PRACTICAL MECHANICS

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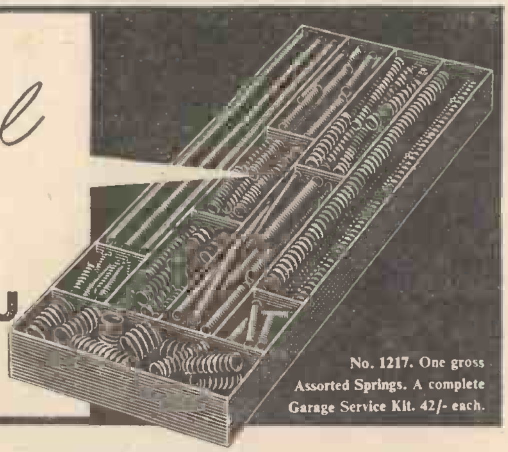

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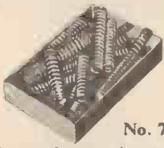

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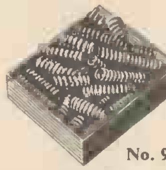

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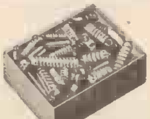

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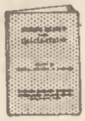

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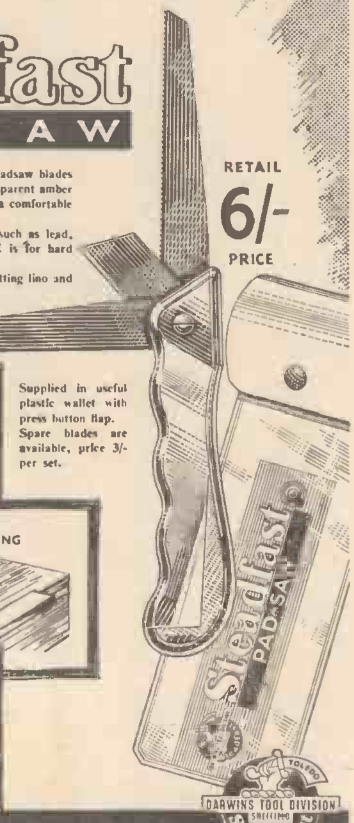

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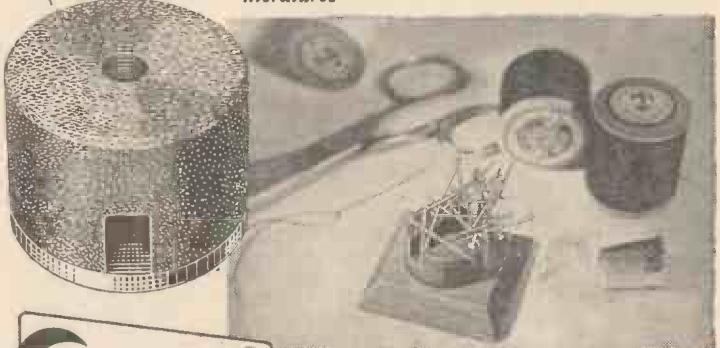

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Practical Mechanics

MAY, 1960

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CONTENTS:

CONTRIBUTIONS

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

FAIR COMMENT

THE AUTOMATION BOGEY

THE word " Automation " is a new one to most of us, or relatively new and from person to person interpretation of its meaning seems to vary a great deal. To the more optimistic it heralds a new age of economic prosperity, a higher standard of living, a shorter working week and more leisure. To others, particularly those who have already been affected by redundancy, it threatens unemployment with its attendant loss of living standard and privation. Few people apart from newspaper cartoonists visualise automation as an electronic robot, the gigantic steel figure with red flashing lights for eyes and a hollow booming voice, as dreamed up by the space fiction writers of a decade or two ago.

All these things are merely the possible effects of automation and there is no real reason why people should gloss over what it actually is by labelling it, " too technical." Complicated, many of its aspects certainly are, but, a lot of its more simple applications have been familiar to everyone for years. The thermostat is a simple form of automation—a type of automatic control; so is the valve in any of its forms, or the gyroscope. The automatic lift in your office building or the automatic safety device on your machine at work are both examples of automation and demonstrate the principle of automatic control, which it is visualised, may, some time in the distant future, result in the automatic factory.

This, however, is a long way off yet and the change over from manual to automatic control will, for a number of reasons, be necessarily a slow one. The worker's fear of becoming redundant overnight has no real justification. A certain amount of adjustment will be inevitable and the main trend will be towards higher skilled and better paid jobs. Arduous physical work has been eliminated in many spheres by the introduction of machines, for example, coal-cutting machines, mechanical grabs, fork lift trucks, snowploughs, and combine harvesters. Now automation will relieve man of some of the mental effort required in controlling this machinery. But just as machines cannot eliminate all physical work, neither is automation likely to replace completely man's intelligence.

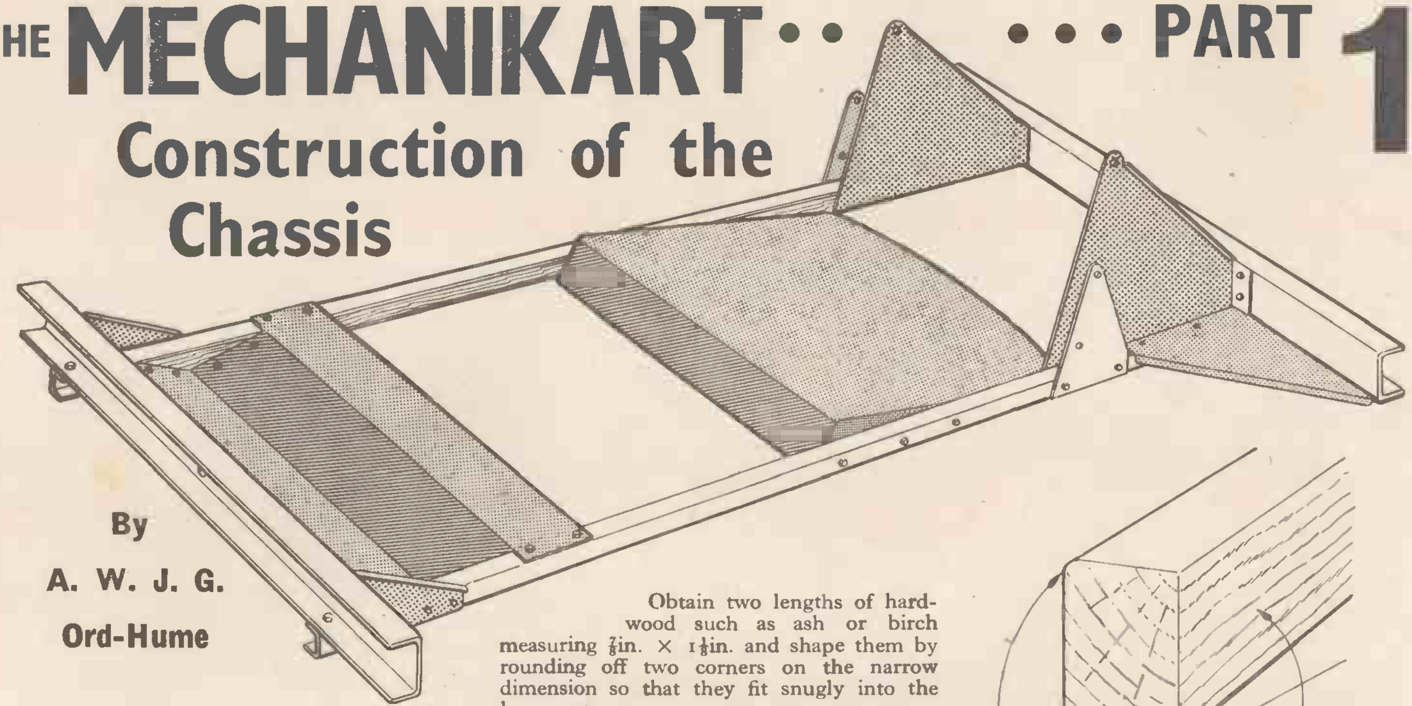
It is true that some of the modern computers can answer problems in a few seconds that would require weeks of calculation on the part of a mathematician but the basic elements of the problem and procedure that the computer is required to follow must be provided by the operator and thus man must always be one jump ahead of any computing machine.

Provided the potentialities of this new advance in science and technology are intelligently harnessed to the country's economy, the results can only be beneficial. However many computers there are controlling however many machines, men will be required to maintain them, design them and to some extent operate them. There is no need to regard the advent of automation as a revolution; it is merely another step forward in the process of civilisation. The first machines were regarded with great suspicion by our ancestors and attempts were made to smash them before they took away craftsmen's employment. Eventually it became obvious that the advent of machinery was not a threat but a boon resulting in increased production and in turn benefiting the worker. In actual fact it was a long time before conditions in the factory became satisfactory, although this was no fault of the machines. Today standards of education are higher and it is reasonable to hope, therefore that automation will come to stay without too much disruption of the relations between management and labour.

Incidentally, it is not only in the field of production that the results of automation are likely to be noticed. Eventually aircraft, ships and trains may be driverless, a great deal of harvesting may become automatic, whole cities may be automatically temperature controlled and certainly the automatic shop is not far off.

THE MECHANIKART ••• PART 1

Construction of the Chassis



By

A. W. J. G. Ord-Hume

Last month introductory details of the MechaniKart were given and now we can proceed with the actual construction. Commence with the chassis.

The front and rear channel steel cross members are formed from 10 gauge mild steel. The front one is 28¼in. in length and the rear one is 27in. long. Mark and drill the ⅜in. holes in the lower flange of each, 9⅝in. each side of the centre line in the front one and 7⅝in. each side from the centre of the rear. The true length of the side rails or longerons is 49¾in. These are made of 14 gauge mild steel and are 1¼in. broad × 1in. Lay them on their sides so that they face inwards (reference Fig. 1) and drill ⅜in. dia. through the uppermost flange only at each end for bolting to the forward and rear cross members. Make absolutely certain that these holes are the same distance apart, otherwise the chassis will be out of true.

Obtain two lengths of hardwood such as ash or birch measuring ⅞in. × 1⅛in. and shape them by rounding off two corners on the narrow dimension so that they fit snugly into the longerons.

Note that they are cut to stop just short of the four ⅜in. corner bolts. Scribe a centreline down the side of the longerons and mark off the positions of the holes as shown in Fig. 2. Transfer these locations from one longeron to the other so as to avoid discrepancies. Now drill straight through both steel and wood.

It is advisable to paint the longerons before inserting the wood filler as a protection against corrosion.

Loosely bolt the longerons to the rear cross member using ⅜in. bolts (plain shank of ¼in.), plain washers and aircraft-pattern stiff-nuts.

Do not use plain nuts or shakeproof washers and do not rely on peening over bolts. The vibration in service is such that these locking devices might come loose, whereas the stiff-nut can be tightened if necessary. This is one reason why rivets have not been used anywhere in the assembly of this kart.

The seat (Fig. 3) should next be made, using 18 gauge mild steel plate. The curved flange

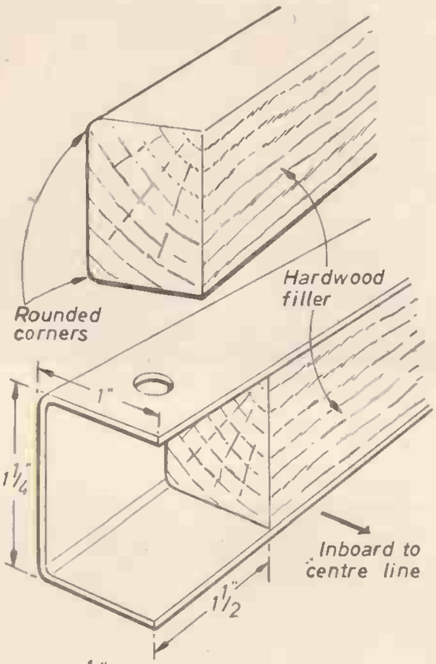


Fig. 1.—The side rails or longerons. The wood filler is held in place by the bolts which attach the various fittings through it.

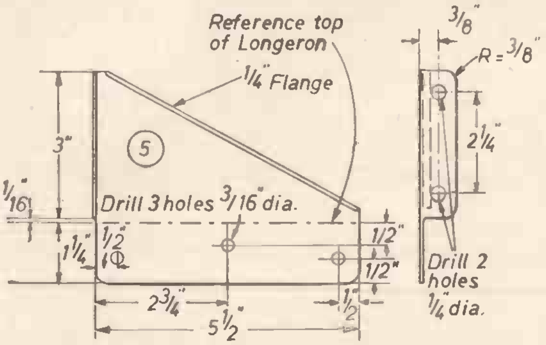


Fig. 5.—Gusset (2 off, handed, 16g. M.S.).

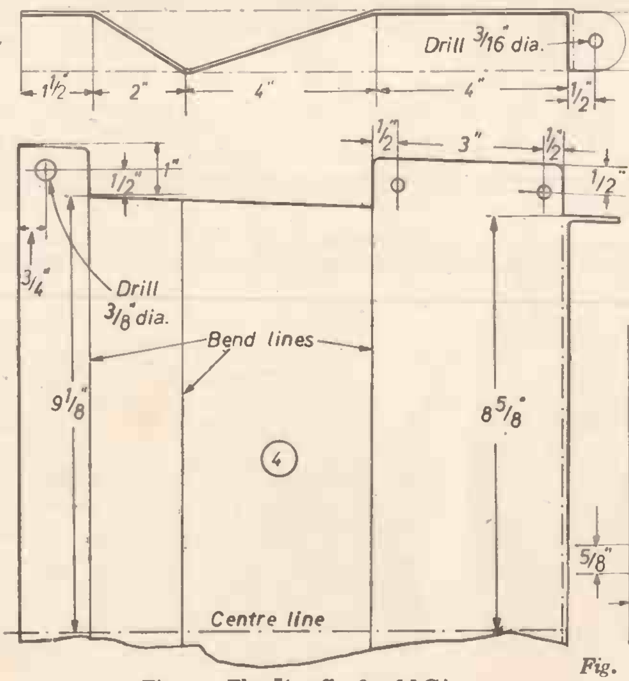


Fig. 4.—Floor (1 off, 18g. M.S.).

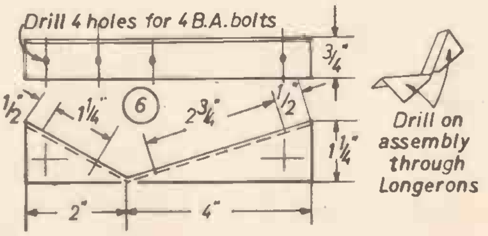


Fig. 6.—Floor support (2 off, handed, 18g. M.S.).

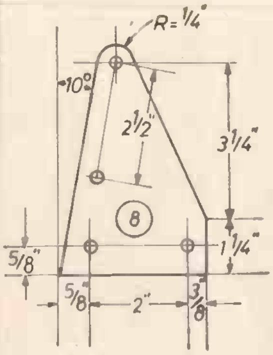


Fig. 8.—Gusset (2 off, 18g. M.S.).

at the rear should be formed last of all in order that the side flanges may help to stiffen the panel. Cut a piece of blockboard or hardwood with an 18in. radius on one side and use this to dress the flange over. If a mallet and block of wood are used, the flange should not distort. Do not drill any holes in the flange for the present.

It will be seen that there is only one hole shown drilled in the seat side. This is to avoid misalignment of holes due to faulty marking out. Bolt the seat into place between the longerons using the one hole provided.

Next make up the foot tray (Fig. 4), again from 18 gauge mild steel. The depression in this permits a comfortable heel location. Place the tray in position on top of the longerons, put the front cross member on top of it and bolt down through with the two ⅜in. corner bolts. Now mark with a pencil where the holes come on the wooden fillers at the lugs on the rear of the tray. Bend the tray up slightly and drill through $\frac{3}{16}$in. dia.

Bolt through these lugs. Note that all bolts have their heads either on the outside of the frame or on the top, nuts being inside or underneath. This improves the appearance and also reduces protrusions which might injure another driver in a collision.

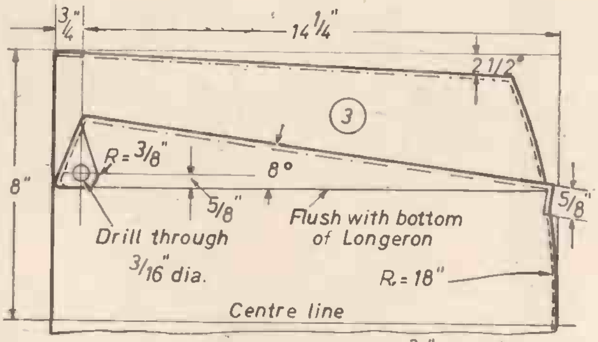
Make up the front gussets (Fig. 5) and the floor supports (Fig. 6). Clamp the floor supports in place underneath the floor whilst the bolt holes are drilled to match the holes in the longerons. Then bolt through the gusset, longeron and floor support. Again, do not tighten up any nuts for the moment. This is to permit any slight movement required to align the parts.

The rear gussets (Fig. 7) are made next, and, having removed the rear cross member bolts, they are sandwiched between the longerons and the rear cross member and bolted up. Mark the centres of the two $\frac{3}{16}$in. dia. holes in the gussets which pass down through the longerons, slip the gusset to one side and drill right through the longeron. Do not use the hole in the gusset to locate the drill as this will tend to elongate the gusset holes. The outboard ends of these gussets are located by the bolts which later secure the rear axles in place.

The next pieces to be made are the seat supports (Fig. 8) and the side gussets (Fig. 9). Offer the seat support into place and scribe through the holes in the flange at the rear for the bolt holes through the rear cross member. Remove the seat support and drill these holes in the rear cross member. Now assemble the seat supports and the side gussets.

Having made sure that the chassis is correctly assembled, tighten up the bolts and drill all the remaining bolt holes through the longerons.

Next month the fitting of the seat-back, engine mounting, stub axles, wheels and engine will be dealt with.



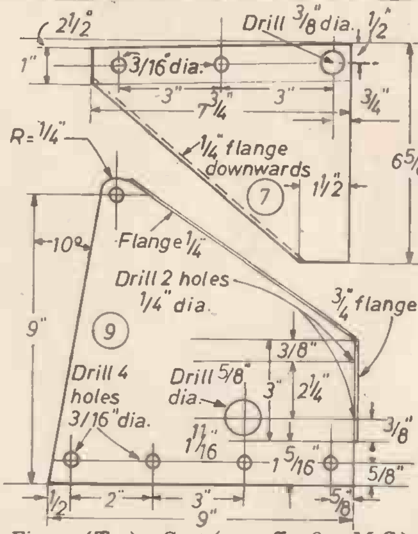
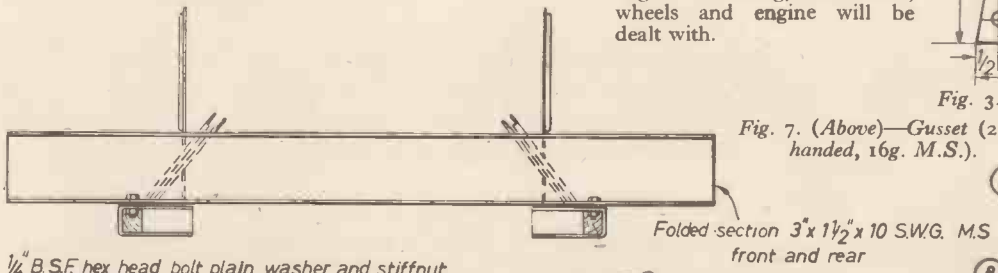


Fig. 3. (*Top*)—*Seat* (*one off*, 18g. *M.S.*).

Fig. 7. (*Above*)—*Gusset* (2 *off*, *handed*, 16g. *M.S.*).

Fig. 9.—*Seat support* (2 *off*, *handed*, 18g. *M.S.*).



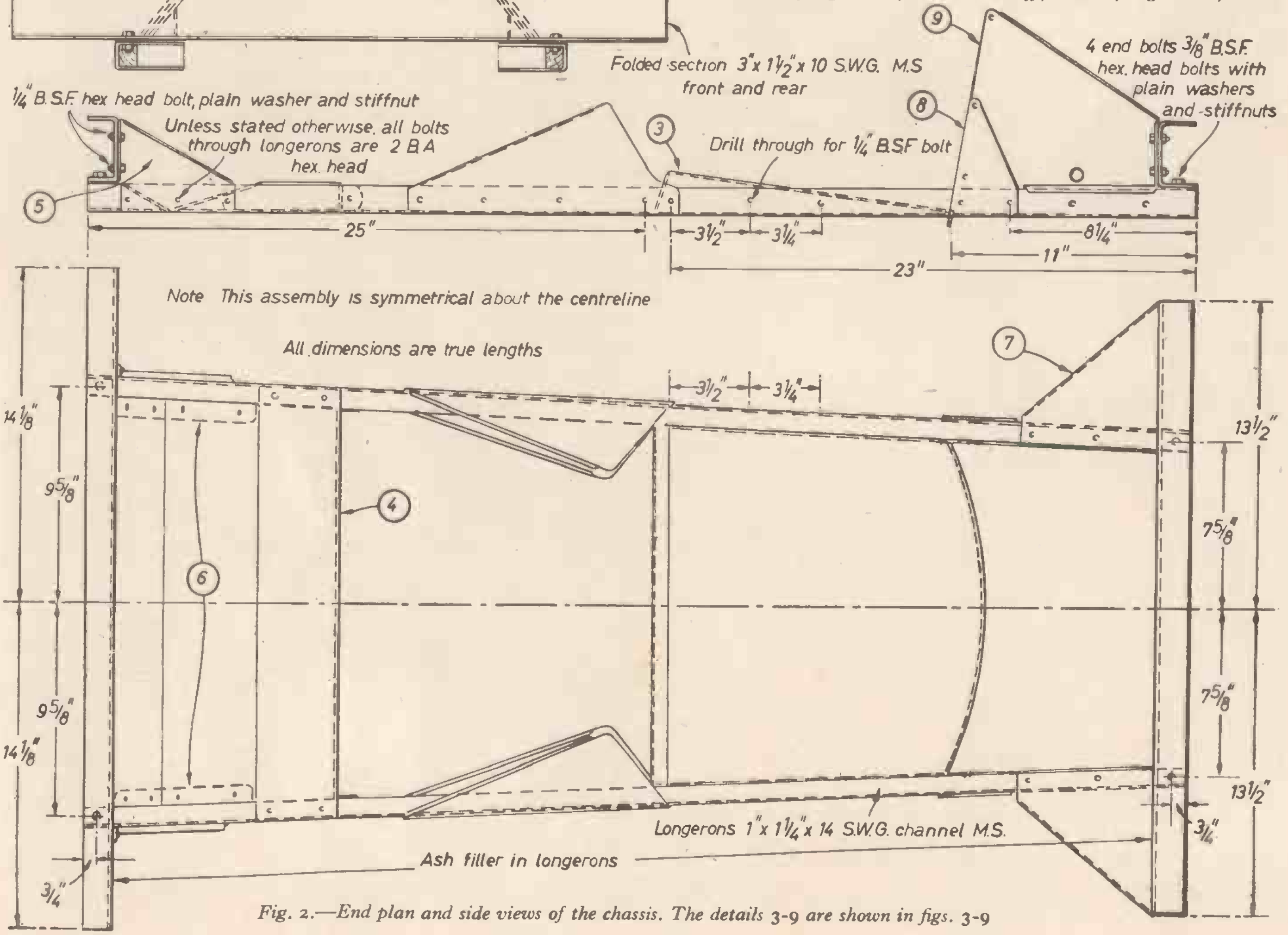


Fig. 2.—*End plan and side views of the chassis. The details* 3-9 *are shown in figs.* 3-9

DRY-MOUNTING

by A. E. Bensusan

This is a good way of mounting your photographic prints says our expert.

THE dry mounting of photo prints is clean, simple and efficient. The print is trimmed to size and a sheet of special dry-mounting tissue—a shellac-coated thin paper—is placed over the back so that it slightly overlaps the edges. If a sheet of sufficient size is not available, two or more sheets may be used, placed edge to edge. Now, an old spoon, fitted with an insulating handle, or a clean soldering iron is heated and plunged on to the centre of the tissue to make it adhere to the print (Fig. 1). This should be done in the centre only.

Next trim the tissue so that the edge is about $\frac{1}{32}$ in. inside that of the print, using a sharp knife or a razor blade and a metal straight edge (Fig. 2). Apply only the lightest pressure to avoid cutting the print. Place the print in its correct position on the mount, lift each corner in turn and tack the tissue down on to the mount with the heated spoon or soldering iron (Fig. 3).

The print and mount should now hold together in their correct relationship while a double sheet of ordinary tissue paper is placed on top and the print ironed down with a domestic electric iron or flat-iron (Fig. 4). Work from the centre to one end, lift the iron off and apply a book or other flat object under hand pressure for about a minute (Fig. 5). Then repeat the process for the other end of the print.

Special attention can next be given to any parts which have failed to stick down. Keep the iron moving all the time and do not apply too much pressure or you will mark the print. If the print sticks to the tissue but the latter does not stick to the mount, insufficient heat is being applied. Too much heat makes the tissue stick to the mount but not to the print.

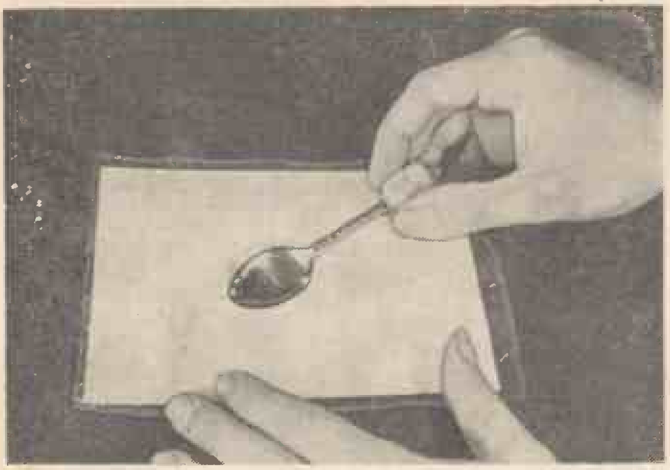


Fig. 1.—Tacking the tissue on to the print.

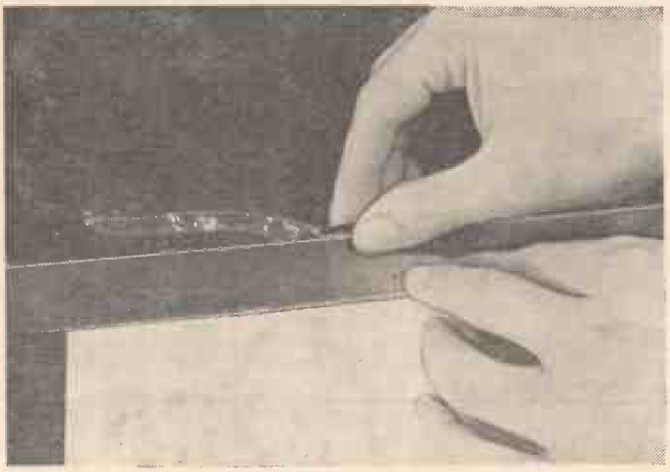


Fig. 2.—Trimming the tissue.

Fig. 3.—Tacking the tissue on to the mount.

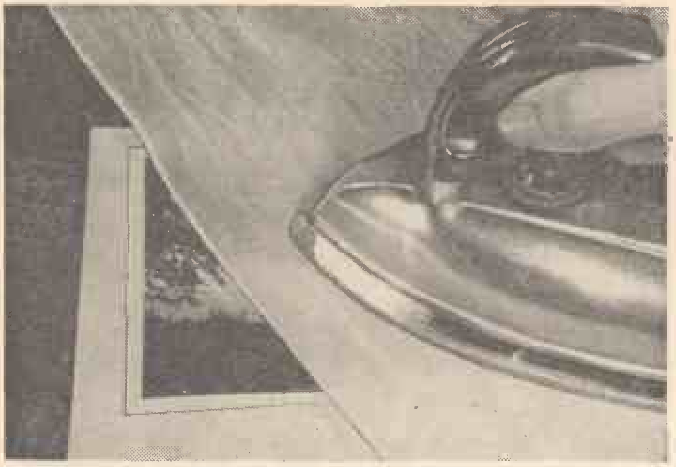


Fig. 4.—Ironing down the print.

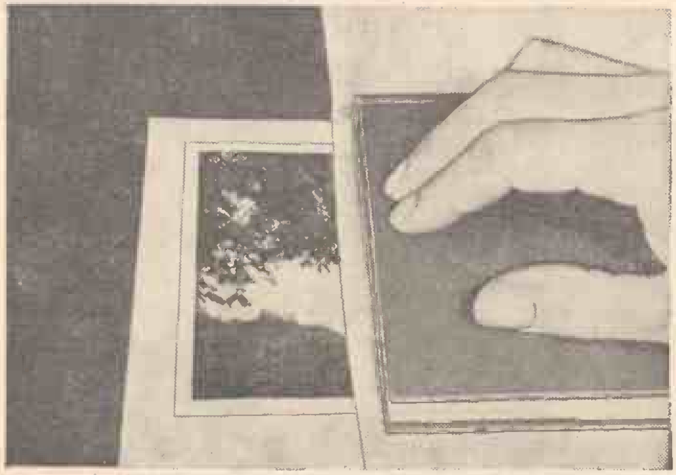


Fig. 5.—Pressing down the print with a book.

There's everything you need in this PICNIC CASE

It can be made for a few shillings

Fig. 1.—The picnic case folded for carrying.

THE smart picnic case, shown in Fig. 1, contains everything you need to ensure a successful picnic—excluding good weather! The contents can be seen in Fig. 2 and all these are readily obtainable from a very well-known nation-wide multi-branch chemists. If items other than those shown in the photograph are being used, the partitions must be rearranged to suit, but the general principles of construction will remain the same. The wood parts should preferably be assembled using all butt joints and a waterproof glue such as "Cascamite" or "Aerolite." The maker's instructions regarding mixing and application should be carefully followed.

Construction

First assemble the four pieces of $\frac{1}{4}$in. plywood to form the outer case, glueing the joints and driving in 1in. No. 16 panel pins on the skew or 1in. No. 4 countersunk wood screws in previously drilled holes. Then glue and pin in position the top and bottom sheets of $\frac{3}{16}$in. plywood, using $\frac{3}{4}$in. No. 20 panel pins or $\frac{3}{4}$in. No. 4 countersunk screws. See Fig. 5.

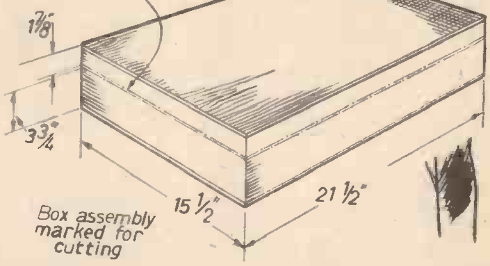
When the glue is fully set, mark off a line $3\frac{3}{4}$in. from one face round all sides of the box and another $1\frac{7}{8}$in. from the opposite face. This will leave a gap of $\frac{1}{8}$in. between the lines. Cut right round with a saw, keeping between the lines, and dress off both faces so that they come together squarely and closely all round. Then smoothly radius all edges and corners.

Clamp the two halves together with paper packing between them equal to four thicknesses of the leathercloth with which the outside is to be covered. Now mark off and locate the hinges, toggle fasteners and handle (Fig. 6). Drill through the rivet holes for securing them, inserting rivets in each hole as drilled to ensure register on assembly. Then remove fittings, rivets and clamps, and sand off any rough edges.

Fig. 2.—The case opened to show contents.

The Separator

Place the deeper half of the case open side up and temporarily fit the four lining strips of $\frac{1}{8}$in. plywood to the sides and ends (Fig. 3), putting paper equal to two thicknesses of leathercloth between the case sides and each strip. On the $15\frac{3}{4}$in. separator strip of $\frac{1}{4}$in. plywood mark the position of the other separator strips. Join together as shown in Fig. 4, dressing the ends as necessary to make the whole a push fit into the inside of the case. The whole should then be glued and pinned or screwed as was the outside of the case. The assembly may be put in the case to set and a thickness of paper should separate the interior from the case to prevent accidental glue adhesion. It is intended that the finished separator assembly should be removable for easy cleaning.



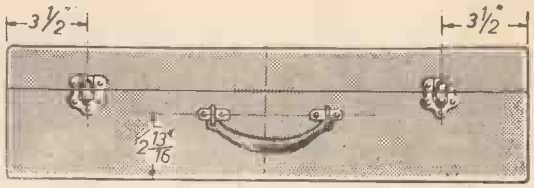


Fig. 5. (top)—Separating box and lid.

Fig. 6.—Positioning hinges, fasteners and handle.

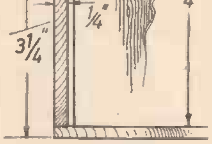


Fig. 3.—Fitting the lining strips.

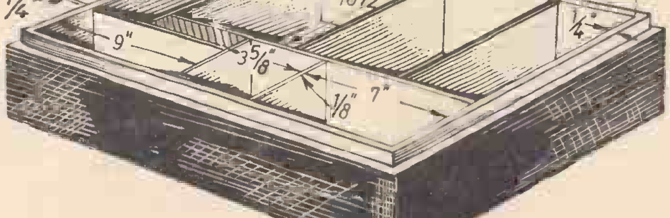


Fig. 4.—Layout of the separator strips.

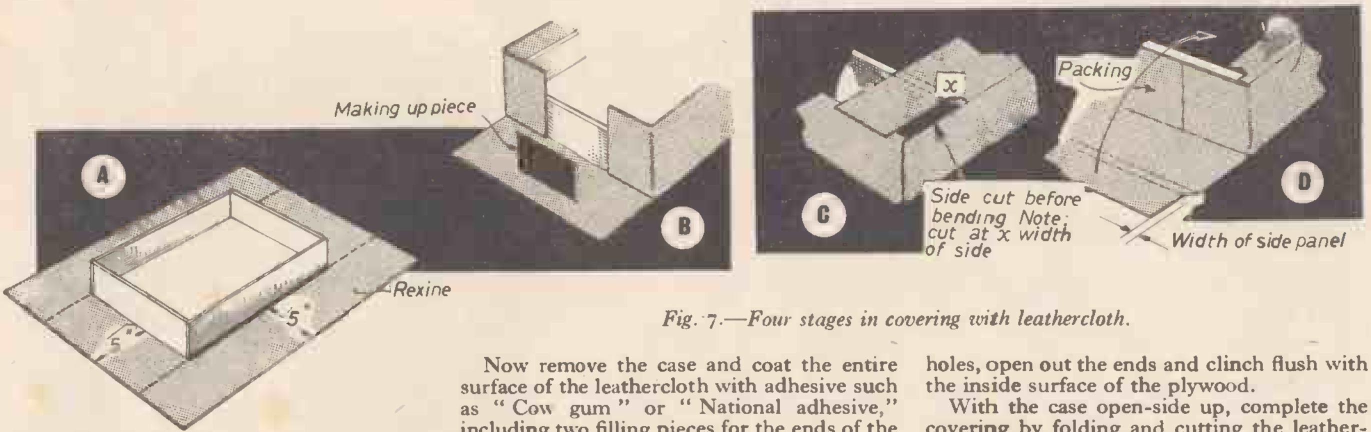


Fig. 7.—Four stages in covering with leathercloth.

Covering

Lay the leathercloth for the outer covering on a flat surface and locate the bottom of the case so that there is at least 5in. of leathercloth extending beyond the case on each side (A in Fig. 7). Mark round the case with pencil and with a straight edge extend the line of the long sides to the edge of the leathercloth. Cut the cloth along these lines from the corner of the case to the edge. Fold the cloth up the 21½in. sides of the case and turn the ends along the other sides of the case, then cut two pieces of leathercloth to fill the gap on the ends between pencil marks (B).

MATERIALS REQUIRED

¼in. plywood:	2 pieces 21in. × 5⅜in.
	2 pieces 15½in. × 5⅜in.
	1 piece 11½in. × 3⅝in.
	2 pieces 10½in. × 3⅝in.
	1 piece 15¾in. × 3⅝in.
	2 pieces 3½in. × 3⅝in.
3/16in. plywood:	2 pieces 21½in. × 15½in.
⅛in. plywood:	2 pieces 21in. × 3⅝in.
	2 pieces 15in. × 3⅝in.
	1 piece 9in. × 3⅝in.
	1 piece 12½in. × 3⅝in.

Miscellaneous: Leathercloth 54in. × 36in. (outside), 60in. × 36in. (inside), glue, adhesive, panel pins, screws, plastic strip, fasteners, hinges, toggle fasteners, carrying handle.

Now remove the case and coat the entire surface of the leathercloth with adhesive such as "Cow gum" or "National adhesive," including two filling pieces for the ends of the case. This can be spread evenly using a piece of plywood, card or a spatula.

Place the case in position on the leathercloth and press firmly together, then raise one side and smooth it on to the case and round the ends; repeat with the other side. Invert the case on a box or stool so that the leathercloth is clear and then with a cloth pad rub the leathercloth into close contact with the case, working from the centre to the edges to remove all air bubbles or excess of adhesive.

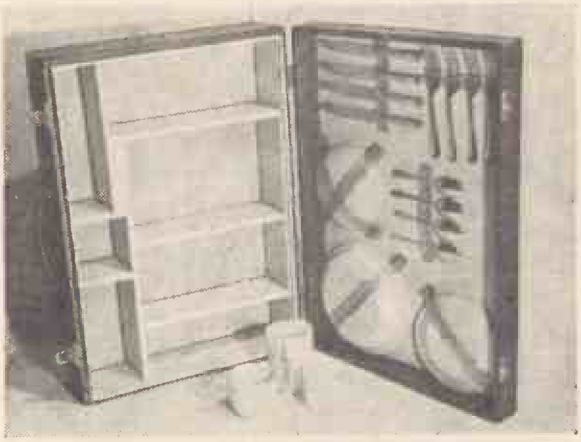


Fig. 8.—A further view of the completed case.

Now fit the handle, toggle fasteners, and hinges. Insert split rivets through pre-drilled holes, open out the ends and clinch flush with the inside surface of the plywood.

With the case open-side up, complete the covering by folding and cutting the leathercloth as shown in Fig. 7, C and D.

The Lid

Cover the lid in the same manner, not forgetting to fix to it hinges and catches, and clinch rivets before folding in side covering. The cloth should extend down inside the lid on to the flat and be trimmed evenly all round ¼in. from the frame. Cut two pieces of the material for the interior covering to fit accurately inside of lid and floor of the case and stick in place.

The four ⅛in. plywood lining strips should now be covered on the inside surface and at least half-way down the outside surface with leathercloth, coated with glue or adhesive on the area contacting the inside of the case and pressed firmly into position and left for the glue to set firmly.

The separator frame for the interior can now be covered with strips of leathercloth or enamelled and fitted in place when dry.

All that now remains to be done is to mark off the positions for the plastic strip and the press studs securing the free ends of those over the plates. Secure the strip with ½in. No. 4 screws and the fasteners in the same way. Take care not to drive the screws too far so that they come out on the outer surface of the case. Install all the contents and the case is complete.

PUZZLE CORNER

Giving a Hand, submitted by Jameson Erroll.

A CERTAIN number of men decide to make the Luton Minor Aircraft described in recent issues for the benefit of their flying club. Each gives the same amount of time and they work at uniform speed. When the job is completed they are so pleased with the result that they decide to shake hands with each other and invite the President, who was not one of them, to contribute 2s. 6d. per handshake to club funds. When approached, however, he does some mental arithmetic and insists on contributing exactly £9, no more, no less, and also insists that this sum must be represented in 2s. 6d. handshakes in which he will also participate. As a result, he shakes hands with a certain number of the men who did the job.

The problem is to discover how much longer the Aircraft would have taken to make if the men with whom the President shook hands had not assisted in the work.

Answer

"Twice as long" is the answer. The number of handshakes that can be exchanged between any number of people can easily be calculated. For example: Let A, B, C and D shake hands with each other:

A shakes hands with B, C and D
B " " C and D
C " " D

Thus four people can exchange six handshakes. In this way it will be found that 12 people can exchange 66 handshakes which, at 2s. 6d. each, totals £8 5s., and 13 people 78 handshakes, total £9 15s. Now £9 15s. exceeds the amount stipulated, and there must therefore have been 12 workers who exchanged 66 handshakes, and the remaining 15s. contributed because the President shook hands with six of the workers, i.e. half of them. Therefore, had they not assisted, the work would have taken twice as long to finish.

The Bering Dam Scheme...

Man's most ambitious project

By R. N. Hadden

RUSSIAN engineers and weather men have drawn up plans for a fantastic scheme that would change the climate of all the Arctic countries. If their scheme is ever put into practice, lands which are now barren frozen wastes may in years to come be fertile farms. The key to this amazing proposal is a dam across the Bering Strait. A dam stretching from Siberia to Alaska, over fifty miles in length. A dam so big that it would dwarf any man-made structure in the world today.

Aim of the Scheme

What the Russians hope to achieve is the warming of the Arctic Ocean. They claim that when they have raised the temperature of this inhospitable sea they will also have eliminated the prime cause of most of the Northern Hemisphere's bad weather. Once the cause of the bad weather has been removed and the winters are milder, millions of square miles of frozen lands will thaw. This can then be used as farmland.

How It Would Work

To understand how this vast scheme would work it is necessary to understand the effect the oceans of the world have on the weather. Take, for example, two cities—Bordeaux and Montreal. Both these cities lie on roughly the same latitude. If other factors did not come into play, they should have more or less the same climate. In actual fact, however, these cities have quite different climates, the average winter temperature in Montreal being 16 deg. of frost, whereas Bordeaux has a mild 50 deg. F. average winter temperature. The reason for this difference is that Bordeaux lies in the path of the warm Gulf Stream, whereas the eastern shores of Canada are washed by the icy Labrador Current. Warm seas and warm winters go together, and conversely cold seas mean cold winters.

What is true for these two cities is also true for the rest of the world. When a country is surrounded by warm seas, or when the prevailing wind blows off a warm sea, the climate is mild. On the other hand when the seas are cold the climate is cold. This then is the theory behind the Russian plan—if they can warm the Arctic Ocean it follows that the climate of the northern countries will become milder.

Fig. 1.—Map showing Gulf Stream and Labrador current.

Gulf Stream Diversion

Fig. 1 shows the ocean currents of the Atlantic. Note how the warm Gulf Stream flows northwards across the Atlantic, and up the western coast of Europe. Wherever this current exerts its influence the climate is much milder than other places in the same latitude, which are not so warmed.

Fig. 1 also shows how the Gulf Stream flows powerfully onwards, not losing its strength until it reaches the latitude of Spitsbergen and Novaya Zemlya. However, when it does reach the Arctic it is at last broken up. Here it is rather like trying to put water into a bottle which is already full, as much flows out as flows in. In the Arctic Ocean, as the Gulf Stream flows in on the eastern side, water flows out on the western side of Greenland. This "overflow" of water is known as the Labrador current and,

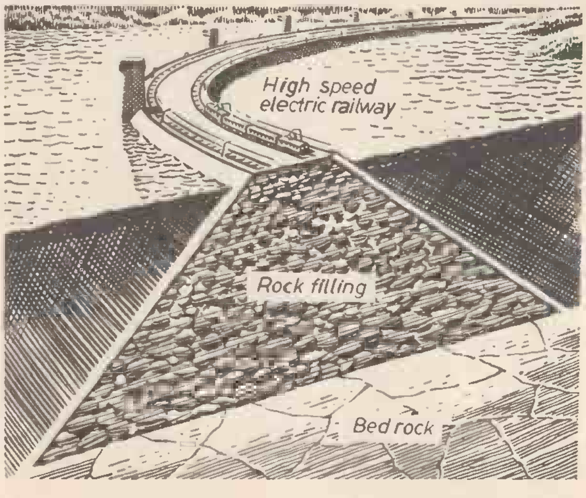
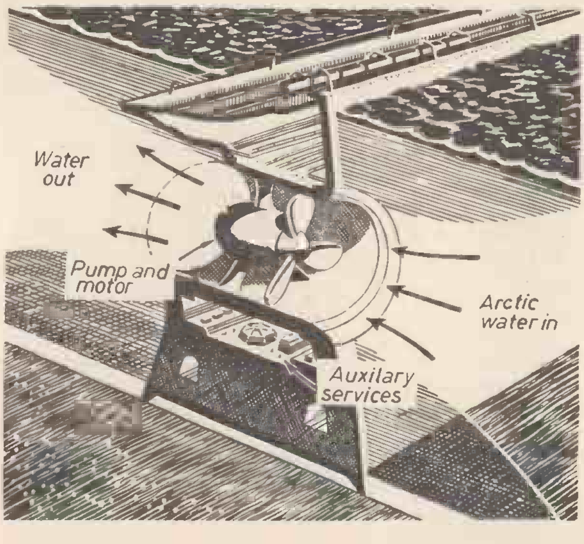


Fig. 2. (Left)—Rock filled section of dam as will be used at the two ends.

Fig. 3. (Right)—The main section of the dam containing the pumps will be constructed of reinforced concrete.



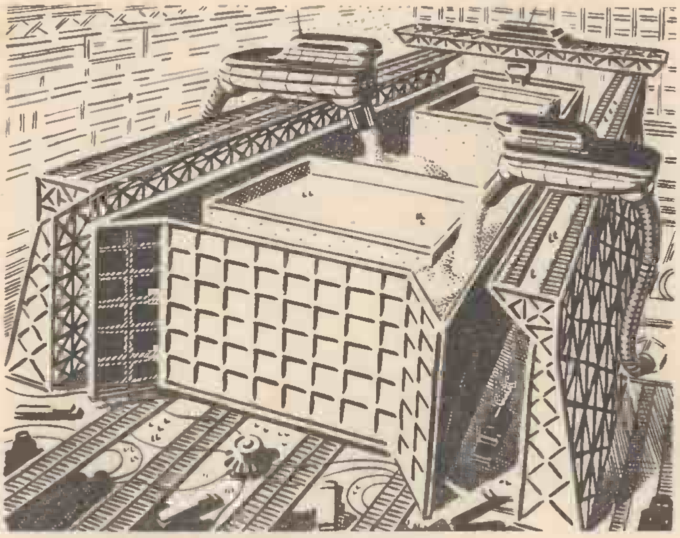


Fig. 4.—Building a section.

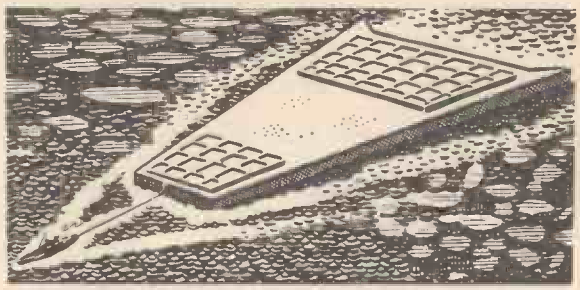


Fig. 5.—Towing a section to the site.

as might be expected, this is an icy current. It is this current which gives Canada its cold winters.

Another important thing to note from this map is that the Arctic Ocean itself has very few currents. In other words it is a stagnant, icy sea, which stores up coldness which in turn freezes the winds before they blast down on the northern countries. It is this situation which the Russians hope to change.

The Russian plan is to build a dam across the Bering Strait, and to pump the cold water from the Arctic Ocean into the Pacific. They say that when they do this the Gulf Stream will not end its journey where it does, but will surge right across the Arctic and the North Pole, and in its turn be pumped into the Pacific. In doing so it will warm the whole Arctic Ocean and so eliminate the conditions which create the harsh weather. This too is shown in Fig. 1.

Affect on the Pacific

There is no doubt that this scheme would benefit Europe, Northern Canada, and Siberia, but what will happen to the countries which will lie in the path of the new current from the Bering Dam? Will they be condemned to freeze as the icy waters from the Arctic are pumped out? A glance at the map of the Pacific will show that, in fact, the problem does not exist. As will be seen, the land on either side of the Strait falls back very quickly, giving free access to the Pacific Ocean. Therefore the current from the Bering dam would be quickly spread out and lost in the vastness of the Ocean. For this reason the effect on the climate of the countries bordering the Pacific would be insignificant.

Practical Aspects

There are three main items which would have to be built to make the scheme a reality. They are the dam, the pumps, and the power stations to supply electricity for the pumps. As yet no really firm plans have been drawn up for this project, but it is possible to predict certain broad outlines. There is no doubt that the engineering skill in the world today is sufficient to make this scheme quite practical.

The Dam

This would be the most massive part of the whole project, and the part which would probably set the greatest number of problems. It would not be conventional. Most dams have water on only one side, which means that they must be very strong to withstand the pressure. The Bering dam on the other hand would have water on both sides at more or less the same level. For this reason it would not have to withstand great hydraulic forces. However it would have to house the pumps, and if the scheme is to be really effective, they would have to have a capacity at least equal to the Gulf Stream. It follows therefore that the pumps would be very large, and there would be a great number of them. It is quite probable that three-quarters of the length of the dam would be required to house the pumps, and that the pumps themselves would be 40ft. in diameter.

The Two Ends

In view of the foregoing considerations it is probable that the dam would be designed in two parts. The ten miles nearest to either shore would be an earth-filled dam as shown in Fig. 2. An earth-filled dam would have several advantages for these sections. The first is that material for building it would be readily available on either shore. Another is that it would be comparatively easy to build, as in the early stages the material would be loaded into barges and towed out to position where it would be dumped. When the filling had reached the water surface the extra material required to finish the dam would be hauled out in giant trucks. When the dam was up to full height a facing of boulders would be laid to protect it from heavy seas.

The Centre

While an earth-filled dam would be fairly easy to construct it would not be suitable for housing the pumps. For this reason the centre portion of the dam containing the pumps would be made from reinforced concrete. A sketch of the probable shape of this part of the dam is shown in Fig. 3.

In view of the difficulties which would be experienced in building the reinforced concrete part of the dam in the middle of the Strait under Arctic conditions, it has been suggested that it should be built in sections and floated out. Figs. 4 to 7 show how this would be done.

Fig. 4 shows how the dam section would be built on its side in a dry dock. An overhead crane would be used to set up the formers, which would be used over and over for many sections. The overhead crane would also be used to place the reinforcing bars, while pumps would be used to pour the concrete. When the section was complete all the openings would be covered over to make it watertight, and it would then be launched.

When the section was afloat it would be taken in tow and brought to the site, as shown in Fig. 5. On arrival at the site the section would be partly flooded with water which would cause it to float the right way up as shown in Fig. 6. The section would then be positioned accurately and finally sunk.

When the section was sunk the sharp feet at the bottom would cut into the mud until they reached bed rock. The mud between the feet would be pumped out, and concrete would be pumped in to replace it. The inside of the section would then be pumped dry, the extra weight of the concrete between the feet preventing the section from refloating. The inside of the section would then be filled with concrete up to the level of the auxiliary services bay, as shown. All the finishing details of the inside of the section would then be completed, including the installation of the switch gear, cables, transformers, lubricating oil pumps, control room, and so on.

Pump Installation

When several sections had been completed internally an overhead gantry crane would be erected. This crane would be used first of all to lower stop logs over the inlet and outlet openings of the pump. This would allow the temporary covers over these openings to be removed. The crane would then unload the giant pumps from ships and lower them into the body of the section where they would be installed as shown in Fig. 3. The pump would come as a fully assembled unit and even when the whole scheme was in operation no maintenance would actually be done on site. If any repairs were required the pumps would be shipped back as a unit to the mainland for overhaul.

To complete the dam a high speed twin track railway, and a roadway would be laid over the top of the dam. This would mean that for the first time in history all the major countries, with the exception of Australia,

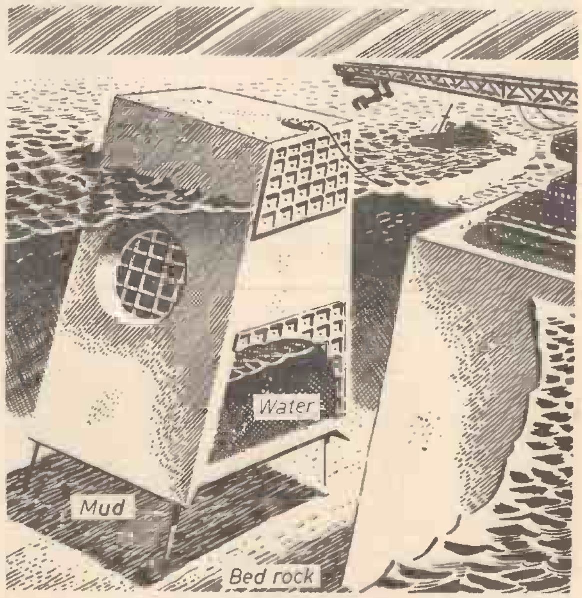


Fig. 6.—Section partly filled with water to bring it into a vertical position.

would be connected by land. It should even be possible to travel from Britain by land, as the Channel Tunnel will probably have been completed.

Pump Details

The next important part of the scheme to consider is the pumps. These pumps would be unusual in several respects. One unusual feature would be that they would not have to pump at great pressure. They would only have to take water from one side of the dam and push it out the other. However they would have to handle tremendous quantities; their output would not be measured in gallons per minute, but in tons per second. The most suitable type of pump for this duty would be the axial flow design, which is very similar to a ship's propeller, and would be about 30ft. in diameter.

The electric motors to drive these pumps would also be unusual as they would be of the submerged type. This design would have the advantage of enabling a direct drive to be used. The motors would be giants, probably not less than 50,000 h.p. each. To prevent water getting into the windings and also to cool them, pressurised hydrogen would be circulated.

Power

To provide power for the pumps would be an engineering feat in itself. It is almost certain that atomic power stations would be used. These power stations would probably be of the fast breeder type, as the indications are that these would be the most economical to run. The constant load requirements of the pumps would be a great advantage as the power stations could run at constant load day in day out.

So much then for the practical engineering side of the scheme, the only thing that stands in the way of its realisation is obtaining the agreement of all the countries concerned. This may be a much longer process than building the dam. The other question is who will pay for it? The Estimated cost is £600,000,000. Probably if the scheme goes ahead Russia, Canada and the U.S.A. will bear the cost between them.

That then is the Bering Dam scheme, it is certainly fantastic but no more so than sending a rocket round the moon. As one Russian engineer said, " When the cold war has thawed we can then set about thawing the Arctic."

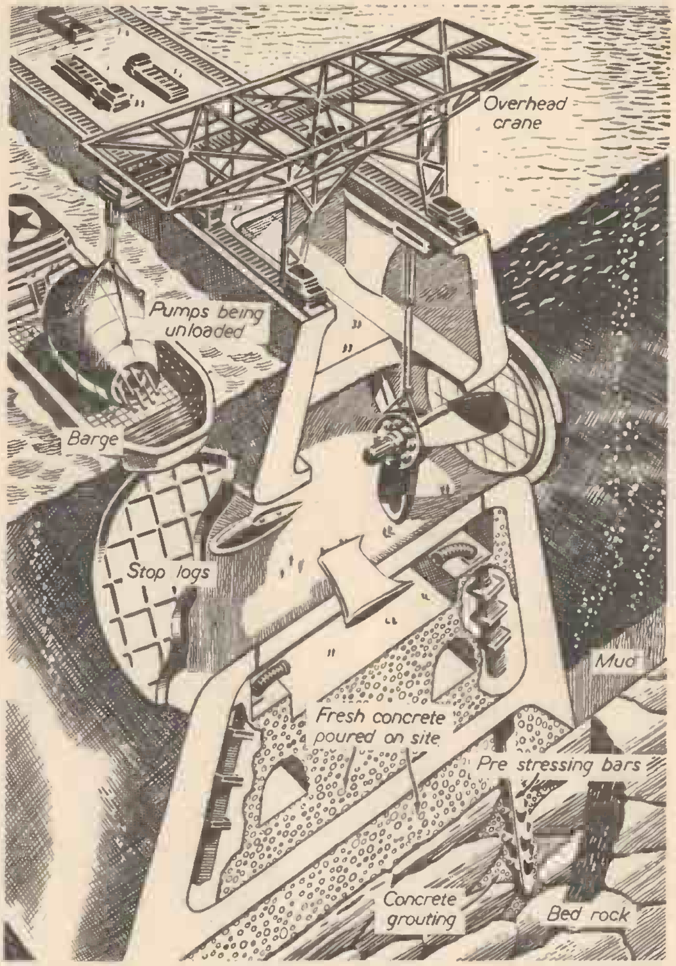
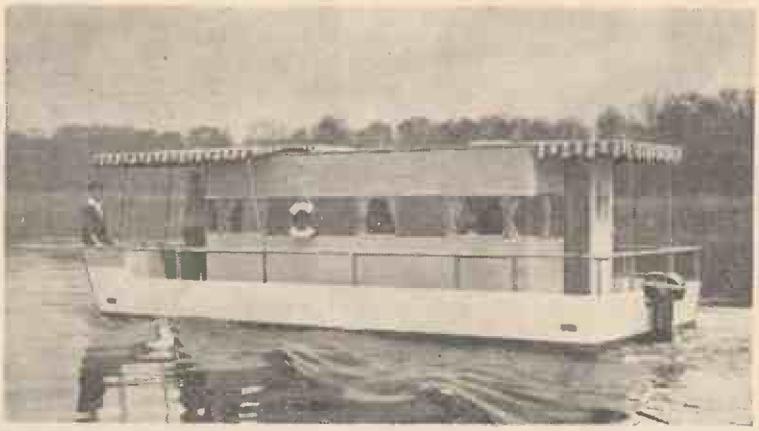


Fig. 7.—Our artist's impression of the section in position and the pumps about to be installed.

NEWS AFLOAT
from home and abroad



The "Flat-Afloat" creates no wash when in motion.

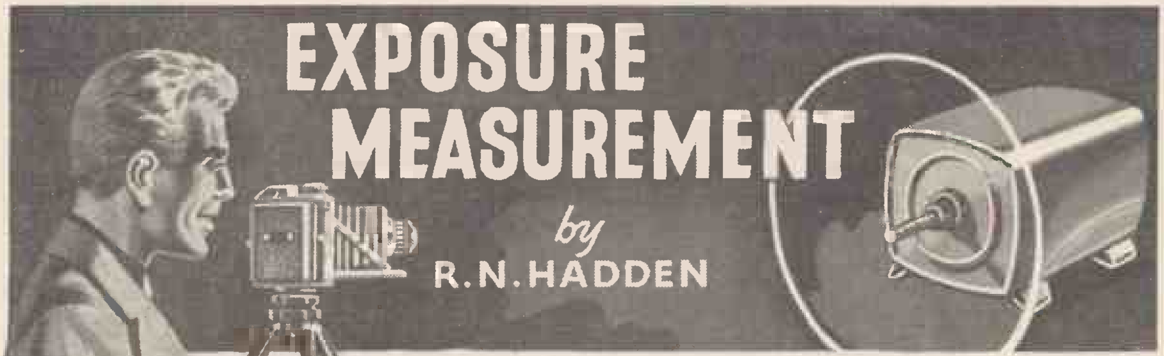
A U.S. Johnson outboard motor in use on a dug-out canoe.

Home

THE above " Flat-Afloat " was exhibited at the *Daily Mail* Ideal Home Exhibition earlier this year. It is completely unconventional in design and is a kind of caravan mounted on a catamaran type unsinkable hull. It is easy to steer and manoeuvre. There is no vibration from the 10 h.p. outboard motor, which enables the Flat to cruise comfortably at 5 m.p.h. Its accommodation includes two single and one double interior sprung berths, spacious storage room beneath the bunks, a built-in wardrobe, sideboard and store cupboard; gas cooker and gas lighting. Electric light, either mains or battery can easily be arranged. The basic price of this home afloat is £795.

Abroad

ONE of the little-known tools in Africa's evolution is the outboard motor, which is mechanising the fishing fleets, propelling native craft up and down Africa's rivers. Along the coast of Angola, more and more outboard motors can be seen on the native dug-out canoes (see photograph left). Unusual methods often have to be used to adapt these engines to the narrow, round-sterned craft, but the advantages that the fisherman can derive are great.




EXPOSURE MEASUREMENT

by R. N. HADDEN

How to Test the Shutter Speeds on your Camera

ACCURATE exposure has always been the first essential of good photography, and this is especially true where colour film is concerned. With colour film the usual tolerance in exposure is half a stop up or down.

However, it is not always appreciated that the setting of the aperture to an exact reading is of little use if the shutter speed itself is not accurate. For this reason, if there is any doubt about the accuracy of the shutter speeds, they should be checked before any film is wasted.

Basic Principle

The basic principle is that a small light at the end of a rapidly rotating arm is photographed. The photograph so obtained is in the form of a circle or part circle of light, depending on if the shutter remained open for a full revolution or only a part. This then is the key to the problem, the speed of the rotating light is set so that the photograph is of a part circle, and hence knowing the speed of rotation, the actual exposure time can be calculated.

In the tests made by the author the rotating arm was 12in. long, and two 2.5 volt 0·3 amp flashlight bulbs were used. One bulb was at the end of the arm, and the other at the centre line of rotation. The speed of rotation was 1,110 r.p.m. The set-up being shown in Fig. 1, while Fig. 2 was copied from a typical photograph taken at 1/100 second.

On the photographs obtained the actual points where the shutter starts to open and finally closes is quite definite, but the points where it is fully open, and where it starts to close, require some care in location. It does of course, help to take the photographs in a darkened room.

The Results

To work out the results from the photographs obtained decide on the four points, shutter starts to open, shutter fully open, shutter starts to close, and shutter closed.

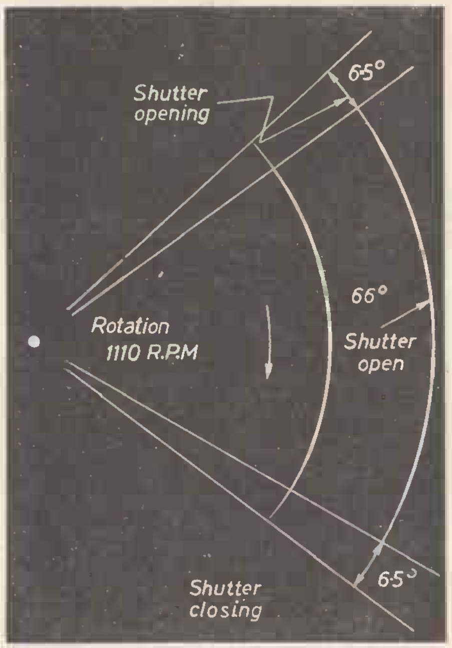


Fig. 3.—Working out the results.

Then draw lines from these points to the centre of the circle, which is located by the central light, and measure the angles, as shown in Fig. 3. Then the exposure can be worked out from the following formula:—

$$\text{Shutter speed} = \frac{a + 2b + c}{12N}$$

Where a = Opening angle
b = Shutter fully open angle
c = Closing angle
N = Revolutions per minute

In the case shown the shutter speed was set to 1/100 second, and a = 6·5°, b = 66°, c = 6·5°, and N 1,110 r.p.m. This gives an actual exposure time of 1/90 second, or in other words the speed is 10 per cent. slower than the nominal value, and the aperture must be reduced by 1/10 of stop to correct for it.

When figures have been obtained for all speeds, they may be plotted on a graph to show the number of stops increase or decrease for each setting. This is shown in Fig. 4, from which it is seen that on average the camera tested required quarter of a stop decrease at each speed to give correct exposures. In practice an error of this amount is not serious and generally can be ignored.

(Concluded on page 341)

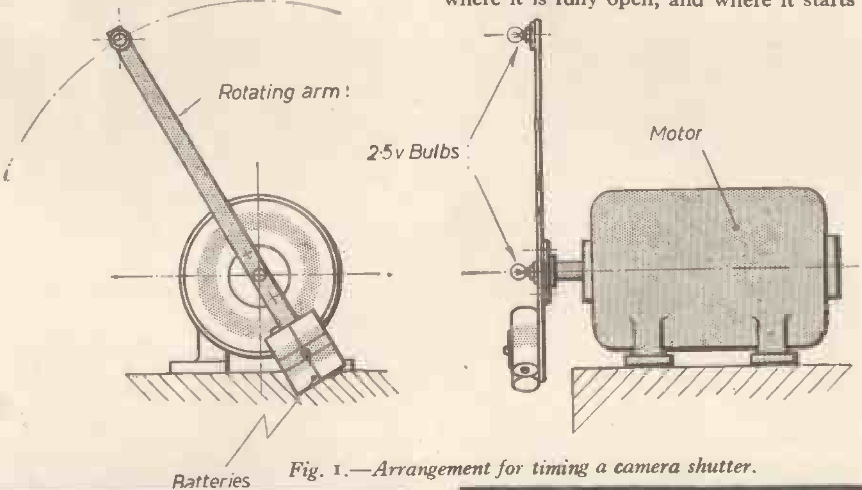


Fig. 1.—Arrangement for timing a camera shutter.

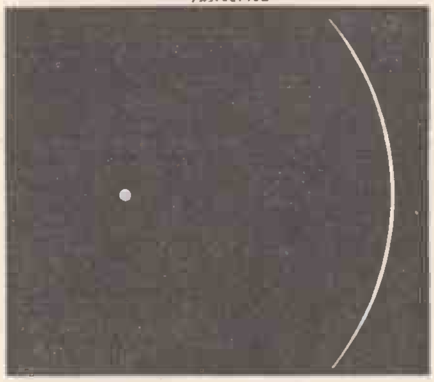
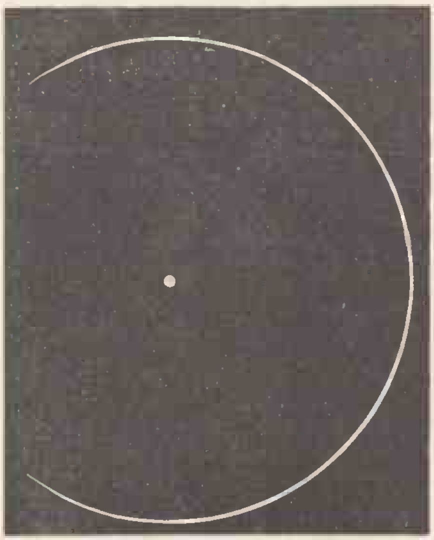



Fig. 2.—Copies of typical photographs taken when timing shutters. The one above shows an exposure of 1/11 second and right 1/25 second.

The Author using his bandsaw.

Jameson Erroll describes the construction of a 4-wheel

BANDSAW for wood or metal

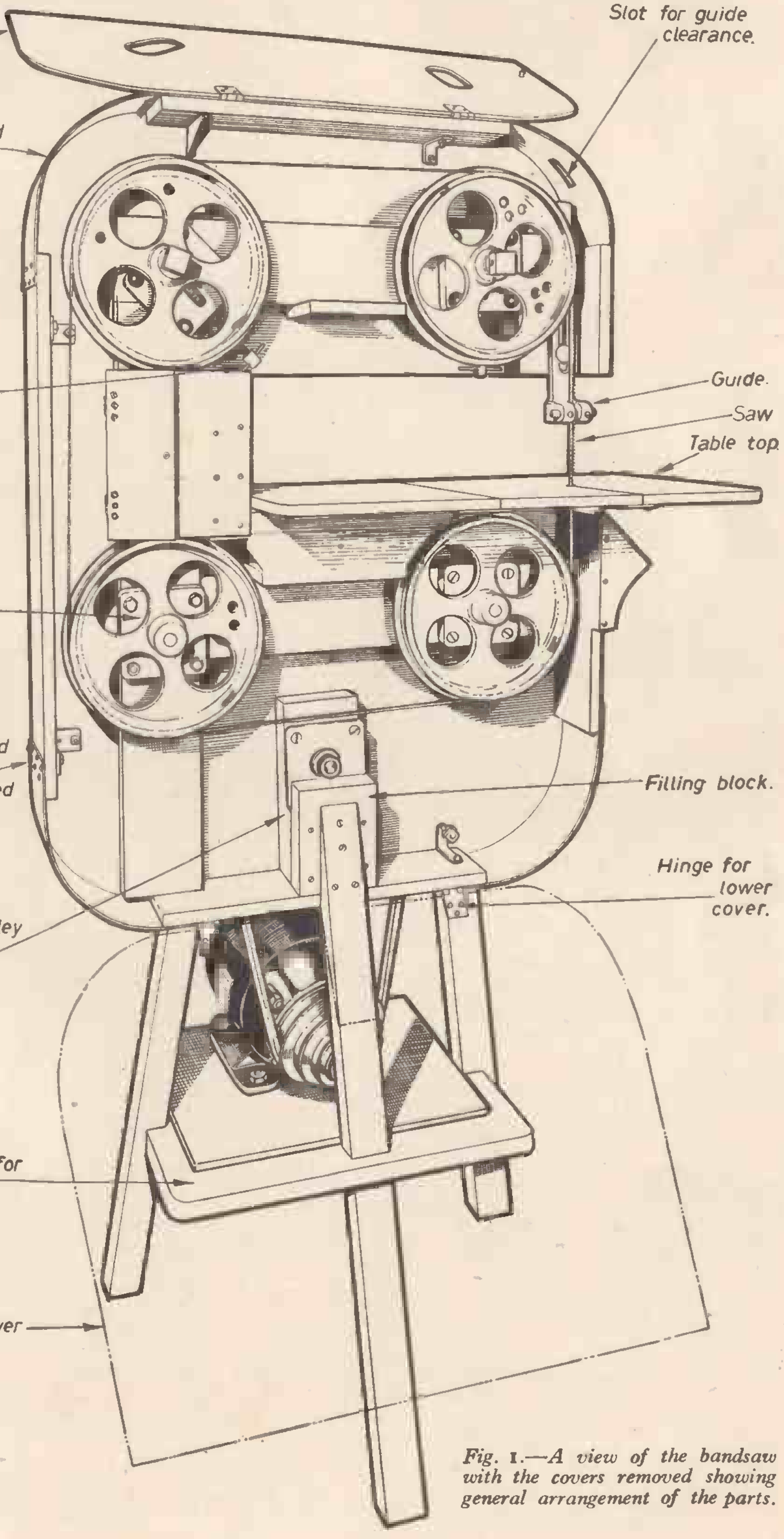


Fig. 1.—A view of the bandsaw with the covers removed showing general arrangement of the parts.

As will be seen from Fig. 1 this machine is a full-size, sturdy job made for hard work. It stands 5ft. high, takes a 95in. blade, has an 18in. throat, will take wood up to 5in. thick and—by the mere change of the driving belt and blade—will cut metal quickly and accurately.

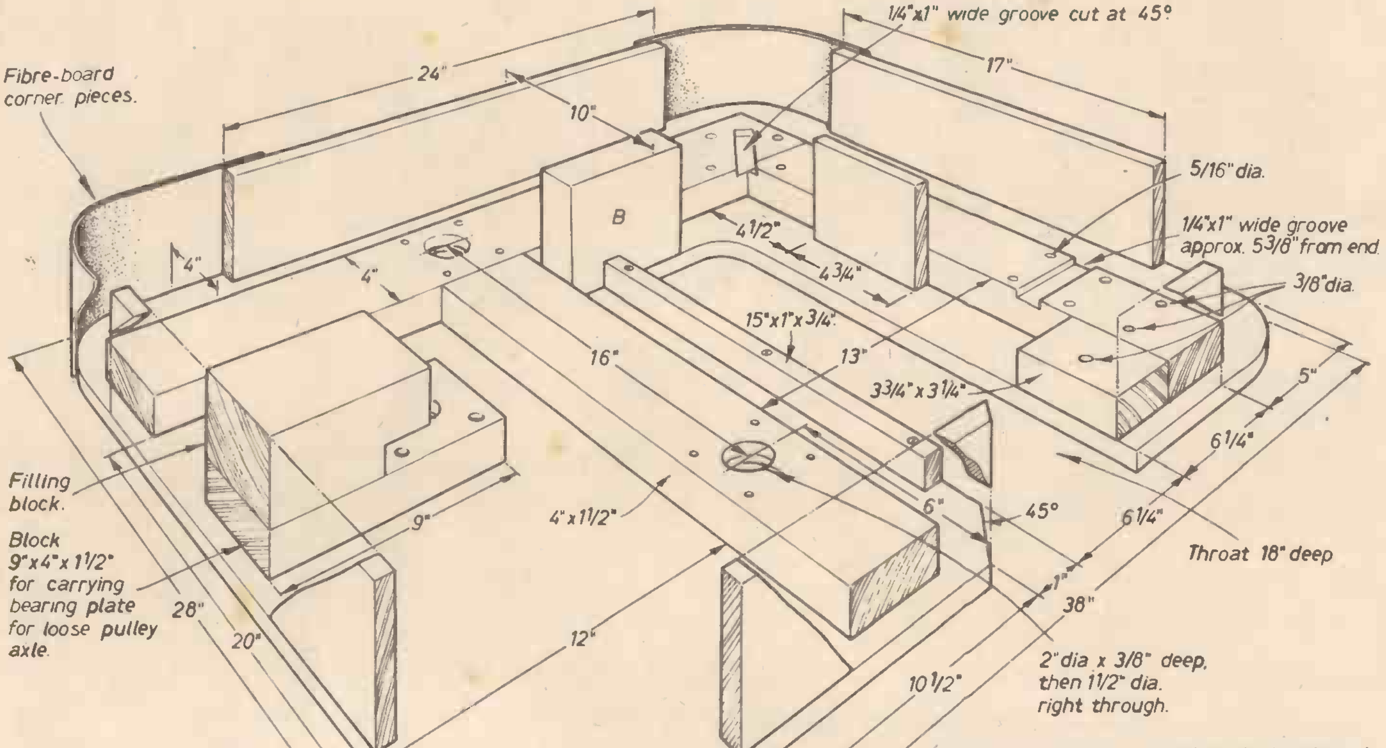
Generally speaking, the bandsaw is used for cutting shapes in wood (or metal within reason) but it *can* be used for straight cuts if required. The wide throat permits work to be carried out up to the centre of 3ft. wide panels and, with a ⅜in. wide sawblade, circles down to a diameter of 3in. can be cut internally. With external cuts considerably sharper curves are possible since the wood can be "wasted" away. Internal curves to which no outside entry is possible cannot be cut.

Metal cutting involves a specially hardened and close-toothed blade and a very much slower running speed. This latter is accomplished through two loose pulleys shown in Fig. 5. If the machine is to be built for wood cutting only, the loose pulleys and 10in. driven pulley may be omitted and the overall length of the main frame reduced by about 6in. Details of construction will, however, be given for the complete machine.

The Main Frame

This consists of a sheet of ½in. plywood 38in. × 28in. braced as shown in Fig. 2 by 4in. × 1½in. deal which serves not only to add strength and rigidity to the plywood but also to furnish a firm anchorage for the bandwheel bearing plates. The 1½in. thickness is almost essential, so buy 1¾in. timber and have it planed down to exactly 1½in. thick.

These braces when cut as shown in Fig. 2 may be screwed on from the back with a few screws at intervals. These screws serve more to keep the braces in place than as strong fixing mediums since the bolting on of the bearing plates also firmly fixes the braces to the plywood. The small block 3¾in. × 3½in. shown at the right of Fig. 2 carries part of the saw guide holder. Note also in Fig. 2 that two 1in. wide grooves are shown, cut vertically in the top brace and at 45 deg. in the top of the side brace. These grooves are about ¼in. deep and allow the adjusting nuts incorporated in the two top bandwheels to move freely up and down. This fitting will be explained later but the grooves may well be cut before the braces are secured to the plywood. The centre of the vertical groove is 5⅜in. from the end of the top brace while the 45 deg. groove is central as shown. Note particularly that the ends of all three braces do not reach the sides



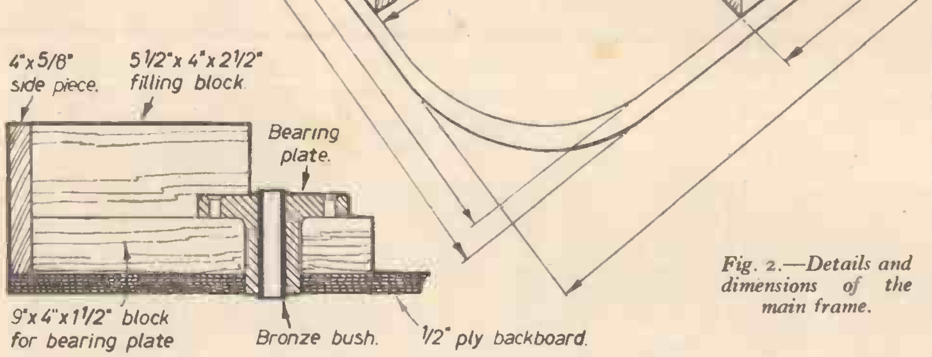


Fig. 2.—Details and dimensions of the main frame.

of the plywood by ⅝in.; this is to accommodate the 4in. × ⅝in. sides to be added later; see Fig. 2. Holes to accommodate the bearing blocks should not be bored at this stage.

The 9in. × 4in. × 1½in. block to carry the bearing for the loose pulleys (Fig. 2) may also be fixed although it should not be bored. The filling block can be added later.

The Bandwheel Kit

It is almost impossible, and certainly not advisable for the amateur to attempt to make the bandwheels. Messrs. S. & G. Sergent, Manufacturing Engineers of Costessey, Norwich, Norfolk, have produced two complete kits of parts—one for the wood-cutting model, and one for both wood and metal cutting. Reference to the "Materials Required" will show of what these kits consist. Figs. 3 and 4 show some of the parts supplied.

The bandwheels themselves are of strong construction and run smoothly in bronze bushed bearings force-fitted into substantial bearing plates which are easily fixed by means of four 3in. × $\frac{5}{16}$in. Whit. bolts.

It will be seen that these wheels are of two types—adjustable and fixed. The bearings of the former ride in a slotted backplate and, through the medium of a tensioning bolt, have an adjusting range of about 3in. This adjustment can easily be made from the front of the machine by means of a tommy bar (any length of metal under $\frac{5}{16}$in. dia.) and can be locked firmly in position. Two of these adjustable bandwheels are used, so the combined range of tensioning is about 6in. This liberal range permits the use of slightly shorter blades than the 95in. one supplied and thus makes ample allowance for the necessary shortening of the blade when it breaks and has to be brazed.

The saw guide holder has an extensive range of adjustment—well within the limits of the machine—and embraces a steel thrust wheel to take saw pressure and two ebonite saw guides to obviate side movement when rounding curves.

Fixing the Bandwheels

Beginning with the top right-hand wheel, adjust the tensioning screw to approximately half way so that the centre of the wheel is in the centre of the backplate. Fix the plate in position and mark and bore the $\frac{5}{16}$in. holes for the bolts. These pass through the 4in. × 1½in. brace and the plywood, and are fastened with washers and nuts.

The top left-hand wheel, also of the adjustable type, is fixed in a similar manner except that the tensioning bolt is screwed right home so that the wheel is at its highest possible point. Note that this backplate is fixed at 45 deg. in this case to allow the tensioning bolt to be reached easily, i.e. in the right-angled junction of the top and side braces. The first wheel having been fixed with its centre 6in. from the edge of the plywood, the centre of the second wheel should approximate 15¾/16in. from it—the distance is not critical within a ¼in. or so.

The remaining two bandwheels are not of the adjusting type and call for a different method of fixing. The bearing plates on these wheels carry behind them a bush housing which is roughly 1½in. dia. It actually tapers slightly, being less than 1½in. at the rear and a little over 1½in. where it joins the plate. The best way to bore a suitable hole for them is first to use a 2in. centre bit for a depth of about ⅜in. and then continue right through with a 1½in. bit. Fix as before with 3in. × $\frac{5}{16}$in. bolts, washers and nuts. To check up on distances, the saw may now be tried on the wheels. A slight adjustment of the tensioning bolt on the top right-hand wheel should make for a satisfactory fit. This tensioning bolt was substituted by a 5½in. length of $\frac{5}{16}$in. rod to the end of which was fixed a turning device.

LIST OF MATERIALS REQUIRED

For the Wood-cutting Saw only:

Kit BS4W from Messrs. S. & G. Sergent, Manufacturing Engineers, Costessey, Norwich, Norfolk, which comprises two adjustable bandwheels and two fixed bandwheels complete with bearings, etc., one saw guide holder, one "A" type 5in. dia. Vee pulley, and one wood-cutting saw blade 95in.
1 piece ½in. plywood 32in. × 28 in.
7ft. deal 4in. × 1½in. (for braces).
1 piece deal 6in. × 4in. × 2in. (block "B").
7ft. deal 4in. × ⅝in. (for side frame).
1 piece stiff fibre board 4ft. 6in. × 4in. wide
1 piece deal 15in. × 1in. × ¾in. (table support).
1 piece hardwood 10in. × 5½in. × 1in. (trunnions).
1 piece ⅜in. ply 24in. × 14in. (table top).
3 pieces deal 30in. × 3in. × 2in. (legs).
2 pieces hardboard 28in. × 12in. (top and bottom doors).
1 piece hardboard 12in. × 8in. (side door).
1 piece ½in. plywood of size suitable for motor board.
3 pairs 1½in. light hinges for doors.
16 Whitworth bolts 3in. × $\frac{5}{16}$in. with washers and nuts.
2 Whitworth coach bolts 3in. × ⅜in. with washers and wingnuts.
Material for lower thrust wheel.
Several dozen assorted wood screws.
Grey matt paint for giving finished appearance to non-working parts.

For the Wood-cutting and Metal-cutting Saw:

Kit BS4WM from Messrs. S. & G. Sergent which comprises the BS4W Kit plus an additional bearing plate, a 6in. length of ⅜in. shafting, one 2in. and two 10in. "A" type Vee pulleys, and a metal-cutting sawblade.
1 piece ½in. plywood 38in. × 28in.
8ft. 6in. deal 4in. × 1½in. (for braces).
1 piece deal 5½in. × 4in. × 2½in. (filling block).
3 pieces deal 24in. × 3in. × 2in. (legs).
1 piece hardboard 28in. × 12in. (top door).
1 piece hardboard 28in. × 18in. (bottom door).
1 "A" type Vee belt 40in. for connecting 2in. loose pulley to 10in. driven pulley on bandwheel.
All other materials for the BS4W machine not already mentioned plus four more bolts 3in. × $\frac{5}{16}$in.

In addition to both the above lists, a driving belt of suitable length will be required for the wood-cutting machine, and two driving belts for the wood-cutting and metal-cutting machine.

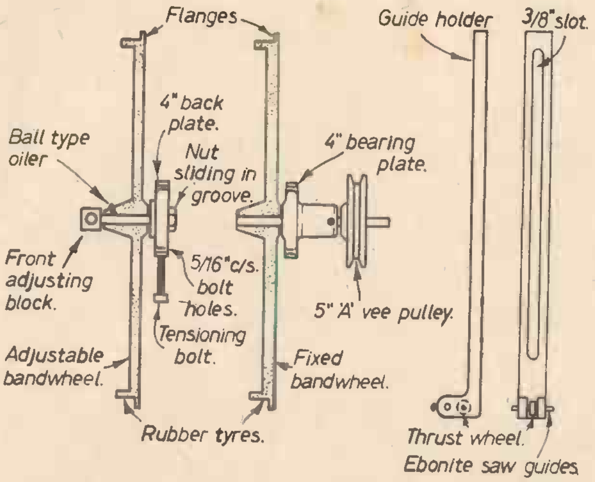
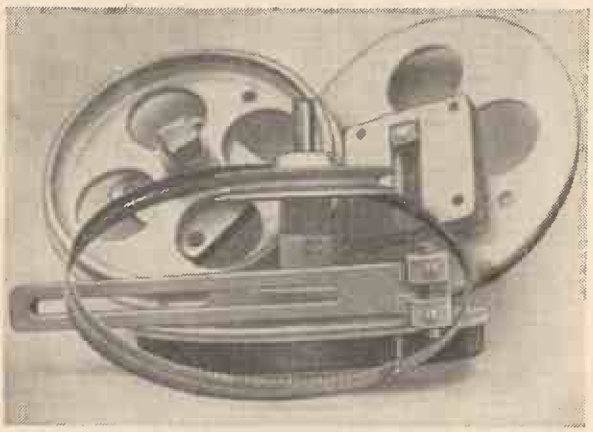


Fig. 3. (Left)—Bandwheel and guide holder details.

Fig. 4. (Right)—Some of the components supplied in the bandsaw kit.



Easier adjustment was provided since it clears the rim of the bandwheel.

Fig. 2 should be constantly referred to when fitting the bandwheels, and at this stage they may be tested for alignment. Loosen the blade slightly, push it against all four wheel flanges, then re-tension—but not too tightly. Now revolve one of the wheels and note if the saw tends to move forward in its continuous passage around the wheels. It should not do so, but if it does, it may be necessary to pack one of the bearer plates slightly to give the wheel an upward cant. This is called tracking and should be repeated later when construction is sufficiently advanced to use the slow speed. The faster the blade travels, the easier it is to check on tracking, but any tendency to run out of true *must* be remedied before the machine is run at top speed: a badly-tracked blade which runs off at speed can be dangerous.

The saw guide holder may also be fixed at this stage and this should be done when the saw is in position and tightened up. Two 3in. × ⅜in. coach bolts with washers and flynuts fasten the holder to the machine. Three holes are bored in order to give ample vertical play and the slot in the holder permits height adjustment when the flynuts at the back are loosened. Take great care when boring these holes to ensure that the holder moves vertically in line with the saw; the ebonite blade guides are principally intended to check side play of the blade when under pressure and should *not* be used to correct a bad alignment of the holder.

The Loose Pulleys

In order to reduce speed considerably when cutting metal, a chain of 2in.-10in./2in.-10in. pulleys has been adopted. The loose pulleys —one 2in. and one 10in. on the same shaft— run in a bearing plate supplied with the kit, and this plate is fixed to the 9in. × 4in. × 1½in. block as shown in Fig. 2. The distance of the centre of this bearing from the centre of the bandwheel carrying the 10in. fixed pulley can vary slightly according to the size of Vee belt used. If this latter has to be bought, then buy a 40in. belt and fix the two centres 10½in. apart. This can be seen in Fig. 5 and a further diagram next month will make it clear. If, however, a 41in. or 42in. belt happens to be available, it can be used by slightly increasing the distance between the two centres. Further information on this subject is given later when the question of fitting the motor is discussed.

After the bearing plate has been fixed, a filling block 5½in. × 4in. × 2½in. is added as shown inset in Fig. 2. This is cut away to clear the bearing plate and is then fixed with four 3½in. No. 10 c'sk wood screws. This filling piece gives added support to the bottom of the side frame which carries considerable weight. The two loose pulleys are fixed to the 6in. length of ⅝in. shafting by means of the grub screws, the shaft being passed through the bush, and fixed on the inside of the machine with a ⅝in. collar. The 10in. fixed pulley may now be attached to the shaft on the bottom left bandwheel (threading the belt on at the same time) and the 5in. pulley fixed to the lower right bandwheel.

The Side Frame

This consists in the main of varying lengths of 4in. × ¾in. deal and is shown in Fig. 2. The block " B " is a 6in. length of 4in. × 2in. added to give support at the throat end and may, at this stage, be added together with the batten 15in. × 1in. × ¾in. which runs along the bottom edge of the throat and gives extra support to the table.

The throat may also be cut out now; it runs back to a depth of 18in. and has a height of 6¼in.: note that the bottom outside corner is cut away 1in. in at 45 deg. to allow for part of the table tilting. In Fig. 2 it will be noticed that the side frames rest on the face of the plywood in some cases between the end of the braces and the edge of the plywood—and that these side pieces will, therefore, have to be screwed from the back of the plywood. To give them further support, where necessary, small but strong metal brackets are added; these can be seen in Fig. 1.

Sides for the rounded corners are made from good quality fibre board about 1/16in. thick; they overlap the wooden sides by 1½in. to 2in. and are firmly screwed into

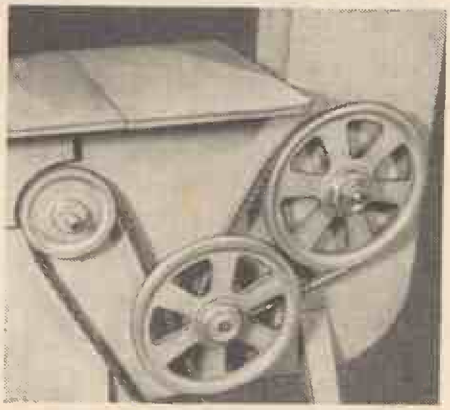


Fig. 5.—Loose pulley arrangement.

them (about eight screws per corner) as well as being screwed into the edge of the plywood. It is advisable to punch holes in the fibre board to take the screws and also to drill the edge of the plywood a little so that the body of the screw does not force the laminations apart. Note that the lower front length of 4in. × ¾in. is bevelled on its top edge to match up with the corner of the throat.

Since the machine is now becoming somewhat unwieldy and heavy to move about, it may well be mounted either on the bench or table or on legs with, perhaps, its own motor.

(To be continued)

Exposure Measurement

(Concluded from page 338)

The result for 1/500 second is interesting as it shows that the shutter is hardly open before it starts to close again. The total time from when the shutter just starts to open to when it is fully closed again is exactly double the rated exposure or 1/250 second.

In general the opening and closing times at all speeds were equal, being about 1/800 of a second. This was for a Syncro Compur shutter.

For the slower shutter speeds the speed of rotation has to be reduced, otherwise the photograph turns out to be a complete circle. For 1/10 second and longer the author placed the lights on a gramophone turntable, set to 33⅓ r.p.m.

The type of film used, and the aperture used in taking the photographs is not very critical, provided the trace is visible. However, it is suggested that one of the fastest films be used, with an aperture not less than f/3.5.

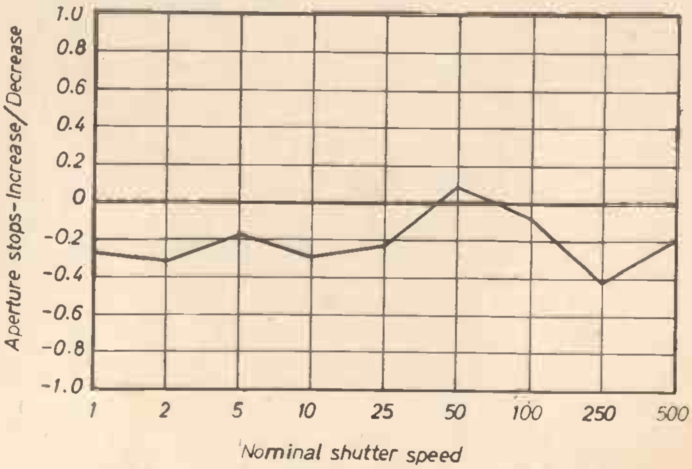


Fig. 4. The figures plotted on a graph.

a 35mm. adaptor

This conversion is suitable for any camera taking 120 film

By A. G. Thorburn

THE materials required are one or two wood-centre spools (Agfa still use this type) and one or two all-metal spools, all 120 size. A photographic chemist will usually supply these free; a 35mm. film cassette which will also be required can be obtained from the same source for about 6d. The tools required are few and include a 1/16in. thick ward file and a penknife.

The Spool Adaptors

Note that the dimensions are given in millimetres; this is because spools are still made in metric sizes.

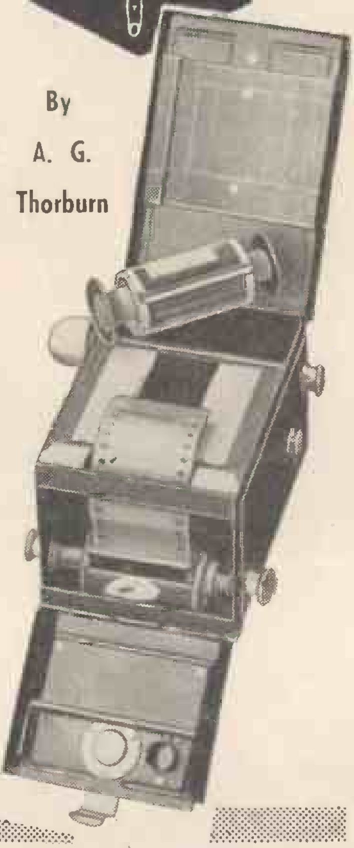
To make the adaptor shown on the left of Fig. 1, cut off the driving slot end of a wooden spool 21mm. from the inside of the metal rim. Next cut a piece of thin sheet metal and wrap it around the body, using it as a safeguard and guide to make the 9mm. dia. portion the correct length. Before finishing the diameter, file in the 2½mm. slot. Make another adaptor exactly the same and then finish and adjust both to make a spring push fit in the driving end of the cassette.

The other adaptor, shown on the right of Fig. 1 is made from a 120 metal spool. Mark off the 11mm. dimension, notch around with a file, break off and smooth off the end and internal diameter. Two will be required.

The final adjustment is made by assembling both ends on the cassettes and making sure the overall length is correct by checking against an uncut 120 spool.

The Mask

It is, of course, not possible to detail a mask suitable for every 120 camera, but Fig. 2 shows the general method of construction. A piece of ¼in. thick soft wood is cut an easy fit for the inside of the camera.



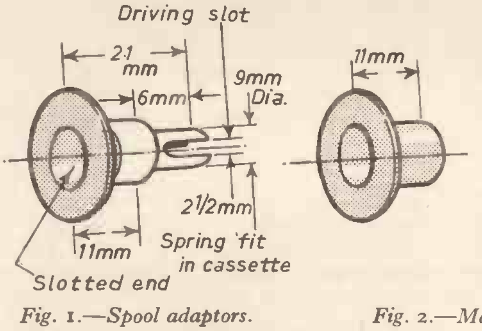


Fig. 1.—Spool adaptors.

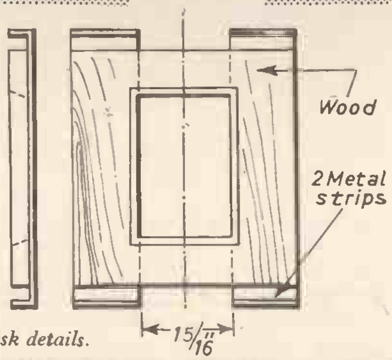


Fig. 2.—Mask details.

A rectangular hole, 24mm. × 36mm. (15/16in. × 13/32in.) is cut and the edges bevelled as shown. Two thin metal strips, set 15/16in. apart with the ends bent over to clip in between body and film rollers are cemented on to the wood. To do this rule two pencil lines 15/16in. apart as guides to the edge of the wood, which is placed in the camera body while the strips are cemented; when tacky, the mask with the strips in place is removed and clamped under a weight. Finally a piece of black velvet is cemented on the sides of the wood, making the mask a push fit into the camera body. The 15/16in. slot or gap prevents scratching of the film while the notched edges of the film slide over the metal strips and the original camera rollers.

The window or counter device registering the number of shots will no longer be of use, but it has been found in practice that ⅝ of one complete turn of the winding knob is exactly right. The total number of shots taken can be ticked off on a card numbered up to 36 and fixed to the camera or inside the ever-ready case.

Changing the Film

If there is no windback mechanism, when all the exposures have been made and if the end of the film is still held in the now empty cassette, the film will have to be changed in a darkroom or changing bag—unless the last two or three exposures are sacrificed.

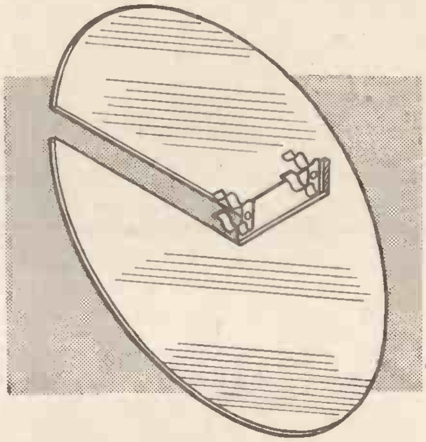
Often, however, when winding on the last one or two exposures the film tag will free itself from the now empty cassette and may be wound right inside the take-up cassette, thus allowing the film to be changed in ordinary light.

The Viewfinder

The field of view will, of course be considerably smaller and the viewfinder must be marked off accordingly. It will be found that viewfinder dimensions will have to be reduced to about 4/9ths of their previous size. The general effect of the conversion is the same as fitting a telephoto lens.

A Heat Guard for a Toasting Fork

THOSE of us who are not fortunate enough to possess electric toasters or who prefer toast made over a real fire will find the heat guard described here very useful. It is made from an aluminium disc 6in. in dia. Two size "00" or "000" tool clips serve to secure the guard to the fork handle. The diagram is self explanatory.



THE AUTOMATIC HOUSE
PART 3

TIME-DELAY SWITCHES

Constructing a latching relay unit and a thermal switch unit

By E. V. King

IT can be quite easily arranged that operation of a push-button type switch will work a light or set of lights for say 30 seconds or a minute and then switch them off automatically. Various methods of operating the switch, including floor pads, light beams, etc., can be used. The control gear required can use relays, limit switches, heaters, bi-metal, motors or solenoids.

Latching Relay Unit

The current required for energising a relay must be D.C. unless special gear is fitted. Most apparatus to be described in this series uses a basic source of D.C. which may be obtained from batteries or from the mains. A suitable unit for this supply was described last month.

Latching relays are available from control gear manufacturers but since P.O. 3,000 relays of 200 are available so readily and cheaply from a number of firms, they are specified here. The relays are available from Messrs. W. Benson, Messrs. K. R. Whiston, Messrs. L. Wilkinson (Croydon) Ltd. and Messrs. Sallis (Brighton) Ltd.

Figs. 11 and 12 show the basic make-up of the unit and the P.O. relay. The circuit is given in Fig. 13 and the smaller parts are detailed in Fig. 14.

Mounting the Relay

In this particular case a rigid mounting is essential and the method used is the unorthodox one of passing small bolts through the gap between the coil and the metal frame. Fibre or similar washers are used to protect the coil insulation.

When purchased the relay may have upwards of eight sets of points. According to the use in mind, some may be removed. In this case one set of normally open contacts are retained. If the others are left in position, they cut down the contact pressure on each set of points, but often this does not matter, as in switching small 60 watt lamps.

The armature is taken off and the copper rivet (see Figs. 11 and 14) removed by drilling. An armature extension of brass or steel is made and screwed in position using a brass screw, or riveted using a copper or aluminium rivet. The screw or rivet is then nearly filed away so that the armature may nearly, but not quite, touch the electromagnet when it is energised. The tip of the armature extension is rounded to a radius, terminating in a knife edge, as shown in Figs. 11 and 14. The screw and lock nuts at P are adjustable for stiffness of the armature pivot and should be left fairly loose, but locked.

Making the Latch

If the coil of Ry3 (Figs. 11 and 13) is energised with 24v. D.C. the armature will pull in. A latch is fitted so that it holds it in even if the initial energising current is now switched off. The principle is that of the simple ratchet.

Refer to Fig. 14 for details of the parts. The latch is made of brass strip with a small plate of soft iron from a transformer stamping or cocoa tin soldered near one end. The end of the latch is bent round as shown and radiused on the outside (Figs. 14b and 11). If the unit can be fixed upright; no springs will be necessary and gravity will be sufficient. If horizontal use is necessary a small spring (from a ball point pen) is located by a small nut and bolt (Fig. 11). A bracket of brass and another small nut and bolt will anchor the other end of the spring. The pivot bearing is made from a piece of small bore copper, brass or steel tubing which is soldered in position. The axle for this is made from a bolt soldered to a small flat brass plate screwed to the base. A washer and lock nuts are applied above to keep the latch in position, see Fig. 14c.

At this stage test the latch. Hold the board upright. Energise Ry3, or push its armature in by hand. It should then be latched in by the "claw." In some cases it may be necessary to fit a small adjustable stop (Figs. 11 and 14d) so that the latch does not fall too far in the normal position.

Fitting the Delatching Magnet

A P.O. type 3,000 relay is dismantled and

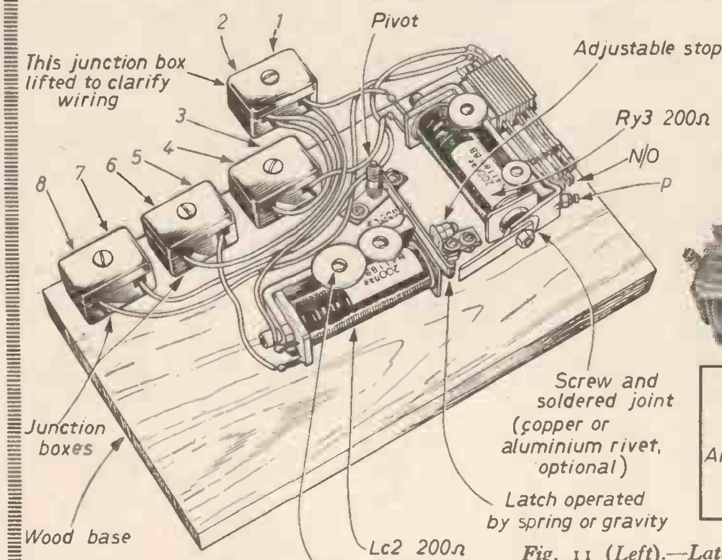


Fig. 11 (Left).—Latching relay unit details.

Fig. 12 (Left).—Latching relay unit.

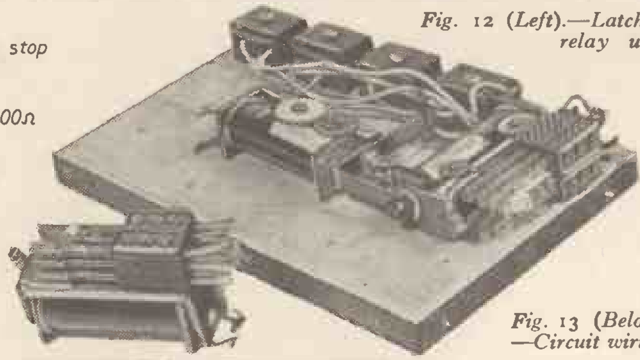
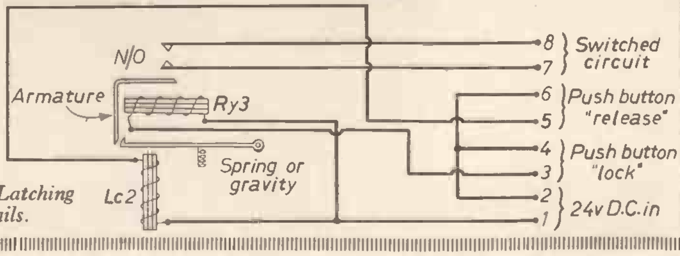


Fig. 13 (Below).—Circuit wiring.



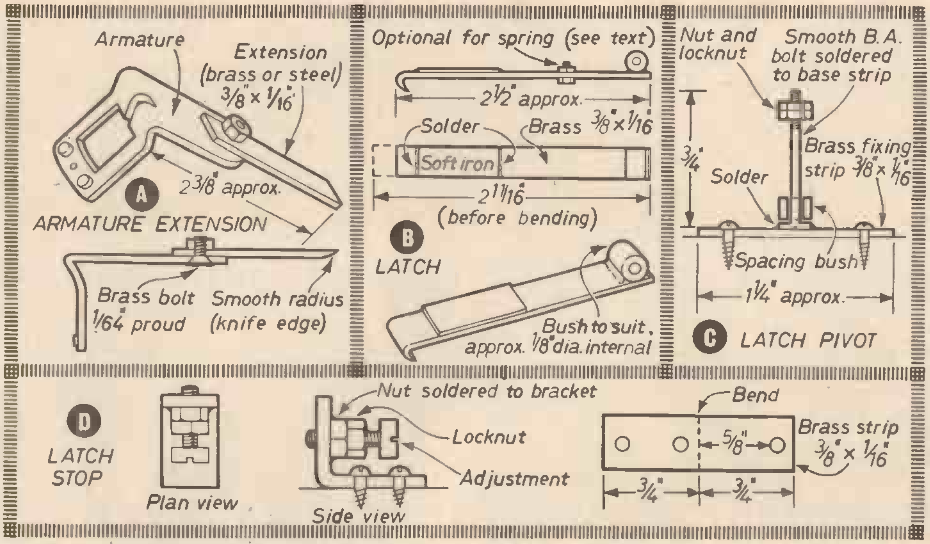


Fig. 14.—Various parts of the latching relay.

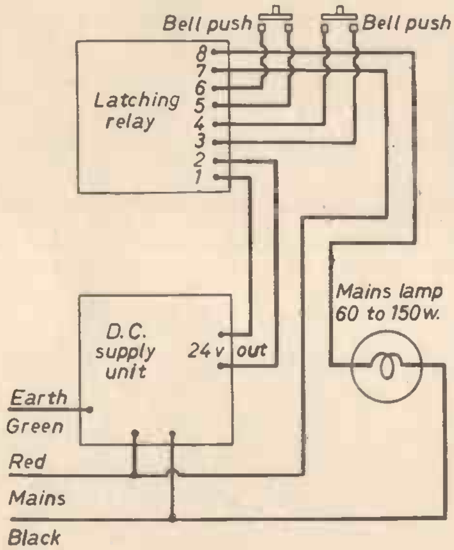


Fig. 15.—Using the relay for simple switching on and off with bell pushes.

the magnet is fixed in the position shown in Fig. 11 in the same way as described for the relay. The gap between the pole piece and the latch must be carefully set; it must be as small as possible, but at the same time it must be possible for the relay to pull in without the armature extension piece becoming jammed. If there is a tendency for the latch to stick to the pole piece when the latter is normal then a small copper rivet may be fixed on the armature (latch) opposite the pole piece, or a layer of adhesive tape fixed over the pole piece.

Wiring Up the Unit

The unit should be built on wood or a suitable laminate; metal should not be used. Do not earth relay cores, etc. This must be remembered when adjusting.

Study Fig. 13 and wire up carefully as shown. This figure is drawn up the other way to show how a spring may be used in lieu of gravity to keep the latch under pressure.

Use insulated copper wire of about 16 s.w.g. for wiring up and soldered joints wherever possible, employ resin-cored solder, and on no account any acid flux or Baker's Fluid. If stranded wire is used then make sure no odd strands remain unattached at joints so as to cause shorts.

Testing the Unit

Connect terminals 1 and 2 to a 24v. D.C. supply, batteries or mains unit. 12v. might suffice for test purposes and a car battery is suitable.

Momentarily short terminals 3 and 4 with a loop of wire. The armature should pull over and the latch will fall over it holding it. Observe that the contacts connected to 7 and 8 are now closed and could switch on a light, etc. Now touch terminals 5 and 6 with the loop and the latch will release the armature. Observe that the points connected to 7 and 8 are now open again in the normal position.

External Wiring

This is shown in Fig. 15. Any number of pushes may be fitted in parallel with those shown. Foot operation by momentary pressure may be arranged in a similar way to the staircase switch, but using a micro switch (Burgess Type BR/S.P.C.O.) mounted in one of the ways suggested in Fig. 16. Care must be taken that the travel is just enough to snap over the action as the over-travel is only 0·007in. Full foot pressure on the plunger after this over-travel is reached might damage the switch. Three terminals will be found on the switch; use the two marked "normally open." Suitable switches are available cheaply as surplus from Messrs. Whiston and Messrs. Milligans, Liverpool.

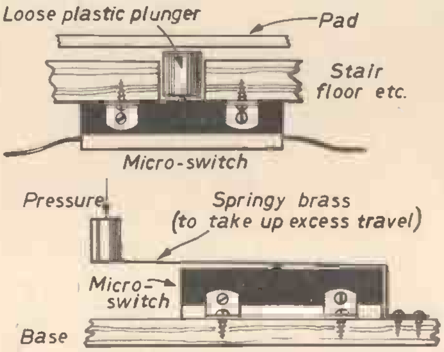


Fig. 16.—Fixing micro switches for foot operation.

The whole wiring system is only at 24v. except wires connected to terminals 7 and 8. 24v. is not considered dangerous from the point of view of shock, but can cause fire. However, fuses are fitted in the 24v. supply unit already described. Terminals 7 and 8 are wired in the mains/light circuit in place of a conventional switch. Good quality cable should be used and no bare wires are allowable. The wires to 1 and 2 may be quite small diameter as the maximum current required is well under ¼ amp. Bell wire is suitable if it is hidden, otherwise use Polythene-covered cable. The same wire will be quite suitable for use with the "bell pushes" which are wired to 3 and 4 and 5 and 6. A cheap and suitable press switch is Whiston's 3020c, or Arcoelectric S936.

The latching relay will require no maintenance other than point cleaning every 3-4,000 operations. It is virtually everlasting. It will be used in the thermal delay device to be described later, and in automatic door opening control gear.

No heat is generated in the device and it may be completely enclosed in an earthed metal container such as a biscuit tin. Care must be taken that children cannot open it and touch the two live contacts (7 and 8 in Fig. 15).

In many cases it is desirable that a light should be on for a set time and then go off. For instance, an outside light lighting the path to a garage. Passage lighting is another case in mind. Pressure of a bell-type push operates the lamp for a predetermined period. Two-way switching is sometimes not practicable.

Fig. 15 shows a latching relay wired to two bellpushes. The one wired to 3 and 4 is retained. This operates the system and the lamp lights. The bell push connected to 5 and 6 is replaced by a "thermal delay heater switch." Thus the latch is not lifted until some 30 secs. or 1 min. later.

Thermal Switches

These either come on, go off, or change over when heated. For this unit one coming on is required.

Various types are cheaply available for a few shillings. Messrs. Annakin market one, No. 1768, marked 10 F/9618, the principle of operation is shown inset in Fig. 19. Current entering the coil ef heats up the bi-metal which bends and eventually joins the independent contacts h and g. It is *not* suitable for direct mains operations.

A valve type vacuum relay marked (AP54103) is also available from Messrs. Annakin. This a better relay unaffected by dirt and external ambient temperature. The principal is much the same and the corresponding terminal connections may be seen in Fig. 17.

The Technical Services, Banstead, market a cheap form of bi-metal known as "Hi-Flex." This may be used for sensitive low current thermal switches. Thicker bi-metal marketed by the same firm will do for more robust instruments. Fig. 18 gives details of a home-made thermal switch. A small heater of a few few turns of 32g Nichrome wire wound on a mica strip is mounted near the bi-metal. Contacts are fixed, one on the bi-metal and

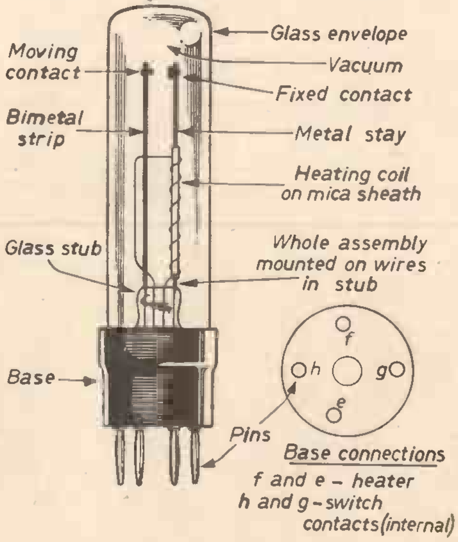


Fig. 17.—A typical surplus vacuum time delay relay (AP54103).

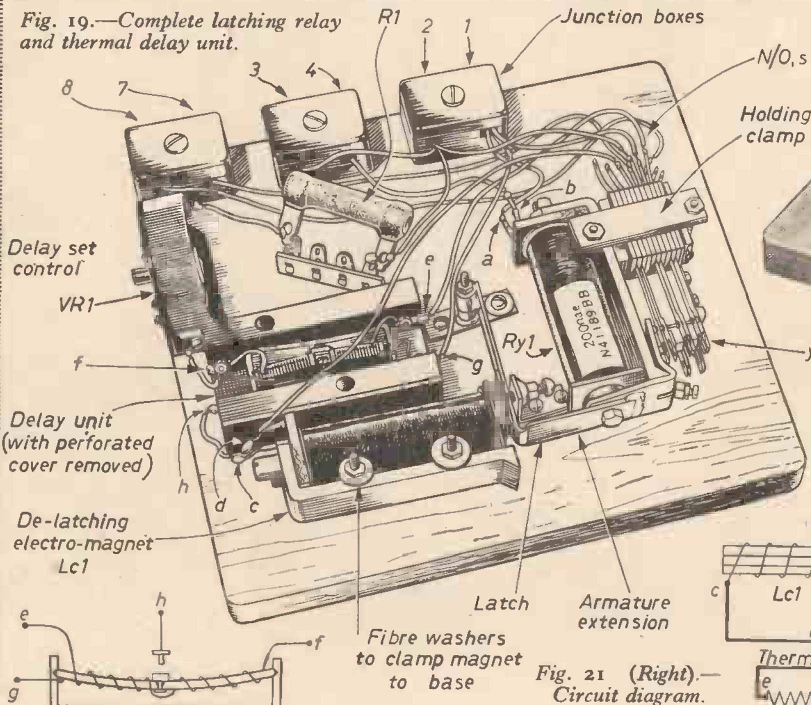


Fig. 19.—Complete latching relay and thermal delay unit.

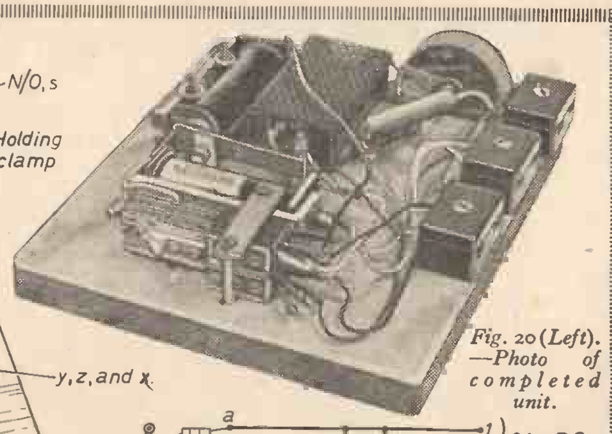


Fig. 20 (Left).—Photo of completed unit.

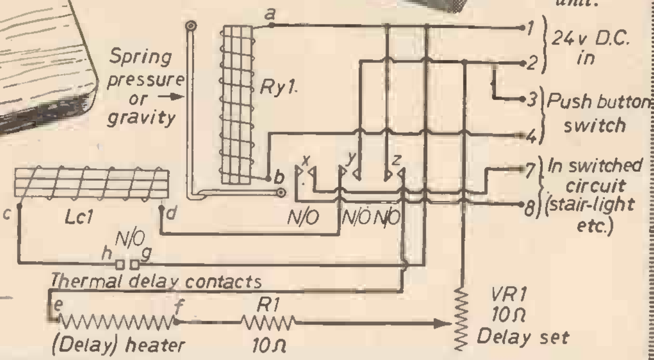


Fig. 21 (Right).—Circuit diagram.

one so that as heated the two contacts touch. Control may be gained by altering the length of wire used and the distance of the heater from the bi-metal. Further control is available by a variable resistance in series with the heater. A home-made thermal switch for low currents is shown in Fig. 18.

A good snap-action thermostat is marketed by Messrs. Whiston as No. 3024B. This will last in this application for ever, is adjustable, and comes *on* when heated. This may be used with a small heater placed nearby with excellent results.

Mounting the Components

The components should be mounted on Ebonite, wood or some other insulator. The layout is shown in Fig. 19. This is not critical as long as the latching relay works by gravity if so intended. R1 (which can be wired as in Figs. 19 or 21) is mounted on a tag strip away from the wooden base.

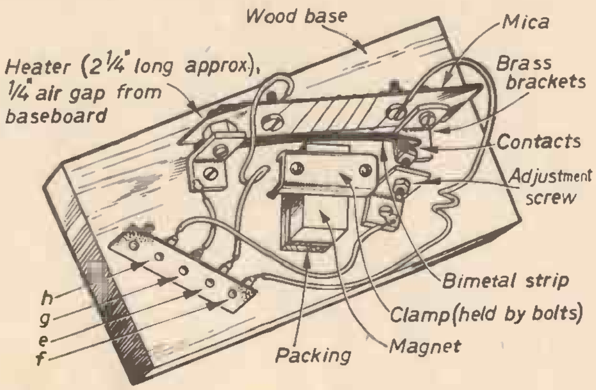


Fig. 18.—A home-made thermal delay switch.

VR1 is mounted so that the control may be external. Terminal blocks are fitted for safe wiring. The whole may be enclosed in a wooden case or earthed metal container. The amount of heat produced is very small and ventilation is not important; a few holes may, however, be drilled if constant operation is envisaged.

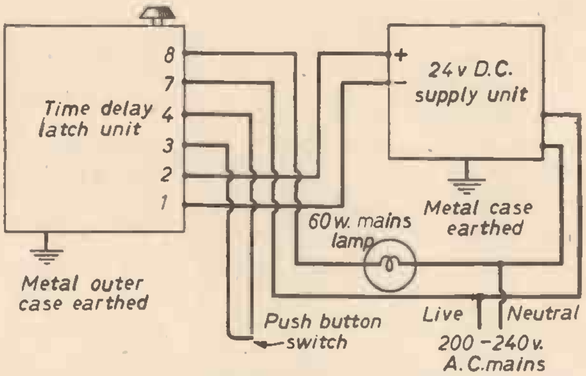


Fig. 22.—Wiring of staircase or passage delayed lamp, using latching relay (Figs. 19 and 20) and D.C. unit.

Wiring

The circuit is shown in Fig. 21. Pick out contacts on the relay which are normally open. R1 is necessary or you will burn out the heater fitted to the Annakin 1768 delay switch. When using home-made heaters it may not be necessary. VR1 is a heavy-duty variable resistance. Messrs. Milligans market one as S98FA, suitable for this purpose.

Use all soldered connections, insulated copper wire and cored solder. Externally wire up as in Fig. 15 but omit the wires and bell push connected to terminals 5 and 6 which are non-existent on the unit under consideration (see Fig. 22).

Adjustment

On trial, the time delay may be too small or too large. Increase of VR1 prolongs the delay. Further lengthening of the delay may be obtained by fitting a higher value to R1, say 20 Ω. This will depend on the individual thermal switch. Further adjustment is available at the contacts. The more they are moved apart the more the delay period. Generally, one minute is the maximum for the light to remain on. A photograph of the unit is shown in Fig. 20.

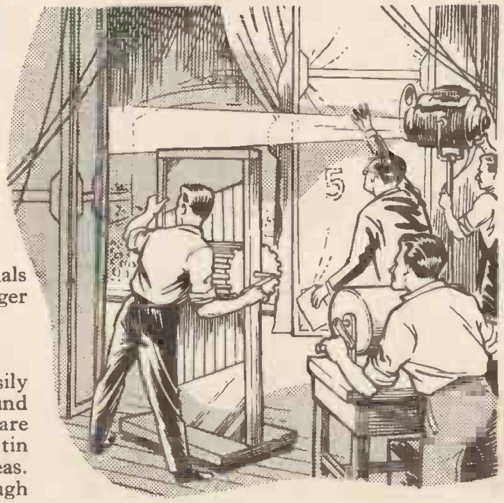
Relay Insulation

The switching part of most ex-Government Type 3000 relays is insulated for 24v. D.C. but the author has used them for many years on 240v. and has never had a breakdown. Type 3000 relays for 240v. and above operation may be purchased new. Readers using ex-Government ones readily available may like to remove the existing insulators and fit Perspex ones. Remember to deal with the small insulator on the armature, the leaves between the contact springs and the sleeves which will be found round the screws holding the wafer assembly in place.

(*To be continued*)

AMATEUR STAGECRAFT

3 Special Effects



Devices to add to your repertoire of sound effects. By C. C. Somerville

THE three basic ingredients which determine the mood in any production are; "Movement," "Spectacle" and "Sound." It is the producer's job to combine these to create a harmonious whole. The play carries its own movement and "Spectacle" has been dealt with when designing and building the scenery. It remains to consider "Sound," which obviously includes the actual dialogue of the characters, but there is more to it than that. Of course we assume that the cast all know their lines, but are we as sure of the revolver shot in the third act, or of the storm which opens the play?

Many plays call for special effects and their accurate suggestion helps to give reality to the performance. They must, however, be used with discretion. There is an old theatrical saying that sound effects, like scenery, should give the desired mood and then get out of the way.

Weather Effects

The weather with all its noise, ranging from the gentle patter of a summer shower to the crashes and downpour of a violent thunderstorm, plays an important part in the plot of many a play. Just how to create these effects may well pose a problem to many amateur groups. This is a problem which may be tackled by any handyman.

The various pieces of apparatus detailed in this article, though based upon professional machines, are so simplified that with a little ingenuity they may be built entirely from scrap. Few rigid dimensions are given since size is largely governed by the materials available. The general rule is that the larger the machine; the louder the noise.

Rain Machine

The rain machine shown at Fig. 1, is easily constructed from a large tin can, round biscuit tin or oil drum. Wooden slats are nailed at intervals around the inside of the tin and it is filled a third full with dried peas. The lid is soldered on, a handle run through the centre and then it is mounted upon a simple wooden stand as shown. By rotating the can the peas fall, hitting the slats to give the effect of rain. The intensity of the downpour is governed by the speed of rotation.

Thunder is easily simulated by suspending a sheet of galvanised iron from a suitable beam and shaking it to produce rolling thunder. For single crashes strike the tin in the centre with a rubber hammer or tennis shoe. The metal sheet should be approximately 4ft. long and 1ft. wide.

Wind Machine

The wind machine shown at Fig. 2 is constructed from a cylindrical drum consisting of two circular wooden ends, about 2ft. in diameter, joined by wooden slats set 2in. apart. This is mounted upon a wooden frame and heavy canvas stretched tightly against the drum which, when rotated by the handle, produces the sound of wind.

Fig. 3, illustrates a device which produces roars or the sound of creaking doors. Make a hole in the bottom of a large tin can, put a cord through it and knot it securely, then fasten the can to a wooden board. Powdered resin is put on a cloth or a canvas glove worn by the operator. He then pulls up on the cord. The pitch is varied by the tautness of the cord.

Various other effects need little in the way of apparatus to produce a realistic sound. A pistol shot is easily simulated without the use of a blank cartridge by snapping a yardstick or thin board on a hard flat surface.

Breaking glass is imitated by dropping a piece of plate glass wrapped in a sack. A more elaborate job can be made filling a wooden box with broken glass and a few stones and then nailing the lid on. By dropping or tipping the box end on end, various crashes, breaking crockery, etc., can be produced.

Two half coconut shells clapped on a wooden board give the sound of horses walking or galloping on a hard road. For hoof-beats on a soft road or turf use wallboard. Place small wire nails or lead shot inside a flat metal tin, move back and forth and you have a train chugging along.

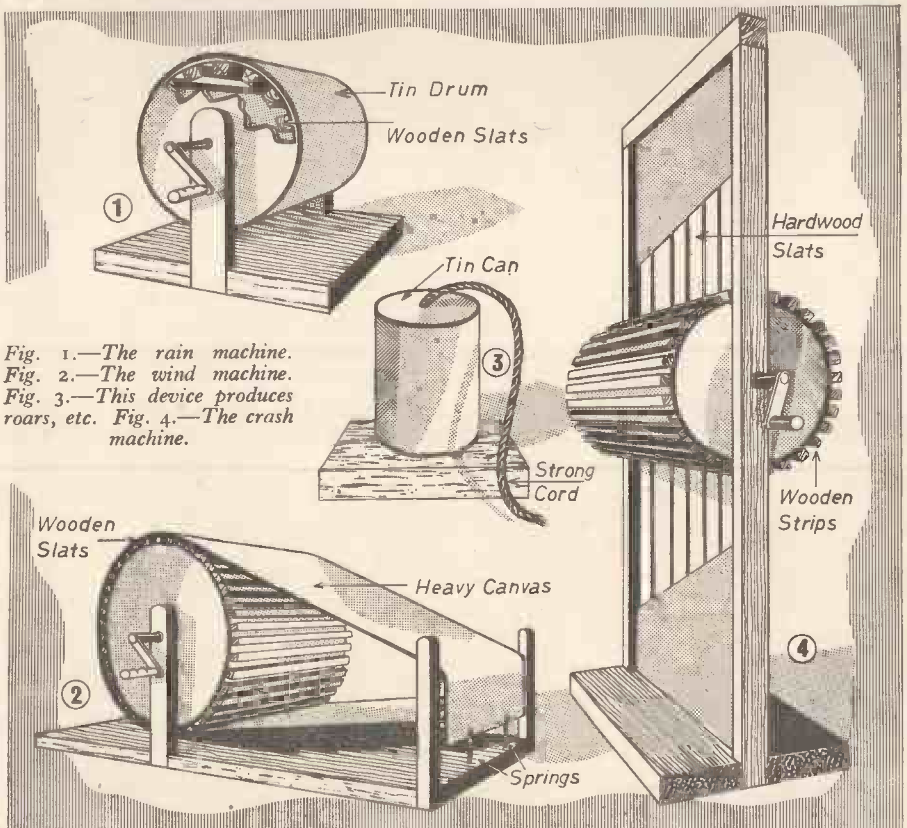


Fig. 1.—The rain machine. Fig. 2.—The wind machine. Fig. 3.—This device produces roars, etc. Fig. 4.—The crash machine.

The Crash Machine

Perhaps the most elaborate piece of sound apparatus found in the average theatre is the Crash Machine illustrated at Fig. 4. Basically it is a football rattle on a very large scale. Hardwood slats are held in a frame as shown, a cylinder with wood strips nailed lengthwise is allowed to strike the ends of the slats for the sound of breaking wood or a crash. The wooden cylinder is made the same way and the same size as that of the Wind Machine, and is in effect a giant cog-wheel.

Common Sound Effects

Besides such elaborate machines there are many sound effects which can be purchased from novelty, music and chain stores. Bird calls, boat sirens, train and police whistles are the most common. You can also get dog barks, cow moos and baby calls. Small sirens of various kinds can be bought in cycle and hardware stores. A doorbell, push-button and dry battery, mounted on a baseboard make a useful device for ringing telephones and doorbells. Also it is quite remarkable the number of sounds which the human voices can imitate when aided by a microphone.

Obviously, all these effects will not be needed in a single production, but as time goes on you will acquire a useful repertoire of sound effects which will save a lot of experimentation and will give an added polish to the show.

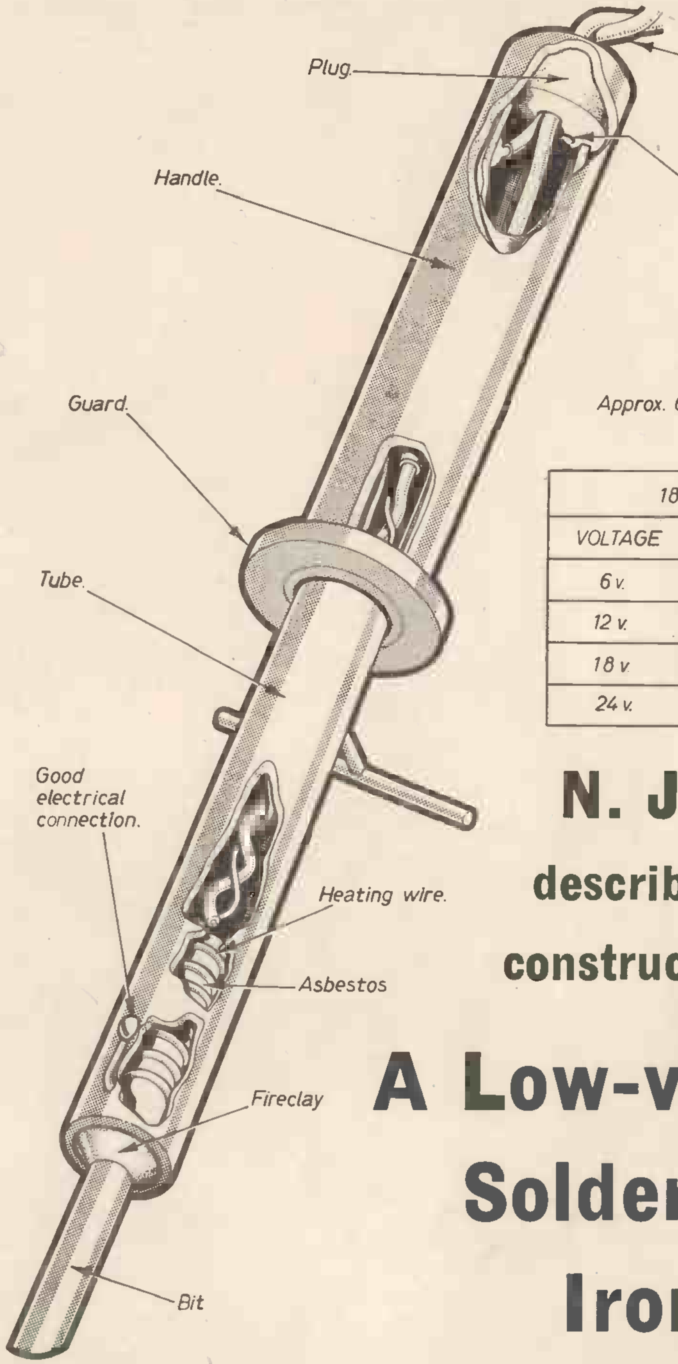
Materials Used

It will be found that most of the above mentioned devices can be improvised from odd pieces of material found in the workshop or obtainable at a small cost from local trades people.

N. J. Taylor describes the construction of A Low-voltage Soldering Iron

Ideal for soldering miniature Radio Parts

Most radio constructors, especially those whose interests lie in the building of delicate miniature equipment such as transistor receivers, must at some time or another have felt the need for a very lightweight soldering iron. Utilising parts from the " spares " box, the prototype cost only a few pence.



18 watt	
VOLTAGE	CURRENT
6 v.	3 a.
12 v.	1·5 a.
18 v.	1 a.
24 v.	0·75 a

The Body

The body of the instrument may be of any metal tube of approximately ¼in. bore. Brass, copper, steel or aluminium are all suitable materials, being stated above in the order of preference. This tube should be cut to length and its ends either turned or filed true.

The bit is simply a length of 10 or 12 s.w.g. copper wire, one end being filed to an angle of 30 deg. Around the bit is wound the heating element of resistance wire. If insulated resistance wire cannot be obtained, then bare wire may be used provided that a layer of insulating material is placed between the element wire and the bit. This layer should however, be thin or it will severely impede the passage of the heat from the element to the bit. A material suggested for this layer is thin asbestos sheet available from most model shops.

The Voltage

No wire size can be stipulated for winding the element since a number of factors must be taken into account, primarily, the voltage the iron is to function on, the current it is to draw and the type and properties of the wire to be employed.

It is not recommended that the voltage applied to such an iron should exceed 24v., due to its mode of construction, whilst a useful power to be aimed at should be in the region of 18-20 watts. If it is made to operate from 6v. then any 6·3v. heater transformer capable of delivering about 3 amps. can be used to satisfy its power requirements. The radio-control enthusiast may find it very useful to construct one that will operate off a small accumulator. The iron will function equally well on A.C. or D.C.

Wire Gauge

Perhaps the simplest method of determining what gauge of wire to use and how much of it it is required is to take various types and gauges of wire and experiment with them by winding lengths around the bit and connecting them across the intended supply. A suitable piece of wire will take about 18 watts from the supply when heating up the bit sufficiently to melt solder, bearing in mind the fact that when the element is encased in the main body the heat will be retained longer and a higher temperature will be reached. The element and bit should not be allowed to get too hot, however, or their lives will be greatly shortened.

The Leads

For connection to the supply some flexible leads capable of carrying the working current, without themselves overheating, are required. One lead is bared for about 1½in. and tightly twisted together with the inner end of the element wire (see sketch). It is of very little use soft-soldering this joint as the solder would simply melt—though silver soldering should prove satisfactory if it is thought to be necessary.

The whole element and bit assembly is now rolled in asbestos sheet until it is a tight fit in the main body of the instrument. The asbestos should cover both the element and the bared section of the lead out to prevent it from short-circuiting to the body of the iron. If difficulty is experienced when sliding the element assembly into the body, the tube can be split lengthways for about half of its length, using a fine hacksaw blade. The two halves are then opened out slightly and the element can be easily slipped in. The two halves are then closed up again in the vice and bound with wire. The results are quite secure. When the element is in place, its outer wire end should be bared and connected to the body of the instrument, either by binding it with wire, or by using a small screw, fitting into a tapped hole in the body. The other flexible lead is connected to the back end of the tube by similar methods, or by soldering; this end of the tube will not attain sufficient temperature to melt the joint.

The Handle

A handle is next fashioned from a piece of wood or plastic tube of suitable dimensions. An ideal handle can be made from a length of garden cane. The body tube is bound with asbestos sheet until it is a tight fit inside the handle, a spot of adhesive being added to hold it in its place. At this point the asbestos should form a fairly thick layer to prevent the handle from becoming uncomfortably hot. The guard on the handle is made from similar material to that employed for the handle itself, and is glued into position.

Completion

To complete the construction, the end of the tube nearest the bit is plugged with fireclay and a wooden plug is glued into the handle end to prevent the leads from being pulled out.

The prototype iron reaches working temperature in slightly less than 45 seconds from being switched on, and its heat capacity proves sufficient for most small soldering jobs.

No dimensions are quoted on the drawings because these depend purely upon the parts which are available.

THE craft was designed to explore the inland waterways of this country and, possibly at a later time, tidal estuaries and serene seas might be attempted.

The narrowest locks on British Waterways will take a boat of 6ft. beam, so this was adopted for the cruiser.

As the boat was to be towed behind a small family car, careful consideration had to be given to the ease of loading and unloading from the trailer as well as the capability of the car to tow the vessel. It was estimated that the finished boat without the various living impedimenta and outboard motor would weigh about 6cwt.

A cabin was required for sleeping and in which to eat, and this has a top on which sunbathers can recline. The design shows the cabin extending back to Frame 4, the cooking and toilet arrangements being restricted to the open well. By simple modification, the cabin could be extended another section aft and the cooking arrangements and a small toilet built into the additional section of cabin. Another arrangement would be to have small cabins fore and aft, separated amidships by a small open well.

The Engine

As the boat was likely to be moved about ashore so frequently it seemed better not to have the exterior encumbrances in the form of a propeller and rudder necessary with an inboard motor. The inboard motor, too, takes up valuable floor space. The obvious choice of motive power was therefore the outboard motor.

This cruiser is a "displacement" type boat, i.e. it passes through the water and not over the surface as would a speedboat. Because of this important fact the boat has a basic maximum speed no matter what engine is used. The marine engineer provides a simple formula which enables the maximum speed of a displacement-type hull, such as this, to be determined. The maximum speed in knots is equal to the square root of the length of waterline, multiplied by 1·5.

Thus as this craft is about 15ft. waterline the maximum speed will be $\sqrt{15} \times 1{\cdot}5 = 5{\cdot}8$ knots.

Size of engine, then, is not of primary importance. The power thrust imparted by the propeller is important and is closely bound up with engine design, reduction gears and design of the propeller itself. Bear in mind that a larger-capacity engine running at a small throttle opening will give a quieter and more economical cruising performance than a small-capacity engine running at full throttle. For cruising on inland waterways, an engine such as the British Seagull Century, Anzani Super Single 5 or other manufacturers' engines of similar rating can be recommended.

The frames are glued and bolted together, using 2in. × ¼in. galvanised gutter bolts, with nuts and washers. For the glued work in the boat, one of the well-known waterproof glues such as Aerolite must be used. The skin is glued and screwed in place with ¾in. × No. 6 brass countersunk head screws. Some boat-

The P.M. 2-berth Cabin C

Design details and commencing construction

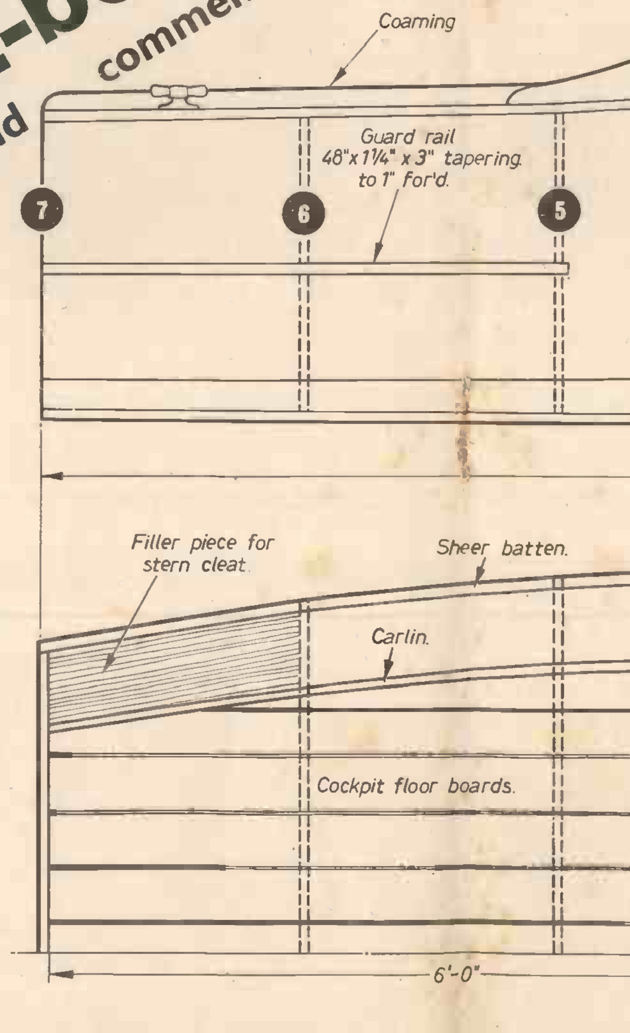


Fig. 1.—Frame 1 braced in position on the building form.

Construction

A side elevation and half plan of the cruiser are shown in Fig. 3. These views give the principal dimensions of the hull and show the disposition of the frames, battens, carlins, etc.

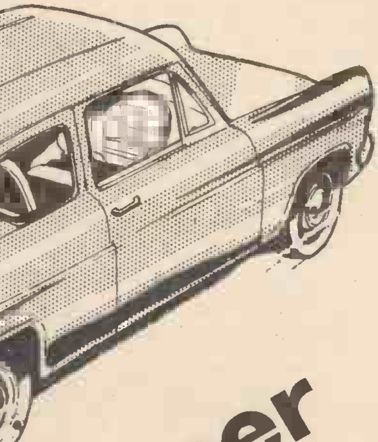
Materials Used

Whilst a list is given on page 351 of the ideal timber to use for the various parts of the boat, it is quite permissible for the constructor to use other timber if he wishes. For example, in place of mahogany one might use the cheaper timber Parana pine.

The stem, keel, hog and frames should be of mahogany. The chines, gunwales and stringers are of spruce. For the hull topsides and bottom sides, mahogany plywood $\frac{3}{16}$in. thickness to B.S.S. 1088 specification should be used. This plywood is particularly suitable for marine use as it is extremely resistant to the effects of prolonged contact with water.

For the floors ordinary deal flooring, 1in. × 6in., may be used or alternatively Parana pine. This latter timber can be used for most of the interior fitments.

The decks, cabin sides and roof are made from ¼in. plywood to the B.S.S. 1088 specification.



Cruiser

By F. Hook

builders economise by using galvanised steel screws instead of brass.

The Stem

From the diagrams it will be apparent that there are seven frames (including the transom) and a stem to support the skin of the boat. These items should be made first of all.

Details of the stem are shown in Figs. 2 and 4 and the timber to use is mahogany, 3½in. × 2½in. finished sizes after planing. The block used to bolt the two pieces together is cut from a piece of timber about 2ft. in length and 6in. wide and finished to 2½in. thickness.

Fig. 4 gives the disposition of the first frame and the building form. In arriving at the angles to which the various parts of the stem should be cut it is better to set out the details of Fig. 4 to full size on one of the sheets of plywood to be used for the hull covering. The setting out of the timber is then very easy to achieve from this plan.

It will be noticed that the bolts holding the two parts of the stem to the strengthening block are at right angles to these members. This makes it necessary to cut four steps on the inside edge of the block. The three parts may then be held in position with some large

Fig. 2.—Bolting the stem pieces together.

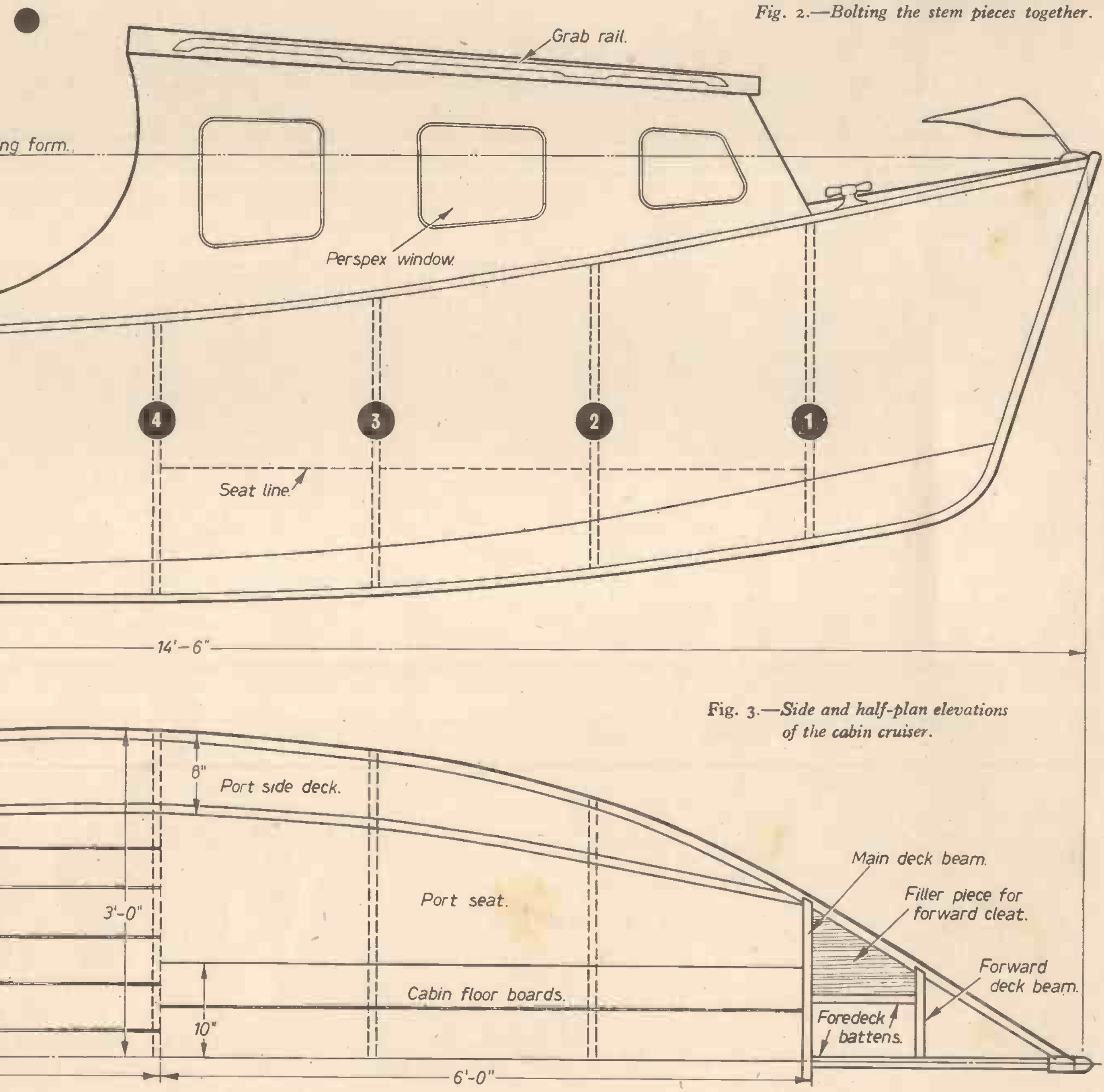


Fig. 3.—Side and half-plan elevations of the cabin cruiser.

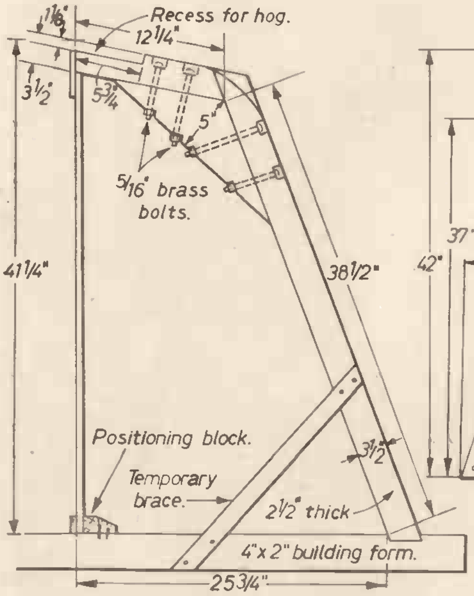


Fig. 4.—The construction of the stem.

G-cramps to test the fitting together of the surfaces. Very careful adjustment must be made with a smoothing plane so that good mating is achieved between all surfaces.

Brass bolts are specified for holding together the three parts of the stem. It may be difficult to obtain such bolts and recourse may be had to using galvanised bolts. An alternative method is to use some ¼in. brass rod which is threaded each end and fitted with brass nuts and washers. The nuts on the outside ends must be countersunk into the stem about 1in. This may seem a lot, but later when the stem is trimmed up to take the skin covering, a lot of wood has to be removed at these points. Nothing is so annoying in the progress of the work than to have to take out these bolts and deepen the holes in which the heads rest.

When all is bolted up satisfactorily in a dry state the assembly may be taken down and glue liberally applied to all mating surfaces and the stem then reassembled and set aside to dry.

Later the recess to take the hog may be cut and the stem is then ready to set up on the building form.

Frame Construction

Dimensions of the frames are given in Fig. 5.

When constructing the frames it is advisable to draw out full-size plans of each frame on one of the sheets of plywood used for covering the hull. The angles of the ends of the individual members can thus be easily determined, sawn to shape and placed in position on the plan. The assembly can be temporarily held together with some small G-cramps whilst the ¼in. holes for the bolts are drilled (Fig. 6).

It is important to bear in mind the position of the chine batten and arrange that bolt holes do not come too close to the notch which takes these members.

When the frame is correctly assembled and bolted together, it may be taken apart and glue applied to the joints. The whole assembly is then bolted together again and finally placed in position on the full-scale plan to check for accurate reassembly.

The tie beams or stretchers at the upper or deck end of the side futtocks are only temporary, and at a later stage of construction, when the cabin is constructed, these pieces are removed. Therefore almost any odd pieces of timber about 3in. × 1in. section can be used. If only new timber is available then of course these pieces may be used for interior fitments of the cabin later on.

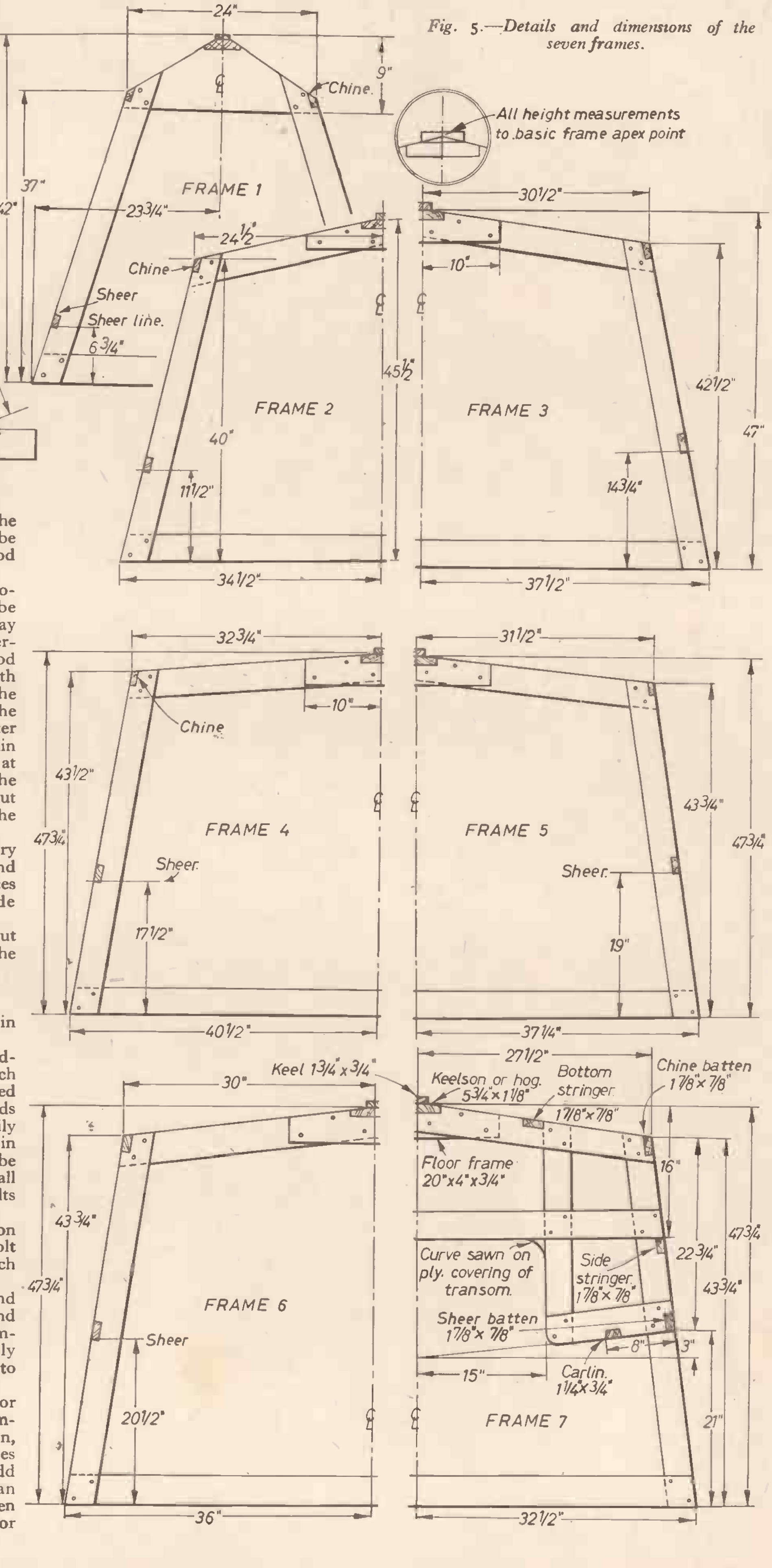


Fig. 5.—Details and dimensions of the seven frames.

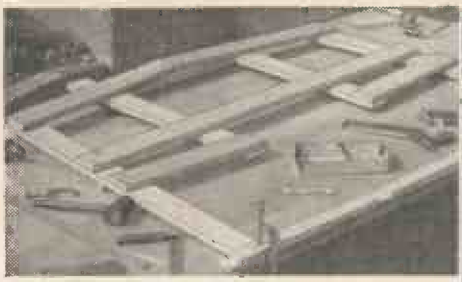


Fig. 6.—*Frame assembly temporarily cramped together.*

Fig. 7 (*Left*).—*Levelling up the building form.*

Fig. 8 (*Below*).—*All the seven frames in position.*

When the frames are assembled upon the building form, it is important to note that the sides of the frames or the side futtocks are on the end towards the stem and the bottom futtocks are towards the stern. The floor support (20in. × 5in. × ¾in.) joining the bottom futtocks is towards the stem.

As each frame is glued together it is important to wipe away every trace of surplus glue with a damp cloth. This resin glue sets glass hard and will ruin the edges of cutting tools if it has to be planed away.

Whilst the frames are resting on the full-size plan it is advisable to mark in quite clearly the position of the sheer batten on the side futtocks.

It should be noted that the frames Nos. 1, 2, 3, 5, 6 and 7 will have to have the outer edges of the side futtocks bevelled away to correspond with the curve of the chine and sheer battens. Frames 1 and 2 are particularly sharply bevelled and it is helpful to take off a good deal of this bevel before assembling the frames on the building form. Final truing of these bevels can only be done when all the frames are assembled in place.

The Transom

Frame 7 is called the transom and it is different from the other frames in that it is covered with ¾in. plywood and a well has to be cut in order to accommodate the outboard engine. Additional battens have to be screwed and glued to the transom frame in order to strengthen the cut-away part of the plywood covering. Further filler pieces may then be secured on the other side of the frame, thus making the transom twice as thick as the other frames. This additional strength is important as rigidity is necessary to cut down vibration from the engine throughout the boat to a minimum.

The building up of the transom should be carried out as described, but the plywood covering is left until the other skin panels are applied. The transom covering is put on last and will thus cover the ends of the sheer and chine battens and the ends of the skin covering.

The Building Form

When the frames and stem are completed, attention may be given to the setting up of these members on the building form. The finding of a suitable site for building such a boat as this is always difficult. A shed or other building with a level wooden floor is ideal. The frames could then be held directly to the floor with screws and bracing battens. Many readers will only be able to use the lawn at the back of the house, and such was the case with the boat shown under construction. Choose as level a site as possible and down the centre of it lay down a piece of 3in. × 2in. deal 16ft. in length. By using odd pieces of wood as packing under the 3in. × 2in., level up the batten with a spirit level (Fig. 7). The batten should also be dead straight from end to end and should be held in this position with some 1in. × 1in. × 18in. pegs driven into the ground on either side. Drive these pegs in at different angles. This will key the batten to the ground so that it cannot be pulled up by tension applied to the frames when fixing the keelson and other longitudinal members. The pegs should be screwed to the batten.

Along this building batten, the position of each frame must be clearly marked and a line squared across. At these positions odd blocks of 3in. × 2in. are screwed, against which the top stretchers of the frame assemblies may be screwed. All the frames are 24in. apart.

First of all erect Frame 1 in position and screw it to the block on the building batten. Brace the frame with odd pieces of 2in. × 1in. so that it is vertical both lengthwise and transversely and test down the centre line of the frame with a plumb line or a spirit level as used by a bricklayer. The frame should also be at right angles to the building form. This first frame must be very securely braced, as it must take quite a bit of pushing and pulling during the course of building.

The other six frames are erected in place and securely braced, vertical in two directions and square with the building form (Figs. 1 and 8).

(*To be continued*)

MATERIALS REQUIRED FOR THE HULL

These materials are listed in approximate order of being used so that the reader may order timber from time to time as required.

Item	No. of pieces	Sizes after being planed all round
The stem	1	5ft. × 2½in. × 3½in.
	1	2ft. × 2½in. × 6in.
Frame 1		
Side futtocks	2	3ft. 6in. × ¾in. × 3½in.
Bottom futtocks	1	2ft. 6in. × ¾in. × 3½in.
Stretcher	1	4ft. × ¾in. × 3½in.
Frame 2		
Side futtocks	2	4ft. × ¾in. × 3½in.
Bottom futtocks	2	2ft. 3in. × ¾in. × 3½in.
Stretcher	1	5ft. 9in. × ¾in. × 3½in.
Floor support	1	20in. × ¾in. × 5in.
Frame 3		
Side futtocks	2	4ft. × ¾in. × 3½in.
Bottom futtocks	2	2ft. × ¾in. × 3½in.
Stretcher	1	6ft. 3in. × ¾in. × 3½in.
Floor support	1	20in. × ¾in. × 5in.
Frame 4		
Side futtocks	2	4ft. × ¾in. × 3½in.
Bottom futtocks	2	3ft. × ¾in. × 3½in.
Stretcher	1	7ft. × ¾in. × 3½in.
Floor support	1	20in. × ¾in. × 5in.
Frame 5		
Side futtocks	2	4ft. × ¾in. × 3½in.
Bottom futtocks	2	3ft. × ¾in. × 3½in.
Stretcher	1	6ft. 6in. × ¾in. × 3½in.
Floor support	1	20in × ¾in. × 5in.
Frame 6		
Side futtocks	2	4ft. × ¾in. × 3½in.
Bottom futtocks	2	2ft. × ¾in. × 3½in.
Stretcher	1	6ft. × ¾in. × 3½in.
Floor support	1	20in. × ¾in. × 5in.
Frame 7		
Side futtocks	2	4ft. × ¾in. × 3½in.
Bottom futtocks	2	2ft. 6in. × ¾in. × 3½in.
Stretcher	1	5ft. 6in. × ¾in. × 3½in.
Floor support	1	20in. × ¾in. × 5in.
Middle cross piece	1	5ft. × ¾in. × 3½in.
Top pieces	2	1ft. 6in. × ¾in. × 3½in.
Vertical pieces	2	2ft. 6in. × ¾in. × 3½in.
Additional filling pieces	1	about 5ft. 6in. to 6ft. × ¾in. × 3½in.
Galvanised nuts, bolts and washers gross	1	2in. × ¼in. Whitworth
Building form	1	16ft. × 2in. × 3in.
Bracing battens	—	about 50ft. × 1in. × 2in. (random lengths)
Keelson	1	15ft. 6in. × 1⅛in. × 5⅞in.
Chine battens	2	16ft. 6ins. × ¾in. × 1¾in.
Sheer battens	2	16ft. × ¾in. × 1¾in.
Side stringers	2	16ft. × ¾ × 1¾in.
Bottom stringers	2	14ft. × ¾in. × 1¾in.
Keel	1	15ft. × ¾in. × 1¾in.
Plywood covering	8	8ft. × 4ft. × 5/16in. Marine ply
Jointing strips for panels	4	2ft. 6in. × ¾in. × 1¾in.
Transom panel	1	5ft. 6in. × 2ft. 6in. × ¾in. Marine ply
Aerolite glue		4lbs.
False stem	1	4ft. × 2in. × 3½in.
Rubbing strips	6	1½in. × ¾in. half-round moulding
Seelastic		4 tubes
Brass screws gross	8	¾in. × 5 c/s head
Brass screws gross	1	1½in. × 8 c/s head
Brass screws gross	1	2in. × 8 c/s head
Galvanised screws gross	1	2in. × 10 c/s head
Paint gal.	½	priming
Paint gal.	½	under coat
Paint gal.	1	top coat
Stopping lb.	½	
Windows	—	rubber moulding and Perspex to patterns
Transom knees	3	1ft. 3in. × 1½in. × 9in.
Floor boards for cockpit	9	6ft. × ⅞in. × 5⅞in.
Floor boards for cabin	4	6ft. × ⅞in. × 5¾in.
Side deck carlins	2	15ft. × ¾in. × 1½in.
Shelf	2	15ft. × ¾in. × 1½in.
Coamings	2	7ft. × ¾in. × 5¾in.
Quarter rubbing strips	2	4ft. 6in. × 1½in. × 3in.
Filler pieces for bollards	2	2ft. × 1½in. × 7in.
	2	1ft. × 1½in. × 7in.

Materials for cabin and decks will be listed later in the series.

SILICA GARDENS

This is an ideal subject for close-up photography enthusiasts and as a novelty it will attract much attention.

By G. I. Lilley

PREPARATIONS for making a silica garden are simple, although the mechanism by which it developes is a little obscure. If certain crystals are placed in a solution of sodium silicate (water-glass) a layer or shell of metallic silicate quickly forms to cover each crystal. The layer, however, being colloidal and of a semi-permeable nature causes the outside silicate solution to be drawn inside the shell by virtue of the osmotic pressure it gives rise to. Beyond a point the shell bursts and the strong solution inside is freed and immediately reacts with the silicate solution to form a further shell. Thus long strings of burst shells grow out from each crystal to form the silica garden. All this bursting and re-growing takes place on a microscopic scale and the result as far as the naked eye can see is long, delicate growths of superb texture and form.

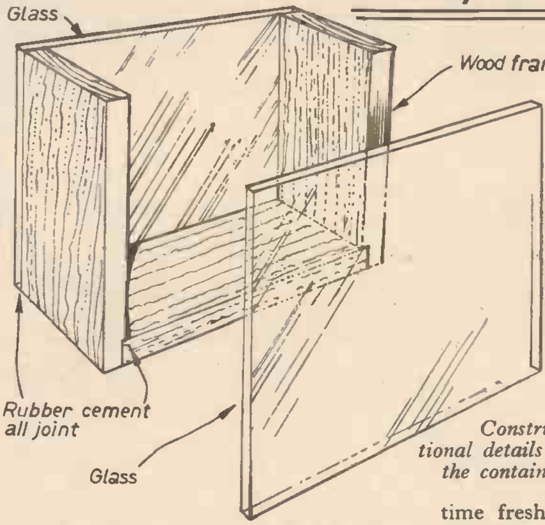
The Crystals

Several different types of crystals may be used, such as manganese chloride, cobalt nitrate, and copper sulphate, the latter probably being the most readily available. The solution of sodium silicate used is quite weak, two or three teaspoonfuls in a small jar of water being quite sufficient. Some workers may wish to experiment to find the effects upon the growth of varying the strength of the solution.

The Container

As a novelty for observation only, a garden may be grown in a small, round jar, a one-pound size jam jar being quite suitable. As a subject for photographing, however, it will be necessary to use a flat-sided glass tank.

This may be quite simply made by sticking two sheets of glass to the front and back surfaces of a three-sided wood frame, the whole being assembled with Bostik. Alternatively the wood may be grooved for the glass if a suitable plough plane is available.



Constructional details of the container.

The inside surfaces of the wood parts should be given a good coat of varnish or paint, since otherwise the wood would absorb moisture and quickly warp away from the glass when the tank was filled.

A layer of silver sand in the base of the tank provides a natural-looking ground for the silica growth, and best results are obtained by using a black backing behind the tank. For a better quality picture it is a good plan to change the silicate solution for pure water before taking the photographs, since the former tends to become slightly cloudy after standing. This may be achieved by syphoning out with a small rubber tube while at the same time fresh water is being poured in the top.

SCIENCE Notes

The Antidote to Oil-Pollution

AFTER recent experiments Polycell Limited state that their product Polyclens has been proved the most effective and economical means of dispersing oil-pollution from beaches, etc. It is a combination of surface-active agents and solvents, being neutral, non-toxic and completely safe to handle. It acts on all oils and once the oil has been dispersed it cannot re-form. The method used is to spray the Polyclens on the affected surface and allow time for emulsification and then hose off or wait for the incoming tide to wash it away. Polyclens has already been used with success on several of our beaches.

Transistors Aid Smoke Detection

A NEW pair of smoke control units using transistors is now available. The smoke alarm type CCSA is designed to fill the need for a low cost unit to enable the small installation to comply with the Clean Air Act at a low cost. The light beam projector throws a beam across the stack on to the photocell mounted in a receiver unit. The output from this cell (which varies with the amount of smoke passing up the stack) is passed to the Control Unit which contains a transistorised amplifier and control relay as well as indicating lights, alarm set-point control and alarm checking switch. The smoke density indicator type CCSI unit provides all the alarm facilities of the CCSA type plus a smoke density meter. The makers are Photoelectronics (M.O.M.) Ltd., Oldfields Road, Sutton, Surrey.

Sound Level Meter

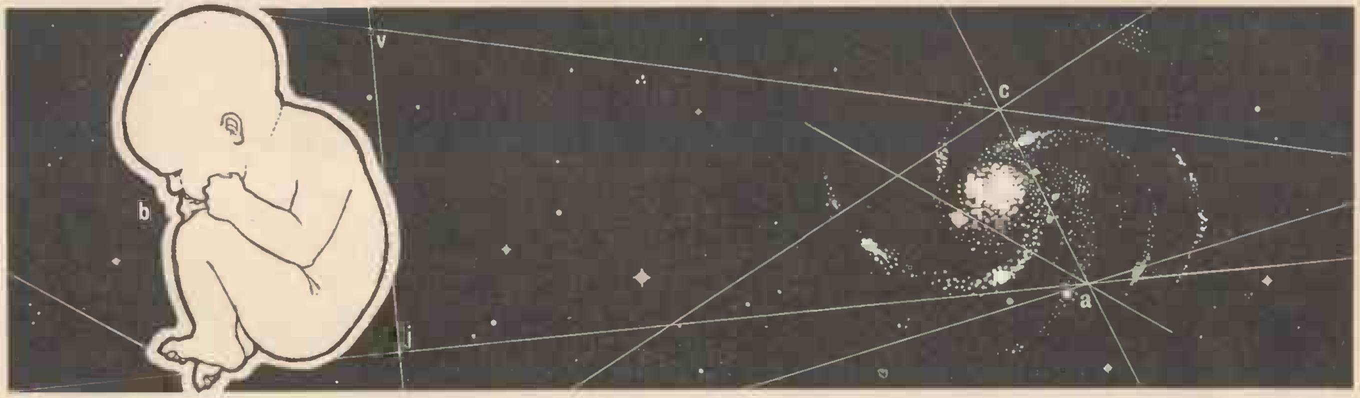
THE location of sources of noise and the determination of the exact nature of a given noise both demand the use of reliable instruments. The Type 1400E Sound Level Meter, claimed to be the first commercial fully transistorised unit of this type in the world has been designed by Daw Instruments Ltd., of 99 Uxbridge Road, London, W.5, with the transport industry particularly in mind. By the replacement of all electronic valves with transistors powered by built-in dry batteries, the new instrument has been fully self-contained with an overall size of only $8\frac{1}{4}$ in. × $5\frac{3}{4}$in. × $3\frac{3}{4}$ in. and a weight of under 4 lb. It can be operated readily with one hand while the other is used to note readings.

Automorse

NOW ready for commercial release is a revolutionary Scandinavian invention that enables anybody not conversant with telegraphy to operate a telegraph transmitter in morse code. The machine, called the Automorse, resembles a typewriter and has the same kind of keyboard. It is also used in the same way after having been connected to the transmitter. It is of great value in cases of emergency or where there is a shortage of trained personnel. In tropical areas and in northern regions where radio teleprinters do not work reliably owing to static, this machine will secure communication. It is equally useful as a means of communication on land, sea and in the air.

The Scandinavian Automorse.

PLANETS and UNIVERSAL LIFE



By William Ellwood

Part one • the origin of the planets

SINCE Man first lifted his gaze to the mighty arch of the heavens, the stars and planets have symbolised for him the mystery of the Universe. He is, with them, an integral part of a vast plan conceived within the eternity of space and time.

In his search for truth, it is inescapable that Man should dwell upon the probability of life beyond the confines of his own planet. The stars in their millions testify to the possibility of planetary systems, wherein the very dust of the physical world may quicken into life; a life which is no frail, transient manifestation compared with life on Earth, but a vigorous and well developed form probably transcending ours in mental accomplishment.

As the quest for sentient life other than our own may lead us well beyond the confines of the Solar System, it is essential to consider how the latter evolved for at present it is the only concrete example of a planetary system that we are aware of. There are two diametrically opposed theories concerning the evolution of the Solar System, viz: the dualistic and monistic theories. Most other theories are but variants of these two. As the name implies, the dualistic concept involves the presence of two bodies—the Sun and another star. The monistic concept relies entirely on the natural development of one star, that is, the Sun.

The Dualistic Theory

This is a concept of violence and accident which postulates a tangential collision between the Sun and a wandering star. Before and after impact matter was drawn from both bodies by the gravitational attraction of the respective stars. As the wanderer escaped it would take with it certain material from the Sun. Conversely, the Sun would retain within its gravitational field certain discrete masses of the extracted matter. These separate masses would be pulled into orbit around the Sun, thus becoming rudimentary planets.

At first view this theory seems feasible, but when analysed two great weaknesses emerge. Firstly, it fails to satisfy the known angular momenta of the planets. This angular momentum per ton of a planet is dependent on the planet's distance from the Sun and its velocity at right-angles to a line connecting planet and Sun. If the angular momentum per ton of the Earth is taken as unity, the respective values for the internal (Mercury) and external (Pluto) planets are about 0·5 and 6·0. If the wandering star approached the Sun almost directly, its angular momentum relative to the Sun would be virtually nil. Alternatively, if it passed within two or three million miles of the Sun, which is a reasonable maximum if one considers that the star's attractive power had to overcome the retentive power of the Sun; the angular momentum per ton of the star would still fall below 0·5. This means that the average angular momentum per ton of the Solar planets is far in excess of that credited to the passing star—which is supposed to have given them birth from the Sun.

Planet	*Distance from Sun (in millions of miles)*	*Diameter (in miles)*	*Density (on scale Earth = 1)*
Mercury	36·0	3,100	0·93
Venus	67·2	7,700	0·90
Earth	92·9	7,913	1·0
Mars	141·5	4,200	0·71
Jupiter	483·0	85,000	0·24
Saturn	886·0	71,000	0·12
Uranus	1783·0	31,000	0·25
Neptune	2793·0	33,000	0·24
Pluto	3666·0	—	—

Table 1.—The Solar Planets.

The second weakness is the improbability of such a collision or " near miss " occurring. The nearest star to the Sun is some 25 million million miles away. Sir James Jeans computed that any given star would probably experience collison in 6×10^{17} years (600,000 million million years). From this we see, that should star collision be the means of creating planetary systems; then indeed the prospects for life in other parts of the Universe are greatly diminished. However, as the first weakness of the dualistic theory disproves that a wandering star was involved; and the second weakness further disproves or casts doubt on the theory: we must look elsewhere for a reasonable solution to the problem.

Our Star the Sun

Before discussing the second theory, we shall briefly review the Sun and its system of planets as they are known today (Table 1). The Sun or primary star of our planetary system is 864,000 miles in diameter. Pluto, the external planet of the system has a mean orbital radius of 3,666 million miles; whilst the mean distance of Mercury from the Sun is 36 million miles. Besides the planets and planetoids (wrongly named asteroids), the Sun controls the movement of many meteor streams and comets. These in many cases pursue extremely elongated orbits and pass well beyond the general confines of the Solar System, only to be recalled time and time again by the Sun's gravitational force.

The Sun, apart from pursuing a proper course within the galaxy, also possesses an axial rotation. This rotation varies with latitude. Thus, at the Sun's equator, the *photosphere* or sphere of light, has a rotational period of 25 days; whilst in polar latitudes it amounts to about 34 days. From this it is obvious that the Sun's surface must be of a gaseous nature. Indeed, it is present-day opinion that the Sun in its entirety is a gaseous body. The temperature within the photosphere is approximately 6,000 deg.C. The sunspots or storm centres of incandescent vapours which are observed on the Sun's disc

Fig. 1.—Solar prominences photographed from Sobral, Brazil in 1919 during a total eclipse of the sun. Photo: Royal Astronomical Society.

occasionally, vary in persistency and magnitude. Many of these cyclonic centres could, however, engulf the Earth, Uranus or Neptune.

Above the photosphere is another gaseous shell of flaming hydrogen, helium and calcium vapour, extending to a height of some 10,000 miles beyond the limits of the photosphere. This is called the *chromosphere*. In sudden eruptions called prominences, these flaming gases may attain heights of 400,000 miles above the *photosphere*, at velocities exceeding 20 miles per second (Fig. 1).

Birth of the Planets

The monistic or star evolution theory related to the origin of the Solar System planets is by far the most acceptable from a scientific point of view. The theory was formulated by Thomas Wright of Durham and later adopted by Kant, the German philosopher. It proposed that the Solar System was at one time a diffuse nebula in which the heavier elements tended towards the centre. Many difficulties were encountered, however, when the rotational movement of the system had to be considered in conjunction with other essential requirements particularly that concerning the principle of conservation of angular momentum. Kant and Laplace in turn tackled the complex problem, but we shall pass immediately to a consideration of the theory as developed by Weizsacker.

The Sun's Nebula

He postulated the Sun in its early state to be surrounded by a gaseous shell or nebula, the latter being about the same diameter as the present Solar System. Both the Sun and this gaseous shell were imagined as possessing a common rotational movement. In time, the shell consisting of various gases and fine particles of matter would assume a disc form (See 1 and 2 of Fig. 2), orbiting in a plane approximate to the Sun's equatorial plane. The forces inherent in such an arrangement of close-orbiting particles would tend to slow up the faster circulating inner portions of the disc, thus causing them to draw nearer to the Sun; whilst the slower circulating outer parts would be speeded up, thereby causing them to move farther away from the Sun. In this we can see a transfer of angular momentum from the inner parts of the disc system to the outer parts. Annuli would be created. (See 3 and 4 of Fig. 2.)

Secondary Eddies

At this stage Weizsacker postulates the formation of elliptical vortices within each annulus or circulating band of particles (Fig. 3). The rotational movement of each vortice would be opposite to that indicated for the orbiting annuli. It is apparent from such an arrangement that the velocity gradient existing between an inner ring vortice and its neighbouring outer ring vortice, would be extremely steep due to the two vortical streams flowing in opposite directions. This would result in secondary eddies of an axial form. They would revolve in the opposite direction to the matter in the vortices, and therefore in the same direction as the annuli. These eddies would present favourable conditions for the condensation of particles stripped from the vortices. These condensation centres do in fact represent the primordial matter from which the Solar planets grew.

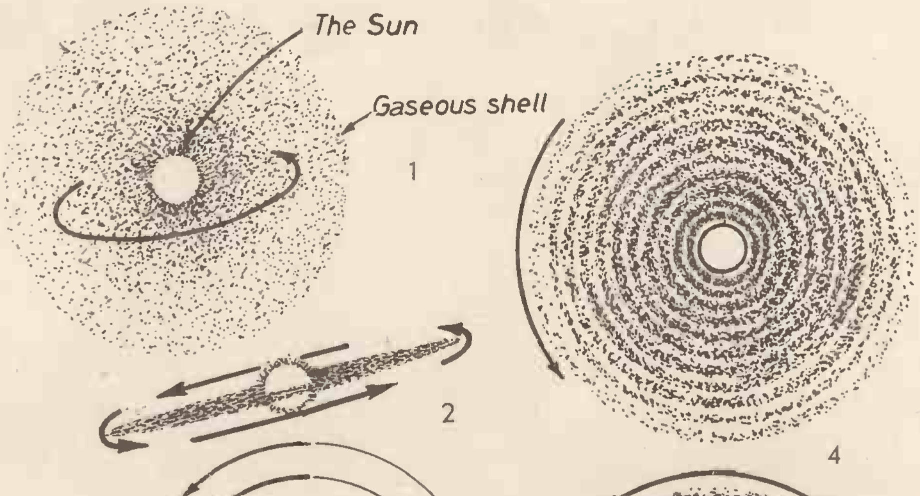
As the condensation of compounds is governed by the prevailing temperatures, it may be expected that water, carbon dioxide and similar compounds, along with heavier material in axial flow eddies situated between outer annuli; would condense together: whilst only the very heavy metal compounds would condense in those eddies nearer to the Sun. Thus, in the early stages, we see a distinct difference in the density of condensed matter as occurring in the internal and external parts of the system. Further temperature loss would promote more condensation, but at this stage the *mass* and relevant gravitational attraction of the globules formed within the eddies would be the governing factor. In this respect the outer condensations would have a decided supremacy over the inner condensations due to their earlier acquisition of matter. Most of the remaining free particles would be of the lighter elements. liable to condensation only at extremely low temperatures. They would most likely be captured by the outer globules of condensation. This would further accentuate the low mean densities of inner and outer planets (Table 1).

One difficulty which confronts us in this monistic theory is the manner in which the globules of matter in the respective rings coalesced into individual planets. Various logical suggestions are available, however, so we shall not press the matter.

This theory proves that the interplay of natural forces could quite easily account for the creation of the Solar System *and billions of systems similar to it*, for there are in our Milky Way Galaxy alone some 100,000 million stars, the vast majority of which are or will be destined to pass through the same evolutionary stages as our Sun. Beyond our galaxy untold millions of galaxies hurtle through space bearing with them their vast families of stars and attendant planets. A truly majestic and magnificent thought. (Fig. 4.)

Our next discussion will deal with the evolution of sentient life and its chances of manifesting on other planetary systems than our own.

(*To be continued*)



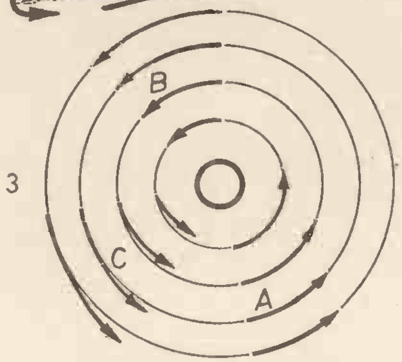


Fig. 2.—Nos. 1-4 indicate the first successive stages of planetary formation.

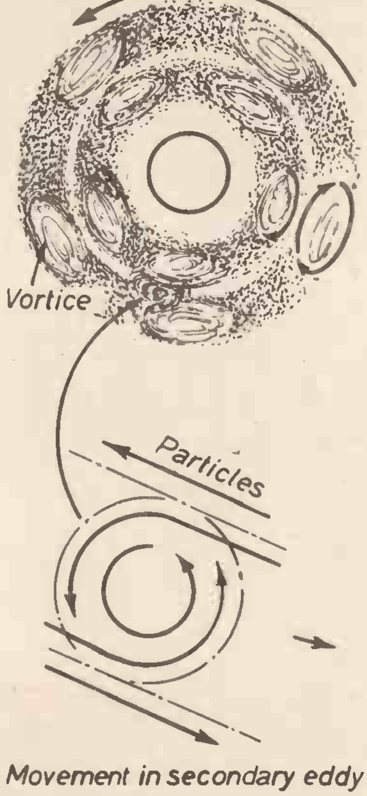


Fig. 3. (Right)—The generation of secondary eddies which would revolve in the opposite direction to the vortices.

Fig. 4.—A typical spiral galaxy, Messier 101, located in the constellation of the Great Bear. Photo: Dr. Ritchley, Mount Wilson.

Building the 'Luton Minor'

(Continued from April issue)

Part 9 Deals Mainly with the Windscreen and Engine Cowlings

THE aluminium tubing is $\frac{5}{16}$in. o.d. × 20 gauge and it is secured to the rear face of the starboard wing main spar with aluminium clips every three feet or so. The tubing is easily bent to shape by hand, but the radius of the bends must be not less than about 3in. to avoid kinking. Lead the two wing pipelines to the root end so that they protrude about $1\frac{1}{2}$in. below the undersurface (Fig. 63).

The ends are joined with 3in. lengths of reinforced rubber hose wired to their respective pipes which pass down the front wing-pylon side struts, one per strut. See Fig. 57.

Get an assistant to watch the airspeed indicator and *very gently* blow into the open-ended tube of the pitot head until the person watching the instrument signals that the needle is pointing to about 70 m.p.h. Place the tongue over the tube end, thus holding in the pressure. The instrument needle should remain steady for at least ten seconds. If the needle rapidly returns to zero, it is apparent that there is a leak somewhere in the pipeline. Try tightening the low pressure unions (if they are used) or checking the wiring-on of the rubber joints. Repeat the test until the line is satisfactory. An alternative method to test the pipeline is to use a manometer.

The Overtank Cowling

This is made of 18 gauge half-hard commercial aluminium sheet. The exact shape should first be found using stiff brown paper. The hole for the tank filler neck should be as small as possible and it is advisable to start by making this hole in the metal sheet, allowing a safe margin on all other dimensions. Position the metal with the filler neck protruding through the hole (do this with the cap *off* so the metal fits snugly round the actual neck), then strap the metal down to the longerons. The edges can thus be marked accurately, the metal removed and cut to size. Smooth the edges with wire-wool or emery cloth.

Having cut and trimmed it, paint the inside with primer and, when dry, fit the cowling, screwing it to the top longerons with $\frac{1}{2}$in. R.H. brass woodscrews. The attachment at the front is achieved with pop-rivets through the firewall flange. Use $\frac{1}{8}$in. dia. domed-head pop-rivets $\frac{5}{32}$in. overall length. The local motor-repair works will most likely loan a pair of pop-rivet " lazy tongs " or pop pliers to do the job. Alternatively, the cowling can be bolted using 6 B.A. mushroom-headed bolts and stiff-nuts at about 3in. pitch to the firewall flange.

Finally, the top instrument-panel attachment bracket is made and riveted to the cowling and the panel connected to it with the special rubber vibration mounting.

The Windscreen

This is made of $\frac{1}{8}$in. thick clear Perspex sheet and is shaped so as to stand at an angle of 60 deg. to the overtank cowling to which it is attached.

The exact shape of the screen is shown in 1in. squares in Fig. 64. Do not cut the Perspex to this shape until it has been curved.

Perspex sheet cannot be bent without heat as it is brittle. When softened by heat, it is easily spoiled by finger impressions and dirt and is readily distorted by uneven bending. It is therefore vital to do the job carefully and properly.

Make a paper pattern of the screen shape and obtain a rectangular piece of Perspex out of which the shape may be cut. Cut also two panels of clean thin aluminium or duralumin the same size and place the Perspex in the middle. Clamp up one end only between battens of wood.

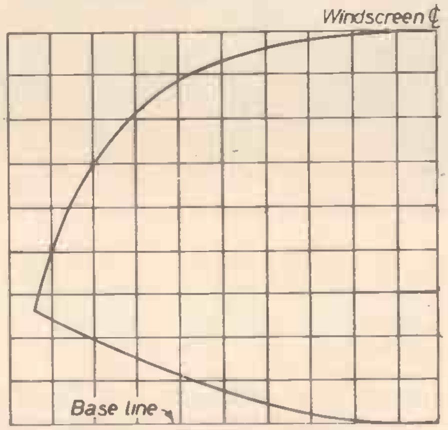


Fig. 64.—True plan of the windscreen.

Now find an old tin tray large enough to take the sandwich and about 4in. in depth. Fill this with water and dissolve in it two or three pounds weight of ordinary cooking salt. The presence of salt raises the boiling point of the water.

Place the tray on a gas-jet and bring to the boil. Carefully put in the clamped-up sandwich. Use thick gloves or a kitchen oven-cloth to avoid a scald. After boiling for about ten minutes, quickly remove the sandwich and, holding it by the clamped end, bend it to the desired radius over a cylindrical can or drum by pressing down on the other end with a batten of wood. This procedure is illustrated in Fig. 65. Do not force the bend—it may be necessary to reheat the sandwich several times before the right bend is achieved.

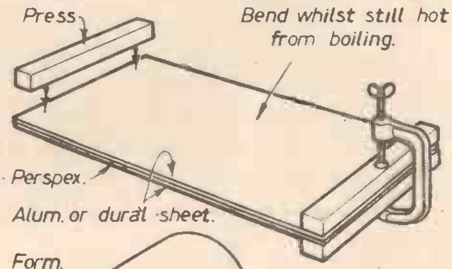


Fig. 65. — Bending the windscreen. Make sure that there is no dust or dirt between the pieces.

When cooled, remove the aluminium panels and mark out the plan of the screen using the paper pattern and a chinagraph pencil. Take particular care not to scratch the surface and work on a cloth-covered table. Fretsaw to shape using a coarse blade. The saw should be worked slowly using the full length of the blade as otherwise the heat generated will tend to melt the plastic locally and trap the blade. Polish the edges.

Try the screen on the overtank cowling to see that the shape is correct and then fit the aluminium clips which mount the screen in place. Drill oversize clearance holes in the Perspex for the 4 B.A. bolts. The screen brackets are fitted to the overtank cowling with 4 B.A. bolts or pop-rivets, but take care when drilling the holes—the fuel tank is close underneath. Temporarily fit the screen.

The wing pylon struts are now faired to a streamlined shape with plywood strips and doped fabric. Use red oxide cellulose tautening dope or clear " glider " dope and

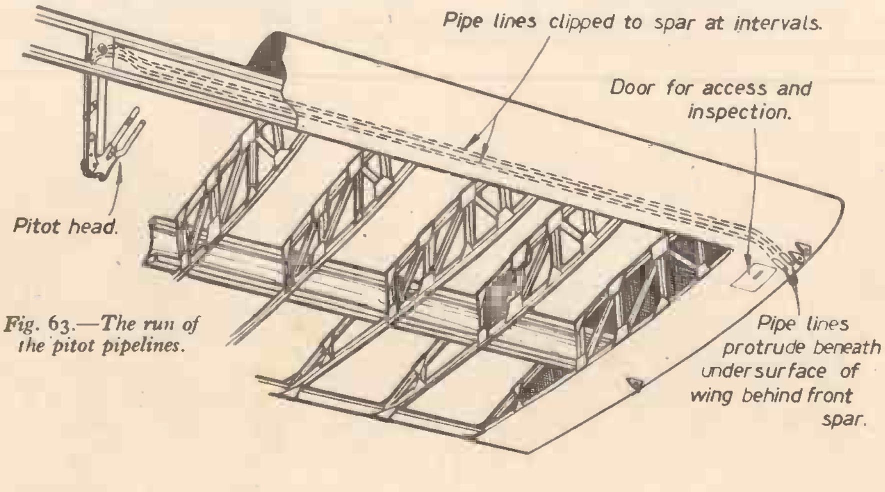


Fig. 63.—The run of the pitot pipelines.

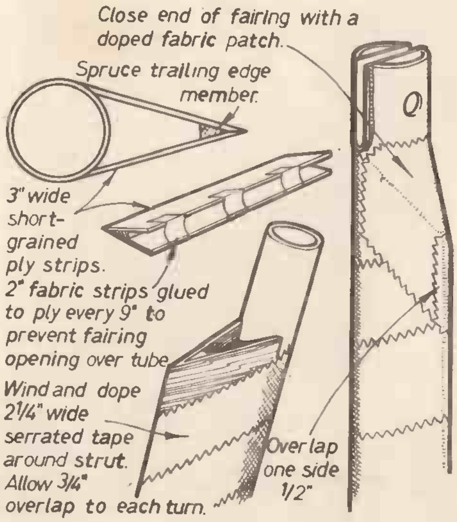


Fig. 66.—Details of the strut fairings.

2½in. wide serrated linen aircraft tape. Thoroughly dope the fairing and the tube before winding on the fabric. Use plenty of dope. The process is shown in Fig. 66.

Engine Cowlings

The exact shape of these must be found by careful use of brown-paper patterns and patient fitting. All the cowlings are of 20 gauge half-hard commercial aluminium and they are all single-curvature, thus dispensing with difficult three-dimensional shaping.

Start with the lower cowling which can be cut from a 6ft. × 3ft. sheet of metal. Begin at the centre underneath, cutting a trapezoidal piece of paper which overlaps the underside of the fuselage by about 4in. (this can be trimmed later and allows a margin in case the cowling has to be brought forward due to inaccurate cutting) and which reaches to the front of the carburetter in a straight line. Cut a "U" piece out of the paper to enable it to slot round the carburetter. Stick the paper with adhesive tape to the fuselage and the carburetter, keeping it as taut as possible. The sides are made in a similar manner, allowing a good margin of overlap at the fuselage and to the bottom paper pattern. Stick the paper to convenient parts of the engine, making cut-outs for the magnetos, induction pipes and so on.

Do not try to save time and effort by marking out one half of the cowling and transferring this pattern to the other. Being a horizontally-opposed engine, the two cylinders are *not* in line and there is a variation between the two sides.

Stick the side patterns to the bottom pattern, then remove the paper as one piece and lay it flat on the metal. Cut round the pattern using hand metal shears ("tin-snips"), preferably of the angled head type, allowing a full inch extra on the upper limits of the sides and also around the engine cut-outs.

Bend the metal from the centre-line as shown in Fig. 68. The fuselage end—or rear end—of the cowling forms three sides of a square, the corners folded to near right-angles, but at the front the sharp lower corners have merged into a curve. This is done using a batten of wood as a bending block, pivoting it at the rear end as a "vanishing point," and making a series of closely-spaced gradual bends.

Offer the cowling into place and mark where it touches the engine, trim it to suit and

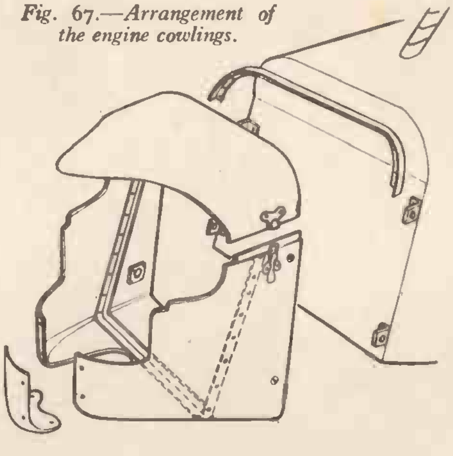


Fig. 67.—Arrangement of the engine cowlings.

repeat again until, gradually, the cowling becomes a snug fit to the engine. Do not try to trim it to a perfect fit at one attempt—careful, patient fitting will be rewarded with a neat and pleasing finished cowl.

Allow ½in. clearance around the induction pipes. Bend in the sides at the front and strap them in place with transparent adhesive tape while the small curved "chin" cowling is made. Also strap this on and drill the holes straight through both thicknesses of metal for the securing screws.

Remove the cowling and rivet 2 B.A. anchor nuts behind the holes in the sides for the chin cowling at the front.

Fold up three 1in. × 1in. angles of the same material as the cowling and rivet them with countersunk rivets to the cowling sides and bottom. As the cowling metal is quite thin, it is advisable to "dimple" the rivet holes rather than countersink them in the normal fashion. Dimpling can be done very

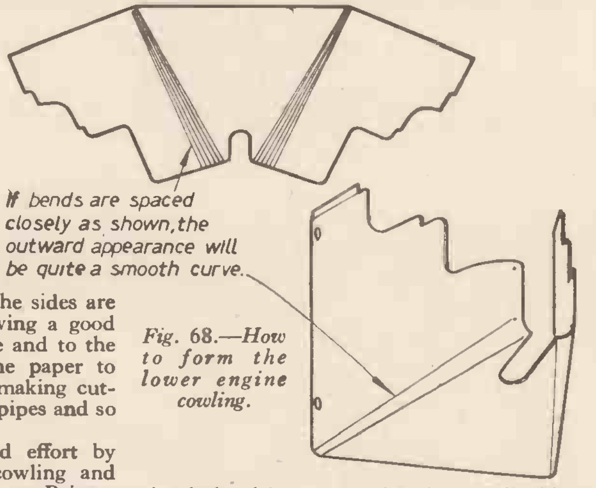


Fig. 68.—How to form the lower engine cowling.

simply by driving each rivet before clinching as shown in Fig. 69. Note how the ends of the reinforcing angles are trimmed to avoid placing undue stresses on the first and last rivets in the row.

Make and fit the anchor-nut brackets which fit to the firewall and to the engine mounting to take the 2 B.A. cowling screws. Note that the cowlings are not positively attached to the engine, thus permitting the engine to move slightly in its rubber mountings without damage to the cowlings.

Stick strips of felt around the top edges of the cowl sides at the front where they bend around the engine crankcase. Use a petrol and oil-resistant adhesive.

Drill a hole through which passes the choke-control lever and fit a rubber grommet in it. The cowling can now be fitted, the choke control rod threaded through its hole and the entire fitted to its brackets with pan-head 2 B.A. screws. Do not use ordinary cheese-headed or round-headed screws as the small heads will quickly tear through the aluminium in service.

The top cowling is very much simpler to make and again a paper pattern is employed and the cowling made from the centre-line.

The cowling fasteners are of the toggle type and must be a tight fit when locked. It is a good idea to fit a thin rubber sealing strip under the rear edge of the top cowling to rest on the support ledge *after* fitting the toggles so as to tension the cowlings in the locked position. The exhaust pipe and carburetter hot-air muff can now be fitted.

Inspection

The airframe of the Luton Minor is now complete save for covering and painting. This must not be attempted until after the aircraft has been examined by an approved inspector. Details of how to arrange this are available either from Phoenix Aircraft or the Popular Flying Association.

Prior to the visit of the inspector—who, incidentally, comes to advise and assist the constructor and not to obstruct—the amateur should carefully go over every part of the aircraft himself and look for insecure bolts, unlocked nuts or turnbuckles and so forth, paying particular attention to those parts of the airframe which will be covered and thus out of sight. See that the controls move freely and easily, that no cables chafe and that they are tight enough to be free from slack or sag without being so tight as to drum when plucked. A good test of this last mentioned item is to measure with the fingers as shown in Fig. 70. Do this on an unsupported length of cable at least 3ft. from a pulley or fairlead.

Fit the anti-vibration discs to the piano-wire bracing in the wings. These are of red fibre (*not* leather) and are laced with waxed thread.

(To be continued)

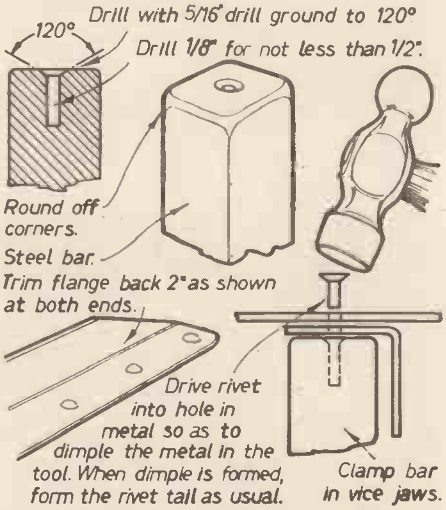


Fig. 69.—Forming the dimples for the rivets in the cowling stiffeners.

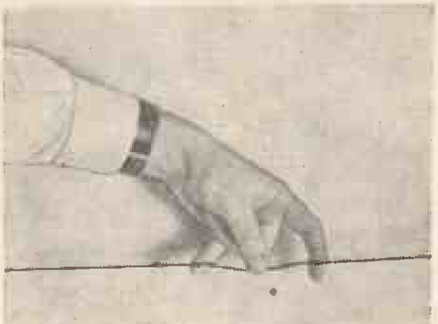


Fig. 70.—Checking the tension of a control cable. It should be possible to deflect the cable about $\frac{1}{16}$in.

READERS' SALES AND WANTS

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

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

AIR COMPRESSORS, single cylinder, two stage, 2½ cu. ft. min. at up to 450 p.s.i.; suitable for spraying, etc.; condition as new but slightly store soiled; cost over £10; bargain at £2 0s. 0d. each. Air Lines, 40ft., new, 30/-.—Cooper, 10 Fowler Street, Nechells, Birmingham, 8.

TELESCOPES, Eyepieces, Finders, Mounts, etc. S.A.E. for list.—Woodthorpe Instruments, 12 Revesby Road, Woodthorpe, Nottingham.

EVERLASTING BATTERIES, 2·5 v. (torches, models, plating, etc.), rechargeable mains, 37/6. Torches, rechargeable mains, 39/6. Dynamo-torches, 27/6. German microscopes, 100/200/300x., fitted case, £8/17/6. Theranews, Tring, Herts.

ASTRO TELESCOPE MAKING.—Standard Ramsden Push-in Eyepieces, ¼in., ½in., ⅓in., focus, 35/-, with R.A.S. thread, 42/6 ea. S.A.E. list, Object Glasses, Newtonian Mirrors, Diagonal Mounts, Focusing Mounts, Tripods, Mountings and Terrestrial Telescopes.—W. Burnet, Grand Sluice, Boston, Lincs.

FOR SALE (Continued)

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BANDSAW, made and described by author in this issue, for sale £20 less motor. Buyer to arrange collection. Write: S. E. Boston, 3 Albany Road, Leyton, E.10.

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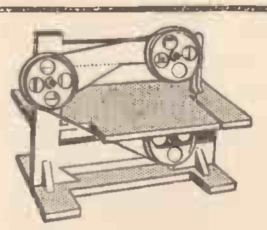

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A Bulk Tape Eraser

A short cut for the tape recorder enthusiast

By A. Drew

MANY readers may well have come up against the question of removing effectively and quickly all traces of recorded matter from spools of recorded tape. Described here is a useful device which will completely erase tapes quickly, without waiting while they are run through the tape deck.

Design

The present equipment was constructed to operate for short periods on standard electrical supply, 230/250v. 50 cycles A.C. current only, but no doubt readers could work out necessary modifications required in the coil formation and windings for alternative voltages and current supplies. Whilst D.C. supplies are now fast becoming obsolete, where such exist, a somewhat different coil technique would be required.

In its final form the present " eraser " is designed round the coils forming the magnetic field. After much trial and error a pair of coils complete with laminated pole pieces were taken from two surplus 24/28v. D.C. aircraft relays. All unnecessary parts were discarded and the pair of coils and pole pieces which remained were mounted opposite each other on a short length of ½in. square M.S. bar. (See Figs. 2, 4 and 9.)

This forms the heart of the " eraser."

Although this " eraser " was primarily intended for use with tape spools of maximum dia. 5in., it was, nevertheless, so constructed that up to 7in. spools can be accommodated into the " field," some tolerance being allowed on the bearings for carrying the removal spindle as required. (See Figs. 6 and 7.) They are cut from ¼in. acrylic sheet. It was, however, later observed that when the 7in. spools of recorded tape were inserted for erasure there sometimes remained a portion of the tape near the hub and, particularly if the spool contained its maximum quantity of tape, a similar portion of tape near the perimeter, which still contained audible signs of non-erasure.

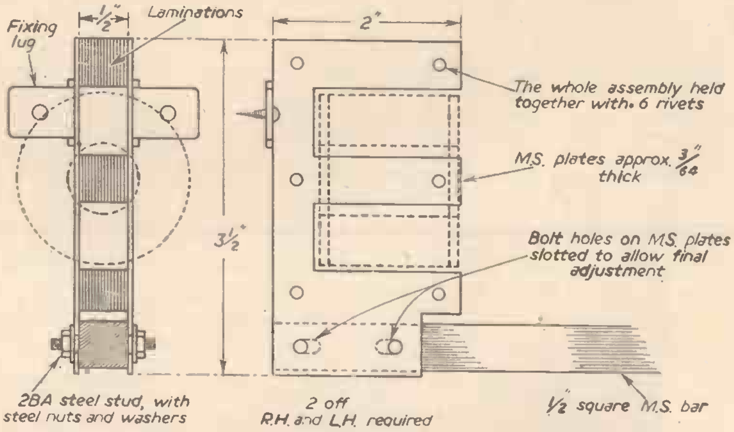
This fault can, however, be overcome in the event of an " eraser " being required for definite use of 7in. spools by broadening the magnetic field.

The apparatus may equally well be constructed to take the spools inserted in a horizontal plane.

Wiring

Other than two suitable coils being found or made up to give a suitable " magnetic flux " no special components are needed. As will be seen by the internal wiring diagram (Fig. 1), the author included a standard three-pin mains outlet—a D.P.S.T. mains voltage toggle switch, an S.P. mains cartridge fuse, and a miniature Arcoletric neon indicator lamp; these latter being connected in the live lead.

Fig. 2 (Right).—Details of the laminated cores.



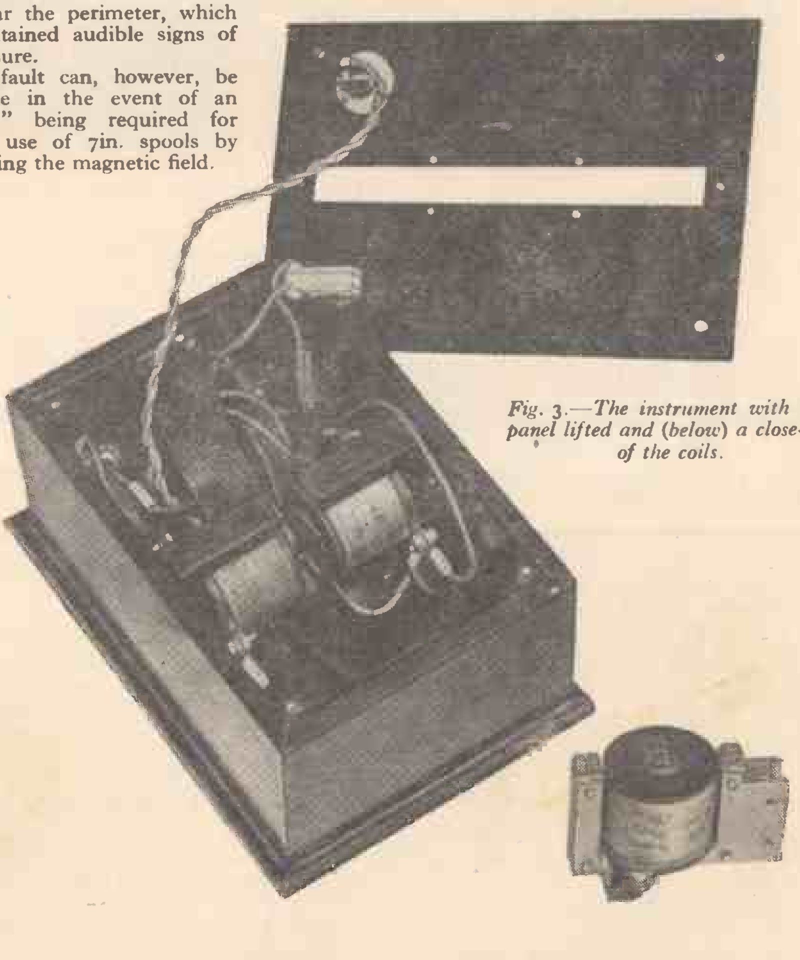


Fig. 3.—The instrument with the panel lifted and (below) a close-up of the coils.

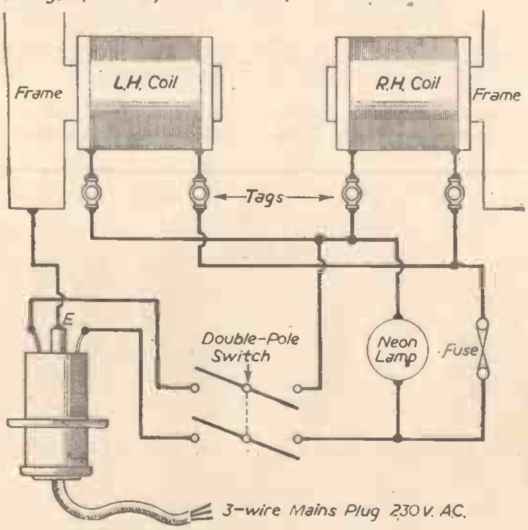


Fig. 1—Internal wiring of the eraser.

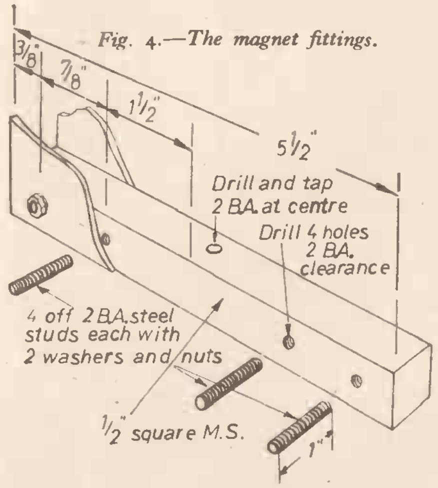


Fig. 4.—The magnet fittings.

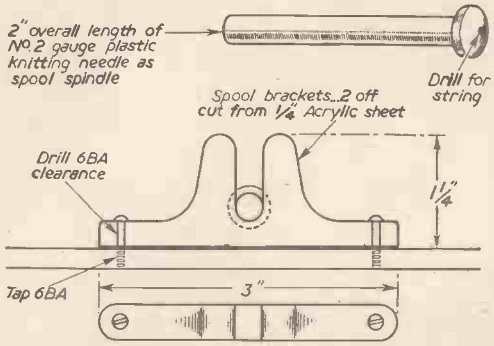


Fig. 7.—The spool bracket.

Every effort was made to give the completed "eraser" a very professional instrument finish. The cabinet, constructed of ⅜in. Obeche, was sprayed with three coats of coach finish black cellulose and mounted on rubber feet. The thin white "escutcheon," details of which can be seen in Figs. 5, 6 and 8, over the spool insertion slot was fret-cut from white opal acetate sheet, the top being 3/16in. black acrylic sheet with polished edges. Any colours may, of course, be used to choice. All screws visible were chrome-plated. The positioning of the components is not important and may well suit the reader's choice. The photograph of the completed eraser (Fig. 3) illustrates a suitable layout.

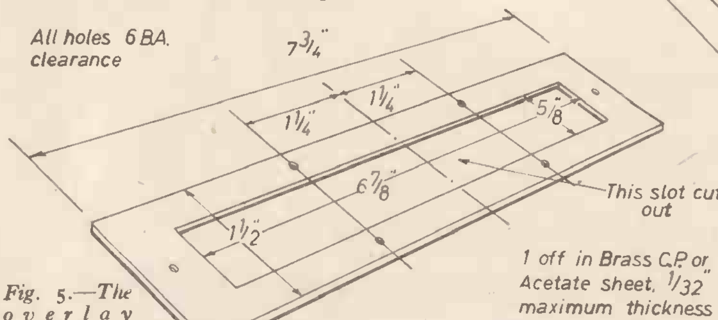


Fig. 5.—The overlay escutcheon.

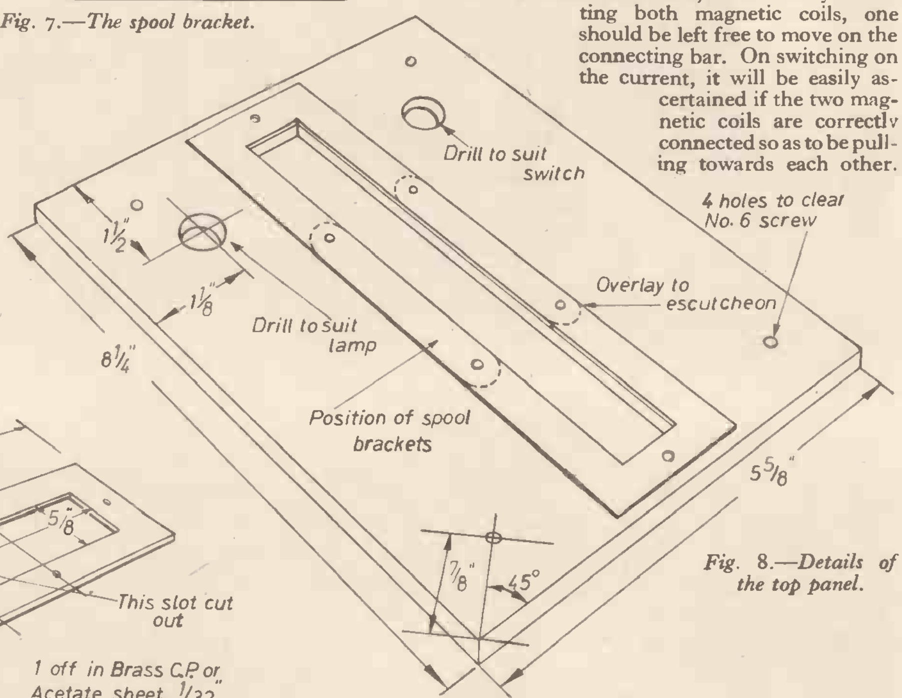


Fig. 8.—Details of the top panel.

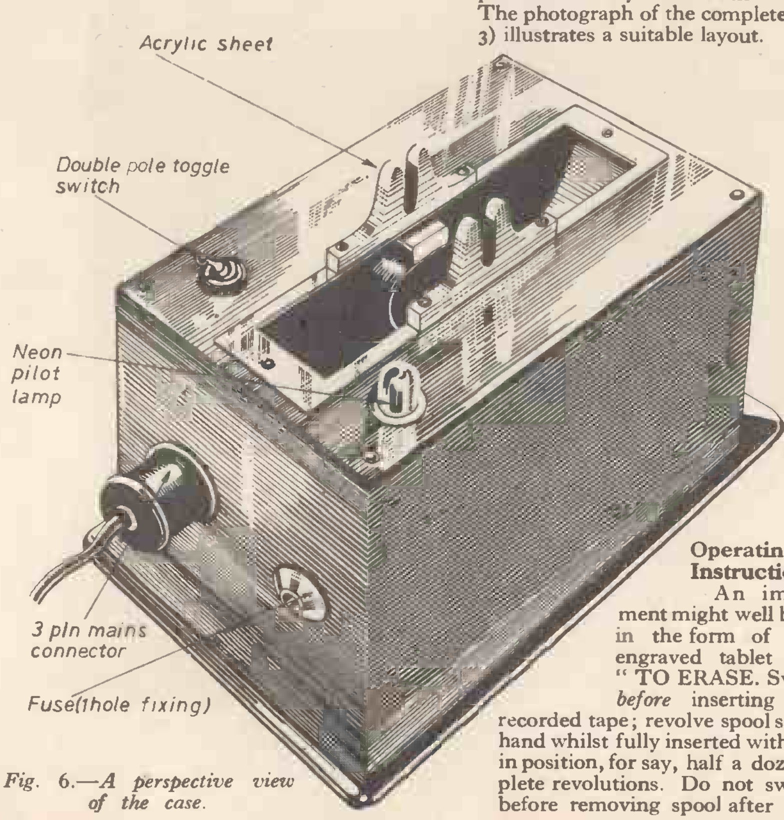


Fig. 6.—A perspective view of the case.

Operating Instructions

An improvement might well be added in the form of a small engraved tablet reading: "TO ERASE. Switch on *before* inserting spool of recorded tape; revolve spool slowly by hand whilst fully inserted with spindle in position, for say, half a dozen complete revolutions. Do not switch off before removing spool after rotating. Do not switch on unless a spool of tape is in the spool carrier." The above, giving an outline of operating procedure, can, of course, be considerably condensed for engraving. Should a metal cabinet be preferred, a ferrous metal should not be used, aluminium being the most suitable.

When carrying out final wiring a good heavy power flex or 3·029 wire should be used, either rubber or P.V.C. covered, and as far as possible all wires kept apart and connections soldered either direct or via suitable solder tags. It is important to remember that the pair of coil windings should be connected in parallel, and that the coils must be so connected that they "pull" together and not repel. In order to make sure of this, before finally mounting both magnetic coils, one should be left free to move on the connecting bar. On switching on the current, it will be easily ascertained if the two magnetic coils are correctlv connected so as to be pulling towards each other.

The Cabinet

In case any reader wishes to reproduce a cabinet similar to that shown, the base was 8¾in. × 6¼in. with the two short sides 5⅝in. × 3½in. and the two long sides 8¼in. × 3½in. The top was made from acrylic sheet (black) and measures 8¼in. × 5⅝in. The inside dimensions were 7½in. × 4⅞in., and small pieces of quadrant were fitted in each corner to which the top panel was screwed. As a refinement, four small rubber feet were screwed to the base, and the upper edges of this were rounded off. If coils cannot be obtained, a bobbin should be made to fit the laminations shown in Fig. 2 and these should be wound full with 22 D.C.C. wire. The resistance of the originals was 170Ω.

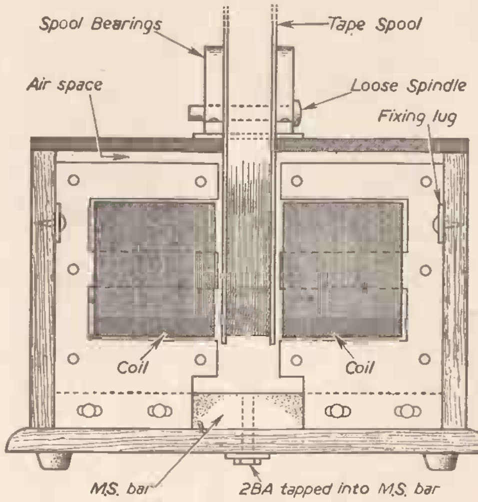


Fig. 9.—The spool in position.

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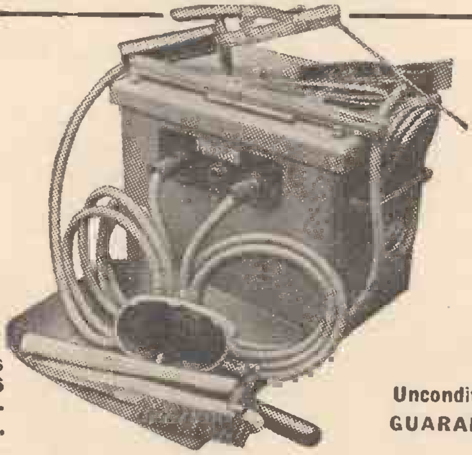

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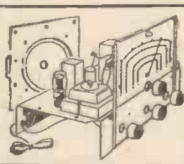

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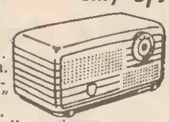

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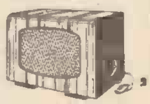

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MYFORD BEESTON NOTTINGHAM

LETTERS to the EDITOR

The Editor does not necessarily agree with the views of his Correspondents

Exakta Camera Repairs

SIR,—With reference to P. A. Carroll's query in the February issue concerning his Kine Exakta camera. From personal experience I do not think he will obtain a book dealing with the Exakta focal plane shutter (although *The Exakta Guide*, by W. D. Emmanual, published by Focal Press, gives useful information of a general nature and also provides operating instructions). Also I do not think that it is advisable to attempt shutter repairs oneself, unless one has equipment with which to measure blind speeds and exposure times. It is possible to attain, say, a "correct" exposure of 1/25th or some other speed, yet at the same time have the shutter blinds travelling too fast or too slow. Obviously too high a blind speed will impose an undue strain on the mechanism, and too low a speed will fail to "stop" movement. I would suggest that Mr. Carroll takes his camera to a photographic shop that is an agency for Exakta cameras.—J. J. PLUMSTEAD (Bristol, 3).

P.M. and Retirement

SIR,—A few minutes in my home would provide ample proof of the value of PRACTICAL MECHANICS, particularly the photographic section. It contains: horizontal enlarger; electric double-side print dryer; print washer with sloping trays; print washer sink adaptor; combined electric safelight and contact printer; portable lights and reflectors; electric touching-up box; portable switchboard. These and many more P.M. ideas are in spanking order.

I am approaching retirement age, but with all the P.M. ideas I have earmarked to make, boredom seems impossible.—C. A. PATRICK (Barnsley).

Gas Turbine Engines

SIR,—I would like to expand your answer to the question of the mystery of the gas turbine (see query in your January issue). This same question used to puzzle me. Your answer did not say why a turbine overcomes its own compression and produces thrust; only that it did. This question is even more pertinent in the case of a ram-jet, which produces thrust without even a compressor to aid it.

To correct your questioner: in a gas turbine there is no pressure rise from combustion, but there is a great increase in velocity. The thrust of a gas turbine is a direct result of the increase of momentum (i.e. mass × velocity) of the air passing through it. The final combustion chamber pressure is reached by a diffuser section between compressor and combustion chamber, which slows the flow down and therefore increases its pressure.

The reason why there is not a reversal of flow from high pressure to low is surprisingly ordinary and is simply that (*a*) the turbine is started by rotating it in the required direction, and (*b*) the turbine is physically made so that it functions most easily in that direction!

It is an interesting point that no man-made power unit is self-starting; they all have to be pre-started by some separate power supply, and, since it has been started, it is easier for the air to continue flowing in that direction rather than push against the compressor momentum.

One could ask, however, how does the turbine keep on going when it has to push just as hard rearwards against the turbine wheel, since the power absorbed by the turbine wheel must exactly equal that delivered by the compressor? The answer is that this only occurs when the assembly has rotated up to its maximum speed; before this the turbine wheel is absorbing an excess of power over that generated in the compressor and therefore it must rotate in its direction, and thus create a uni-flow. This, however, only occurs because of the unsymmetricality of the gas turbine.

I firmly believe, though I do not think it has even been demonstrated, that a turbine could be made which would run in either direction of rotation. It would have to be made exactly symmetrical about a lateral centre plane positioned on the burner nozzle centre line. All the blading would have to be symmetrical about its own vertical centre lines. Gas turbines have been made in which two centrifugal impellers of very similar shape have been mounted back to back, one compressing, the other expanding, thus approaching symmetricality, and they run quite efficiently.

The non-self-starting remark made in the query refers only to mechanised power plants; an electrical power plant consisting of battery and motor starts up as soon as fuel (acid) is poured into the battery cell.—M. COLLINSON (Bradford, 3).

Amateur Rotocraft Pilots

SIR,—I have read your letter from Mr. Taylor regarding Bensen Gyrocopters, and which appeared in your March 1960 issue.

The simple answer to approval by the P.F.A. of this type of aircraft is that nobody has yet supplied adequate data regarding strength characteristics, blade flutter characteristics and other technical data necessary to ensure that the type is not a danger to its pilot or third parties. In any case, the Permit to Fly system for Ultra Light Aircraft does not, by Ministerial decision, apply to rotorcraft, therefore people wishing to fly Gyrocopters must deal directly with the Ministry of Aviation.

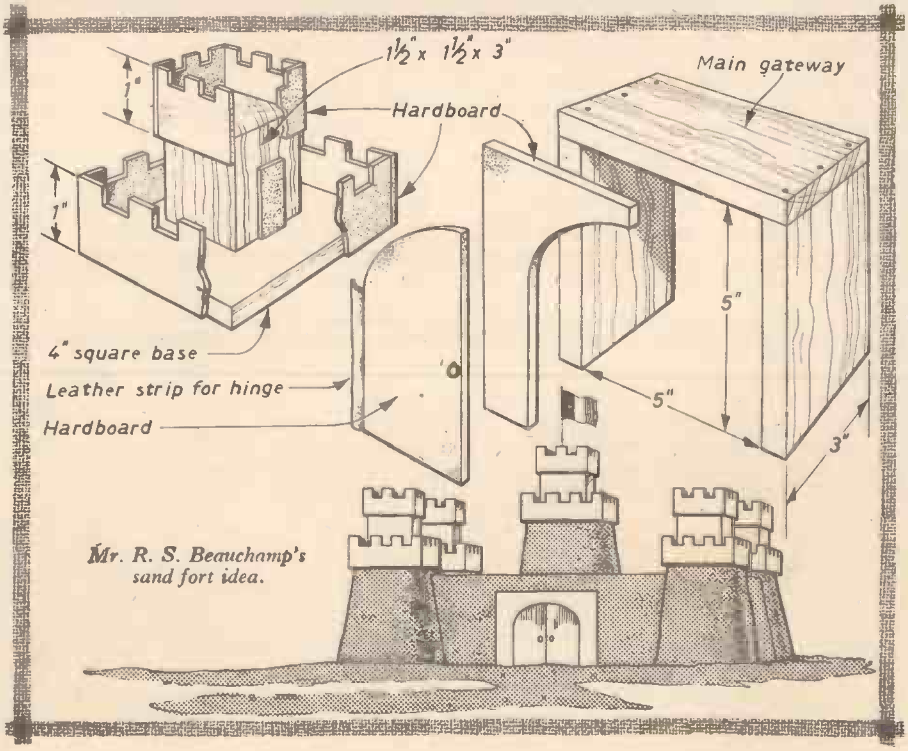
This is the ruling against which the P.F.A. has protested, but the Ministerial view has so far been adamant.—CHAIRMAN, Popular Flying Association (London, W.1).

Amateur Modelmaking

SIR,—While looking through back numbers of P.M., I re-read your Fair Comment in the October issue where you discuss the tendency of the home hobbyist to interest himself in hobbies where there is a chance of financial return, to the exclusion of other less profitable interests. Modelmaking would, I suppose, be classified among these latter, and I wonder if this is the reason that there is less apparent interest in this subject in modern times? I have been an enthusiastic modelmaker for a great many years and when I first started was a member of a thriving modelmakers' club. We took a pride in producing models which were true to scale in every detail; some worked and some did not. Accuracy, workmanship and appearance were the points on which we judged our success. Today's modellers seem to concentrate on boats only as test beds for radio control equipment, aircraft, not for appearance, but for the fun of flying them, and, models, not for their accuracy, but for their value as household ornaments, i.e. vintage cars and pseudo galleons, etc. I know there are still a great number of people enthusiastic about models for modelling's sake, but are their numbers declining?—R. J. SAMSON (Liverpool).

Model Fort

WHILE watching my children making castles in their garden sandpit last year I hit upon a novel way of improving the results which intrigued my children and may interest others. The battlements and gateway were made from odd scraps of wood and hardboard, and when added to a sandcastle made by children in the usual way the result as shown below can be quite impressive. —R. S. BEAUCHAMP (Luton).



Mr. R. S. Beauchamp's sand fort idea.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

STEADFAST PAD SAW

DESIGNED to fit comfortably in the pocket, this is an occasional tool which can be used for a multitude of purposes. The three blades, which are pivoted, may be folded into the handle for convenience of carrying, the handle being of translucent amber plastic. As can be seen, the shorter blade has a knife edge and can be used for lino cutting, marking out, etc.; the other two are pad saw blades, one a fine tooth blade for hard materials, the other a coarse tooth blade for cutting softer materials. The price of 6s. includes the plastic carrying wallet. Replacement blades cost 3s. per set of three. The makers are the well-known firm of J. Stead & Co. Ltd. and the tool is available from most tool dealers and ironmongers.

EVERYTHING FOR THE AMATEUR POTTER

WE have received a very interesting catalogue from the firm of J. W. Ratcliffe & Sons (Engineers) Ltd., Rope Street, Shelton New Road, Stoke-on-Trent, which details their whole range of pottery machinery, equipment and materials. This includes kilns, wheels, moulds, glazes, transfers, etc., etc. Of interest to the beginner is a special do-it-yourself beginner's pack which includes clays, various colours and glazes, moulds, brushes, tools and utensils. Details of this equipment are available from the makers at the above address.

STANLEY TRIMMING KNIFE

STANLEY WORKS G.B. LTD. have brought out a new version of their trimming knife. This has a wider selection of blades than its predecessor, a new heavier alloy handle with a hole to facilitate hanging and a captive securing screw which cannot be lost. Replacing the five normal-duty blades previously supplied are three normal-duty, one heavy-duty and one hooked blade. These together with the blade guard are carried in the handle. All the blades are double ended. The price is unchanged at 6s. and replacement blades are available.

PORTABLE HAND EMBOSSER

THE man running a small business or a shop where labelling is used to a large extent will find this hand embosser of interest. The " Midgie " embosses letters and numbers on hard-wearing, corrosive and chemical resisting Vinyl red plastic tape. This has a pressure-sensitive adhesive backing for application to most smooth and clean surfaces. The plastic labelling is self-feeding and cost per label is a few pence. The " Midgie," which is simple and quick in use, retails for £12 10s. and is available from the British Automatic Co., 14 Appold Street, London, E.C.2.

VALTOCK BLOWLAMP FITTING

THE many users of the well-known Valtock blowlamps will be interested to see the new soldering iron attachment which has been produced to fit them. In the photograph it is shown fitted to the " 2000 " model but it is designed also to fit the " Major." As can be seen, the soldering bit is held firmly at the correct distance from the flame by means of a nickel-plated clip, it being used in the normal way. The price of the new fitting is 5s. and it is available only from Valtock Ltd., Regency House, Warwick Street, London, W.1.

" NUFLEX" POCKET RULE

THE flexible tape is made from pre-treated tempered steel and is provided with a white synthetic finish. This when graduated in jet black makes the rule particularly easy to read. A sliding tip is fitted to facilitate end-on measuring and the rule is housed in a robust green plastic case. The rules are available 6ft. or 2m. long, calibrated feet and inches in eighths; consecutive inches in sixteenths and thirty-seconds or consecutive inches in sixteenths, thirty-seconds and millimetres. Replacement blades are easily fitted. The rule costs 5s. from tool dealers, ironmongers, etc. The makers are John Rabone & Sons Ltd.

THE ARDEN KART

KARTERS LTD., P.O. Box 1, Havant, Hants., are distributing the new Arden Kart, which has a number of interesting features. These include a Vincent-Harper engine, interchangeable sprockets, detachable front and rear axle assemblies, a specially designed centrifugal clutch, a self-energising wedge type disc brake acting on both wheels, Ackerman type steering, a bucket seat of fibreglass reinforced plastic, a live rear axle and a robust underslung tubular steel frame. All enquiries should be made to the above address.

" Midgie " portable hand embosser

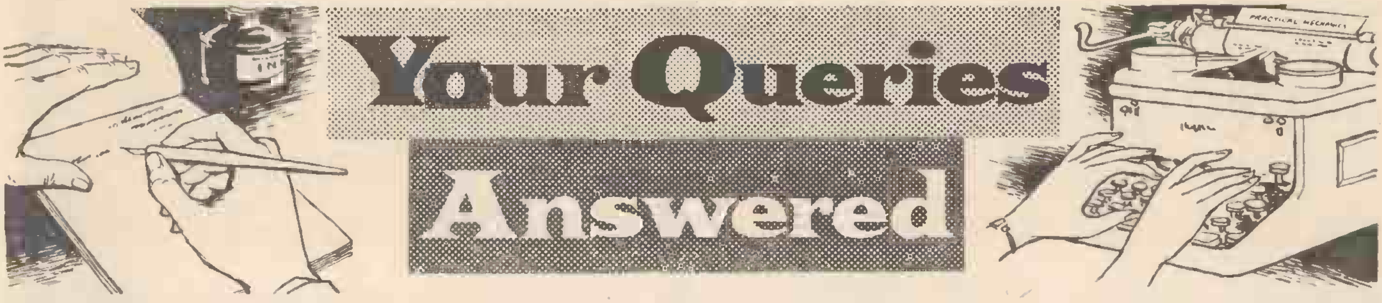
(Left) " Steadfast" pad saw

(Right) "Valtock" blowlamp fitting

The "Nuflex" pocket rule.

(Right) Stanley trimming knife.

Pottery equipment available from J. W. Ratcliffe & Sons Ltd.



Underground Rain Water Storage Tank

I AM contemplating building a rectangular tank to store between 6,000 and 7,000 gal. of rain water. It will be approximately 18ft. long, 10ft. wide and 6ft. deep, constructed with 6in. concrete slabs and treated inside with waterproof cement.

Will one or two dividing walls built in ensure enough strength to withstand the pressure? What depth of concrete base do you suggest? — W. J. Smyth (N. Ireland).

YOUR storage tank for rain water should be sunk into the ground and have a concrete lid with an access manhole for inspection and cleaning out if necessary. To build such a tank above ground will impose too much pressure on the sides even if you put in two honeycomb cross walls. Excavate for the tank and lay a 12in. bed of waterproof concrete and on this build up the concrete block walls so that you have three-quarters of the tank as storage and the other quarter half filled with a filtering media, such as coarse sand or washed clinker. The outlet from the filter tank is at the bottom into the storage tank and the draw off pipe is vertical into the storage tank and terminates 6in. to 9in. from the bottom so that the pump does not pull up any possible sludge. When you have laid one course of blocks and they have set, plug the space between the outer face of the wall and the vertical face of the excavation with wet clay to reinforce the walls and prevent possible movement. Do this all the way up and then cover with a concrete roof which drains into the filter bed and thus adds to the catchment area.

Amperage from kVA

IN the course of my work I handle transformers and I wish to know how one finds the amperage from kVA or vice-versa. As an example a transformer is stamped: Primary 240v. 1 P.H. Secondary 200v. 6 kVA. Also how does one work out kVA on 415v. 3 phase circuits as simply as possible?—J. Halls (Beds.)

IN a single-phase transformer the full-load primary current is approximately equal to 1000 × kVA divided by the primary voltage; the full-load secondary current being equal to 1000 × kVA divided by the secondary voltage.

In a three-phase transformer the full-load primary current is approximately equal to 1000 × kVA divided by 1·732 V_p, where V_p is the primary voltage between phases. The full-load secondary current is equal to 1000 × kVA divided by 1·732 V_s, where V_s is the secondary voltage between phases, or to 1000 × kVA divided by 3 V_n, where V_n is the secondary voltage between each phase and neutral.

Changing the Object Glass

IF the object glass of a 6 × 30 ex-Government eye cup focus binocular is removed and an object glass of larger diameter and longer focal length fitted in its place, by how much would the magnification be increased and how would it effect the field of view? The object glass I have in mind is of 44mm. dia. and 8½in. focal length, or 50mm. dia. 7/7½in. focal length.—L. R. Farrow (Glam).

TO find the increase in magnification, divide 6 by the focal-length, in inches, of the 6 × 30 binocular objective, and multiply by 7 for the 7in. lens, or 8½ for the 8½in. lens.

The existing objective's focal length can be found by focusing a sharp image of a distant object (e.g., the sun) on a card, and measuring the distance from lens to card. To obtai nmuch increase in magnification, a lens of much longer focal length is required. All such normal lenses will give a smaller field of view than the existing objective, as their larger diameter will not compensate for the increased focal length. With a given system, doubling the magnification will reduce the field of view to approximately one-half linear.

RULES

Our Panel of Experts will answer your Query only if you comply with the rules given below

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.

Terrestrial Telescope

I AM hoping to make a terrestrial telescope with a 3in. to 3½in. object glass and a magnification of about × 60 to × 80. It will be used mainly for marine purposes with a small boat club. and will be mounted semi-permanently. Can you give me details regarding focal length of the object glass, details of the erectors and the eyepiece?—D. J. Moore (Wilts).

THE magnification of the proposed telescope can be found by dividing the focal length of the objective by the focal length of the eyepiece. If a magnifying erector is used, multiply by the power of this. The power of the erector may be found by dividing its back focus by its front focus. For infinity, distance between erector and objective equals objective focal length plus front focus of erector. Distance from erector to eyepiece equals back focus of erector plus focal length of eyepiece. Thus a wide range of lenses could give the magnification you require, especially as erector magnification can be modified easily. Suitable components, including ready-made assemblies, may be had from Charles Frank, 67-73 Saltmarket, Glasgow, C.1., and Holmes, Wilson & Co., Martins Bank Chambers, 33 Bedford Street, North Shields, Northumberland. Making a telescope set at infinity by calculation only is possible when the *exact* focal lengths are known. Failing this, a little movement of the eyepiece is necessary, to secure sharp focus.

Transformer for Fairy Lights

I AM considering purchasing a mains transformer, input 210/250v. output 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30v. Rating 3amps. I want to use this on a set of fairy lights connected in parallel using 20v. 3watt bulbs.

Would this transformer be suitable?—H. Davis (Cumberland).

A 3 WATT 20v. bulb takes a current of 0·15 amp. Consequently 13 such bulbs could be fed from the 20v. tappings on the transformer.

Boxing in a Flushing Cistern

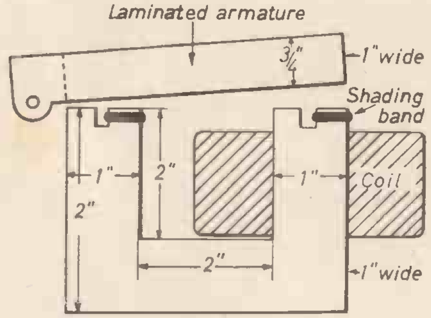
I HAVE a cast iron flushing cistern in a lavatory and have a great deal of trouble with it dripping condensation on to the floor. Can you tell me how to prevent this in some neat and not unsightly way?—A. J. Osman (Kent).

CONSTRUCT a framework made of 1½in. × 2in. wood round sides and long enough to allow the bottom and the sides to be filled in with granulated cork or slag wool. Cover the sides and bottom with hardboard neatly finished on all sides. Give three coats of paint and finish to match existing colour scheme.

Small Household Lift

I AM making a small household lift, using a motor and reduction gear. I wish to use a spring-operated brake on the motor but have some difficulty with the design of a suitable A.C. motor current solenoid to lift the brake off when power is supplied to the motor. The motor takes 230v. 2 amps. so will you kindly let me have design particulars of a suitable solenoid through which I can pass the motor current? I would like ½in. movement in the motor brake arm against approximately a 5lb. spring.—David Richards (Glam).

WE do not advise you to connect the brake-release coil in series with the A.C. motor, as the brake coil current and



Electromagnetic coil details.

magnetic pull would then fall on reduced motor load. We advise you to use an electromagnet coil which is connected across the motor terminals. We presume that the supply is 230v. single-phase at 50 cycles. In this case you could use a laminated core of 1 sq. in. cross sectional area to the dimensions given below, the coil having 1,000 turns of 20 s.w.g. enamelled copper wire.

A slot should be cut in each pole face, into which is fitted a short-circuited copper band to encircle half to two-thirds of the pole face. The purpose of the shading band is to avoid chatter. The cross sectional area of the band should be as small as will suffice, and may be in the region of ⅛in. × 3/16in. It is important that the armature beds exactly on to the pole faces when the coil is energised. Maximum pull will be obtained, and the overheating of the coil avoided by limiting the air gap between the armature and field poles to a minimum.

P.M. Tape Recorder Rectifier

I AM building the tape recorder detailed in the November 1959 issue of "Practical Mechanics." Could you tell me if the metal rectifier (STC type) is contact cooled? What value is it and has it a code number? What type, size and rating of speaker is best suited for use with the tape recorder?—A. Williamson (Manchester 20).

THE metal rectifier is proving difficult to obtain by many constructors, and it is permissible to use a substitute type (or alternatively, run the first stage from the A.C. heater line). A small type full-wave rectifier is required, rated at 6v. 0.5 amps. and these can be obtained from several advertisers, where they are generally referred to as rectifiers for battery chargers. These rectifiers are not generally contact cooled, but are finned for the purpose.

Any good type of speaker is suitable, of about 8in. or 10in. dia., but if a better class of speaker is wanted, the W.B. 810 is recommended.

Seasoning Apple Wood

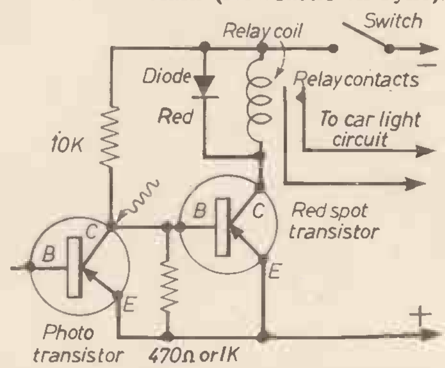
I HAVE recently been given some old apple trees and have heard that this is a good wood from which to turn small articles. Can you tell me the correct method of seasoning—the wood is still very green?—James McQuillan (N. Ireland).

APPLE wood is used for dance floors and paving blocks and is very hard wearing, though a good deal depends on its water content. With reference to seasoning, the logs can be cross piled and small wood cleats fixed to the ends to prevent splitting. The wood can be built-up high on a concrete base and in the open away from buildings. The wood pile should have a roof of some description and the logs tested from time to time for water content. This process is known as natural seasoning.

Artificial seasoning is done in a kiln or oven, though only a large amount of wood would justify the expense of a kiln. We suggest that you send a sample of the wood to the Forest Products Research Laboratory, Princes Risborough, Aylesbury, Bucks. They will assess the water content and the time required for seasoning.

Light-Operated Switch for a Car

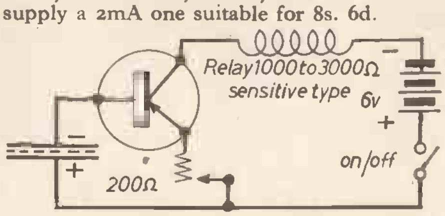
BELOW is a light switch circuit for 12v. operation. Any idea how I can adapt or make one for using with my 6v. car circuit?—N. Clark (Newcastle-on-Tyne).



12v. light-operated switch circuit.

WE see no reason why the circuit given should not work on 6v. This depends to a large extent on the type of relay fitted. This should be of a type which will operate on a small current, i.e. pull in on about 2mA and fall out on 1mA. The standing current in the circuit can be adjusted by use of a variable resistance in the emitter lead to the second transistor.

We suggest you use a barrier layer light cell in conjunction with the red spot transistor (instead of the photo-transistor) in the circuit given below. The relay must be able to pull in on 2mA. Dull daylight will give 3mA current and sunlight over 5mA. The circuit is rugged and will give no trouble as long as a suitable relay is used. You would be advised to purchase the catalogue of Messrs. A. Sallis of Brighton with a view to obtaining a suitable relay, or Messrs. H. W. English of Rayleigh Road, Brentwood, Essex, will be able to supply a 2mA one suitable for 8s. 6d.

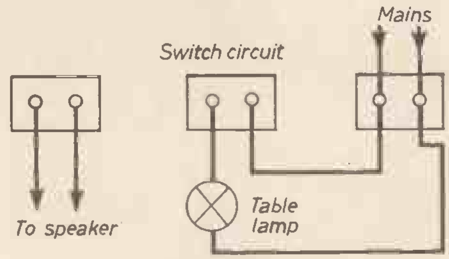


Circuit using barrier layer light cell.

Baby Alarm

I AM making the baby alarm which appeared in your March issue but would like to have a 40 watt light bulb attached to the head of our bed instead of the alarm bell, as my wife and I are both deaf and the light would wake us up when the baby cries. Also I wonder if a miniature microphone could be used instead of a loud speaker?—H. G. McWhinney (N. Ireland).

IT is very easily arranged to have a 40 watt lamp in lieu of the alarm bell or small warning lamp. All you have to do is to connect the switched terminals in the lamp circuit. This is most easily arranged by taking one lamp lead from one mains terminal and one lamp lead from one switched circuit terminal and then joining one main terminal



Altered circuit.

to one switched circuit terminal. Strictly speaking a high voltage type relay ought to be used, but it is unlikely that yours will break down and provided it is used in a bedroom away from concrete floors and water it would be quite safe. A sketch of the circuit is given above.

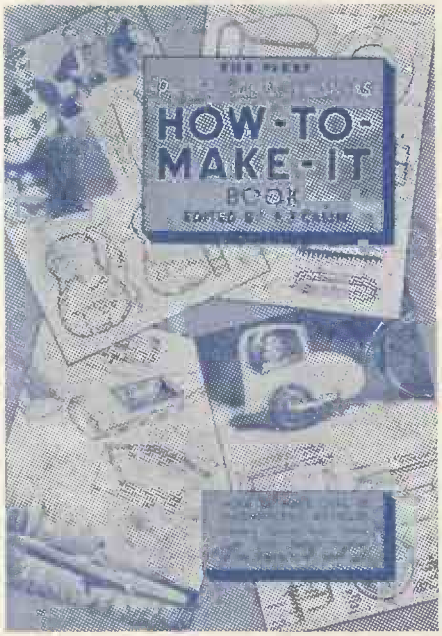
The second part of your query is not so easily dealt with. When the prototype was made many months were spent evolving the circuit for this baby alarm and the conclusion was reached that all normal microphones will not work satisfactorily on the unit. It is possible to use a crystal microphone, in which case the loudspeaker transformer is omitted from the circuit and a one or two M Ω resistor is fitted from pin 7 to central tag. This will not be so sensitive. If more sensitivity is required another valve wired exactly as Va is required; the problems involved in doing this are probably beyond the scope of the amateur. Feed back from one circuit to another may cause oscillations which would make the relay behave as if noise was present. We would suggest that you use a small moving coil P.M. speaker, say 3½ or 5in. in diameter. Results will then not be far short of those published.

Treating a Glass Roof

I HAVE a glass roof comprising some 1,500 sq. ft. which I want to treat with a view to preventing glare from sunlight, still retaining as much translucency as possible. Due to interior fittings it would not be practicable to treat the inside and previous treatments by painting on the outside have peeled off in a few weeks. Perhaps you could recommend a more lasting preparation to suit my requirements.—Edward Hughes (Eire).

A GOOD translucent, waterproof coating for your glass roof would be a solution of 1 part of bitumen in about 20 parts of naphtha. The bitumen should be allowed to remain in contact with the cold naphtha overnight, after which the mixture should be heated until near the boiling point of the naphtha. A dark solution will result, but when brushed on glass quite a good deal of light will be transmitted by it. The coating has the advantage of being highly waterproof. If too much light is transmitted the solution can readily be made stronger.

The books for the man who likes to make things for himself—



Shows you how to make over 30 magnificent articles. 224 pages and 320 diagrams and illustrations.

THE 1st "PRACTICAL MECHANICS"
HOW-TO-MAKE-IT BOOK

Edited by F. J. CAMM

THIS is a book for the man who likes to make things for himself. It has been compiled from the columns of "Practical Mechanics," the monthly journal for the handyman and model maker. Everything herein described has been designed, built and tested in the "Practical Mechanics" workshop, and may thus be built with confidence.

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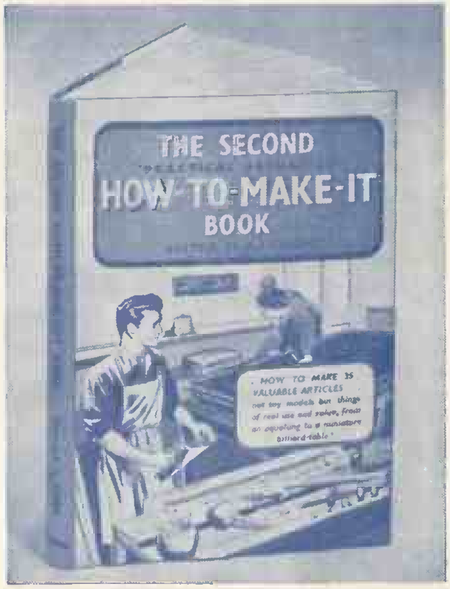

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