufacturers are H. D. Murray Ltd., 21 Queensway, Ponders End, Middx.

DAFILE COPING SAW BLADES

DAFILES Ltd., of 37 Sheen Road, Richmond, Surrey, manufacturers of tension files and allied tools, announce a further addition to their range of industrial and retail products. Their new product has been designed to fit the normal coping saw frame, which with its characteristic deep bow and light weight is an ideal profiling medium. The blades, known as Dafile Coping Saw blades, are circular section with teeth all round. They cut all materials in common use, including steel, brass, copper, plastics, hardboard, plywood, etc. A pack of two costs 1s. 9d.

TUNGSTEN CARBIDE DISCS

A PERMANENT, non-wearing sanding disc of tungsten carbide is now available for use with the Stanley "Swirlaway." "Swirlaway" is the recently introduced flexible ball-joint sanding attachment which works with the whole disc flat to the surface and which fits all makes of electric drills. They are available in three grades, the coarse costs 8s., the medium 7s. and the fine 6s. The manufacturers are Stanley Works (G.B.) Ltd., Rutland Road, Sheffield, 3.



The Reliance Handyman twist drill sharpener.

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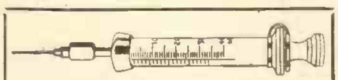

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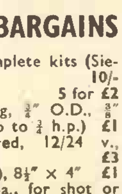

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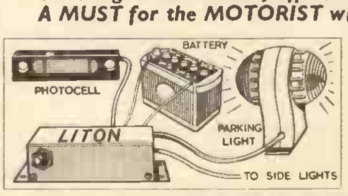

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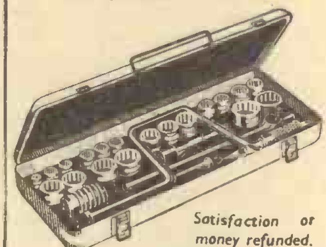

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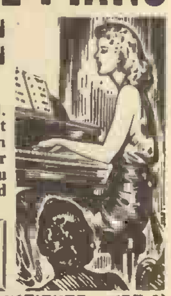

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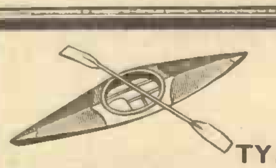

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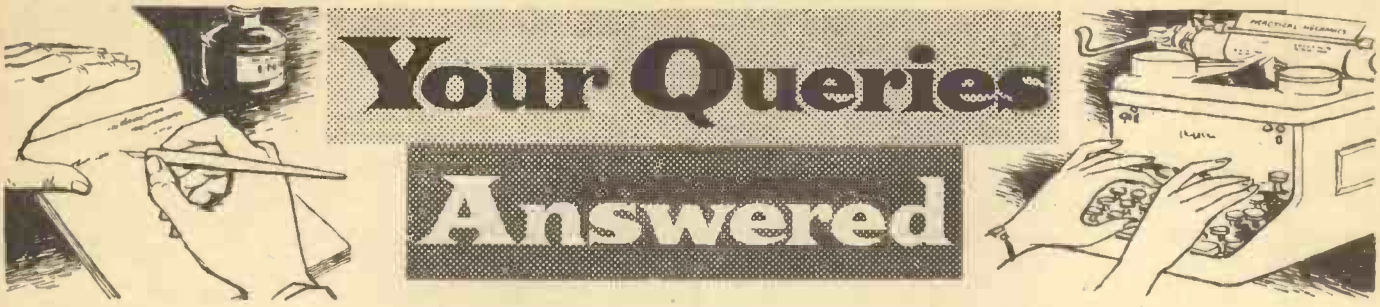

Copying Small Items

I HAVE a number of small items in silver and china, jugs, etc., which I want to copy in wood. To save measuring with gauges, etc., I want to make metal templates. Can you suggest a method whereby I could trace the silhouettes from a screen or glass plate?—W. J. Osborne (Stratford-on-Avon).

SHARP silhouettes may be obtained by having a point source of light as far as possible away, and placing the subject very near white paper. Photographic paper, subsequently developed and fixed, would provide a silhouette without hand tracing. Etched outlines on the metal plates can be made by heating these over gas, and rubbing with beeswax. Then trace the outline with a steel stylus or very hard pointed pencil. With a glass dropper place an etching solution (such as three parts nitric acid to one part muriatic acid) along the outline, washing off after a few minutes, or when the etching is deep enough.

Soapless Shampoo

I SHOULD be obliged if you could supply me with a formula for making a soapless shampoo.—L. A. Horsley (Liverpool).

WE do not recommend any shampoo mixture that contains a detergent; we therefore give you the following:

Whites of two eggs;
Water, 5oz. (fluid);
Ammonia water, 3oz.
Cologne water, ½oz.
Industrial alcohol, 4oz.

By ammonia water is meant a dilute solution of ammonia in water, i.e. water rendered alkaline with a few drops of 0·880 ammonia.

Beat the egg white thoroughly into the water and add the ammonia water, agitate thoroughly with a stirring rod. Do the same successively with the other ingredients, mixing well after the addition of each.

Small Castings

I AM thinking of trying to make some small castings from softer metals such as brass, aluminium, etc., but I do not know how this can be done with regard to a container and mould. Also would the ordinary gas supply give sufficient heat? Could you also supply the addresses of two or three small firms who carry out turning and casting for model making?—Allan Jones (Sunderland).

YOU will not be able to melt either brass or aluminium satisfactorily with a normal unpressurised town gas supply. With a powerful brazing lamp burning paraffin you should get better results. Build up a dozen or so fire-bricks into a hollow box, leaving a hole for the brazing lamp nozzle. Stand a half-brick in the middle of the space thus formed to support a small crucible. Scrap metal must be sawn or broken very small, or it is difficult to start it melting. Recommending individual firms is hardly possible without knowing exactly what class of work is involved, and we are inclined to think that you would do well to join one of the model-making societies. Not only would you have opportunities to exchange experience and acquire knowledge, but most such societies include amateur machinists and foundrymen of high proficiency. They are usually willing to help fellow-enthusiasts not equipped to cast or machine model parts.

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

Silvering a Light Bulb

I WISH to silver a small area of a 150W. light bulb to reflect the light in one direction. Would you please give full details of the method and chemical used?—J. S. Hubert (Sussex).

THE following method must be performed with care:

1. The surface of the light bulb which is not to receive a deposit of silver must be masked with Amber Amorphous Wax, supplied by Claude Campbell, 4 Lloyd's Avenue, London, E.C.4. Warm this wax over a low flame until it becomes fluid and paint with a brush dipped in the molten wax that portion of the bulb that is not to be silvered.

   Before doing this, however, the whole glass surface must be degreased with trichlorethylene or carbon disulphide. Attach some form of handle to the bulb so as not to contaminate the surface after this previous operation has been carried out.
2. (*a*) Let the bulb, after treatment with wax, stand in a solution of potassium dichromate and strong sulphuric acid. Avoid contact with metal clip of bulb.

   (*b*) Rinse thoroughly in clean water under running tap.

   (*c*) Immerse bulb in a solution of stannous chloride for a minute and then wash off with distilled water. This solution is made by adding:
   Stannous chloride, 10gm./litre.
   Concentrated hydrochloric acid, 40ml./litre.

   (*d*) Immediately after this last process proceed to the actual silvering of the unwaxed surface by immersing the bulb in the following solution:
   (1) *Silver solution*
   Silver nitrate, 100gm./litre.
   Potass. hydroxide, 50gm./litre
   (2) *Reducing solution*
   Silver nitrate, 2gm./litre
   Rochelle salt, 1·7gm./litre.

N.B.—Equal parts of (1) and (2) are poured into an appropriate vessel and it is to this solution that the bulb is finally immersed until a coating of a silver mirror appears.

Absolute cleanliness of surface is essential for success, hence the preliminary processes described under sections 1 to 2 (*c*).

Repairing a Mercury Barometer

WE have a mercury barometer which has been in the sea and sea water has leaked into the tube. Will you please tell me how I might remove the water from the tube and replace the mercury? Also how we might ensure that there is sufficient mercury in the instrument to bring it to the correct pressure?—E. G. Rae (Shetland).

THE mercury and sea water will, of course, separate themselves. The mercury should be washed in plenty of distilled water and dried in an oven (the fumes are very poisonous, so do not let it boil). The tube should be filled with distilled water many times and finally filled with methylated spirit, or better still, clear alcohol. This will dry out much more quickly than the water.

The tube may be warmed in an oven to quicken the process, sometimes it is possible to insert a small-bore tube, such as cycle valve rubber, and to connect to a clean (oil-less) air line such as those used in garages. Which-ever process is used it is most important that the tube and mercury are absolutely dry before re-use.

The tube is filled absolutely full of mercury, inverted, with the finger or other stopper holding the mercury in, and then placed in the mercury chamber. This latter process may have to be slightly adapted according to the instrument being serviced.

When filled, tilt the tube sideways and the "vacuum" gap at the top should completely disappear as the vertical height becomes something like 29in. at sea level. If the "vacuum" gap is still present the tube has been incorrectly filled and air is present.

Calibration may be done against a standard barometer situated near you. Probably there is an airport nearby or perhaps a Technical Institute. If you wish to calibrate on your own you must measure exactly the distance from the top of the mercury meniscus under the vacuum to the top of the mercury meniscus in the reservoir (this is often difficult). If this is done at room temperature and the scale set accordingly the error will not be great.

The mercury may be collected in a painted tray, but tin plate, etc., is not suitable. A drawn-out thistle funnel is useful for pouring the mercury in the barometer tube. Really dirty mercury may be cleaned with nitric acid, but the action is vigorous and the fumes dangerous. Compensation against expansion of glass and mercury is quite complicated and details are found in any advanced physics text-book.

Stencil Materials

I WISH to make a suitable stencil for producing various forms of lettering. I should be glad if you could advise on a suitable material which would not fracture on cutting in any direction, maintain its shape and not adhere to the surface of paper. I do not wish to purchase plastic or similar material that will deteriorate. Could you please suggest thickness and type of cutting instrument?—A. J. Palmer (Essex).

THERE are various materials from which stencils can be cut, depending upon the use, rough or otherwise, to which they will be subjected. Thin Perspex is one useful material; but if somewhat intricate lettering has to be cut out we would suggest stiff brown paper that has been treated with size on both sides. Zinc is another material which is used under certain conditions as a stencil matrix.

Proportional Dividers

I SHOULD be obliged if you could tell me how to use proportional dividers, also the meaning of the graduations stamped on them.—J. W. Spencer (Bacup).

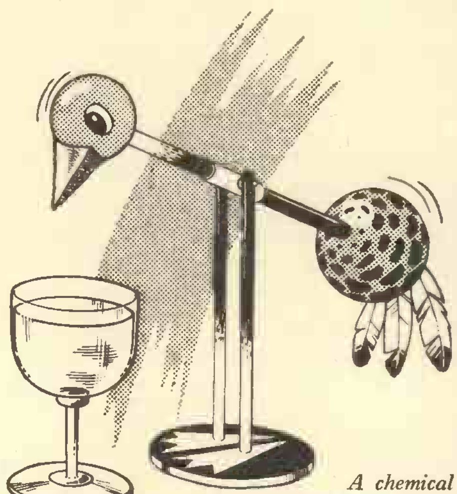
PROPORTIONAL dividers are used for enlarging or reducing a drawing and they may be used for dividing straight lines or circles in equal parts. For this purpose, points of division are marked on the instrument in order to secure the required subdivisions readily. The dividers may also be used for securing special ratios such as $1 : \sqrt{2}$, the diameter of a circle to the side of a square, or feet to metres, etc.

Without actually examining the dividers in question we cannot of course give reliable information on the markings, but we imagine the above reply will assist you in determining the actual relationship.

The Drinking Duck

SEVERAL years ago there appeared on the market a novelty in the shape of a duck that made a continual drinking movement. Could you please explain the principles of this novelty to me?—E. Allen (London, S.W.17).

THE bodies of the "drinking ducks" to which you refer were in thin glass and consisted of a tube about ¼in. dia., with a large bulb at one end and a small bulb at the



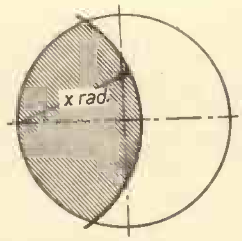
A chemical causes the duck to "drink."

other. The smaller bulb was given a "beak" covered with felt (see sketch). The nodding or drinking action was produced because the birds contained a low-boiling-point liquid such as Freon. This evaporated from the lower bulb and condensed in the head, due to the slight fall in temperature caused by the evaporation of water from the head. The liquid which collected in the head would eventually evaporate and the bird would then move back to its original position and after an interval the process was repeated. Freon is the liquid used in most small domestic refrigerators and the trick depends on the use of this or some other fluid which boils at about ordinary atmospheric temperatures.

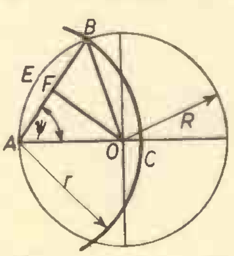
Halving the Area of a Circle Problem

COULD you give the answer to a problem which has baffled me? Find the formula to find the radius of the arc, that when centred on the circumference of a circle will mark off half its area.

Mr. Senior's problem.



The diagram shows circle with half its area inscribed by the arc of radius *x*. D. Senior (Mexborough).



Method of working out the solution.

Area of sector ABC $= \frac{1}{2} r^2 \psi$

Angle AOB $= \pi - 2\psi$

Area of AEB $= \frac{1}{2} R^2 (A\hat{O}B - \sin A\hat{O}B)$
$= \frac{1}{2} R^2 (\pi - 2\psi - \sin 2\psi)$

To fulfil the conditions of the problem,

Area ABC + Area AEB $= (\pi R^2)/4$

Also $r = AB = 2\,AF = 2\,AO \cos\psi = 2R\cos\psi$

So $\frac{1}{2}(2R\cos\psi)^2\psi + \frac{1}{2}R^2(\pi - 2\psi - \sin 2\psi) = \pi R^2/4$

whence $4\psi\cos^2\psi + \pi - 2\psi - \sin 2\psi = \pi/2$

or $\sin 2\psi - 2\psi\cos 2\psi = \pi/2$

This must be solved by repeated trial.

It gives $\psi = 54$ deg. app.

Whence $r = 1{\cdot}18$ R.

Removing Plastic from Walls

OUR walls are covered with plastic (a hard type of plaster that can be patterned and then painted). Is there an easy way of removing this other than glasspapering and scraping?—F. H. Williams (Yorks).

THERE is a special stripper for this type of finish, the stripper being of the chemical type. It is known as Miracle Paint Remover, and the makers are Purval Products, 51 St. Andrews Dock Chambers, Hull. If you care to write to this firm they will supply full details, price, etc.

Invisible Ink

COULD you please give me the chemical formula for invisible ink?—V. G. Williams (Glam.).

A VERY effective invisible ink can be made by pouring starch into boiling water and using this as the invisible ink. To reveal the writing merely immerse the paper in a dilute solution of potassium iodide.

Any hygroscopic salt can be used for "ink" and developed by driving off the water by heat. But this disappears as it picks up moisture again.

Printing on Linen

I HAVE a small printer's press and I wish to print on linen. Is there a marking ink available that can be used on a printer's press, if so, please let me have the manufacturer's name. I might add that I have tried ordinary marking ink without success, as it will not cling to the lead type.—F. H. Williams (Bridlington).

YES, you can use a special marking ink for linen with a printer's press. Specify the purpose for which you desire the ink and write to: B. Winstone & Sons Ltd., 150 Clerkenwell Road, London, E.C.1.

Desensitising Chemicals

IS there some chemical or dye which renders a photographic film less sensitive to light when added to the developing solution, or used before the film is placed in the developer?—P. J. Slevin (N. Ireland).

ILFORD LTD., Ilford, Essex, and Johnsons of Hendon, Hendon, make densensitising chemicals. Follow the maker's directions. They should not be used with colour films, and some brands of black and white films, so make a preliminary test, or refer to the maker's advice.

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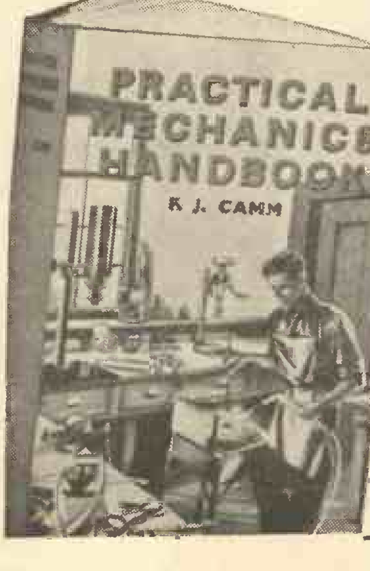

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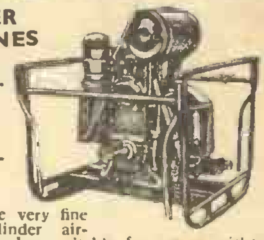

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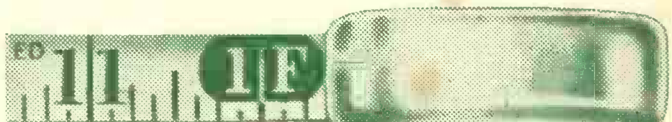

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