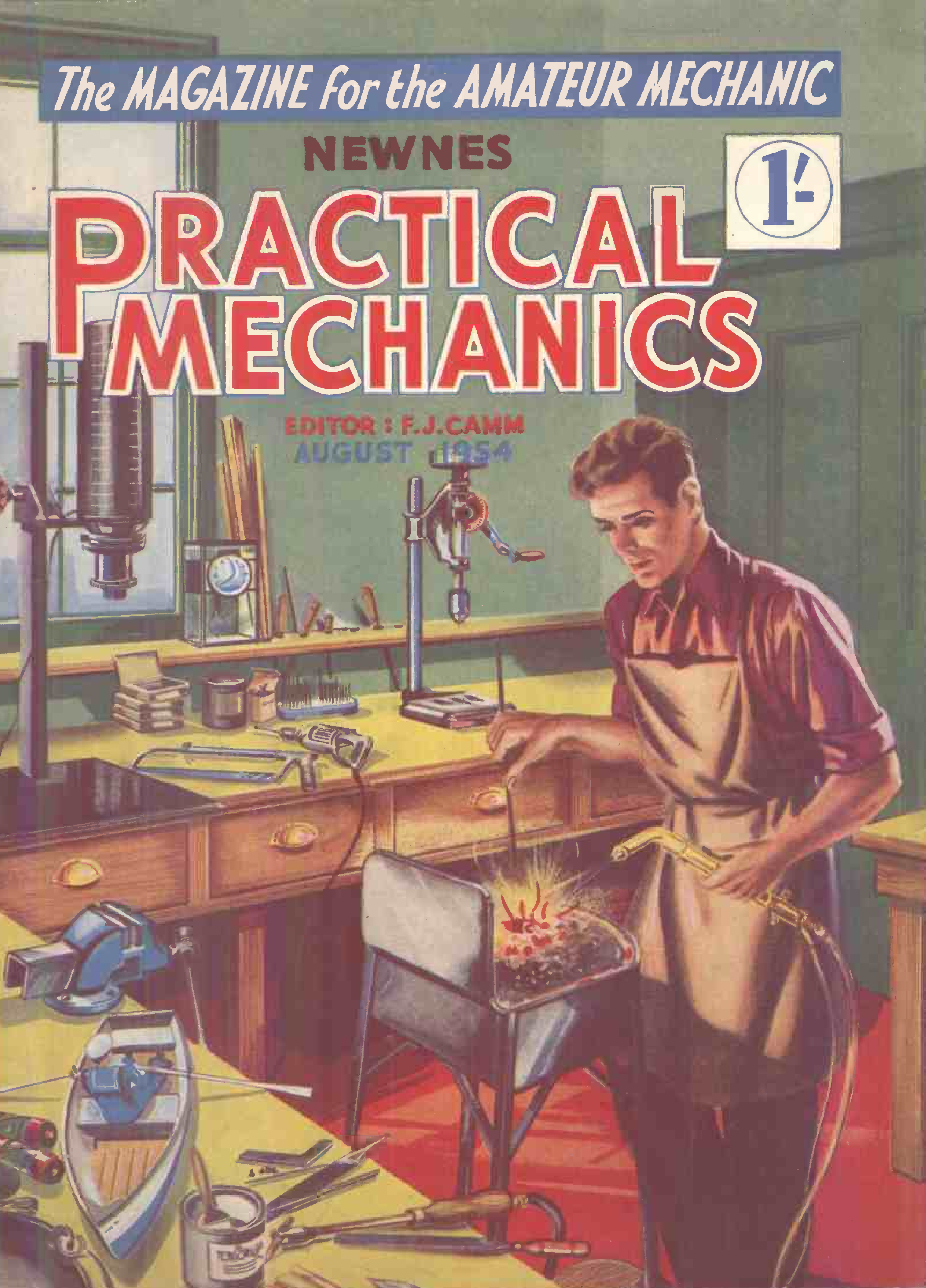
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EDITOR : F. J. CAMM
AUGUST 1954

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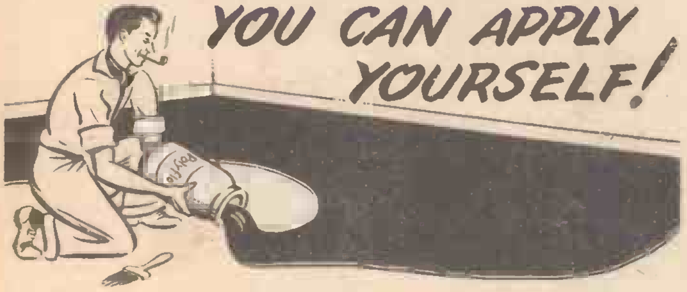

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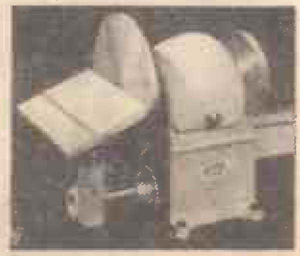

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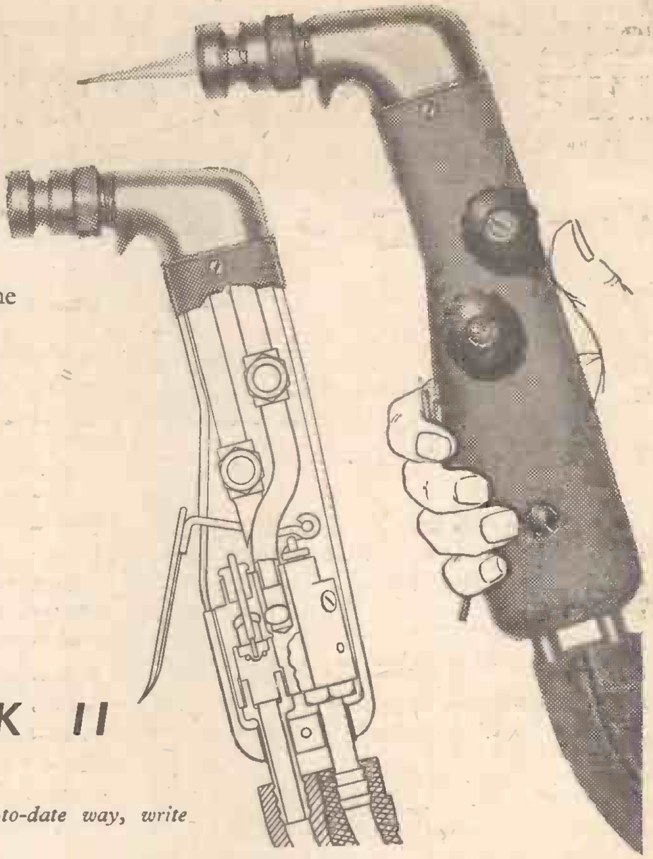

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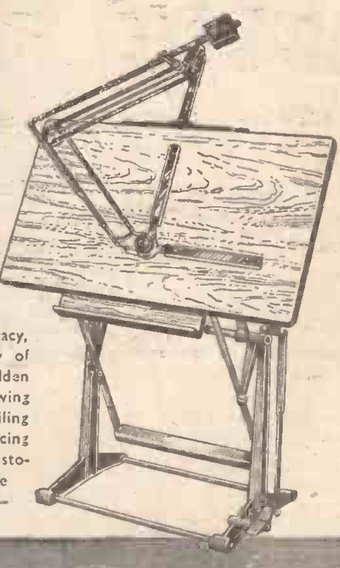

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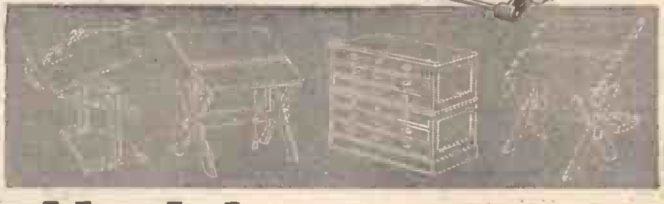

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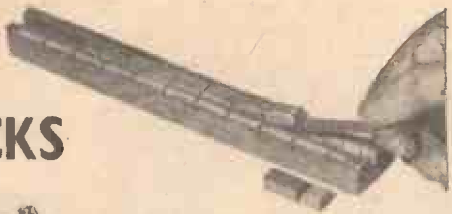

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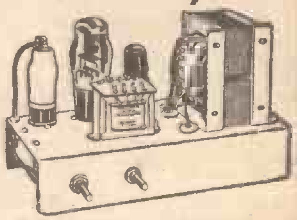

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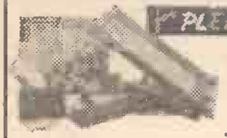

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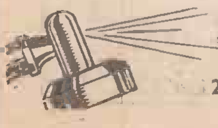

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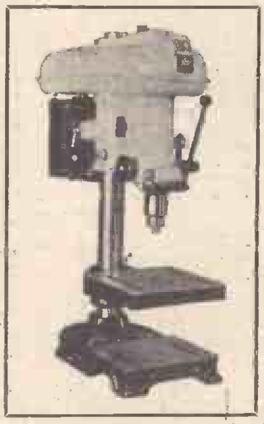

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VOL. XXI. No. 248 Editor: F. J. CAMM AUGUST, 1954

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By

The Editor

The Eclipse and Flying Saucers

THE eclipse of the sun on June 30th was the occasion for a further crop of stories concerning flying saucers which had been sighted. These stories must not be dismissed as hallucination or phantasmagoria for they have come from responsible people well versed in scientific matters. One of them was an experienced pilot who made a sketch of what he saw, and it would be foolish to suggest that this was a figment of his imagination. He was the pilot of a Stratocruiser and he saw seven mysterious flying objects when flying at 19,000ft. over Goose Bay, Labrador. The centre machine he described as resembling a flying jellyfish, because it seemed to be constantly changing shape. His sketch shows three main shapes, and also three smaller shapes which alter their positions, sometimes three ahead and three astern, and at other times one or two ahead and the rest astern. Notwithstanding this, the pilot states that he is still sceptical of the flying saucer theory, which credits these saucers as coming from other planets. He can only believe what he saw, and cautiously states that they were not like any planes he had seen before, except for one short period when the larger object took on the shape of a delta-wing aircraft. He is certain that the objects were not the result of reflected light, mirage, or any other of the usual phenomena met at high altitude.

Flying saucers have been reported so frequently and from such widely differing localities over the last few years, that it is impossible to discredit that something unusual, of which we are at present unaware, is taking place. But then many mysterious things *are* taking place behind locked doors, and it is only to be expected that they will be tested in the air; also that as they are on the Secret List no one will confirm or deny the accuracy of the reports.

The explanation put out by a noble lord, that the saucers contain visitors from another planet who are anxious to help us in our present economic difficulties, must be dismissed as unacceptable and nonsense. It is straining credulity too far to suggest that the inhabitants of other planets, if any, are conversant with the various languages of the world and the economic difficulties of each nation, any more than we are aware of theirs.

If the inhabitants of other planets are endeavouring to visit the earth, it would be on the same basis as our desire to visit them, namely, that of scientific exploration.

Like some so-called spiritualistic manifestations, which investigation has shown to be utter fraud, no doubt a large amount of the rubbish which is spoken and written about flying saucers can be considered as hoax and humbug, and we are astonished that one who ought to know better should promote such stupid beliefs in the minds of those members of the public who are without scientific knowledge.

After several years of flying saucer stories, we are no nearer an accurate explanation than we were at the start. If these visitors from the planets are trying to help us, their education regarding the state of the world at the present time is not so advanced as their knowledge of space travel, for their assistance would have been made manifest long before this.

One extraordinary aspect of the problem is the absence of photographs, with the minor exception of those published in a book which I recently reviewed herein. The space ships have been visible long enough for someone to have produced a camera with a tele-photo lens. However, the author of this particular book is to appear at the Albert Hall in September, and no doubt he will be able to answer some of the questions which scientific people are asking.

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Exploration in Egypt

IS it not remarkable that whilst so much has been accomplished in discovering the tombs of the Pharaohs and the contents of them, no one has yet discovered the tools with which the objects found were made, nor the workshops in which they were made? These beautiful pieces of craftsmanship, many of them made in gold and silver, delicately chased and made in complicated patterns, required finer implements than the stone tools of the palæolithic and even the neolithic ages. No one, however, has discovered the tools nor the methods of melting and refining the metal nor of rolling it into sheet form or drawing it in wire form. No examples of prehistoric drills exist nor of saws, chisels, mallets, and all of the other implements which would be necessary to work even the softest metals into the shapes found.

Some of them do not appear to be cast. Steel had not then been discovered. How then were the beautiful carvings executed? Some of the parts would seem to have needed an instrument such as a lathe, but no prehistoric examples of lathes exist. Others would appear to have required a press, and although the wine press is mentioned in the Bible, such an instrument would hardly be capable of exerting the very high pressure necessary for pressing metal into shape. They must have been real craftsmen in those days to have wrought such wonderful work with such tools as we know exist. Tubal Cain must indeed have been a man of might when he fashioned the first ploughshare.

"Practical Motorist and Motor Cyclist"

THE fourth issue of our companion monthly *The Practical Motorist and Motor Cyclist* is now on sale at 1s. Similar in size and style to PRACTICAL MECHANICS, it is packed with articles on the upkeep, overhaul, and repair of all makes of motor car, motor cycle, and motorised bicycle, irrespective of year of manufacture.—F. J. C.

Overhauling a Lawn Mower

Points About Dismantling a Lawn Mower and Grinding the Blades

Fig. 1.—Adjusting the height of the blades.

THE essential parts of a lawn mower are a set of rotary blades mounted on spiders, attached to an axle. These form a skeleton cylinder, each blade being twisted to form a segment of a coarse pitched spiral. The blades are made of shear steel, and the edges forming the outside diameter are truly ground with the axis of the spindle. The leading or cutting edges of these blades are also ground on the faces. Mounted in bearings, the cylinder is driven by the action of pushing the machine. On the bottom of the machine is a stationary blade, arranged in such a manner that the revolving blades are almost rubbing it throughout their entire length. Each blade, bearing in turn along the edge of the stationary one works like a pair of scissors.

Scissors or shears that are blunt and rocky in the joint have their cutting action impaired and made difficult. This also applies to a mower, the condition that is analogous to a loose joint being excessive clearance between the blades. Then, instead of cutting, the tendency is for the grass to fold between the blades and tear. The effort required to propel a machine with blades that are blunt and out of adjustment is many times greater than that necessary when in proper order.

Lawn mowers in general use are one of two types—these are "side-wheel" and roller, or drum. The fundamental difference between these types lies in the method of driving the cylindrical cutters. The first, driven by a pinion attached to each end of the cutter spindle, actuated by internal gear teeth made on the insides of the rims of the wheels of the side-wheel type. In the other type the drive is taken from the live spindle of the drum, either through a train of gears or by a chain. A slight variation between different makes occurs in the manner of adjustment, arrangement of bearings and so forth apart from difference in type, but the following remarks will be found to apply more or less generally.

Examination

Presumably the machine was put away in a clean condition, as far as the exterior parts were concerned. Therefore, the first thing to look at is the condition of cylinder spindle and bearings. To do this properly means that a certain amount of dismantling will have to be done. While the bearings may not be worn, there is every likelihood that they will be clogged with grass particles and dried oil which, if allowed to remain, would prevent any lubricant from reaching the bearing surfaces.

To do this with a side-wheel machine, remove the split pins from the wheel spindles, or if the spindles are made with a head, loosen the set screws in the frame and drive out the spindles. These should come out fairly easily, driving from between the frame, of course, and using an old bolt as a punch. The removal of the wheels exposes to view the driving pinions on the ends of the cutter spindle. Lift these off, but when so doing watch that nothing falls out. The backs of the pinions are recessed to form internal ratchet wheels, having three teeth. Corresponding with these are short slots cut through the spindles, into which pieces of flat material are loosely fitted. This arrangement acts like a free-wheel when the mower is pulled backwards. Remove these pawls noting which way the straight edges are facing. On some machines channels are cut in the frame castings to facilitate their removal.

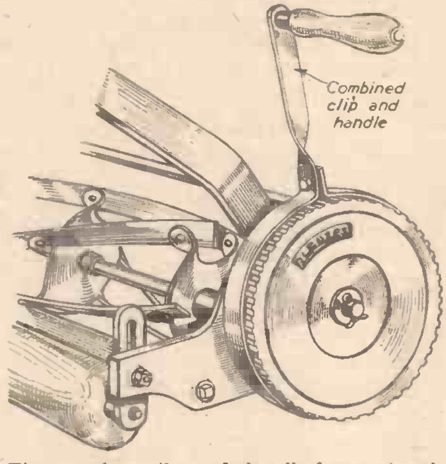


Fig. 2.—An easily made handle for turning the wheels.

The ends of the spindle can now be tried by shaking to see if there is any play in the bearings. If no shake is apparent, spin the cylinder to see if it revolves freely. Then, if satisfied on this point wash out the bearings with paraffin, but if very sticky, it is best to remove the cylinder for cleaning purposes. This is done by removing one of the nuts on the ends of the tie rod, exposed by removal of the wheels and one rocker bolt holding the bottom blade. One side plate can then be lifted clear and the bearings thoroughly cleaned. The bearings may be ball or roller, in which case there is less likelihood of them being badly worn than if made of bronze. In the latter case, some wear can be taken up by adjustment of the set screws, afterwards securely tightening the locking nuts. Do not let the bearings go without adjustment if at all slack, as the degree of fineness to which the blades may be set depends upon them.

After cleaning the gear teeth, the parts are reassembled in the order in which they were removed. Do not forget to oil properly all working surfaces before putting back, or the chances are that the oil will never find its way where it is wanted if assembled dry.

Sharpening the Blades

We will presume that the blades are merely dull and not badly gapped. Should such be the case, regrinding may be successfully carried out by hand. Lay the machine on its back, resting it on a plank or block, and supporting it by the tie bar and handle bar, so as to leave the wheels free to rotate.

The bottom blade is adjusted by means of the set screws acting on abutments on either side of the rocker bolts until the cylinder blades rub when rotated. There are also other systems of adjustment, see Fig. 1. It will be necessary to provide some form of handle with which to turn one of the wheels.

A suitable one for this purpose is shown in Fig. 2. As will be seen, it is of iron, about 1in. × $\frac{1}{4}$in. section and made to clip with one bolt on to the rim of the wheel. Apply a liberal quantity of fairly fine carborundum grinding paste thinned with oil to the extreme edge of the bottom blade. Rotate the cylinder, stopping occasionally to replenish the abrasive and to adjust the bottom blade slightly as necessary. Continue the process until all of the rotating blades give evidence of having made contact over their entire length with the bottom blade. A word of warning must here be inserted, calling attention to the danger in touching the revolving blades, and any feeding of grinding paste should be done with the cutters at rest. One hand must necessarily hold the machine down, and a convenient point out of harms way to do so is on the wooden roller.

Free the blades of the grinding medium by wiping dry, finally cleaning with a rag damped with paraffin. Washing off must be avoided, as it will result in the substance entering the bearings.

Now remove the bottom blade and sharpen

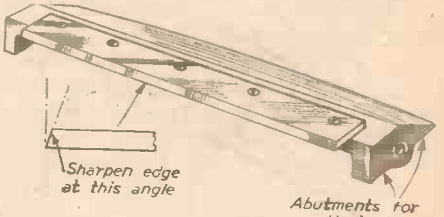


Fig. 3.—Details of the angle at which to sharpen the blade.

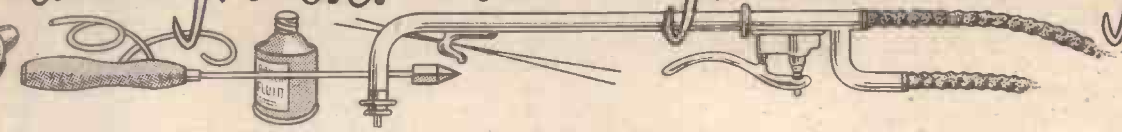
the edge with an oil stone or reaper file to the angle shown in Fig. 3. The edge should be like that of a scissor blade. Look at the faces of the rotary blades, on the edges that pass the bottom blade first. Should they appear at all rounded off, bring to a sharp edge by stoning along the face, taking care to maintain the original plane of the grinding.

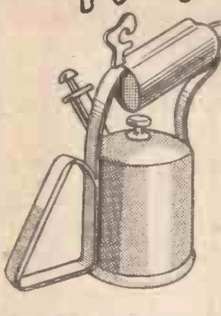
Replace the bottom blade and adjust up so that edges of the moving blades just touch evenly. After making sure that the bolts and adjusters are screwed up, the machine is ready for use.

The foregoing remarks as regards sharpening apply to both types of machine, with the exception that a driving handle is attached to one of the gears. This is provided for on some makes of drum-type machines. Half bearings are usually fitted to the cylinder bearing ends. Wear on this type of bearing is taken up by filing the faces of each half. The adjustment of the cylinder in relation to the bottom blade is by means of screws, which raise or lower the bearings.

After grinding has been carried out, it may be necessary to readjust the meshing of the gear train. Allowance is made for this, usually on the drum bearings, and by moving the position of the intermediate gear spindle.

Soft Soldering, Silver Soldering, and Brazing





Notes on the Techniques and Apparatus Used in these Three Methods of Metallic Bonding

By E. W. TWINING

SOFT soldering is a comparatively simple method of so joining two metals and these two metals can be of entirely different natures; thus, brass can be soldered to copper and either of these to steel. Aluminium is the one metal which cannot be soldered, silver soldered or brazed, except by using a special solder and adopting special methods. Cast iron is not easy to soft solder; though it can be done it is difficult to get the solder to flow.

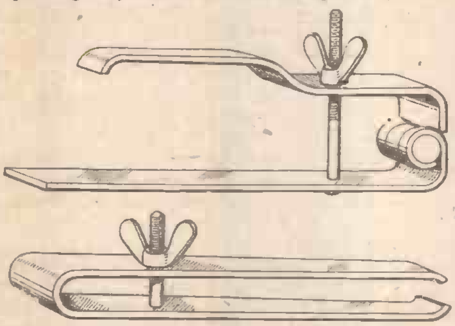


Fig. 1.—Clips for soldering work.

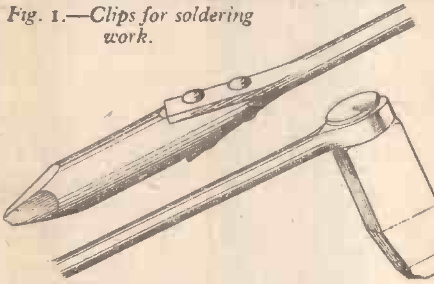


Fig. 2.—Two copper soldering bits.

Soft solder is an alloy of lead and tin, and the addition of the tin not only hardens the mixture but lowers its melting point. The fusing point of lead is 620 deg. F. and of tin 446 deg. F., so the solder will melt at something between the two, according to the proportions contained in the alloy.

Perhaps the only difficulty in soldering when more than two pieces of metal have to be united is found in holding them together, especially if they have to be joined, as they nearly always have, to exact positions on each other. The whole assembly can sometimes be performed in one operation when all of the pieces are arranged vertically one above another. They can then be held together by their own weight, though if they are small and light they are liable to move by tending to slide when the solder melts, especially if the work is held in the hands. The solder acts as a lubricant and prevents adhesion by gravity; in fact, if the surfaces are not truly horizontal gravity will cause the movement when a small piece of metal floats on the molten solder.

So it is apparent that in most cases some means must be provided of holding the pieces of metal together and one excellent way is by means of clips of various sizes and shapes. Two such clips are illustrated in Fig. 1.

In cases where clips are not practicable, a binding of black iron wire may be put around the work and, occasionally, when the shape does not permit of either binding or clipping, pinning must be resorted to; such pins can be of brass wire driven lightly into drilled holes, or screws into tapped holes.

Applying the Heat

With regard to the application of the heat, almost everything depends upon the size, complication of shape and the amount of metal in the object, also to some extent upon the number of pieces in it. Unless the object is very small or very light, it will be a blowpipe job and the object will be laid on several thicknesses of asbestos card or better on a firebrick slab and played upon with a bunsen flame in which an air jet is fitted. The size of this flame and the air pressure required will depend upon the size and amount of metal in the work to be soldered. It is a great advantage, before assembling the parts, if all the surfaces to be joined are "tinned," i.e., thinly coated with solder, see Fig. 3. This can usually be done with a soldering iron which, by the way, is not iron at all, but is a copper bar in an iron holder and will be referred to here as a "copper bit." Two forms of this are shown in Fig. 2.

Tinning the Iron

To "tin" an iron with either of the fluxes the bit should be cleaned up with a file until the copper is bright. Heat it until the copper is about to change colour, and rub with a stick of solder which has previously been dipped in the flux. Apply it quickly to all sides, afterwards wiping the solder over evenly with a piece of rag. The iron is now "tinned" and ready for use, but there is another method which is equally as good, and that is to have a small piece of tinned steel on the bench on which to rub the iron instead of wiping it with the rag. Both methods apply to both fluxes, see Fig. 4. When the iron is "tinned" it should still be carefully heated, as a "burned" iron ruins the tin on the surface, turning it into a very brittle dark mass that will neither convey heat nor hold the solder.

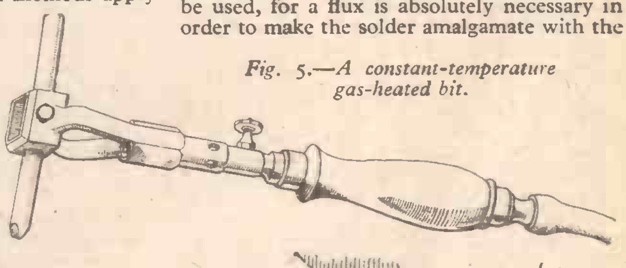
If the object to be soldered is small and for the greater part made up of brass or copper plate the whole of it can be done with a copper bit; usually, however, this handy tool is kept for very light work such as electrical wiring and the soldering of seams in tin and other plate work. The disadvantage with the bit is that it rapidly cools and has to be reheated, though for continuous work gas-heated bits are obtainable in which the temperature is kept constant by a small Bunsen flame. These have, of course, to be connected up to a gas supply by means of a rubber or other flexible pipe, which limits their range of movement. Fig. 5 shows one form of such a gas-heated bit.

In doing all-round small work, nine out of 10 soldering jobs can be done in the flame of an ordinary vertical Bunsen burner, with the work to be soldered held in the left hand by means of a pair of pliers or small tongs; objects up to 1½in. or 2in. square being perhaps the limit. But here again the limit is really set by the shape and weight, or mass, of metal to be heated. No blowpipe need be used in such cases.

With large pieces of work which are fairly open and have no heavy masses forming a part of them, it is possible to add small pieces of metal to the structure by local heating without risk of unsoldering what has already been done. Suppose we have an open cylinder of brass tube, say, 2in. or more in diameter and something is already soldered on one side of the cylinder. We want to add two small bosses, one at each end, to the opposite side. We can safely sweat on those bosses with a very small blowpipe flame, if we are careful not to let the flame play upon any part of the cylinder other than the spot to which we are attaching a boss, nor to let it play too long. After the first boss is on let the cylinder cool down; such cooling being accelerated with water or with a wet rag to save time. Then apply the second boss in the same way.

With regard to the soldering flux—either "Fluxite" or Baker's Soldering Fluid may be used, for a flux is absolutely necessary in order to make the solder amalgamate with the

Fig. 5.—A constant-temperature gas-heated bit.



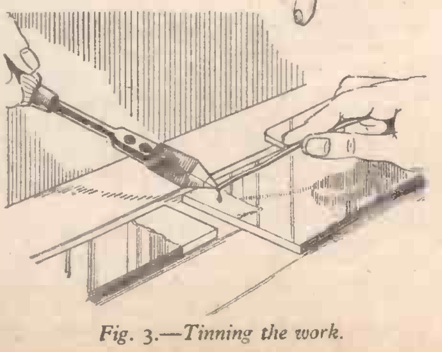


Fig. 3.—Tinning the work.

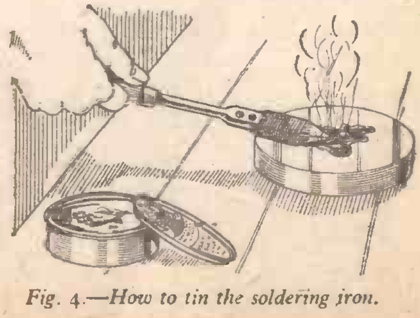


Fig. 4.—How to tin the soldering iron.

surfaces of the metals to be joined. Whichever is used the work should, after soldering is completed, be well washed in water and then in turpentine to remove the grease and the acid or chloride. For all-steel work the correct flux is zinc chloride and this or sal-ammoniac may be used for all-copper and all-brass fittings.

Silver Soldering

Fig. 6 is a drawing of a Bunsen burner with a blowpipe jet suitable for local soldering, such as the putting on of the bosses on the cylinder just referred to; it is equally applicable to the silver soldering of small work; indeed, comparatively small work is all that is likely to be done by silver soldering. The biggest job which the writer has ever seen entirely silver soldered is a ½in. scale locomotive boiler. Many mechanics and amateurs are afraid of silver soldering, but it is just as easy to do as soft soldering, though a much higher temperature must be raised in the work, in as much as the metal must be brought to a fairly bright red heat. The flux in this case is borax and this must be applied sparingly to the joint as a paste, the powdered borax being mixed with a little water. The water is merely to prevent the borax powder being blown away by the blast from the blowpipe. It dries quickly by the heat and solidifies into a mass or film before it fuses down on to the metal.

The silver solder is sold in sheet form at so much an ounce; it can be had in several gauges, s.w.g., and in three varieties of flow or hardness. It is an alloy of silver, copper and zinc, and the higher the percentage of silver it contains the higher is its melting point; thus the hardest contains 80 per cent. of silver and the softest 60 per cent. The zinc content averages 8 per cent., the rest in each case being the copper.

Using Silver Solder

There are two ways in which the silver solder can be applied. In both cases a narrow strip is cut with tinman's shears from the sheet, say ¼in. wide. In one case tiny cross pieces are cut from this strip, measuring $\frac{1}{16}$in. by ¼in., and these are packed in with the borax paste; then the blowpipe is brought into play. In the other way the blowpipe is made to play on the work and when the borax has fused and the metal is at a bright red heat the joint is touched with the strip of silver solder and in a second or two the hot end of the strip will melt and instantly flow around the joint, displacing the borax. The writer has found the first to be the better way because it is easier to control the amount of solder which makes the joint, though of course it requires nice judgment of the quantity needed. With the second method there is liability of more than is necessary being melted off the strip.

If the fitting which is to be soldered is circular and all parts of it which are to be soldered have been turned in the lathe there will be no difficulty in holding all together if each component sockets into the next; or if one part is turned and has to fit into a drilled hole in, say, a part that is square. A good fit of the spigot in the hole will ensure the holding together for soldering, but if a flat to flat joint has to be made—a simple butt joint—there a steel clip, like one of those in Fig. 1, must be used to hold up the two parts to be soldered. It is an excellent plan to have a goodly number of these clips, two or three of each of two or three different sizes large and small.

For most small silver soldering jobs sufficient heat can be concentrated on the work by a Bunsen flame from 4½in. to 7in. long, and a jet supplied with air by the breath and lung power of the operator, but if the work is larger, with upwards of two or three ounces of metal in it, a power air pump will be necessary, such, for instance, as a motor car tyre pump which can be worked by the foot and having an air drum between the pump and the blowpipe to give constant pressure by equalising out the strokes of the pump.

chiefly confined to bigger structures almost entirely of steel and owing to the still higher temperatures required must be done entirely on a hearth.

As the name of the process implies, brass is the metal employed to make the joint. Brass is an alloy of copper and zinc and the fusing temperature of the solder, or "spelter" as it is called, depends upon the proportions of the alloyed metals; the greater the proportion of copper the higher will be the melting point and vice-versa. In most spelters for brazing the proportions are so arranged that with care there is no risk of melting or burning the work.

Apart from this matter of higher temperature and the use of spelter instead of silver solder there is no difference between brazing and the hard soldering last described. In both, borax is used as a flux and in both can the fusible metal be applied in particles with the borax or in the form of a stick of the metal at the moment when the joint is ready to receive it. The methods of holding the parts together which are to be brazed are much the same except for the fact that screw-down clamps are advisable instead of spring clips and there is perhaps more frequent occasion to resort to the binding with iron wire to hold together loose pieces. It is good practice to pin together the parts before brazing but this need only be done when the work is of such a shape that it is impossible to apply either a clamp or a binding, for instance in the brazing together of tubular and other frames.

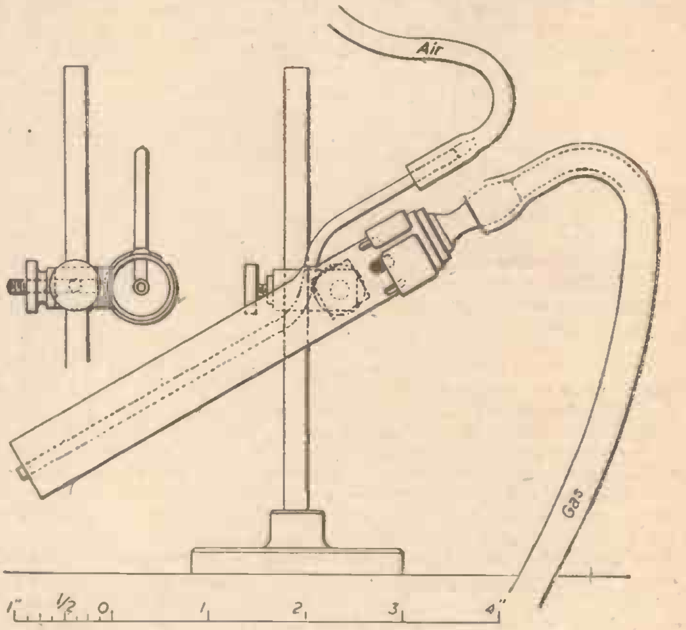


Fig. 6. (Right)—A small Bunsen blowpipe.

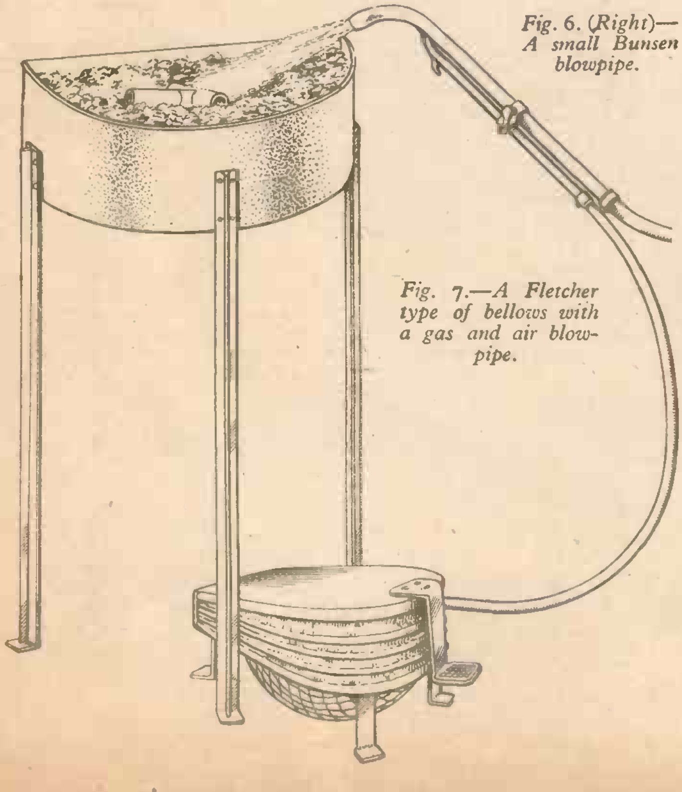


Fig. 7.—A Fletcher type of bellows with a gas and air blowpipe.

The work must be supported on a piece of firebrick or, for very small jobs such as jewellery, or model fittings, on a number of thicknesses of sheet asbestos. On a slab of firebrick with pieces of broken firebrick or asbestos packed around the work, to conserve the heat, in medium size work and, for comparatively big jobs such as a model boiler, on a proper hearth filled with broken firebrick or coke breeze.

Brazing

This mention of a hearth brings us to the matter of hard soldering, which is known as brazing. This method of making joints is

As the temperatures which the job must reach in brazing are high there will be required not only a hearth but a powerful blowpipe capable of giving a flame, when required to do so, at least a foot long; the blowpipe must be able to yield a correspondingly big supply of air and maintain it. A Fletcher type of bellows will meet the case and a sketch of one of these, with a gas and air blowpipe, is reproduced in Fig. 7. Some people obtain excellent results in brazing by using a paraffin blow lamp of large size, but it seems certain, however, that the gas and air blowpipe would give better control over ther operation and the flame can be shut down immediately the spelter has flowed into the joint.

After both silver soldering and brazing there will remain around the joint some of the fused borax; this is hard and glossy, like a vitreous enamel. It is difficult to remove by chipping but it can be dissolved by immersion in a 5 per cent. to 10 per cent. bath of hot caustic soda solution.

Attachments for an Electric Drill

Some Home-made Additional Accessories for the Wolf Cub Drill Kit

By C. W. TINSON

ONE or other of the popular makes of small electric drill is a piece of equipment now in use in many homes, and is a tool which the handyman or amateur constructor would not like to be without. In the case of the Wolf Cub, accessories can be purchased by means of which the drill can be adapted to drive a small circular saw, a wood-turning lathe or a vertical driller. Some of the components are common to all three, making it practicable to mechanise one's workshop at a very small cost. There are some accessories for which one feels the need, however, not at present offered by the makers. It is possible to make these and they will widen the scope and utility very considerably, particularly in the case of the circular saw set. In this article some of the simpler attachments are described. The prototypes of them have been made up in metal, but they could be produced in wood; in either material there is no doubt they will be found most useful.

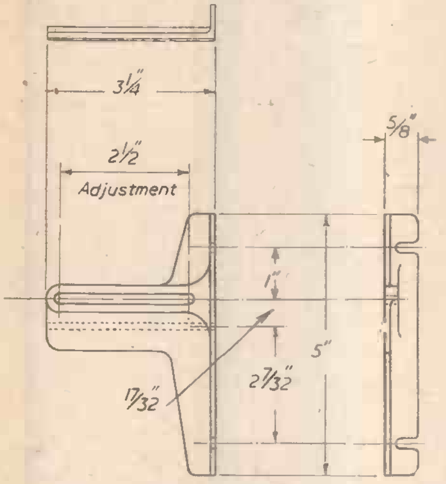


Fig. 2.—The longitudinal fence.

Assuming one already possesses the electric drill, the parts to be bought to make up the saw set comprise a saw table, a holder for it, a back centre support, a straight-edge forming a longitudinal fence, a circular saw, a saw guard, an arbor, with its nuts and washers, and a length of ⅜in. diameter steel bar, on which the components are assembled. These combine to make an extremely useful and efficient little machine, which will accept timber up to 1in. in thickness. The height of the table can be regulated to set the extent of emergence of the circular saw above it, and the fence can be adjusted for distance from the saw, so that in addition to the ability to cut off material to width it is possible, by setting the emergence appropriately, to produce first-class rebates. One quickly realises, however, that the range of jobs that could be done on this saw could be increased if one or two extras were available.

The dimensions of the table and straight-edge, or longitudinal fence, which are supplied with this set are shown in Figs. 1 and 2. The table height can be varied 1in., while the lateral adjustment of the fence is 2½in.

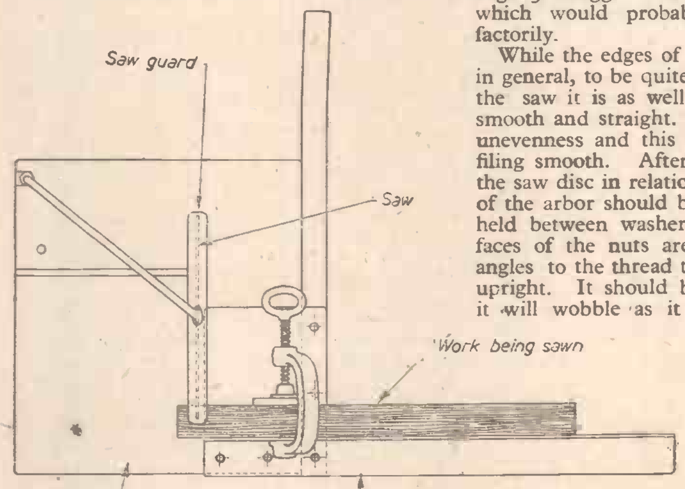


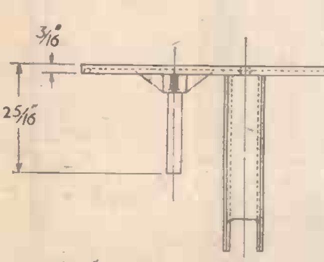
Fig. 3b.—Application of the right-angled fence.

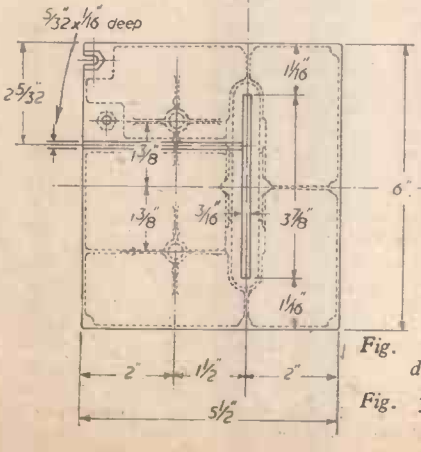
Right-angled Fence

Perhaps the first piece of additional equipment for which one feels a need is a right-angled fence, to enable the ends of work to be cut off truly square to the length. Fig. 3a shows the dimensions of such an accessory of size suited to the saw table and Fig. 3b shows its application. This was made in metal, but could be made with a plywood base and a plywood guide, and with a fence made of wood having a cross-section of, say, 1in. by ¾in., but a watch should be kept from time to time for possible warping of the fence piece. In metal any trouble of this kind is unlikely. Fig. 3a suggests thicknesses of ply, etc., which would probably do the job satisfactorily.

While the edges of the table will be found, in general, to be quite parallel to the plane of the saw it is as well to check that they are smooth and straight. There may be a slight unevenness and this should be corrected by filing smooth. After that the squareness of the saw disc in relation to the axis of rotation of the arbor should be checked. The saw is held between washers and nuts, and if the faces of the nuts are not perfectly at right angles to the thread the saw is not held quite upright. It should be, of course, otherwise it will wobble as it rotates, will cut more sawdust than it need, and it will be difficult to gauge where to start cutting if it is required to cut up to a pencil line previously marked on the work.

It is necessary to ensure that the fence piece is secured to its base precisely at right angles to the saw cut and to achieve this it is as well to pin one end only of the fence at first, by a rivet (nearly tight) if in metal, or a





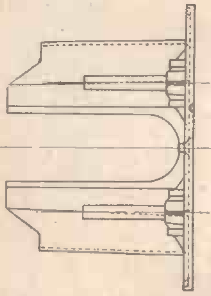
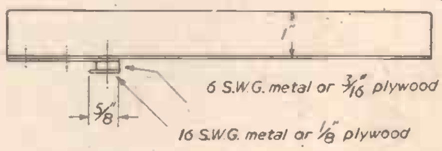


Fig. 1 (Left).—Dimensioned drawing of the table.



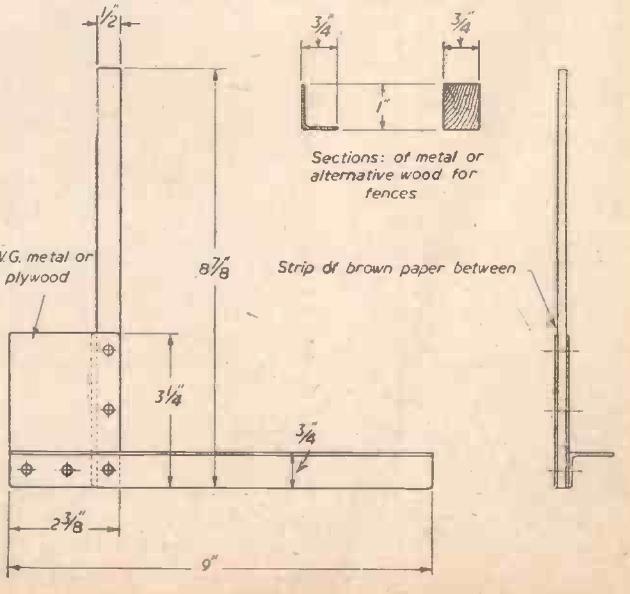


Fig. 3a (Right).—The right-angled fence.

woodscrew (nearly home) if a wood fence is being fixed. A small trysquare, or a cardboard square on which the right angle has been set up with a pair of compasses, is called for here. Celluloid setsquares are not always sufficiently accurate. Lay one edge of the square against the side of the saw disc and rotate the fence to meet the other edge of the square. Adjust to obtain contact throughout the length of the fence and cramp it firmly for drilling for the next rivet or screw. This method is better than drawing a line across the base and then matching up the fence to the line. A strip of brown paper between the guide piece and the lip or flange will be found a convenient way of ensuring a suitable gap so that a nice running fit is obtained.

If the work to be cut is held to the fence by means of a cramp the operator's right hand is then free to press the base guide sideways and forward, to maintain contact with the edge of the table and to advance the work into the saw at the same time.

Cutting Mitres

Another most useful piece of equipment well worth making is an attachment for cutting mitres on the saw set. Suitable dimensions for this are illustrated in Fig. 4a. This attachment was also produced in metal, as shown in the figure, but could be made using wood and three-ply if desired. Fig. 4b shows it in use. One advantage of timber as a material for constructing this is that the components of it can be produced on the saw set itself; a disadvantage is that a certain amount of warping could occur after a time, tending to reduce the accuracy which is so essential if a really neat mitre is to result. In the design shown, however, any warping which might take place is not likely to give much trouble in this respect.

The base plate is cut true and square and a line is then drawn on it precisely parallel to one edge and coincident with the centre line of the saw slot in the Wolf Cub table. The guide strips must be exactly parallel to this and must also be so separated in plan view that the plate is able to move freely over the table, but without any backlash. To permit a limited amount of adjustment to ensure the desired fit it is as well to drill slightly oversize rivet holes through the guide strips. Then, with the rivets partly closed, not fully home, the guide can be tapped sideways into position to get a freely running fit without slackness. As this is so important it is as well first to fix one of the guide strips to the base plate and then, with the base plate upside down, to invert the saw bench table and place it in position with its edge hard up against this strip. The table then acts as a gauge; the other strip can then be pressed against its opposite edge and cramped to the base plate firmly while the fixing holes are drilled.

After securing the second guide strip the table ought to slide up and down quite freely, but if it does not, a rub with a file along the edges of the table will give the freedom required. If the plate tends to bind anywhere in its traverse across the table when in use the work will feed into the saw jerkily and this, naturally, is most undesirable; but if, on the other hand, the plate is at all loose because of backlash in the guides, then it will almost certainly wobble sufficiently to menace the accuracy of the mitre, and it is not much use going to the trouble of making this attachment unless it is perfect and will produce accurately. The fixing of the guides, therefore, demands great care.

It is of equal importance that the fences should be secured to the base plate with precision, for not only must they have an included angle of 90 deg. between them, each must be exactly at 45 deg. to the centre line on the base plate along which the saw will be cutting. A good method is to prepare a fairly large cardboard setsquare set out with compasses to give the required 90 deg. and 45 deg. angles. Mark the centre line, bisecting the 90 deg. angle and the base, because this line will be used subsequently. Then cut out the square, using a sharp knife against a straight-edge. In the case of the right-angled fence it was recommended to pin one end of the fence first; in the case of this mitreing attachment, also start by pinning one end of one of the fences before doing anything with the other one. Lay the cardboard setsquare on the base plate with

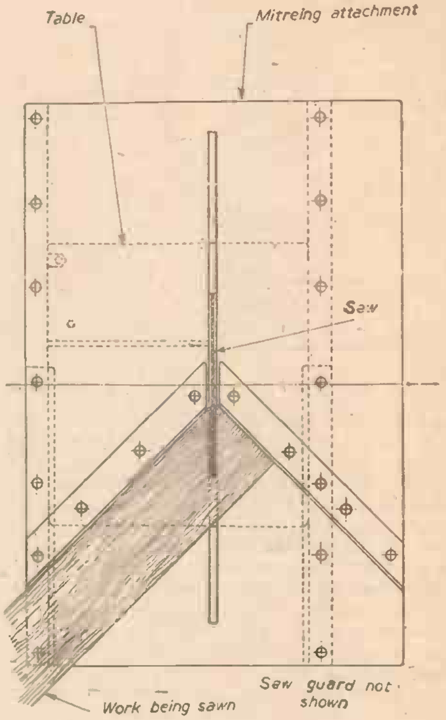


Fig. 4b.—The use of the mitre cutting attachment.

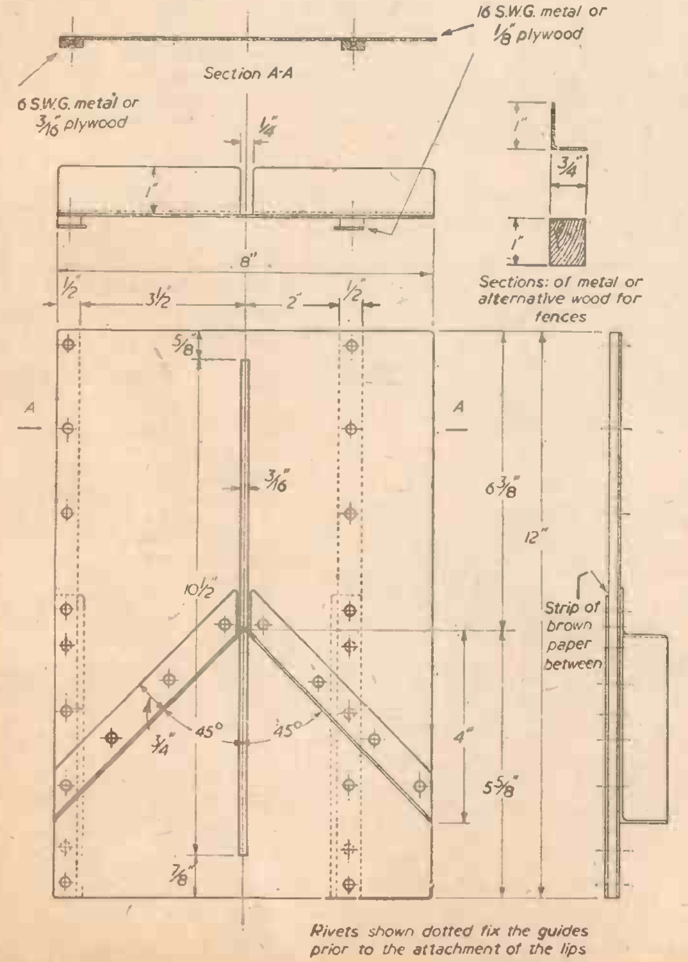


Fig. 4a.—An attachment for cutting mitres.

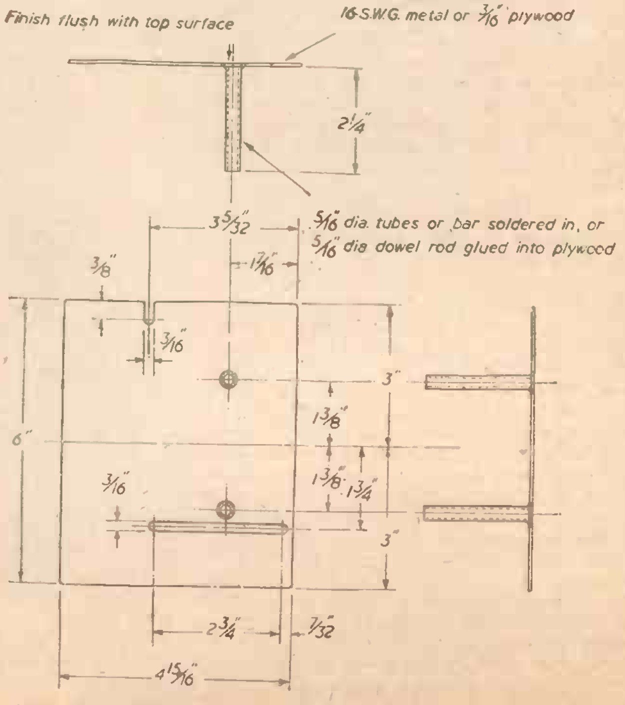


Fig. 5a.—Attachment for cutting discs or wheels.

its centre line running through the length of the saw slot. Then rotate the fence to meet the edge of the setsquare and cramp it in that position to hold it there while drilling to fix it. This fence will then make exactly 45 deg. to the cutting line. Repeat the

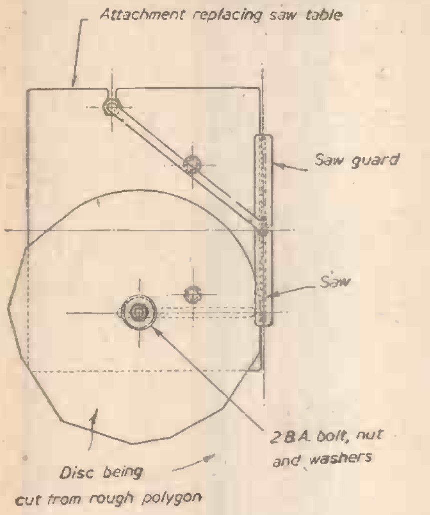


Fig. 5b.—Disc cutting attachment in use.

operation for the opposite fence and the result will be that both of them will be set at precisely the correct angle for making a perfect mitred joint.

The lip strips are put on last and are separated from the guides by a strip of brown paper, as before. It will be noticed that these do not extend the full length of the guide pieces and this is to allow the plate to drop on to the table over the saw. It will then be resting on the table, and a small forward movement of the plate will then engage the lips and bring them into action before the saw reaches the work. There is adequate overlap of the lips by the time the table is advanced sufficiently for the saw to start cutting.

A simple form of saw guard (not shown in the figure) should be made and fitted, as the standard one is not suitable.

This method of producing mitres will be found more satisfactory than by using the fixtures described in my article in the January, 1954, issue of PRACTICAL MECHANICS, for it is very much quicker and, due to the high speed of the saw, the cut is extremely clean and requires the minimum of dressing with glasspaper afterwards, particularly in the case of hard woods.

Discs and Wheels

The saw set can also be adapted to produce discs or wheels up to a diameter of 6in. and with a maximum thickness of about 1in. First, draw the required circle on the article to be cut, using compasses. Then drill a 3/16in. diameter hole through the centre. Next cut across several tangents to a circle about 3/32in. larger in radius than the radius of the finished disc, thus cutting away most of the redundant material, so that the material is now roughly of polygonal shape. The work is now mounted on the attachment shown in Fig. 5a; a centring pin is fitted in the slot and set to a distance from the saw equal to the radius of the finished circle. On rotation of the work the saw will trim the polygon down, as shown in Fig. 5b, producing a truly circular shape, which will need very little dressing with glasspaper, particularly if the disc is inverted and rotated once again to remove the whiskers left from the first cut.

This attachment needs little explanation. It is used in place of the saw table and therefore requires two legs which will enter the table holder. Two tubes of 5/16in. diameter, each 2¼in. long, are soldered into holes 2¾in. apart and to make quite sure that the fixture will be interchangeable with the saw table these tubes should be inserted and clamped in the holder while soldering them to the plate. The holder is then being used as a jig to keep the tubes the right distance apart and parallel to one another.

The slot shown in the end of this attachment is to receive the arm of the saw guard which is supplied with the set, so a special guard is not necessary.

Sanding Wheel

One of the most useful pieces of equipment for the workshop is a sanding wheel with which to dress up end-grain. Although the Wolf Cub saw cuts extremely cleanly, the cut usually requires a bit of finishing off with glasspaper. Using the disc cutting attachment as shown in operation in Fig. 5b three-ply discs ⅛in. thick and 4in. in diameter can be cut, to which glasspaper is glued, making excellent miniature sanding wheels.

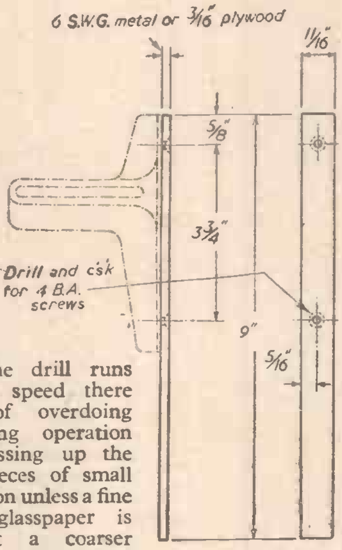


Fig. 6 (Right).—The longitudinal fence extension.

Since the drill runs at a high speed there is risk of overdoing the sanding operation when dressing up the ends of pieces of small cross-section unless a fine grade of glasspaper is used, but a coarser grade is satisfactory when the cross-section is bigger. For this reason it is recommended that two discs be made, one with quite fine paper stuck to it and the other with a medium coarse grade.

For finishing ends at right angles to the length use the fence shown in Fig. 3a. Mitre cuts can be finished by adding the attachment shown in Fig. 4a in place of the right-angled fence. To avoid having to remove the saw from its arbor in order to replace it by the sanding wheel each time the sander is wanted it is better—as all parts are sold separately—to buy a duplicate saw arbor complete with its nuts and washers, on which the sander can be mounted permanently in its correct position, the arbors alone being changed over according to the job to be done.

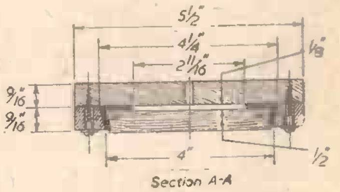
When cutting it is wise to have the saw slightly outside the finishing mark; this seems too obvious to point out, but the sanding wheel is so effective owing to the rapid rotation of the drill that until one gets a bit of practice there is risk of overshooting the mark and finishing undersize in consequence. Even with a light touch against the wheel, the glasspaper removes material quickly and it is for this reason that a fine grade of paper is recommended for small cross-sections.

Longitudinal Fence Extension

The length of the fence part of the straight-edge which is supplied with the saw set is not great, and a worth-while improvement is to add an extension to it such as is shown in Fig. 6. This will be found to have certain advantages, among them the provision of a finer control over any long piece of work as it first enters the saw, making it certain that there is no difficulty in leading the work in absolutely straight right from the beginning of the cut. The material used for the extension is preferably metal, of course, as drawn in the figure, but plywood might be a satisfactory alternative, and a plywood strip for this purpose can be produced on the saw itself.

The attachments described enormously increase the utility of this saw set and give the speed and perfection of machining to jobs which otherwise would take longer and would probably be a little less perfectly done by hand.

(*Continued on page 501.*)



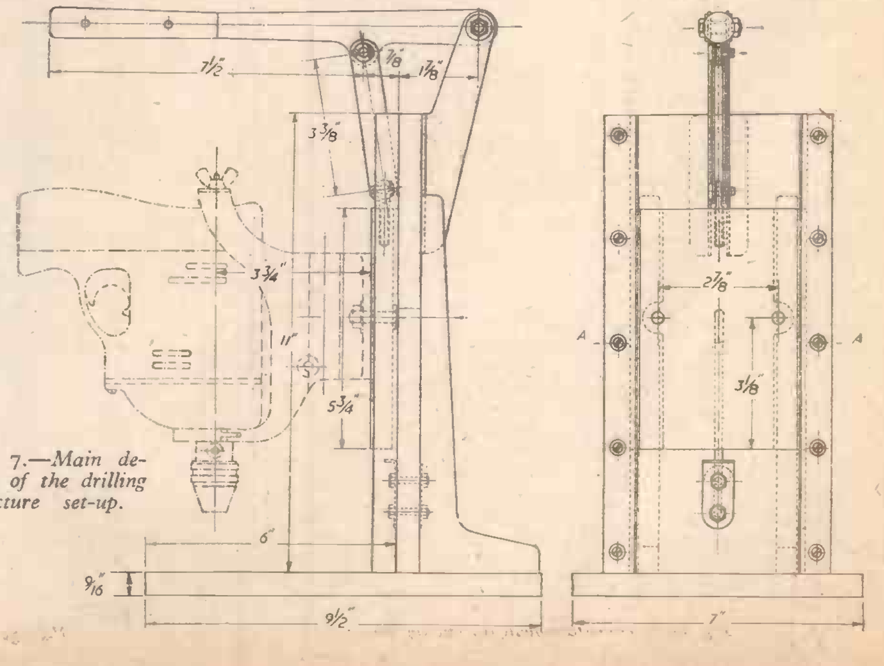


Fig. 7.—Main details of the drilling fixture set-up.

A Parallax Corrector

A Handy Accessory for Close-up Photography

By ARNOLD E. BENSUSAN

MODERN miniature and roll film cameras which have their viewfinders set above the taking lens have a particular fault in common with twin lens reflexes. They all suffer from parallax when close-up pictures are being taken. This can

A view of the completed parallax corrector.

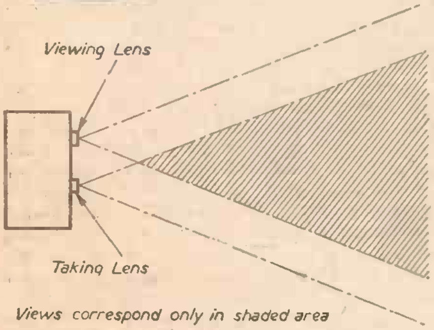


Fig. 1.—The effect of parallax.

largely be defined as the inability to see in the viewfinder exactly what is being recorded on the negative, due to the difference in height between the centre of the lens and the finder, as shown in Fig. 1.

Special prism attachments, obtainable for fitting to the viewing lens of some makes of reflex cameras, do not entirely correct the trouble for, although they deflect the light rays reflected from the subject so that centring of the image in the viewfinder ensures that the upper part of the subject will not be cut off from the negative, the picture is not seen from the exact angle which is presented to the taking lens. In theory, this might seem to be a very minor point, but, when working at extremely short range, this difference is amazingly apparent. However, these prisms are only available for use with a limited number of cameras and some other method must be generally employed.

The only true solution to the problem is to move the camera up bodily after focusing so that the position previously occupied by the viewing lens or finder is now adopted by the taking lens. The amount of movement must, of course, be predetermined and constant for all kinds of close-up photography, and preferably some form of device should be used to control the degree of correction.

The accessory described here can be constructed cheaply and simply and, with the care usually devoted to the handling of photographic apparatus, it should last indefinitely. The material should, as far as possible, be brass as this is easily soldered and requires no special treatment to resist corrosion. As can be seen in Fig. 2, the principle of the device is that of two tubes, one sliding within the other, and if the outer one is 2in. in outside diameter by 10 s.w.g. wall thickness, the nominal bore size will be 1.744in. This means that a 1¾in. outside diameter tube by 10 s.w.g. will require only slight rubbing down with fine emery cloth for it to fit snugly in the outer tube, and slide up and down without excessive side play. The length of the inner tube is about ¾in. plus twice the vertical distance between the centres of the viewfinder and the taking lens and the outer tube length is approximately $\frac{5}{16}$in. more.

Two end caps are prepared from 10 s.w.g. or thicker brass sheet or strip, each being of 2in. diameter or just over, and these have a central hole drilled and tapped ¼in. or ⅜in. Whitworth, depending upon the thread in the camera bush and on the platform of the tripod. The smaller size is the standard British fitting while the larger one is generally found on Continental cameras and tripods. One end cap is soldered to an end of the large tube with the hole reasonably concentric with the periphery of the tube. Silver solder is, without doubt, the best jointing material as the strength of the assembly will then be more than adequate but, failing this, ordinary soft solder may be used provided that the mating

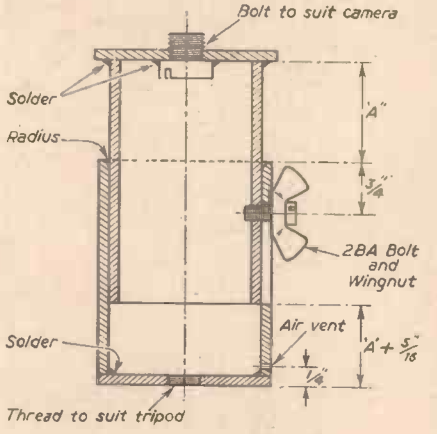


Fig. 2.—A vertical section.

surfaces are really clean and the join is properly made.

The second cap has a bolt of the appropriate size screwed firmly into the central hole, sufficient thread being left protruding for the camera to be fitted on when the corrector is in use. This cap is now soldered to the inner tube in a similar manner to the other and, in addition, a little solder is allowed to flow around the head of the bolt so that it is locked firmly in position.

A small radius or chamfer is cut around the inside edge of the large tube in order that the solder fillet of the upper one can be accommodated when the device is fully collapsed. A hole of $\frac{1}{16}$in. diameter is drilled near the base of the lower tube for use as an air vent.

A dimension consisting of the separation between the centres of the lenses plus ¾in. is marked off on the upper tube, measuring from the underside of the end cap. At this point a hole is drilled and tapped 2 B.A. The lower tube is marked off at a dimension of ¾in. from the open end and again at a distance from the first point equal to the lens separation. These points are the centres of the end radii of a $\frac{5}{16}$in. wide slot. An easy method of making the slot is shown in Fig. 3.

The two components are now brought together and the slot in the outer tube is lined up with the tapped hole in the inner one, while a 2 B.A. thumb screw is fitted to keep the assembly as a unit and to control the movement. If it is not convenient to make up

Two views of an object, the first taken without parallax correction and the second, using the device described.

a special knurled head screw, a 2 B.A. bolt may be screwed into a standard wing nut and secured there with solder. A trace of oil on the surface of the inner tube will facilitate its working and the outer tube may be finished with black enamel.

In use the parallax corrector is mounted between the camera and the tripod with the tubes in the retracted position. The picture

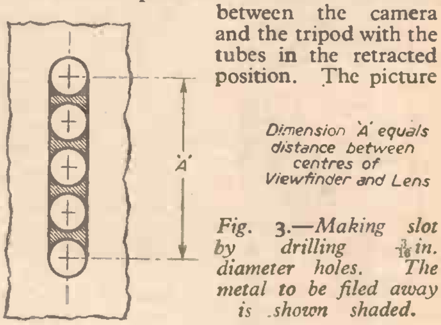


Fig. 3.—Making slot by drilling $\frac{5}{16}$in. diameter holes. The metal to be filed away is shown shaded.

is composed in the viewfinder or on the reflex screen, the thumb screw then loosened and the corrector extended and locked in the upper position. The shutter is now tripped. To make this adjustment it is only necessary to lose a very few seconds between viewing and taking the picture while the results are consistently satisfactory.

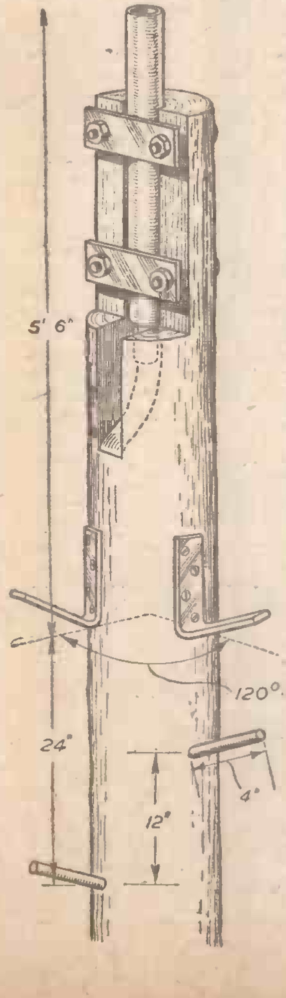
Small Wind Power Plants

4.—Erecting the Pole : Instrument Panel and Wiring

(Continued from the July issue.)

This series of articles was first published in "Practical Mechanics" in 1944, and is now being reprinted in response to readers' requests.

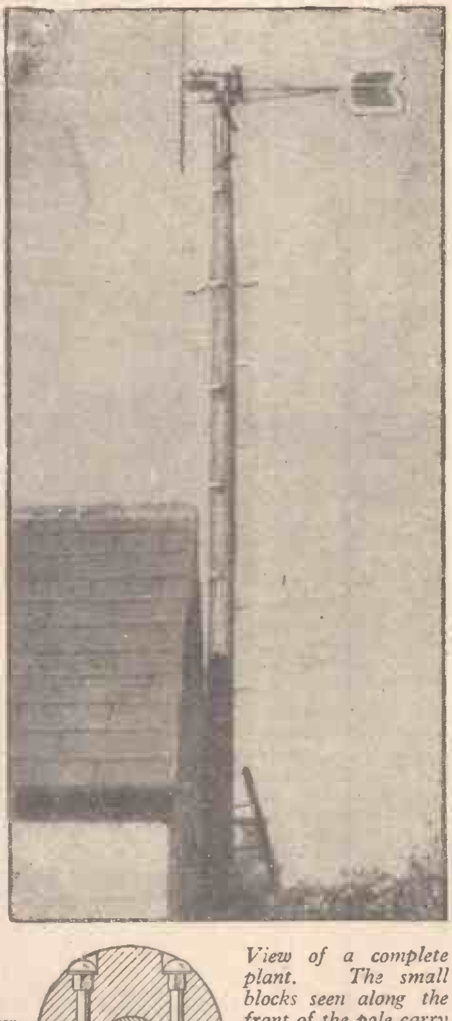
THE success of a home-made windcharger depends to a large extent on the erection, wiring and associated equipment. Usually a wooden pole is the only type available. One sees very many small units perched on top of light poles only 3in. or 4in. thick, but sooner or later they disappear from view. It is very easy to underestimate the power of a storm, but it is a mistake that is seldom made a second time. A small pole must be well tied with guy-wires, particularly in the direction of the prevailing wind. It is much less trouble in the end to use a large pole containing the greater part of a good straight larch or fir tree, sunk about 4ft. in a hole filled with loose stones and cement Once erected such a pole forms a permanent support worthy of the best windcharger.



Erecting the Pole

It is usually convenient to erect the pole beside the wall of a house, to which it is secured by two iron bands passing around the pole and through a hole in the wall. The pole in the illustration is held in this way at a point about 13ft. from the ground, the total length above ground being 32ft. The bands used were two leaves from a motor - car spring, bent to "embrace" the pole, where they are held in position by a bolt, and bolted similarly over a long flat iron plate bridging the hole on the inside of the wall. No other supports or tying wires were found necessary.

Fig. 1 shows the best method of attaching the windcharger to the pole. The four long bolts were originally used for adjusting the tension of a wire mattress. The top steps, where one may have to stand for long periods, are made from flat iron bars, 2in. by ½in., projecting from the pole for about 6in. They are spaced like all the steps at an angle of about 120 deg. and are tilted slightly upwards. Four 6in. nails, or long screws, hold them in position. The climbing steps are made from lengths of solid ½in. iron bars, driven into ⅜in. holes in the new timber. Four inches will be found sufficient to leave projecting. Such a system of steps is much easier to climb than a ladder of similar height, and even the most nervous climber becomes accustomed to it after attempting easy stages.



View of a complete plant. The small blocks seen along the front of the pole carry the copper conductors. One row of climbing steps can be seen on the right of the pole.

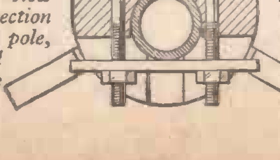


Fig. 1.—Side view (left) and section (right) of the pole, showing method of attaching the windcharger.

Conducting Wires

The wires from dynamo to instrument panel must be as heavy as possible, to avoid excessive losses at the low voltage. In the absence of proper rubber-covered cable bare 7/22 aerial wire is quite good, and is the cheapest heavy wire available. Those living in a locality where there is a scrap yard or large garage at hand should try to get sufficient copper strip for the job from field-coils of old motor-car self-starters. The small starters only yield lengths about 6ft., but one may be lucky enough to find an old model with large coils. The author found an old Hupmobile dynamo which supplied two 30ft. lengths of flat ½in. by 1/10in. copper strip, which, along with that already taken from the coils of the A900C, reached to the panel. To join the strips, clean 1½in. of each with emery paper, bind together with bare 18 or 20 gauge wire and melt solder well into the joint. Alternatively drill small 6 B.A. holes and rivet the strips together with brass boot nails before soldering. The conductors are held on the pole by wooden blocks every 3ft., some of which can be seen in the photograph. No attempt is made to cover the wire, either here or at any other point in the lighting circuit, since no leakage occurs at 6 or 12 volts across timber or plaster. The problem of raising the heavy pole, with the weight of the windcharger already assembled on top, is best solved individually. Ten men were needed to lift into position the pole illustrated. A home-made windcharger

The instrument panel.

should always be "run-in" for several weeks on a small 8ft. temporary pole, where weak points in the construction can be detected and corrected.

Instrument Panel

An ammeter and a cut-out form the essential parts on the instrument panel. However, we shall describe the construction of an elaborate panel, and each reader may include as many of the refinements as he likes. The operation and wiring of a cut-out often puzzle beginners. Two separate coils are wound on the electromagnet, a coil of many turns on the inside, and a coil of 10 or 20 turns of heavy wire on the outside. The inside coil is connected across the dynamo circuit, while the small coil is in series with the main charging current. The inside coil alone would not be sufficient for correct working. If adjusted to close the contacts at 6 volts, then, once closed, it would not open again until the 6-volt battery is exhausted. On the other hand, if adjusted to close at 7 volts, it would behave as a vibrator, since the dynamo voltage falls back almost to 6 once the points close and connect it through to the battery. The second coil is necessary so that the points are held in the closed position in spite of this small drop in voltage by the added attraction due to the charging current now flowing through the outside coil. When

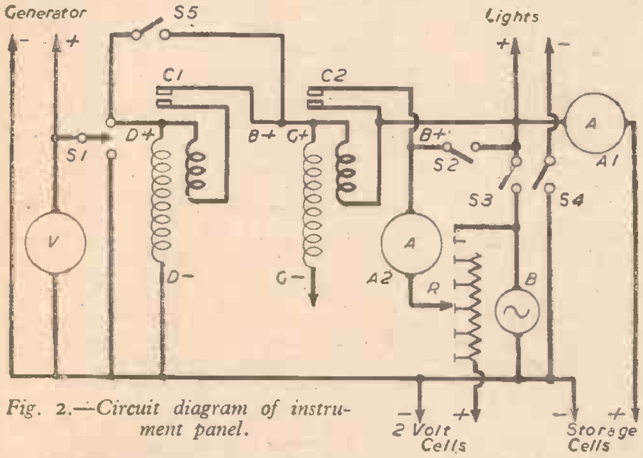


Fig. 2.—Circuit diagram of instrument panel.

the charging current again falls to zero the points open, since the inside coil is no longer able to keep them closed without help from the outside coil.

The connections are usually marked clearly by one of the methods illustrated in Fig. 2, but can easily be traced by examination once the above is understood. A 12-volt cut-out with a weakened spring will work on a 6-volt circuit, but a 6-volt cut-out would heat up badly on 12 volts. The voltmeter is connected directly across the incoming wires, so that it registers the actual dynamo voltage under all conditions. The dynamo control switch (S.1) stops the dynamo generating by short-circuiting the field coils when changed into the second position. Under these conditions the propeller "races" when the load is removed, so that the switch should not be used as an alternative to the brake rope! It is useful, however, when one is charging batteries, or working at the instrument panel, or for emergencies, to protect the dynamo windings. The push-pull switch (S.5) shorts the main cut-out points, allowing the dynamo to run as a motor from the battery. Its main use is for testing the condition of the battery, indicated by the battery voltage registered on the voltmeter while the battery is supplying 4 or 5 amps. to the dynamo. It is useful also when oiling the dynamo or cleaning the commutator.

Cut-out

The cut-out (C.2) automatically switches on the 2-volt charging circuit whenever the main charge exceeds 6 amps., or any other value for which the spring in C.2 is adjusted. In this way the 2-volt batteries will receive their current at a time when it can best be spared from the main charging current, and can be left connected for a week or so until their indicators register a full charge. The current delivered to the 2-volt cells is set by means of the rheostat (R). This was made from the wiper of an old volume control moving over flat contacts cut from the brass vanes of an old variable condenser. Short lengths of resistance wire are attached from contact to contact, the lengths being found by trial. The last pieces should be doubled or trebled to carry up to 6 amps. if necessary. The ammeter (A.2) has a full-scale deflection of about 6 amps., and can be made by increasing the number of turns in the deflecting coil of an ordinary car ammeter. The needle is also bent to one side to extend the range. The switch (S.2) short-circuits the second cut-out, leaving the 2-volt cells to charge at a steady rate from the car battery. This rate will not be affected when the dynamo begins to charge, but will remain reasonably constant even when the charge rises to 15 amps. Two 2-volt cells in series can be charged simultaneously. The end contact on the "off" side of the rheostat goes to a bulb-holder. If a bulb which consumes 5 or 6 amps. is plugged in, it acts as an artificial load for high winds, so that the current reaching the storage cells does not vary so much. The second last rheostat contact is the "off" position. Normally, a 6-watt bulb in the holder (B) acts as a panel light, controlled by the switch (S.3). A fuse in the charging circuit is a source of trouble, since it may cause the dynamo to burn out if it blows at the beginning of a windy night. A 10-amp. fuse may be included in the lighting circuit, to protect the battery. A slight alteration is needed in the connections of the cut-out (C.2), but the wiring diagram makes it clear. The main ammeter (A.1) is connected directly to the battery, so that no current may enter or leave the latter without registering on the meter. Remember that the negative wire must be well earthed, preferably at the foot of the pole, as a protection from lightning damage. A 1-mfd. condenser across the brushes on the dynamo will stop any radio interference. See that the 2-volt charging circuit draws its current from the positive line after the heavy coil of cut-out (C.2), so that the operation of the cut-out will not reduce the current through its own coil and cause it to vibrate.

House Wiring

For wiring the lights 7/22 aerial wire is very convenient. For small living-rooms two

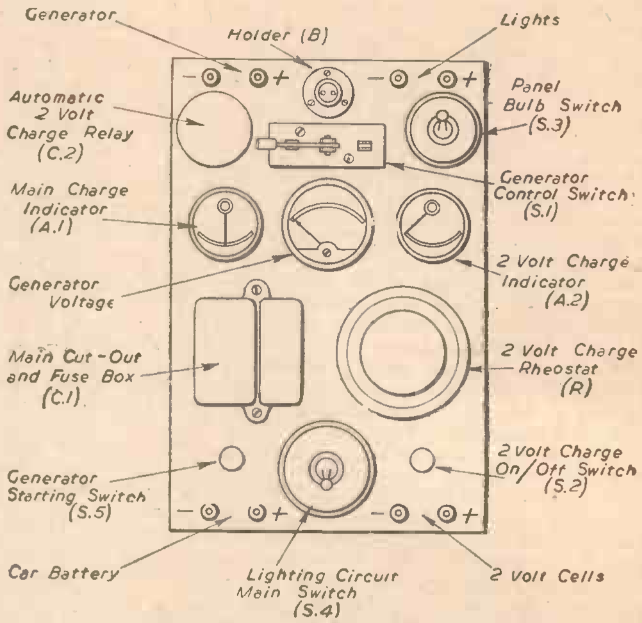
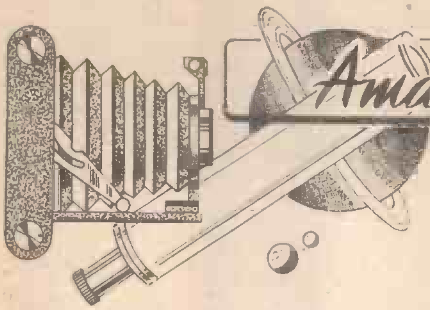


Fig. 3.—Layout of instrument panel.

12-watt bulbs suspended over the two main "chair positions" at each side of the fire is a good arrangement. When only one person is in the room the second light can be left off. With a large conical shade made from a circular cake-tin lid, well polished, good reading light is obtained beneath a 12-watt bulb. Two 24-watt bulbs may be kept at hand to be plugged in for special occasions. For passage-ways and halls 6-watt bulbs are quite sufficient, and can be mounted artistically under thick glass ointment jars with their lids screwed to the wall or ceiling. For very small lights on 6-volt circuits, screw-in cycle bulbs, consuming 1.5 watts, are very suitable. It is advisable to economise on power wherever possible by using efficient tin or other reflectors, even at the expense of appearance.

(*To be continued.*)



Amateur Astronomical Photography

How to Photograph the Moon and Planets Without Expensive Equipment

By ERIC BURGESS, F.R.A.S.

HOW often must the amateur astronomer wishing he could obtain lunar and planetary photographs, have despaired when he looked at the excellent pictures produced by the large observatories and noted that they were obtained by telescopes having apertures of 24in. and upwards ? Moreover, he would be very disappointed if he tried photographing the moon in the normally accepted way, that is, by placing a photographic plate or film at the focus of the objective or mirror of a telescope as shown in Fig. 1. For in such circumstances the image of the moon which is obtained with most amateur equipment is only a half-inch or so in diameter. The size of this image depends, of course, upon the focal length of the objective, and a rough guide is given in Fig. 2. Although enlargement by projection printing can give some passable results from the lunar negatives obtained in this way, the use of this technique on the planets is completely hopeless.

Fortunately there are other methods available whereby the amateur can obtain excellent pictures of both the moon and the planets. Most astronomers will know of the method of observing the sun by projection, namely by using the eyepiece in the telescope to project an enlarged solar disc on to a sheet of paper held about a foot or so away from the eyepiece end of the telescope, Fig. 3. In this case the size of the image is given by the distance between the eyepiece and the screen. It also varies with the telescope focal length and the power of the eyepiece which is being used. There is no doubt that this method could be used for photographing the moon and the planets and it would give enlarged negative images. However it is not a suitable method for the amateur due to a number of practical difficulties. In the first place, some manner of light-tight box has to be constructed and attached to the telescope. Then arrangements have to be made for focusing and for a suitable shutter to expose correctly the sensitive emulsion. In a final analysis the complete apparatus might be so unwieldy or heavy as to upset the balance and mounting of the telescope.

The system used by the writer obviates these difficulties and it is one which has been developed from experimental work over a large number of years. Theoretically it was unlikely that the system would work, due to the fact that astronomical instruments are visually corrected and not photographically so. This was stressed by a number of my astronomical friends, when the experiments were begun — but in practice the system *does* give good results, which is the main criterion.

A Simple System

The idea is extremely simple and is shown in Fig. 4. Essentially it consists of using the camera in place of the eye at the eyepiece of the telescope. It is, moreover, interesting to note that this system can be used for terrestrial as well as astronomical work. The writer once obtained by it some excellent coloured ciné films of the famous lighthouses through the telescopes at Land's End.

The eye is employed first to focus the telescope at infinity, and this is the part of the method which needs experience. It may, for example, be necessary for the beginner to use both eyes alternately to find the correct position, or even to make a series of test exposures at different foci and mark the correct one on the draw-tube of the telescope. The camera is focused at infinity also, and the iris diaphragm opened to the largest aperture. It must, however, be emphasized that the *f*. number of the camera is of no importance whatsoever in the optical arrangement. The sole reason for having a large aperture is to ensure that the complete pencil of rays emerging from the eyepiece is able to pass into the camera, thereby ensuring that the field photographed is the field covered visually by the telescope. The *f*. number of the telescope/camera combination is determined from the size of the image of the moon on the sensitive plate coupled with the aperture of the telescope itself. The image size can thus be used to determine the correct exposure. Now the size of the objective or mirror is governed by the equipment which is available to the amateur, most of whom will only have one telescope which consequently is not a variable. But the size of the image on the plate or film depends upon the eyepiece used with the telescope and upon the focal length of the camera, so these become the variable factors.

Fig. 1.—The normally accepted way of photographing the moon by placing a photographic plate at the focus of the objective or mirror of a telescope.

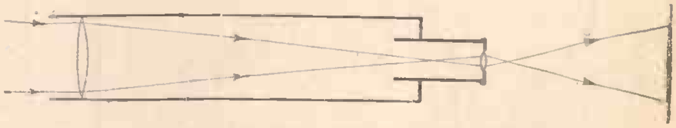
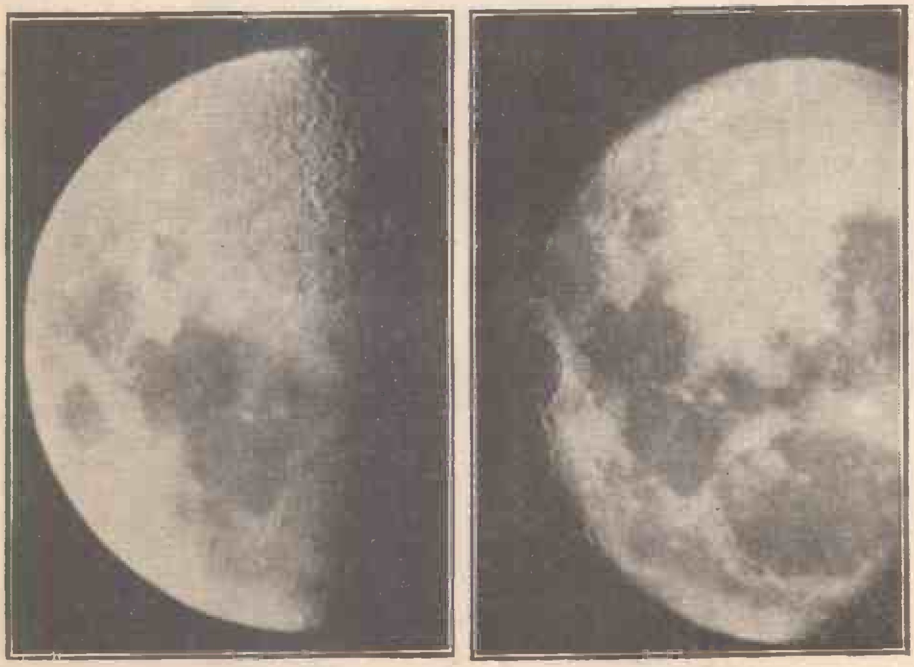


Fig. 3.—Observing the sun by projection.

For reasons of simplicity and ease of handling, the writer prefers a miniature camera, but the choice of eyepiece is made relative to the " seeing " conditions. It is advisable to use the highest power which can be employed visually without running into troubles due to bad definition. It is important to remember that, with planetary and lunar photography, it is not possible to obtain better detail on photographs than those which can be visually observed ; in fact, for reasons which will be discussed in the next article, photographic definition is much worse than the visual definition. So the golden rule is to use the greatest magnification possible under the seeing conditions which are being experienced.

The procedure is to set the telescope on the moon ; focus either visually, if experienced enough to do so, or by means of the predetermined marker, if not. Then substitute the camera for the eye, hold the camera close up against the eyepiece—the writer rests it against the eyepiece and has never found it necessary to complicate matters by using clamps even with planetary photographs of five to ten seconds duration—and make the exposure as determined from the tables. It is as simple as that.

Accordingly, with this streamlined system



The moon photographed with a 3in. fixed telescope. Exposure ½ sec. on Kodak Super XX roll film.

it is possible to photograph the moon several times per minute without upsetting the arrangement of the telescope for visual observation. The system thus makes it possible for the amateur to combine visual and photographic work during the same set of observations with one instrument. His photographic work can, for example, give an overall view with accurate shadow determinations, while his visual work can fill in the finer details, and the two together will result in a most accurate drawing of an area of the moon being made later, without wasting good observation time to draw those rougher details which can easily be captured photographically.

Fig. 4.—The method of photographing the moon recommended in this article. The telescope is focused with the eye and then a miniature camera is substituted.

Working Without Clock Drive

Obviously the ideal equipment will have a clock drive, but most amateurs are without this refinement to their telescopes. Many, indeed, will have only an alt-azimuth mounting. This does not mean that they are completely out of the picture as far as lunar photography is concerned. If the mounting is a steady one good results can be achieved. In fact, the photographs illustrating this article which were taken with a 3in. refracting telescope were actually obtained by clamping the telescope to a window-frame of the house, waiting until the moon was approaching the centre of the field of view, and then making the exposure.

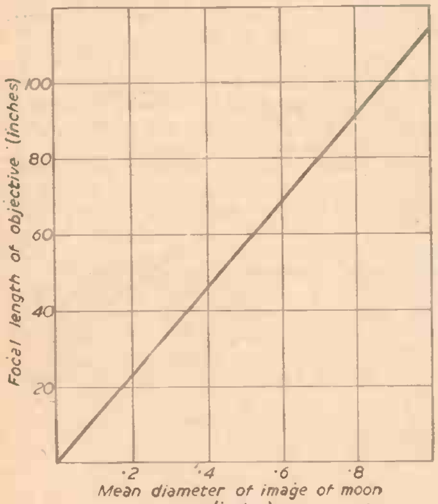


Fig. 2.—Guide to rough diameter of moon image for a given focal length.

As the moon appears to move through its own diameter in about two minutes due to the rotation of the earth on its axis, a long exposure will result in a blurred and useless image. Landscape photographers have found this out when taking moonlit scenes, often ending up with a sausage-shaped object in the sky. Now, it is simple to calculate the maximum exposure which can be given with a fixed telescope if we assume that an object must not move through more than one-third of its diameter during the exposure. If its motion is less than this the object should be recognisable. By choosing craters as objects for the photographical definition we arrive at the data of Table 1. This table indicates how short the exposure must be for a fixed telescope to produce negatives on which craters larger than a given size can be recognised.

The exposure is also governed by the phase of the moon and the part of the moon which is being photographed, and also by the aperture of the telescope and the size of the negative image. These are factors which also apply to clock-driven telescopes.

Using a Clock Drive

It has been shown how photographs can be taken with a fixed telescope, but obviously a clock-driven instrument or a telescope with slow-motion handles, equatorially mounted, will facilitate the work. The writer has used both an 8in. refractor and a 12in. reflector for this type of photography and the illustrations to this article have been obtained with these instruments.

The next stage is, therefore, to determine the basic exposure for a lunar photograph, assuming the use of a fast panchromatic emulsion such as Kodak Super XX or Selo HP3. The exposure depends upon the aperture of the telescope and the diameter of the lunar image. If high powers are used and thus only a part of the lunar disc is obtained on the negative, the size of the complete disc must be calculated. A number of trials will have to be made but it is also possible to save expense by using the sun. Remove the back of the camera and substitute a ground glass for the film so that the image of the sun appears on the ground glass. The image size of the moon can then be determined for the various eyepieces, because the sun will give an image approximately equal in size to that of the moon. There is a word of warning though, do not keep your camera at the eyepiece for long periods of time, especially if you are using a large telescope, for if your alignment is not correct, a concentration of solar heat on the iris diaphragm or shutter can have ruinous consequences to the camera.

The Basic Exposure

By referring to Table 2 it is possible next to ascertain the basic exposure by noting the image size resulting from the eyepiece coupled with the aperture of the telescope. This will be the permanent basic exposure for the eyepiece considered.

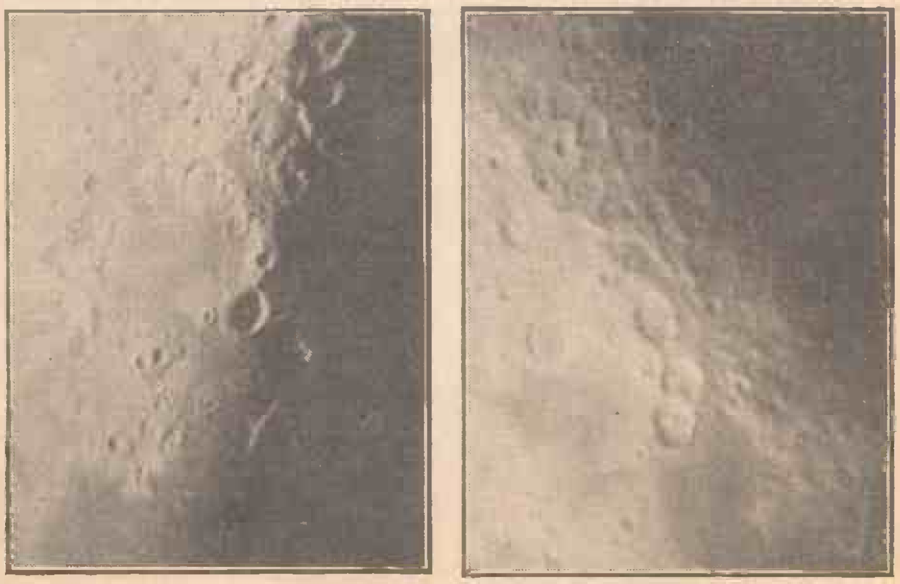
The basic exposure is, however, only a guide. In practice it is found that the level of illumination varies considerably at different phases of the moon and over the moon's surface at any one time. In the crescent phase the intensity of illumination is the least, because the sun is then shining from behind the moon relative to the earth and the shadows of each tiny hill on the surface are cast towards the earth. The bright parts, on the other hand, are turned away from the observer. At the gibbous phase, on the contrary, the sun is shining on to the surface of the moon from behind the earth, the shadows are partly hidden by brightly illuminated hills, so that the general level of illumination is high. Correcting factors for the basic exposure are accordingly given in Table 3. In addition, at any phase of the moon, it has to be remembered that when photographing the whole of the moon the camera is trying to record illumination which may be varying from very low along the sunrise or sunset line (the terminator) to a maximum value at the limb. Correcting factors for these effects are also given in Table 3 and, in practice, it will be found that shading must be resorted to during projection printing in order to produce an acceptable print.

TABLE 1

Diameter of crater which is to be recognised (miles)	Maximum exposures with a fixed telescope-camera combination Exposure (seconds)
60	1
30	½
15	1/5
6	1/10
3	1/25

For example: An exposure of 1 second, if called for by the magnification and atmospheric conditions, would allow craters the size of Plato to be recognised. An exposure of 1/5th second would enable Pico to be recognised.

From the above it would appear that the ideal to be aimed at is the maximum possible exposure to give the greatest image size. In fact, this is not entirely true for, unfortunately, when we are observing the moon through a



The moon photographed with an 8in. refractor on February 2nd, 1949. The exposure was 5 seconds on Selo HP3 roll film. The photographs show Theophilus and environs of the Mare Nectaris.

telescope the image is not steady because we are looking at it through many miles of turbulent atmosphere. All astronomers are familiar with the troublesome "boiling" which makes the image shimmer like a scene viewed through the hot gases over the top of a glowing brazier. When visual observations are being made, the eye can seize on the steady periods and record fine detail. The camera cannot do this, especially if long exposures are being used. Larger telescopes help by reducing the exposure but an opposing factor operates because they gather light from a larger column of air, and they are consequently more subject to "boiling." Hence the aim of the lunar photographer must be to use the minimum exposure.

Developing to Completion

An aid to doing this has been made available during the past few years. It is the technique of development to completion. The exposures are reduced to a quarter or a fifth of those called for from the tables given here and the film is then developed for two hours. With the 8in. telescope, photographs have been obtained in this way which show extremely fine details, and this technique can be recommended.

TABLE 2

Diameter of negative image of moon (inches)	Basic exposure for 32 deg. Sch. Emulsion (in seconds) Aperture of telescope in inches			
	12	8	6	3
1	1/50	1/25	1/10	1/5
2	1/25	1/10	1/5	¼
3	1/5	½	1	2
4	½	1	4	6

TABLE 3

Phase	Correcting Factors for Basic Exposure Multiply basic exposure by :—	
	(I) for waxing moon	(II) for waning moon
Crescent	8	10
Half-moon	3	5
Gibbous	1¼	1

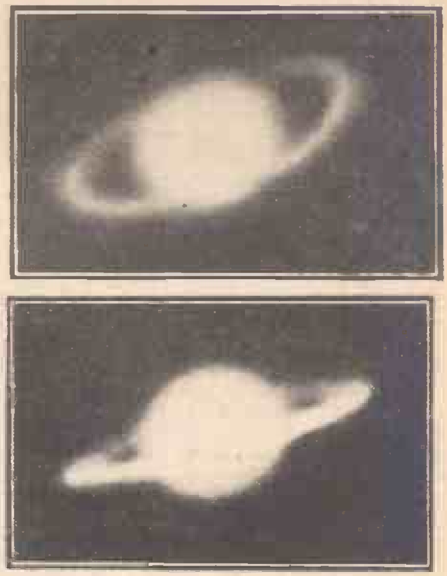
The above apply to terminator regions. Away from the terminator the basic exposure must be multiplied by another factor, ½ to 1.

In addition to photography of the moon, the method which has been outlined can be employed to obtain planetary photographs which can be quite surprising in their detail. Most amateurs regard planetary photographic work as completely out of the range of their instruments; something only to be attempted by the larger observatories. This is not so.

The author has worked mainly on the planet Saturn, using an 8in. refractor, but he has also made some experimental exposures on Mars (at poor oppositions) and on Jupiter. With Jupiter, it is quite easy to record the belts and the satellites, but not on one and the same photograph. This is because an exposure long enough to record the satellites will burn out the details on the surface of the planet; while the correct exposure for surface detail is not long enough to record the satellites. A disc of Jupiter can be obtained even with a 3in. telescope, but a 6in. is about the minimum for serious work.

The phases of Venus can be recorded and the polar caps and markings of Mars should be recognisable on photographs taken in this way with an 8in. refractor or comparable reflector at a good opposition.

Saturn is a very interesting object because, with this size of equipment, it is possible, quite easily, to photograph the ring system. The shadow of the planet on the rings and the rings on the planet can be recorded and photographs over a period of years will produce a series showing the closing or opening of the ring system. Again it is necessary to minimise the exposures in order to prevent atmospheric distortion, and development to completion pays dividends. Another useful hint is in the production of planetary prints. It will be found that even with an 8in. telescope, using a high power, the negative image of a planet is very small. The writer enlarges this on to a lantern slide, first with the negative the correct way round, and then with it reversed in the enlarger. By careful arrangement of the projection apparatus it is possible to ensure that the two slides can be mounted face to face. The result is a lantern slide with a dense background, enhanced details on the image of the planet, and a reduction in emulsion grain. A negative can be prepared from this slide and used for projection printing of positives of the planet (see above photographs).



Photographs of Saturn, taken with the 8in. telescope and printed by the method described in the text.

A final word on this method of astronomical photography is perhaps of interest to readers who may wish to experiment further. If the telescope is clock-driven, an exposure of fifteen minutes or so can produce fascinating photographs of stellar objects which have a suitable separation to show double stars.

Making Moulds for Casting Lead Toys

THE process of duplicating existing lead models may be undertaken with ease by any amateur, provided he is willing to take a reasonable amount of care. Let us assume that the model to be duplicated is 1¼in. high by ½in. broad; a model soldier for instance. The first article to be constructed is the box stop. Cut out a piece of cardboard to the dimensions and shape shown in Fig. 1, score along the dotted lines and bend up the flaps to form a lidless box, placing an elastic band round it to hold it together.

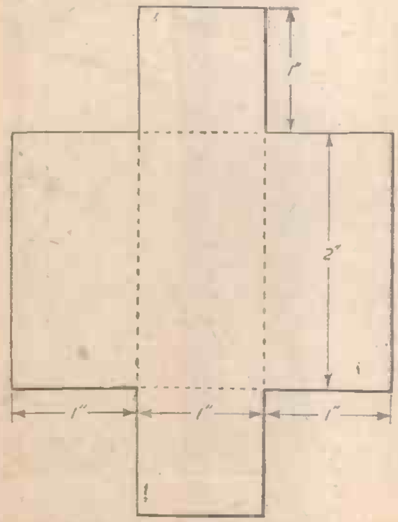


Fig. 1.—How to make the mould.

Making the Mould

Obtain a small quantity of plaster of paris. Carefully cover the model with oil and then mix a tablespoonful of plaster with sufficient water to make a thin paste; place this mixture in the box so as to fill this half-way up the sides, and then level up the surface. Allow the mixture to become "tacky" and sink the model evenly into it, face downwards, until it is half immersed. Leave the plaster to set, and then carefully remove the model with a pair of pliers. If it has been thoroughly oiled it should come away from the plaster without breakage. Slip off the elastic band, bend down the sides of the box and remove the mould. The edges of this half of the mould should now be bevelled with a penknife, see Fig. 2.

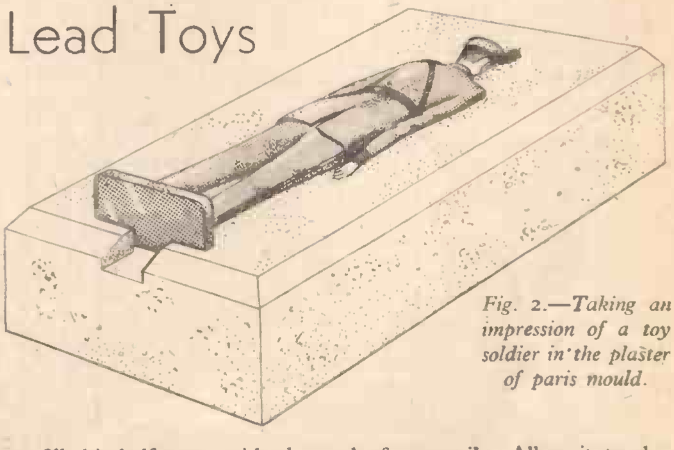


Fig. 2.—Taking an impression of a toy soldier in the plaster of paris mould.

Replace the mould in the box, re-oil the model and also the surfaces of the plaster, and insert the model in its original position. Mix some more plaster and place this in the box, filling up flush with the surface, removing all air-bubbles by pressing down the wet plaster with the end of a pencil. Allow it to dry thoroughly and then remove from the box. The two halves of the mould may now be separated, and should come apart easily if oil has been applied freely. A small channel should be cut in the plaster from the base of the model to the edge of the mould through which to pour the lead. The mould is now ready for use.

Warm up some scrap lead in a tin, place the mould on a piece of wood and grip the two halves together with two more pieces of wood. Pour in the lead—keeping the head well back to avoid splutterings—and allow a few seconds for cooling; separate the half-moulds and remove the casting with pliers; it may then be trimmed, filed and afterwards painted to suit personal tastes.

PLASTIC HANDICRAFTS

2.—Further Notes on Working this Popular Material

By W. G. HOWL

(Concluded from the July issue)

ALL woodworking tools may be used for turning plastic by raising the handle above the centre of the cutting edge to create a negative rake. Take a scraping cut to give ribbon-like shaving. Do not let the plastic powder or chip. The best speed for the woodturning when working plastic is 1,100 to 2,500 r.p.m.

The best speed for the machine lathe is 2,000 r.p.m., with a fast speed taking light ribbon cuts. The cast phenolic plastic, although not particularly hard, will be found to take the edge off the turning tool very quickly and should be honed frequently. Again, the tool should have a negative top rake and the cutting angles recommended in Fig. 6 will be found most suitable.

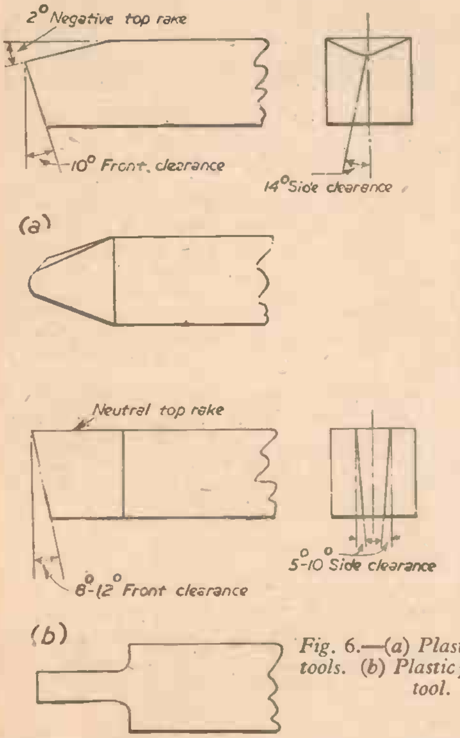


Fig. 6.—(a) Plastic turning tools. (b) Plastic parting off tool.

Although finishing and polishing of plastic will be dealt with separately it is advisable to polish cylindrical pieces while they are still set up in the lathe. Depending on the surface of the piece after turning, take the surface down with a suitable grade of emery paper and follow up with smoother grit to an extremely fine wet paper. Pumice or household scouring powder with water will fetch the polish higher, finishing with a very smooth emery stone and water will give a jewel-like lustre to the plastic article.

Drilling and Tapping

It has been pointed out that when shaping plastic it is more prudent to scrape it away than actually to cut it, and in drilling we follow the same procedure.

When drilling with a twist drill the inclusive point angle is left as for general metal, but the cutting face angle is ground neutral; see Fig. 7(a). A fast speed is advisable, but care must be taken in feeding for fear of softening the plastic. A fair amount of latitude may be allowed in speeds and feeds when drilling, for a perfect job may be effected with a woodworker's brace if carefully manipulated. Although a twist drill is adequate more favour may be expressed for a hand-made spade drill of soft mild steel stock, or, better still, silver steel, as shown in Fig. 7(b). Not only does this type of drill dissipate the heat, but a wide variety in the size of hole can be obtained by striking an eccentric. Another type of drill may be made by grooving a piece of stock silver steel, Fig. 7(c). The countersunk spade drill shown in Fig. 7(d) is very useful for setting countersunk head screws and centre popping before drilling, because, it may be remembered, a centre punch must not be used, but an awl is permissible. Holes may be tapped with standard taps, using no lubricant. A simple tap for small holes may be made by fluting or vee grooving a stock screw. The most secure type of screws to use are the self-tapping Phillips Type "Z" screws. These may be obtained with countersunk, round, raised, mushroom or cheese heads, and if Form No. A.134 is obtained when purchasing, tapping drill sizes will be at hand.

Routing

Routing grooves, etc., is generally beyond the scope of the home mechanic for a spindle moulder or routing machine is rarely at his disposal.

Simple grooves and forms can be routed, however, in the drilling machine. Design the grooves or form that can be obtained in one continuous movement under the cutter. Make the former block, Fig. 8(a), from wood, and move the plastic through the block with a very firm but even pressure, always ensuring that the cutter rotates into the block and away from the pressure, to avoid lifting the work off the block.

Small straight fluted end milling cutters will cut the groove well if the cutting angle is neutral or negative. If forms on the edge of the work are desired, obtain routing cutters which will give the form required (a wide range is obtainable) and relieve the former block to clear the cutter, Fig. 8(c).

It is well to remember whilst on the subject of routing, that an angle face plate on the cross slide of the lathe makes an excellent line router or milling machine. Most suitable effects and finishes may be obtained by replacing the cutter with coarse grit grinding wheels, either plain or formed.

Heating, Bending and Forming

The varied formation of plastics by bending is unlimited strips and sheets, under heat, can be curled, twisted and bent into almost any desired shape.

Bending and forming is so simple that it tends to breed carelessness. But waste of material should be avoided, and if the following pointers are observed a perfect product should result.

Before heating remove all masking paper. Keep the material under observation throughout, for overheating will result in blisters and extreme overheating will be made evident by small lines showing in the material.

The plastic is ready to form when it has reached the consistency of crude rubber. Use gloves for handling if you wish, but the plastic will be marked less if bare hands are used for manipulating. Sharp curls may be effected with a clothes peg or tool, shown in Fig. 9(c). Acrylic plastic has the peculiar property of returning to its original moulded form when it is heated, hence when bending complicated forms it is advisable to make a former or template to bend to.

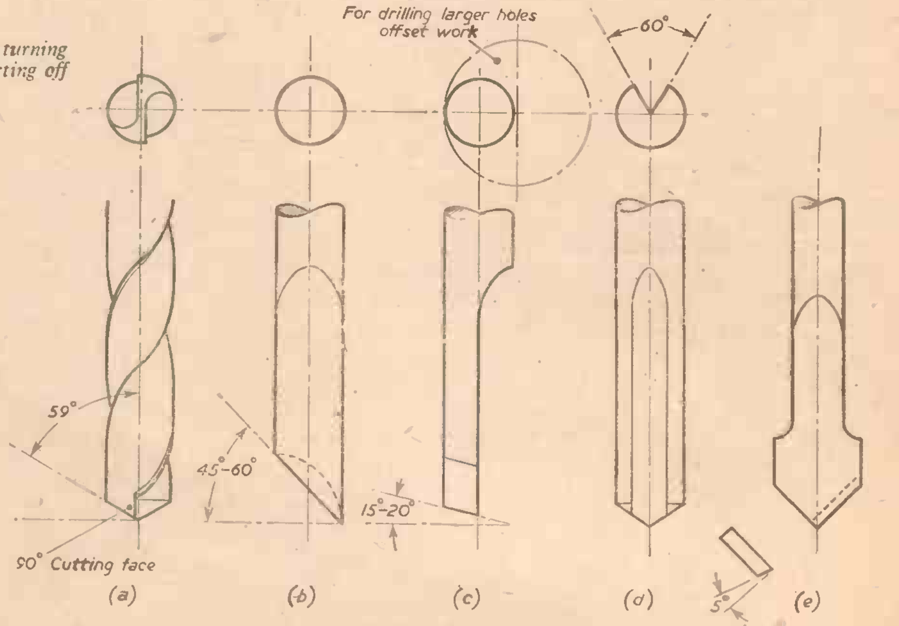


Fig. 7.—Drills for plastics.

When designing the project keep the bend as large as possible, for a sharp bend tends to break the molecular structure of the material.

Each of the groups of plastic material requires a different type of heat and temperature for bending, and if the following temperatures and methods are used, successful bending will be achieved.

The acrylic group will be procured in an unplasticised state, in which case it will not soften in boiling water, but will require a dry heat of 200 deg. F. to 300 deg. F. This can be achieved by placing on a piece of asbestos board in a domestic gas oven or in a simple home-made oven which will hold the heat, as shown in Fig. 9(a). Two domestic baking tins or dishes can be cheaply obtained. The object to be formed is placed on the canvas, fine mesh or asbestos which is fixed to the rim of the lower tin and the remaining tin is placed above it to retain the heat and the whole placed in the oven. It will be evident to the enthusiast that this type of oven could have added to it a number of improvements. A thermometer could be fixed in the top plate or a heater element in the lower. A basic design is shown, which may be improved to taste and need.

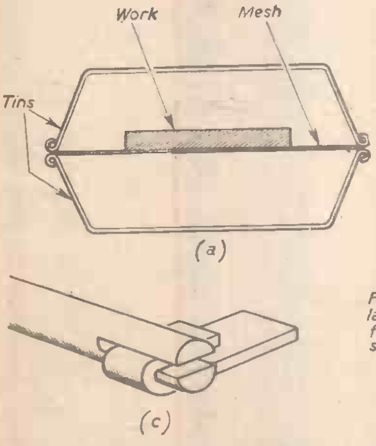
If only a small amount of bending is needed, it can be easily effected by holding the Perspex in front of or placing on an asbestos sheet on the bars of an electric fire.

For the enthusiast with a great deal of bending to perform, an oven, shown in Fig. 9(b), is desirable.

All general sizes are omitted, for these will depend on the largest work undertaken, although a can about 10in. diameter should be sufficient to accommodate most general work.

Three metal feet are fitted to the open end of the canister, which is placed on an asbestos table. The closed end of the can is bored to take a lamp adaptor fixed to a porcelain or asbestos retaining plate. This is connected through a switch to the house power supply. The frosted infra-red lamp should be about 6in. above the material to be heated.

Cellulose plastics are heated in water at 160 deg. F. to 212 deg. F. To accelerate the heating, add glycerine to the water, allowing about three minutes for ⅛in.-thick material. In all cases when heating in water raise the piece above the bottom of the container. Pieces of old garden hose are excellent for this purpose.



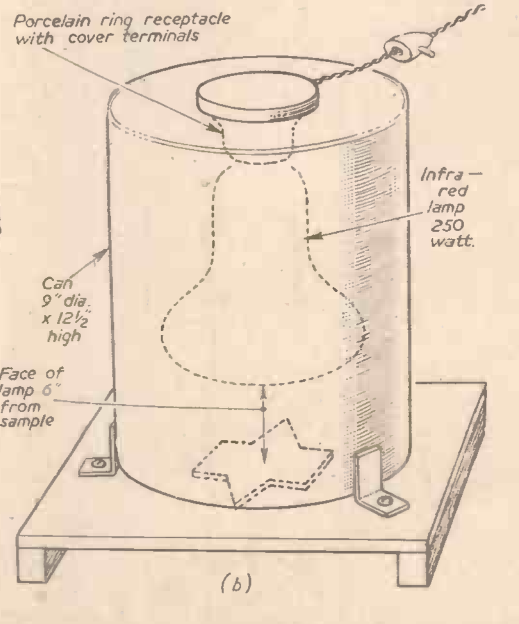


Fig. 9.—Equipment for bending. (a) A simple heating oven. (b) Infra-red heating oven. (c) A simple tool for sharp bends.

Cast phenolics are heated in a similar manner, in water, from 212 deg. F. to 250 deg. F. It may be necessary to heat two or three times to obtain the desired bend.

To raise the temperature of water above boiling point add either glycerine or three parts hydrochloric acid and one part distilled water. If you are not familiar with hydrochloric acid consult someone who is, or leave it alone !

Jointing

When making joints in plastic let care and patience be your watchwords. A "sloppy" joint is not worth the time taken. It will only break at the first opportunity.

The cementing of plastic is not just a bond, as in gluing wood, but the cement dissolves the plastic to fuse the pieces into a whole. It is important that air bubbles are dispersed from the joint, for these will weaken it. Where possible clamp the work in jigs to enable the joint to set. By jigs elaborate contraptions are not anticipated, for instance, when cementing a box place the cemented side around a piece of wood and clamp with an elastic band. A number of everyday articles will be found useful when joining plastics, such as clothes pegs, battery or bulldog clips, rubber bands, wood or toolmaker's clamps, masking and insulation tapes, etc.

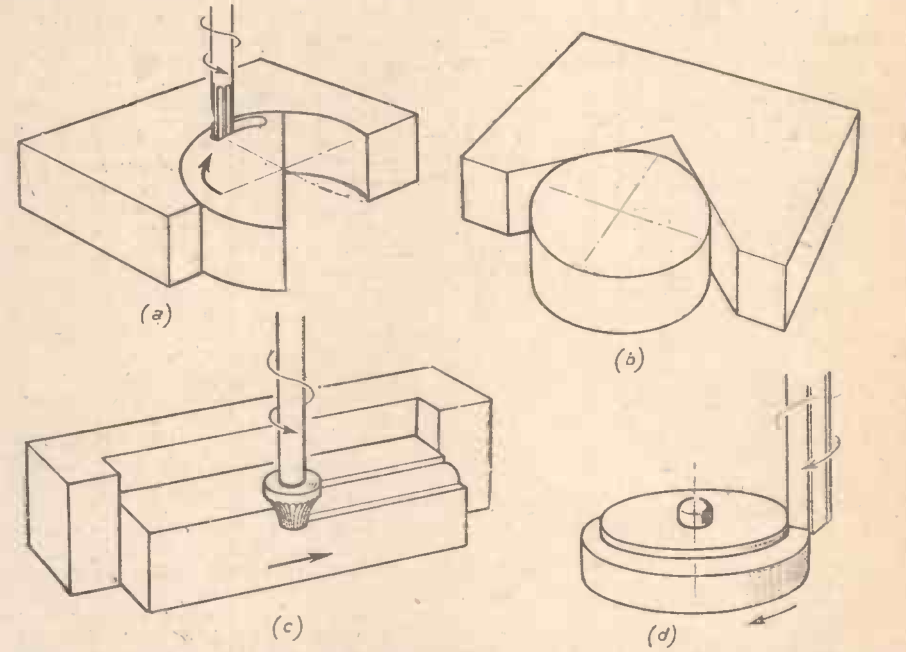


Fig. 8.—(a) Router block for curved form. (b) A more universal block for circular routing. (c) Block for straight routing. (d) Edge routing for pieces with a centre hole.

Use a good cement and give the joints time to harden off and a good joint will result. Diakon No. 2 or Perspex No. 6 are good proprietary cements for acrylic plastics. There are also a number of chemical solvents which are excellent for cementing acrylics. vinyl trichloride, ethylene dichloride, and methylene dichloride with monomeric methyl. methachylic mixed (50-50) with enough benzoyl peroxide and a little acrylic filling to a consistency of treacle, are first class for craft work. These will set in 30 seconds and dry off in about three hours. The best method for applying the solvent to the workpiece is to wipe the work across a cloth pad, soaking in a shallow tin of the liquid cement (see Fig. 10).

Another very simple yet strong home-made cement is made by dissolving 100 grammes of acrylic filling to one pint of 100 per cent. glacial acetic acid at 80 deg. C. This should be applied with brush or matchstick, and will take one minute to set and four hours to dry off.

If a delicate job is on hand and you deem it expedient to clamp it before applying the cement, use chloroform and apply to the joints with an eye-dropper. Do not let other parts of the work contact with the chloroform: remember it is a solvent. Chloroform will take half an hour to set and about two hours to dry. Plastics in the cellulose group should be cemented with cellulose dope, obtainable in jars or tubes. This is the same cement as used for model aeroplanes.

An excellent home-made cement for cellulose acetate can be made by mixing 20 per cent. scrap cellulose acetate with a solution of 25 cc. benzine to one pint of acetone.

The manufacturers recommend a good fish glue for cast resinoid plastics. Hide glue is also recommended and a good cement can be made by adding 4oz. of hide glue in small pieces to 6oz. of hot glacial acetic acid. Apply hot and leave under pressure until set.

Welding

The welding of plastic is very different from the welding of steel, although it is still a fusion of material. The object is to heat the surfaces to be fused under pressure. Fig. 11(a) shows a napkin ring of plastic being welded by the hot plate method. The strip of metal, preferably a good conductor, is heated at the opposite end to the work end, which is allowed to reach a temperature of about 400 deg. F. to 660 deg. F. The work is clipped on to the metal until it just melts, then snapped off and held until it is cool. Allow the heat to dissipate naturally; under no circumstances must it be force cooled.

Fig. 11(b) shows a mallet being friction welded. The stale is held in a drill chuck and the head clamped in a vice. The fit of the stale in the head is a good push fit. Revolve the chuck at its top speed and lower into the hole; it will keep revolving until fusion has taken place due to the frictional heat. When the belt slips, switch off the motor and leave the work under pressure until cool.

Decoration (Inlay and Overlay)

Overlaying is mounting plastic upon plastic to form a motif or decoration. Effective overlay may be made by using a different coloured or different group of material, the overlay being cemented to the main object. All parts should be completely finished before fixing the decoration. By colouring the cement used

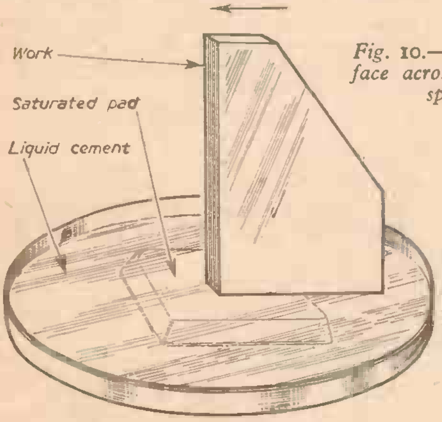


Fig. 10.—(Left) Wiping joint face across saturated pad to spread cement.

in overlaying, delightful effects can be achieved.

More accuracy must be used in inlaying than overlaying, and the inlay must be a good push fit in the receptive groove before being cemented in. If the end of the inlay is open, as in Fig. 12(a), the groove should be cut on a slight taper to form a dovetail. For a dovetail in a closed inlay use coloured cement in the groove and finish after hardening. Plastic can be used effectively in inlaying other materials, such as aluminium, wood, ivory, etc.

Carving

Plastics can be carved equally as well as wood or ivory with the same tools. If no standard carving tools are available a very serviceable set can be made from broken french files, as shown in Fig. 12(b).

Carving, of course, needs a great deal of practice to achieve perfection. A simplified method can be effected by using one of the many pencil grinders or vibro-engravers. These are supplied with a wide variety of forming tools, which will create professional carving when used with a certain degree of care.

Hot point work although adequate is tedious and the results do not reflect the time and work expended. The object is to burn the pattern in the work with a hot steel wire in a holder. Two or three points should be used to enable points to be heated while one is in use. When hot cast phenolics resinoids give off an odour of formaldehyde, which is an eye and nose irritant, for which the use of goggles is recommended. The length of part of the pattern should not take longer than the time needed for the point to cool, joints in the pattern will show. This type of design is similar to wood burning seen on spill and matchbox holders which are so familiar.

Further Ways of Decorating

There are other forms of decoration which enhance plastic as no other material. One of these is scratch work, which is very simple to perform. The patterns are worked with a scriber, mortise gauge or divider, an example being shown in Fig. 12(c). After the design is completed the scribe lines may be filled-in with coloured pencil, preferably chinagraph pencil, which is greasy and will polish with the plastic. Lacquer may be used for filling, in one colour. Simply paint all over the design area with lacquer and wipe off immediately, leaving the residue in the scribed pattern.

Patterns worked with drilled holes are also very effective. These can be left as from the drill or the holes can be filled in with coloured cement or lacquer, as in the dice shown in Fig. 12(d).

If a set of steel letter stamps are available the letters H, I, L, O, U, V, X and 8 can be used for decorative edging, Fig. 12(e). To prevent the plastic cracking when stamping warm it first.

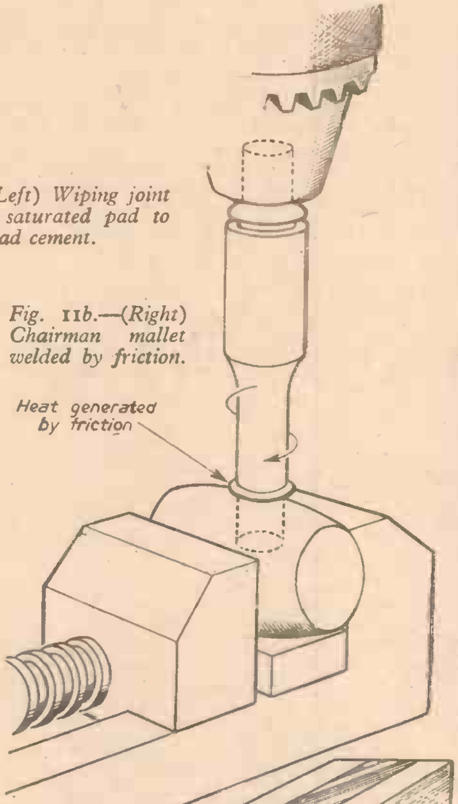


Fig. 11b.—(Right) Chairman mallet welded by friction.

Colouring

All types of plastic can be coloured by painting with lacquer, which is obtainable in a wide variety of colours. Use only Chinese lacquer to obtain a good polish and if the plastic has a polished surface roughen it with glasspaper to bind the lacquer. Brush marks will show if the lacquer is applied by hand, so, if possible, either spray the paint or dip the object. A pleasing effect is obtained by applying the lacquer to the opposite side of the plastic which is on view.

The acrylic resins may be dyed with a special plastic dye. The dye, which is supplied ready mixed with a developer, is inexpensive and can be procured from most good handicraft stores. Take care to see that the plastic is perfectly clean before dyeing. The makers supply full instructions for using their particular product with the packet of dye, but they all conform to the same general procedure.

Any clean vessel can be used for the dye bath. Put in the dye and developer mixed, add the specified amount of water and raise the temperature to about 180 deg. F., until the powder has dissolved to form a saturated solution. The liquid dye will be poured through a filter to strain off the undissolved residue.

Before dyeing the finished product test the dye for colour with a piece of scrap plastic. Agitate the dye and plastic to obtain a uniform colour. The shade may be varied from a faint tint to a deep colour. To obtain a light shade add more water, but if a deep shade is needed the object should be left in the bath for a longer period of time. After dyeing wash the plastic in warm soapy water and dry with a soft cloth.

Working on the phenomenon that the longer the plastic is immersed the deeper becomes the shade, an interesting colour variation can be obtained by lowering a piece of acrylic very slowly into a tall jar, to give the end which enters first the deepest shade, gradually becoming fainter, until a pale tint is achieved at the other end.

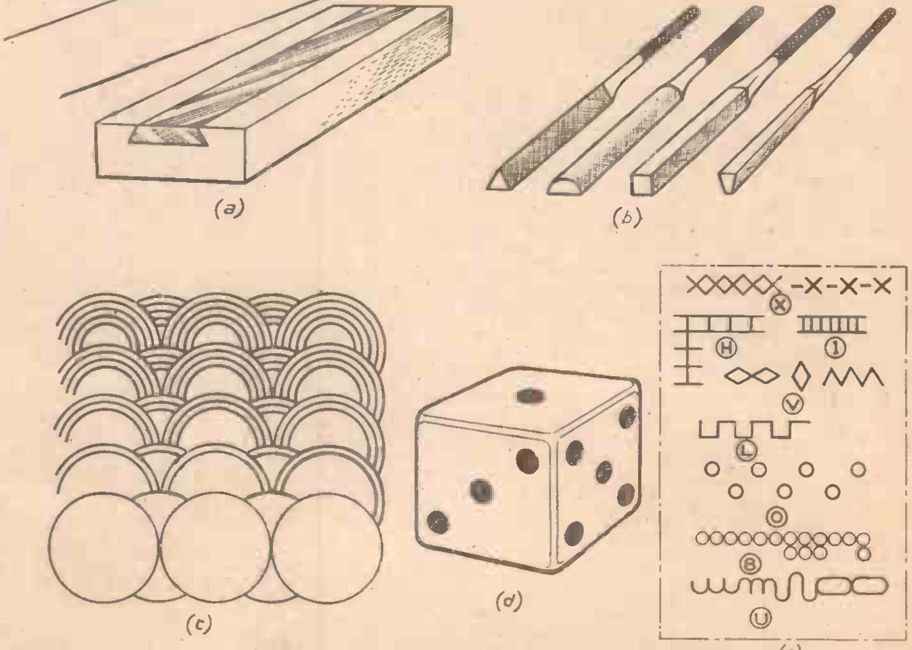


Fig. 12.—Decoration on plastic. (a) Inlay plastic dovetail. (b) Carving tools can be made from french files. (c) An example of scribed design in plastic. (d) A drilled dice filled with lacquer. (e) Examples for using steel stamps to decorate edging.

Masking off certain parts of the object with tape before dyeing will open another interesting avenue for experiment with coloured patterns on the plastic. The dyes are obtainable in the colours of yellow, orange, blue, red and violet and if these are mixed dry a wide variety of other shades may be obtainable. Another interesting effect may be tried by dipping the project first into one colour, washing and drying, then dipping the same piece wholly or partly in a second or even third coloured dye. Edging and corner jointing may be coloured by mixing the dye with plastic cement, a method effectively used when laminating plastic strips.

Finishing

The finishing of plastics may be divided into two parts—faces and edges.

The edges should be planed with a woodworker's block plane, with the iron well back so that it only just cuts. If possible plane the edges before jointing, taking one smooth sweep. This will be enough to produce a polish on the edge.

With the face a different and more arduous procedure must be followed. In most cases when the protective paper covering is removed, a polished surface is discovered, but invariably this is destroyed in subsequent operations.

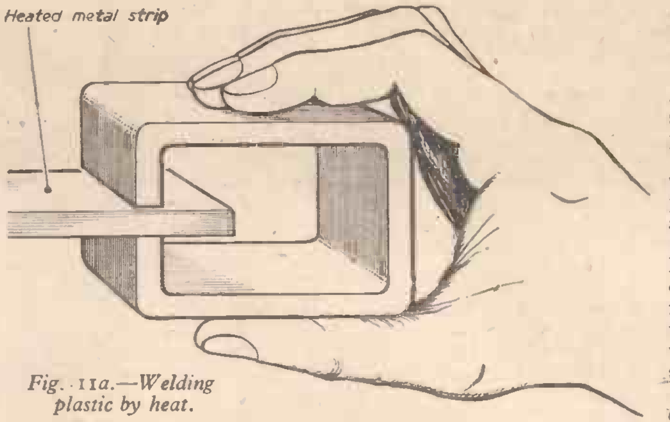


Fig. 11a.—Welding plastic by heat.

The first step is rubbing with a damp rag household pumice or scouring powder. With these processes always rub alternately at right angles. Mix the pumice powder with hot tallow to form a paste and use as the first polish on a cotton-wool pad, following this with a good wax, and finishing with metal polish. In place of these Perspex polishes Nos. 1 and 2 can be used.

When polishing plastic an electrostatic charge is set up which will attract particles of dust, these can be removed by blotting with a damp cloth. If a polishing head is available a fine high polish can be obtained by using Perspex polishing paste on a calico mop. To clean finished articles wash with a mild soap and warm water; never use scouring powder.

With plastic we have one of the most adaptable and attractive materials on the market to-day. With a knowledge of how it can be worked and fabricated, enthusiasm, a certain amount of care and good common sense many articles both useful and attractive can be made on the table top or in the home workshop.

A Simple Map Measurer

Known as an Opisometer, this Instrument Will Accurately Measure the Scale Distances on Your Map

Fig. 1.—The completed map measurer.

THE measurement of road distances on the map rarely gives accurate results. When you come to traverse the actual route, whether on foot, in the saddle or by car, the laboriously worked out mileage almost invariably proves to be longer on the road than it appeared to be on the map. Part of the reason for this discrepancy is, of course, that one cannot be certain of making the correct allowance for small bends and deviations in the road, which add up to a considerable distance on a long journey. If you measure the road with a ruler, and check the distance on the scale of the map to get the mileage, you will also inevitably miss many of the minor bends which the map shows. This latter fault can be corrected quite easily, and measurements on the map can be much simplified by using an opisometer instead of a ruler.

How it Works

This simple device is shown in Fig. 1. R is a threaded rod fixed in a U-frame (F). On the rod is a little wheel (W) with a knurled or toothed rim. The round handle gives a convenient grip for the fingers, allowing the instrument to be guided easily in any direction. Imagine that you wish to measure the length of a wavy line. You start with the wheel at one end of the rod, rest it on one end of the line, and push it forward, steering the wheel carefully along the line and using just enough pressure to prevent it from slipping. When you reach the far end of the line, the wheel will have run along the thread a certain distance. Now you rest the wheel on a ruler and run it back again straight along the scale until it comes to a stop against the frame at the point from which it started. In

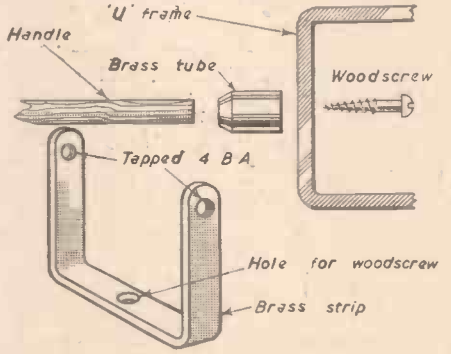


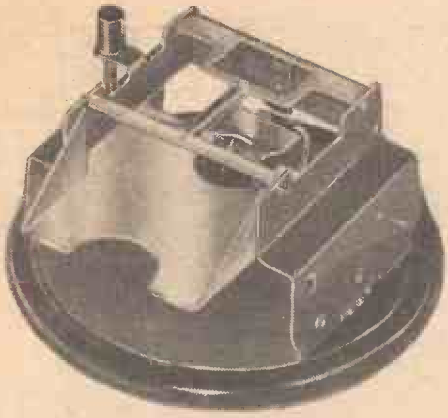
Fig. 2.—The U-frame and details of the handle.

applying the opisometer to a map, you follow the same procedure, except that in this case you run the wheel back along the scale of the map instead of along the ruler, thus getting your answer direct in miles. With care you can follow every bend in the road which is given on the map, and the accuracy of the result will depend largely on the relative scale of the map and the amount of detail which it shows.

The Frame and Handle

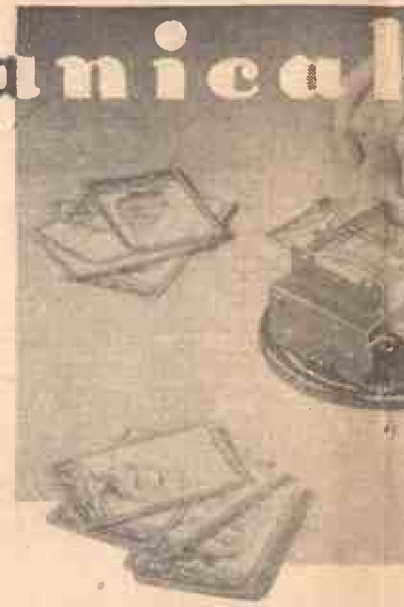
To make the opisometer, choose an old clock wheel with a good, solid hub, so that it will have a long bearing surface on the thread. Tap it out (4 B.A.) and clean up the thread of a piece of 4 B.A. studding so that the wheel will run perfectly freely on it. The U-frame is bent up from brass strip, and the three holes are drilled in it as shown in Fig. 2. The handle is a piece of dowelling fixed to the frame with a woodscrew. A piece of brass tube, a tight fit on the dowelling, is driven on to the lower end of the handle to prevent the wood from splitting when the screw is turned home (Fig. 2). Tap the holes in the arms of the frame (4 B.A.), screw in the rod with the wheel on it and secure it with solder at each end. Use as little solder as possible, so that it does not run inside the arms.

The exact dimensions of the instrument are not important. Use a reasonably fine thread for the rod, or the wheel will travel across so rapidly that you will find it difficult to steer it accurately. You will find that you can go a surprisingly long distance in one "run" of the instrument in spite of its small size. A simple calculation will show you that if you make the wheel 1in. in diameter and fit it on a 4 B.A. rod, allowing 1in. of travel, you will be able to run the instrument about 10ft. forward before the wheel has travelled across to the other end of the rod.



A Mechanical

A Novel and Useful Device



By H. NOR

THE machine described here will deal a pack of cards into four heaps with unfailing accuracy, and avoid the misdeals which are so irritating to card players. It thus may be used for any card game where the cards must be dealt from right to left, one at a time. It cannot, for example, be used for solo whist, where the cards are dealt three at a time except for the last round, when the remaining four cards are dealt singly.

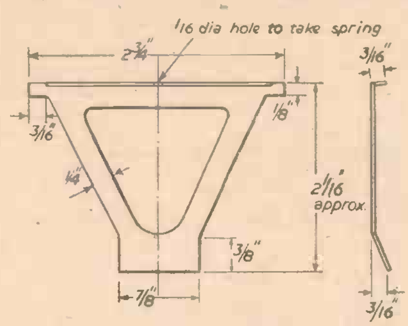
A surprising number of people cannot deal cards with that nimble digital dexterity which marks the skilled card player. Quite often two cards are dealt instead of one, necessitating a reshuffle and a redeal. Such a machine will preserve the cards in a clean state for a much longer period than is possible when they are dealt by hand. There is usually at least one in a party of four whose hands are not clean or which suffer from perspiration. Sticky cards are one of the main causes of misdealing, and it is in the shuffling that moisture and dirt from the hands become transferred to the cards.

All cards, of course, are dealt clockwise round the table, and to avoid the possibility of the machine being turned the wrong way it incorporates a free-wheel device, so that if the machine is accidentally turned the wrong way it fails to function.

The machine automatically "counts" so that if the dealer is interrupted in the course of his dealing he does not have to remember to whom he last dealt. The machine cannot make a mistake and deal two cards to the same person.

Points About Construction

It will be seen from the drawings below that it consists of a base with a series of holes equi-pitched around its periphery, on which is pivoted the revolving carriage carrying a train of two gears, one of which drives the roller carrying on its circumference a strip of rubber, which grips the bottom of the cards and ejects them as the carriage is revolved. This roller or platen has a gap in its circumference, and it is when this point reaches the card that it is ejected. The gear ratio is such that the platen revolves four times in one revolution of the carriage. At the top of the carriage is a spring-loaded pressure plate to keep the cards in contact with the platen, and there is adjustment, of course, at the side to accommodate cards of varying thicknesses.

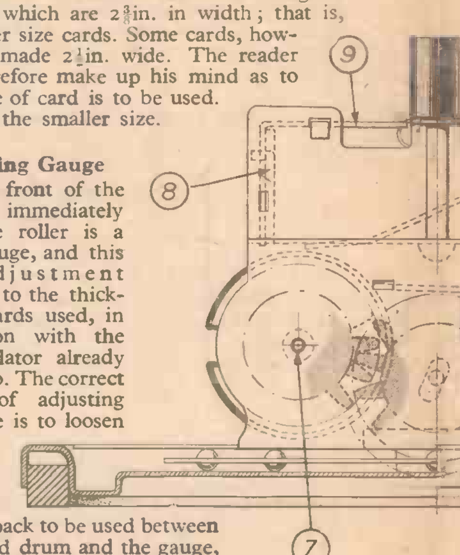


① CARD RETAINING PLATE

When using old cards it is essential that each card be straightened and made flat before placing in the card dealer. The backs and corners of cards are often bent. The regulator at the side, for cards of normal thickness, should be in the central position, but it should be moved upwards or downwards until it deals correctly. Different makes of cards differ in thickness and size. The machine here illustrated has been designed for cards which are 2 3/8 in. in width; that is, the smaller size cards. Some cards, however, are made 2 1/2 in. wide. The reader must therefore make up his mind as to which size of card is to be used. I suggest the smaller size.

The Setting Gauge

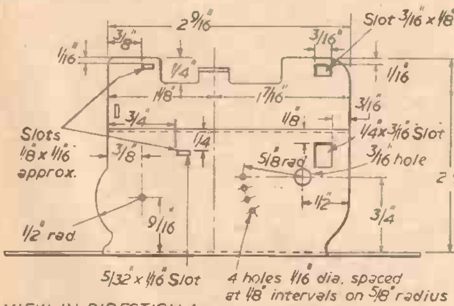
On the front of the carriage immediately above the roller is a setting gauge, and this needs adjustment according to the thickness of cards used, in conjunction with the side regulator already referred to. The correct method of adjusting this gauge is to loosen the set screw and insert two cards from the pack to be used between the banded drum and the gauge, inserting them from the front end of the card holder. Press the gauge down gently until it rests on the cards and then tighten the set screw. After this adjust the regulator at the side. A slight downward pressure on the operating handle during rotation will prevent the dealer sliding on the table while in operation.



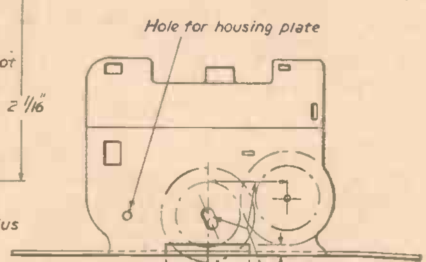
Side elevation of the

The Gears and the Base

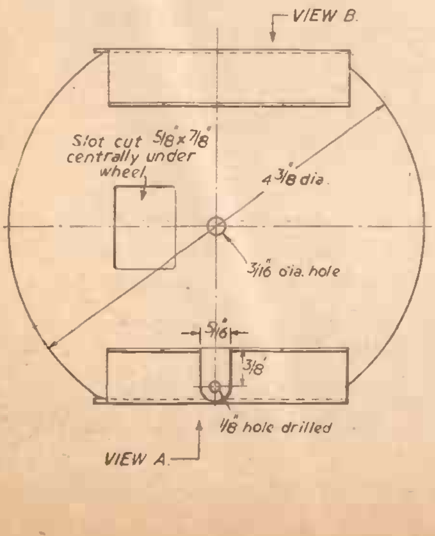
A side elevational view above shows the

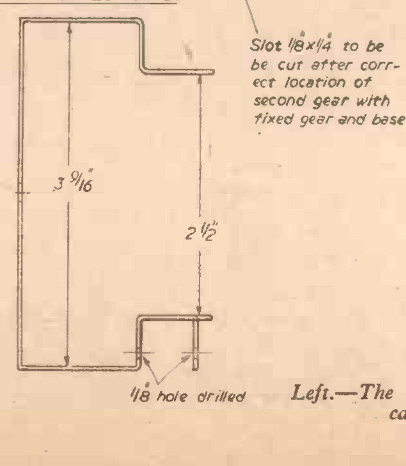


VIEW IN DIRECTION A.

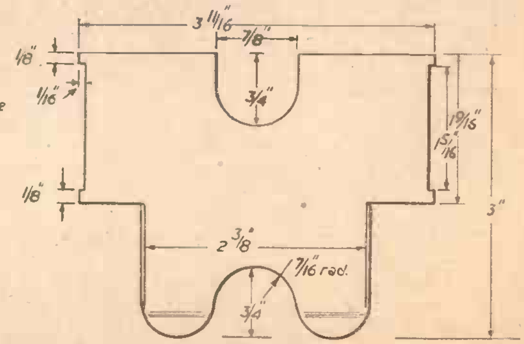


VIEW IN DIRECTION B.





Left.—The revolving carriage.

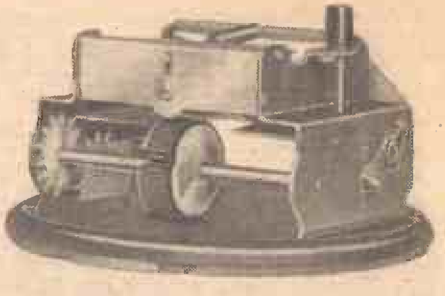


The card tray.

End of plate slightly raised to hold cards

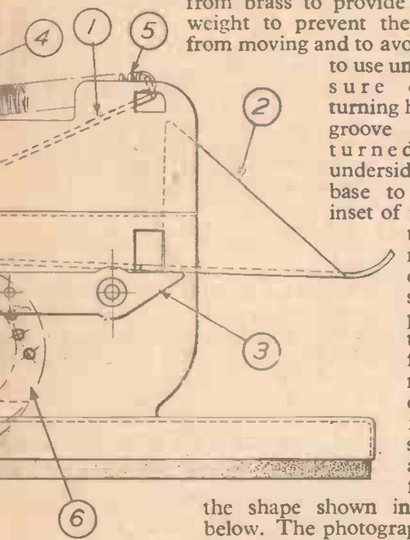
Card Dealer

for the Card Table



RMAN

complete assembly with the various parts numbered, and these numbers correspond to those on the detail drawings. It is not necessary to get two gears specially cut; with careful marking out they can be filed up to form. Needless to say, the spacing of the holes in the base into which the gear teeth mesh must be very accurate, otherwise the carriage will not revolve freely. Preferably the base should be turned from brass to provide sufficient weight to prevent the machine from moving and to avoid having to use undue pressure on the turning handle. A groove must be turned on the underside of the base to take an inset of rubber so that the machine does not scratch polished table surfaces. The revolving carriage is cut from sheet steel and then folded to the shape shown in diagram below. The photographs at the top of this page clearly show the general assembly and the shapes to which the various parts have to be bent.

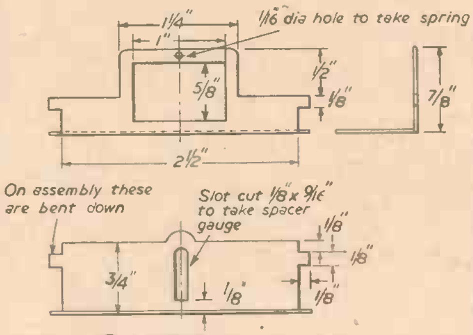


complete machine.

Aluminium of about 18 gauge will suit for the various parts of the carriage and the card tray. A spacing washer must, of course, be interposed between the base and the carriage of a thickness to ensure the correct mesh of the gears and to enable the carriage to revolve freely. The tubular eyelet which secures the carriage to the base acts as a bearing. It can be cut from a piece of ¼in. tubing to provide a suitable bearing area, but for preference it should be turned.

When mounting the driving drum, which ejects the cards, on to its spindle it is necessary to ensure that it revolves quite truly. The rubber band passes right round the boss, through the slot and round the circumference of the drum.

In the model illustrated there are 56 holes, which means that the gears must have 14 teeth. The leading or driver wheel is mounted



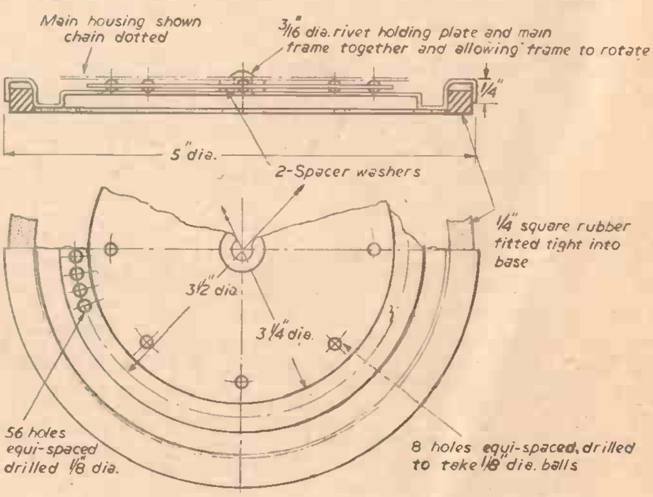
⑨ BRIDGE

between an auxiliary plate secured to the side pieces of the revolving carriage. Its short spindle runs in elongated holes, so that it may freewheel when turned anti-clockwise. As mentioned earlier, the spacing of the holes in the driving disc is, of course, very important, and if the reader is without access to a dividing attachment or other means of accurately indexing, the disc will have to be very carefully marked out in the following way. First of all, make a very light centre punch in the exact geometrical centre of the disc and then scribe a circle of 3½in. radius. Next, make a light centre punch on this line to act as a starting point, and then, with a pair of engineer's dividers, step off round the circle, resetting the dividers as necessary until exactly 56 spaces are stepped off. Then proceed to scribe off the positions of the centres of the holes and lightly centre punch. Drill through with a 1/16in. drill, and check, and where necessary correct with a rat-tail file before opening out to the full diameter of ⅛in. Remove all burrs with a ¼in. drill, held in the hand.

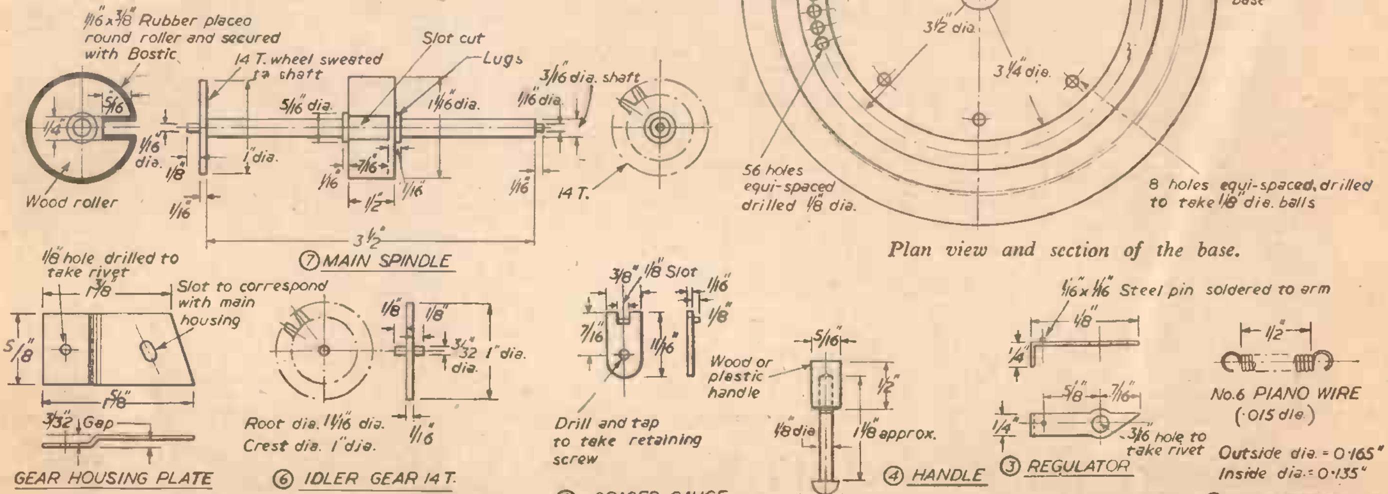
If the reader experiences any difficulty in making this particular part, model makers, such as those who advertise in this journal, will undertake to make it for him. It is essential that the movement should be absolutely free, otherwise the cards will be distributed unevenly. Freedom of motion is entirely dependent on the accuracy with which this drilled base driving disc is made. It will be understood that lubricant cannot be used on the various moving parts because of risk of soiling the cards or the table or cloth on which the instrument is used.

Readers who are tempted to make this device for sale should remember that certain novelties of this type attract purchase tax! Whilst readers are entitled to make a copy of anything for their personal and experimental use, they are not entitled to market anything incorporating a method or principle which is the subject of a patent.

Apart from these special points the construction is clear from the drawings.



Plan view and section of the base.

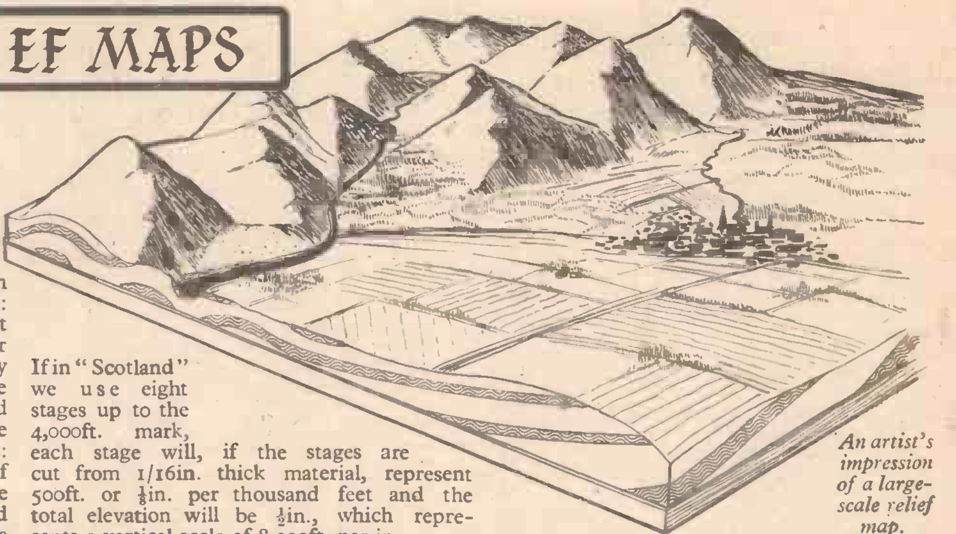


Various details.

MAKING RELIEF MAPS

How to Make Maps With the Added Third Dimension of Height

By "CARTOGRAPHER"



An artist's impression of a large-scale relief map.

An ordinary map, such as one finds in any atlas, has two dimensions only: length and breadth. It is perfectly flat and all details are shown by lines, drawn or printed. It is frequently embellished by colouring, which emphasises either the physical features or political boundaries and partitions. The relief map differs from the ordinary map in being given three dimensions: length, breadth and *height*. It can still, if required, give the political divisions and have the positions of towns and cities marked upon it, or any other features, such as railways and roads, but its chief purpose is to give the physical details; i.e., the undulations of the land, its rivers, hills and valleys.

Ordinary flat maps, such as those issued by the Ordinance Survey Department, give contour lines, marked and figured to indicate height above sea level, and those made for the use of motorists, cyclists and others, by John Bartholomew and Sons, Ltd., to a scale of two miles to 1in, do the same. These latter give not only the contours in figures but show the elevations in differing colours; at every 100ft. up to 400ft., then at every 200ft. up to 1,000ft. and after that at every 250ft., and so on. These Bartholomew maps are mentioned because they will be found particularly useful if one wants to make a relief map, whether it be to a small scale or to a large one. By a small scale is meant a map of a whole country, such as that of England, Scotland or Wales.

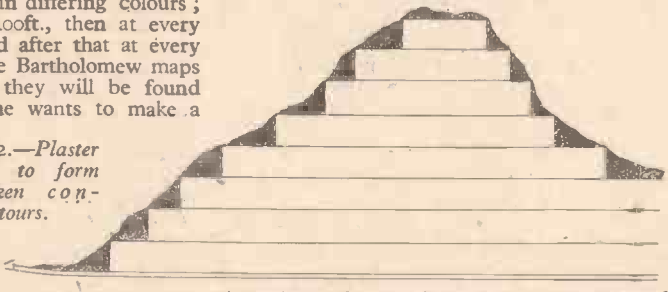


Fig. 2.—Plaster filling to form unbroken contours.

Just suppose that a relief map of Scotland is desired and it is wanted to measure about 20in. by 16in., then the scale can be 15 miles to 1in. This would not include the Orkneys or Shetlands but it would the Outer Hebrides.

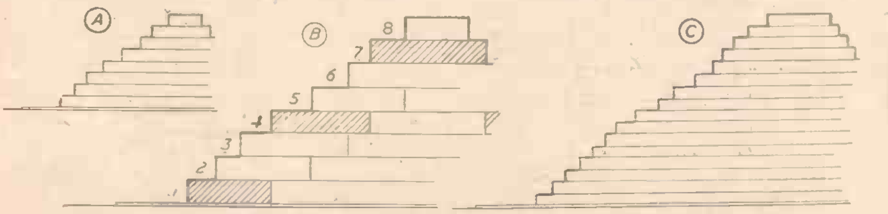


Fig. 1.—The laminated method of building-up contours on relief maps.

The relief in such a map could be in eight stages above sea level, with an additional stage at about four points (literally points) to show the mountain peaks which exceed the 4,000ft. elevation. With eight stages, each stage will represent an elevation of 500ft.

The Vertical Scale

On most flat contour maps where the elevations are indicated by lines and figures, the rate of progression in elevation is not uniform: in the lower elevations it may advance in 250ft. stages, then jump to 500ft., finishing with 1,000ft. stages. This should not be so in relief maps; whatever rate of progression is decided upon it should be perfectly uniform and it will be necessary to adopt a uniform and definite vertical scale. If in "Scotland" we use eight stages up to the 4,000ft. mark, each stage will, if the stages are cut from 1/16in. thick material, represent 500ft. or ⅛in. per thousand feet and the total elevation will be ½in., which represents a vertical scale of 8,000ft. per in.

It will be understood that if the map were to be made twice the size, i.e., 40in. by 32in., the scale for the elevations can still be the same. The only result would be that the map would look flatter and the relief would not be so bold. It may be asked why the vertical scale cannot be made the same as the horizontal. As a matter of fact it can, in certain cases, as will be explained. In the case of modelling such a vast expanse of country, if the horizontal scale is 15 miles to 1in., an elevation of 4,000ft. will be represented by only: $(15 \times 5{,}280\text{ft.}) = \frac{79{,}200\text{ft.}}{4{,}000\text{ft.}} = \frac{1}{20}$ in. approximately (the figure 5,280 is the number of feet per mile). So it will be seen that in order to obtain any marked relief, which can be seen and appreciated, we are bound to adopt an enormously larger vertical scale than that of the horizontal.

The Small Area Map

With small areas of country, modelled to a fairly large scale, the case is entirely different. Suppose it is required to make a relief map of Loch Lomond, the largest of the Scottish freshwater lochs, from Balloch at the southern end to Ardlui at the north, or of the Avon Gorge, from Bristol to Avonmouth. The distances are so short, about 25 miles in the first case and 6 miles in the second, that there would be no need for a larger scale for the elevations and a uniform scale could be used throughout. Usually with large scales the purpose of the maps is different from that of small scales, and what is wanted is something more in the nature of a scale model. Indeed, it could readily be converted into a model by adding fields and trees and perhaps buildings. But whether it is a large scale, small area map, or a model, the construction of the relief contours can be the same. It will be seen that, with small areas to a large scale, there is little difference between the map and the scale model; the only difference being in accessories and finish.

Between these two there is the large type of map, made to scales of perhaps 6in. to the mile; in these the vertical scale may be twice or three times the horizontal and would, or could, be constructed differently from either of the foregoing, according to the nature of the contours. This construction will be dealt with in due course.

Large Map Construction

Taking the first class of map, dealing with the construction of "Scotland" as a whole, it is assumed that it is to measure 20in. by 16in. with eight stages of 1/16in. each, as at A in Fig. 1. But suppose we want it to be twice this size with the same exaggerated elevation; we can either double the thickness of the stages to ⅛in. as at B and still use eight, or we can double the number of thicknesses to 16, as drawn at C, and still adopt the height of 1/16in. at each stage. The reader who contemplates making a map must decide these things for himself; the principle is, however, made clear in Fig. 1.

With small relief maps, especially when layers of cardboard are used, it is best to let the edges of each sheet of cardboard show, sharp and square cut, and to paint each step or stage in the elevations a slightly different colour or depth of tone, just as is done in the Bartholomew maps, using three or four shades of green for the first three or four stages then changing to greenish-brown, or greenish-grey, increasing the depth of tone as the elevations get higher, the 4,000ft. level being the deepest brown or the darkest grey of all. Above the 4,000ft. level the four peaks, Ben Nevis (4,406ft.), The Cairn Gorm (4,094ft.), Ben Macdhui (4,296ft.) and Cairn Toul (4,241ft.), can be painted white to show that these are often snow-capped.

It is understood that the flat surface of the base of the map represents the sea level and must be painted a pale blue; it must also be understood that if the first cardboard layer represents a rise of 500ft. it will not do to let the ground around the coast rise abruptly from the sea to this level since in many places the lowest lying land will be only a few feet above the sea.

Therefore where there are such low levels of meadow land or stretches of sand dunes it

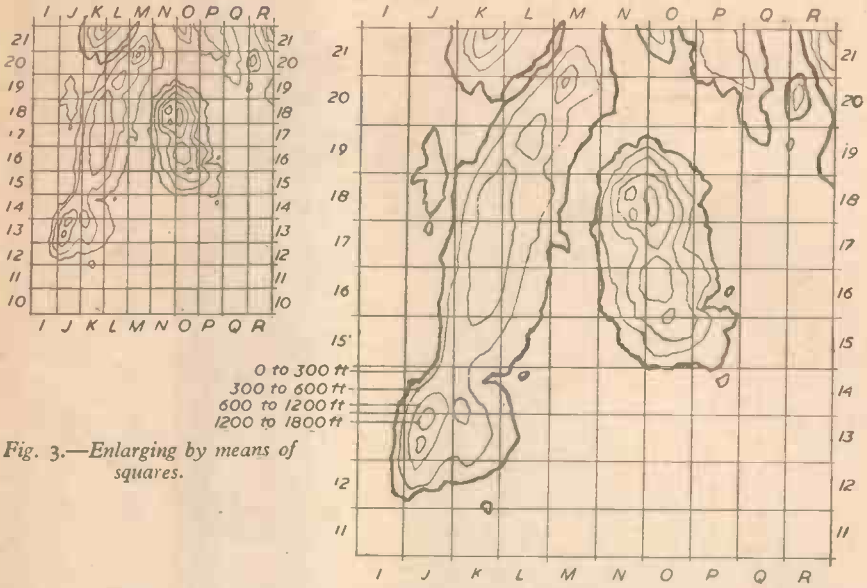


Fig. 3.—Enlarging by means of squares.

would be advisable to glue down a thick cartridge paper under the first sheet of cardboard and let this paper give, and be cut to, the true coastline, see Fig. 1. In modelling Scotland the reader is reminded that most, if not all, of the freshwater lochs are above the sea level and there is a definite drop in their outfall to the sea.

In making large relief maps, especially to large scales, sheets of plywood are used for the laminations and these need not be laid solid; the fourth layer, sheet or ply can be cut out of the first, the fifth out of the second and the sixth out of the third, and so on, as shown at B (Fig. 1), but this depends largely on the angle of the slope. If the angle of slope were very steep it could not be done because there would not be a sufficiently wide overlap of each ply to make good joints, but some cutting can certainly be done and the pieces removed can be used in other places on the map.

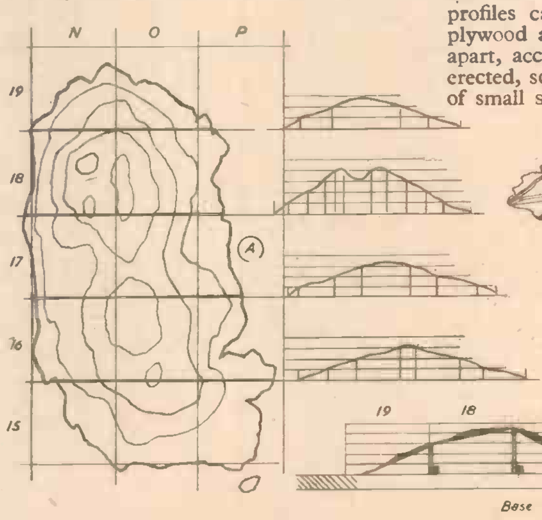
Some relief maps, made by the laminated method, especially large ones and to a large scale, should have the angles formed between the laminations filled in with plastic wood, plaster, glue plaster and whiting or some other filler. There is a material called Church's "Alabastine" filler which is used by builders and decorators and which is excellent for relief map work. It can be purchased in packets from hardware shops and wallpaper and decorators' stores. The powder is mixed into a paste with a little water and can be applied with a table knife or an artist's palette knife. The relief map must be prepared to receive it, or any other plaster, by having a thin coat of glue applied to all the steps of the contours. When completed, a cross section of a map, or a portion of it, would present the appearance shown in Fig. 2, where the filling is drawn in solid black.

Making a Scale Drawing

The first step will be to make a drawing to scale of the whole coastline, but it must first be decided what size the model is to be and from that the horizontal scale settled. A good plan will be to make the size a multiple or a fraction of that of the contour map from which it is proposed to copy. Suppose this map measures 10in. by 8in. and the scale of it is 30 miles to 1in., we want to make our relief map twice this size, i.e., four times the area or 20in. by 16in., then the scale will be 15 miles to 1in.

Rule up the copy map, or an accurate tracing from it, into ¼in. squares by vertical and horizontal lines. Next, pin down on a drawing board a piece of drawing paper measuring, with a margin, 20in. by 16in. and rule this up into ½in. squares. On both the map and the paper letter the horizontal squares, putting the letters at both top and bottom. At the sides number the squares, either from top to bottom or from bottom to top; it does not matter which so long as the map and the drawing are done the same. Now, commencing at some point on the coastline, note the letter and number of the square in which it comes, find on the drawing by means of the letter and number the corresponding square and commence to draw the outline of the coast, following through from square to square, checking up the letters and numbers frequently to see that you are drawing in the correct square.

Having drawn the whole of the coastline,



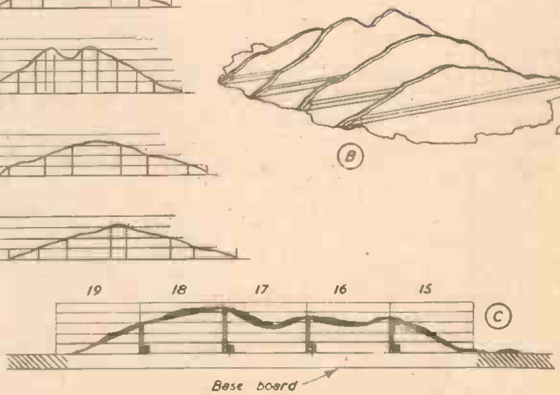


Fig. 4.—Construction by plywood profile formers with fabric and plaster covering.

make a 20in. by 16in. tracing of it and use this tracing to transfer the outline, by means of carbon paper, to the baseboard and to the before-mentioned cartridge paper which is to form the foundation for relief; cut it (the cartridge) to the drawn line and glue down accurately to the outline transferred to the baseboard.

Now go back to the copy map and the drawing and draw, square by square, the outline of the first stage of the elevation. Trace this on the same tracing, transfer it by carbon paper to the glued-down cartridge paper and also to the first sheet of cardboard or plywood, whichever is to be used for the relief. Cut this to the transferred outline and glue it down. Again, go back to the map and drawing; draw the second stage of the elevation, trace it, transfer its outline to the first elevation and to another sheet of cardboard, cut this to outline and glue it down and so on until you have all the elevations drawn, transferred, cut out and glued in their proper positions. It may sound, from the description, a long business, but it is an extremely interesting and by no means a tedious one. Moreover, it is the only accurate way.

It may be mentioned, in connection with accuracy, that the smaller one draws the squares in ruling up the copy map and the enlarged drawing, the more exact will be the result. Thus, instead of ¼in. and ½in. squares, 3/16in. and ⅜in. could be used, or even ⅛in. and ¼in. The finer ruling leaves less chances of error in drawing the lines of the contours through the squares. Of course, the tracing and particularly the cutting of the cardboard, as well as glueing down to correct position, must be accurate also. If cardboard is used for the relief work it should be cut with a keen-edged and pointed knife, cutting on a sheet of glass, preferably plate glass; whilst if the elevations are of plywood a fretsaw will have to be used.

Method for Intermediate Maps

We now come to the intermediate size and scale map in which we want to make the vertical scale only two or three times that of the horizontal. A scale of 6in. to one mile was mentioned as a possible scale for such a map, and for this the greatest elevation may be many inches in height. To build up such elevations by the laminated method—although it is the most accurate—would entail the use of a great deal of plywood and would make the weight of the model very great. Therefore we can adopt a different method of construction. Instead of considering the contours in plan we treat them vertically in elevation by a series of vertical profiles. Each of these will represent a cross-section through the hills and valleys and this at regular intervals apart. The profiles can be cut from, say, 3-millimetre plywood and be spaced at 2in., 3in. or 4in. apart, according to the scale. They will be erected, square with the baseboard, by means of small strips of wood about ½in. square in cross-section. The profiles will naturally be all different and each one will have to be drawn by the aid of the contour map. In Fig. 4 (at A) is drawn the same island as appears in Fig. 3, but here in Fig. 4 the thick lines drawn across indicate the positions the profiles may occupy. At B is drawn the profiles in perspective, showing the wooden strips by which they are fastened down. At C is a longitudinal section of the island. When the profiles are all fixed, the edges of them must be given a coat of glue.

Fitting a Covering

We now have to fit a covering over the profiles, and this can be of strong cotton or linen material soaked in glue, stretched taut and pinned down all around the coastline. The fabric had better be cut on the cross so as to allow it to stretch. When thoroughly dry there will be angles over the profiles with straight lines in the fabric in between the profiles: these straight lines must be built up with Alabastine and the contoured surface nicely rounded off so that no angles show at or between the formers. The painting of the levels in differing shades of colour will not be easy, but it can be done by making a tool something like an engineer's scribing block, but of wood. It will consist of a flat-bottomed wooden block holding a blacklead pencil by means of a vertically swivelling fitting which will allow the point of the pencil to be adjustable for height. Then by setting the pencil by a scale for the first elevation, say, 200ft., or whatever it may be and letting the block rest and slide upon the sea, draw a line around on the white surface of the Alabastine. Then move the pencil up for the next elevation; again draw a line, and so on in succession, until all the elevations are indicated by lines horizontal and parallel with the sea. Then it will be a comparatively simple matter to paint in between the lines with the different colours.

A Potato Harvester

A Device for the Complete Mechanical Harvesting of Potatoes

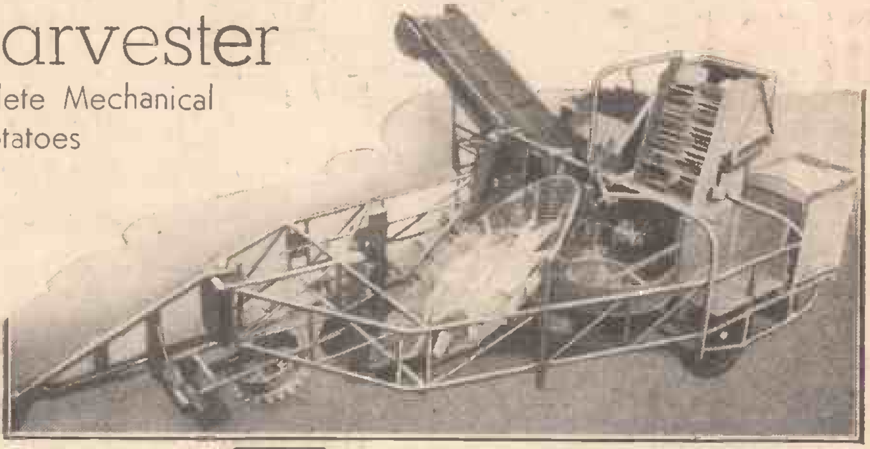


Fig. 1.—The Packman Potato Harvester.

FINDING labour for lifting potatoes has always been a problem on the farm, and in these days when labour is at a premium the Packman Potato Harvester would appear to be the answer for the large grower. Fourteen years of research has gone into the problem of producing an efficient potato harvester, and one of the things that emerged from this research was that precision planting had a great bearing on the subject. The Packman precision planter was evolved. This ensures that potatoes are placed on the ground, not dropped, and that the potato once placed does not roll out of position. The potatoes are laid down gently in straight rows at the precise spacing required, with equal distances between rows, ensuring that the tubers draw an equal amount of sustenance from the fertilised soil.

Harvester Requirements

The planter was evolved more easily than the mechanical harvester. The harvester must lift up to 20 tons per acre of potatoes from ridges at an economical speed and deliver to trailer and bags undamaged. The conditions under which this must be done vary considerably, e.g. different types of soil, stones, clods, haulm, weeds, wet and dry, and level and sloping land. Potatoes vary considerably in size and skin texture.

The potato harvester running at 2 m.p.h. has to eliminate 4½ tons of soil per minute. On a heavy crop, approximately 1,800 potatoes pass through the machine every minute and these may be mixed with stones, clods and rubbish which must be separated before potatoes reach the trailer.

The Packman Potato Harvester embodies a novel system of soil riddling and stone separation which is unique in that potato damage is eliminated and labour reduced to a minimum, so that the grower can achieve the very desirable objective of lifting his crop with his own permanent farm staff instead of seeking squads of hired pickers.

The performance of the Packman Harvester at the end of last year's harvest showed that the intensive research work by Packman Machinery Ltd. has resulted in the provision of two of the most needed potato machines. The cost of lifting and planting by these machines is considerably less than is possible by hand methods and the work is done in a much cleaner and more uniform manner.

Both machines are of light tubular construction. The harvester is driven by a Ford 10 engine and special precautions are taken to keep bearings free from dirt and grit. No fewer than 50 ball races are incorporated in the mechanism to ensure free running and long life. The frame is of tubular steel construction.

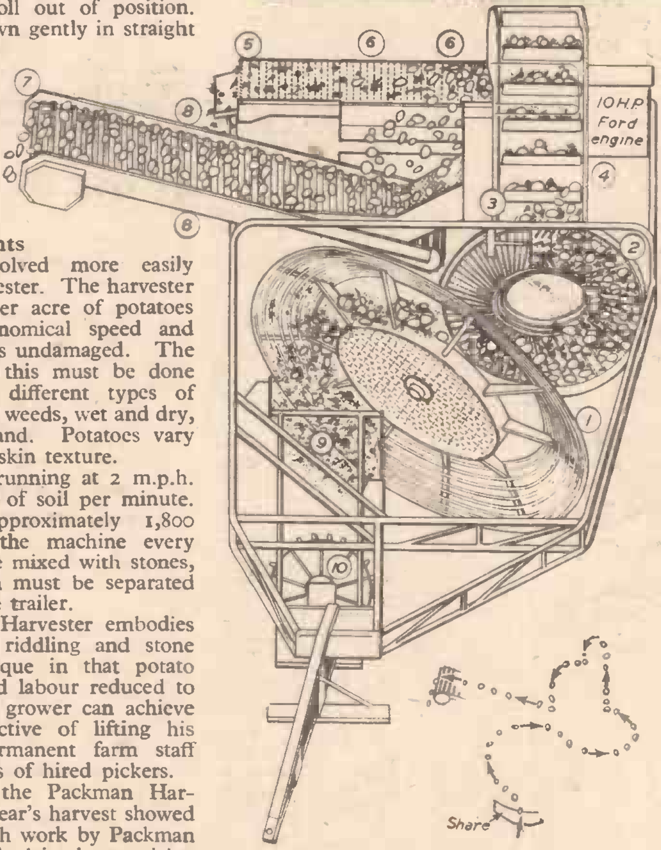


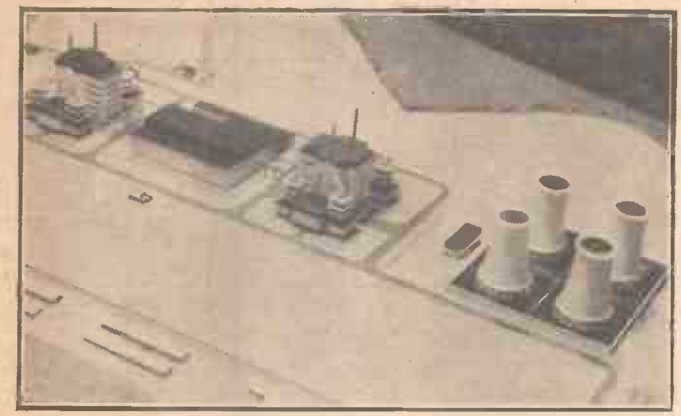
Fig. 2.—The operating sequence.

Sequence of Operation

This is shown in Fig. 2 and is as follows: 1. Large elevating riddle. Speed controlling lifting of potatoes with cushion of soil to No. 2 riddle. 2. No. 2 riddle disposes of remaining soil. 3. Rubber brush gently deflecting flow of potatoes, clods or stones into rubber formed buckets of patent elevator. 4. Picking position and receptacle for rubbish. 5. Rubber separation carpet. Potatoes bounce from carpet on to rubber receiver at bottom of final elevator. Stones and clods go over end of carpet on to worked land. 6. Carpet picking positions. 7. Final elevator to trailer with rubber receiver at bottom. 8. Elevator picking positions. 9. Share. 10. Floating haulm stripper.

The harvester can lift up to 4 acres per day and requires permanent farm staff only. All the potatoes are lifted, clean and undamaged and delivered into carts or bags. No after harrowing is required.

Both the planter and harvester are being manufactured by Thos. Storey (Engineers) Ltd., Vernon Works, Stockport, England.



A model of the British experimental power station, which is being constructed at Calder Hall in Cumberland. This scale model was prepared by scientists of the Ministry of Supply's Atomic Energy Production Division. The turbine house is seen in the centre with its attached administrative control and workshop block and on each side are the two reactors.

Nuclear Reactors for Power Production

How Atomic Energy Can be Used for Peaceful Industrial Power

By "PHYSICIST"

RECENT developments in this country have indicated that we intend to go ahead rapidly with a programme of atomic power production which should put us in the forefront in this field, in much the same way as two hundred years ago when we led the world in the industrial revolution. In addition to setting up the experimental atomic power station at Calder Hall, Cumberland, the Atomic Energy Authority intend to establish a new atomic power generator of the fast reactor type at Dounreay in Caithness. It is also proposed to disclose considerable information relating to the release of atomic energy which will allow universities and industry to become familiar with the experimental techniques and also to establish a School for Reactor Technologists, where men from industry can learn the basic principles of atomic reactor design.

More than any other country we need to make full use of atomic power, for our fuel reserves are fast running out. Furthermore, if the planned increase in Britain's electric power needs between now and 1965 are to be realised, the consumption of coal will have to rise from its present level of 35 million tons to 60 million tons per annum, and it is impossible for such an increase in coal production to be achieved in this interval of time.

The impending shortage of fuel reserves is not, however, confined to Britain. It has been calculated that at the existing rate of fuel consumption the world supplies of coal and oil will only last for about 400 years. If the demand for fuel increases as expected, by the year 2000 these will be used up at such an alarming rate that they will hardly last for another 80 years. On the other hand, if all the economically accessible uranium and thorium could be converted into energy by nuclear fission, they would meet the world fuel needs for at least 1,700 years, even at the rate of consumption expected by the year 2000 !

Nuclear Fission

The release of atomic energy as we know it to-day is based on the fact that when the nuclei of certain atoms are bombarded with minute particles of matter they are split into two smaller atoms and, in the process, a small amount of matter is annihilated and appears as energy, see Fig. 1. Of course, in every process of power generation some of the energy which is associated with the atoms of the fuel is liberated, but in atomic fission the amount of energy liberated is very much greater—so much so, that as much energy can be obtained from one pound of atomic fuel as from 2.5 million tons of high-grade coal.

It was found that when uranium was bombarded with electrically neutral particles called neutrons, certain atoms underwent this fission process, giving out considerable energy and at the same time yielding two or more neutrons which could, under favourable conditions, collide with neighbouring atoms and cause them to split. Clearly, here was a self-sustained process which, when once initiated, would maintain itself. Its potentialities as a military weapon were quickly realised and studies to determine the ultimate speed with which fission could occur

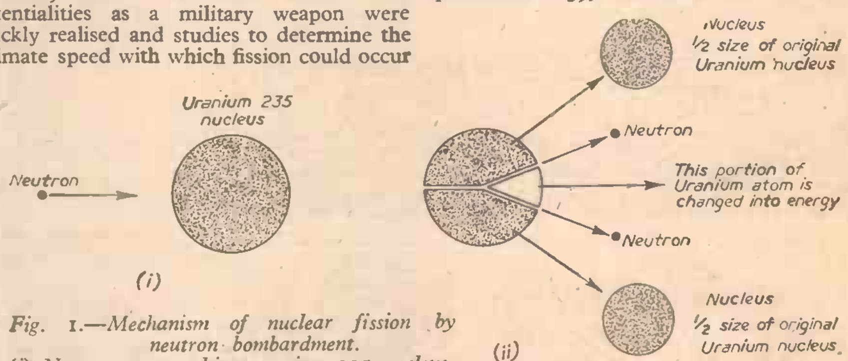


Fig. 1.—Mechanism of nuclear fission by neutron bombardment.
(i) Neutron approaching uranium 235 nucleus.
(ii) After impact with neutron, uranium 235 nucleus splits into ; (a) two nuclei of approximately half size of uranium nucleus ; (b) two or more neutrons ; (c) portion of matter from the nucleus (considerably less than shown in this figure) is annihilated and converted into energy.

led to its use in the atom bomb towards the end of World War II.

Three materials have been found in which these chain fission reactions can be induced, viz., uranium 233, uranium 235 and plutonium 239. (The numbers after the name of the material refer to its atomic weight.) The first two are different forms of the same element and are called isotopes, but the third is an isotope of a different element, plutonium, which is man-made.

Nuclear fission was first discovered in naturally occurring uranium and was found to be due to the isotope of atomic weight 235 which is present only to the extent of 0.7 per cent. For military purposes, where it is essential to have the maximum amount of energy liberated in the least possible time and where the size and weight of the weapon are important factors, it was necessary to isolate the uranium 235 from the natural material, but for power production this is not essential and a slower evolution of energy can be tolerated.

It was subsequently discovered that another isotope of uranium, viz., uranium 238, which does not undergo fission directly can capture neutrons, thus becoming uranium 239. This isotope is very unstable and emits an electron from its nucleus to become an isotope of a new element—neptunium 239. Within a short time another electron is emitted from the nucleus of this element and another new element, plutonium 239, is formed. This material is as valuable as uranium 235, because it also undergoes fission with the evolution of energy and, therefore, is used in atomic weapons, see Fig. 2.

Another fissionable, man-made material has also been discovered and is made by bombarding thorium 232 with slow-moving neutrons. This gives thorium 233, an unstable isotope which emits an electron from its nucleus to become protoactinium 233 and this, in turn, becomes uranium 233 after emitting another electron (Fig. 3). Uranium 233 is also fissile and has certain advantages over plutonium 239, for there are substantial supplies of thorium in the world and uranium 233 is much less dangerous to health than plutonium 239. It is also easier to separate from its parent isotope than plutonium 239.

Both plutonium 239 and uranium 233 are made in what are known as "breeder" piles. Basically, these are designed to "burn" a primary nuclear fuel, such as uranium 235, and produce an equivalent amount of another atomic fuel in addition to giving out energy. An idealised "breeder" pile is shown diagrammatically in Fig. 4. Such a pile or reactor would consist of a central region

(1) Thorium 232 + neutron → thorium 233.
(2) Thorium 233 → protoactinium 233 + electron.
(3) Protoactinium 233 → uranium 233 + electron.
(4) Uranium 233 + neutron → 2 nuclei of half the atomic weight of uranium 233 + two or more neutrons + energy.

Fig. 3.—Schematic representation of the derivation of uranium 233 from thorium 232, and the fission of this material.

containing pure primary fuel surrounded by a shell of the material to be converted into the secondary fuel. The whole would be enveloped in a radiation shield to protect the operators from exposure to the atomic radiations. Ideally, in this type of reactor the fission reactions would be confined to the core, but the neutrons liberated therein would penetrate the surrounding material and produce transmutation of the material. The energy liberated during the fission processes occurring in the core, which appears mainly as heat, would be removed by a coolant circulating around the core. Unfortunately, such an idealised system is not likely to be realised in practice, for the fission reactions cannot wholly be confined to the core.

Types of Nuclear Reactors

Attention is, at present, focused on the use of atomic energy in electric power production and this is likely to prove its first major peaceful application. Because the energy is transformed in bulk, before transmission to the individual users, it offers certain advantages in so far as expensive and complicated equipment need not be duplicated and suitable safety precautions can be taken to guard against the harmful effects of the fission materials. Fundamentally, the generating equipment of the atomic power stations will be conventional: the nuclear reactor merely replacing the boiler of the normal power station.

The generating and transmission costs of the atomic power station will be much the same as for a normal power station and what economies there might be will be in the cost of the fuel. Consequently, it is unlikely that electricity from atomic energy will be any cheaper than that derived from coal.

Unlike atomic weapons, in nuclear reactors the liberation of energy must be strictly

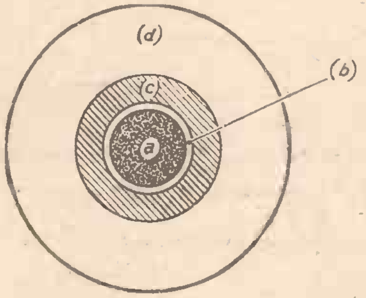


Fig. 4.—Idealised construction of a "breeder" reactor.
(*a*) *Core of primary fuel.*
(*b*) *Coolant and/or moderator which envelopes the reactor core.*
(*c*) *Shell of material for transmutation into secondary fuel by neutrons from primary fuel.*
(*d*) *Radiation shield.*

controlled. It is little use setting up extremely efficient reactors which are likely to explode without warning! On the other hand, nuclear fuel is so expensive that it must be burned economically and the temperature of the reactor must be so maintained that the energy is efficiently converted into electricity.

(1) Uranium 238 + neutron → uranium 239.
(2) Uranium 239 → neptunium 239 + electron.
(3) Neptunium 239 → plutonium 239 + electron.
(4) Plutonium 239 + neutron → 2 nuclei of half atomic weight of plutonium 239 + two or more neutrons + energy.

Fig. 2.—Schematic representation of the derivation of plutonium 239 from uranium 238 and the fission of this material.
[*Note that the neutron has an atomic weight of 1 and no electric charge, but that the electron is virtually weightless but has unit negative charge.*]

Three types of reactors are possible, each of which is suitable for particular applications, and in every case economy of operation can be ensured if they are constructed as "breeder" reactors. The three types are: (a) *slow reactors*, in which the neutrons are slowed down by moderators such as water, graphite and beryllium before colliding with the nuclei; (b) *intermediate reactors* in which the fission neutrons are slowed down somewhat, but not nearly so much as in (a); (c) *fast reactors* where the fission neutrons are not slowed down at all, see Fig. 5.

Slow Reactors

Both the low-powered Gleep and the high-powered Bepo piles at Harwell and the Windscales piles are of the slow reactor type. They use natural uranium as fuel and are moderated by graphite.

Gleep is capable of running at 100 kW. power output, but is essentially a low-temperature reactor with air cooling and is unsuitable for electricity production. The nuclear fuel consists of 12 tons of natural uranium metal and 21 tons of uranium dioxide, and there are 505 tons of graphite used as a moderator. The reaction is controlled by cadmium rods, which can be inserted into the pile and absorb the fission neutrons, thus reducing the rate at which fission occurs.

Bepo is of a similar construction and was intended to operate at a power of 6,000 kW. It contains a total of 40 tons of uranium, is air cooled, and its maximum operating temperature is 200 deg. C. The reactor proper is in the form of a 26ft. cube, but this is surrounded by a massive radiation shield of concrete and steel. Boron carbide rods are used to control the reaction.

Both these piles were meant for experimental purposes and never intended as sources of electric power, although some of the heat is now extracted and used to supply hot water for space-heating some of the laboratory buildings.

Some reduction in the size of the reactor can be achieved by using uranium enriched in uranium 235 or by using uranium 233 or plutonium 239. Such units would, however, be very wasteful of fuel since they would not be breeder reactors and their use will, no doubt, be confined to special applications, such as ship, submarine or aircraft propulsion, where their small size would be a decided advantage.

Presumably the Calder Hall reactor is of the natural uranium type, but it is specially designed to develop power for electricity production and at the same time breed plutonium 239.

Intermediate Reactors

There has been no indication that any reactors of this type are to be built in this country, though one is under construction in America. This is known as the Submarine Intermediate Reactor and, as its name implies, it is intended as a power unit for a submarine. The advantages of this type of reactor over the slow neutron types are that it will be smaller in size and be capable of running for longer periods of time without refuelling. It is proposed to use uranium enriched in uranium 235 as a fuel and to extract the heat with molten sodium metal as a coolant. The heat thus extracted will be used to liberate steam which will drive a turbine and turbo-generator. Beryllium is to be used as a moderator for the fission neutrons.

Fast Reactors

This type of reactor is usually of the "breeder" type and the proposed new power generator at Dounreay in Caithness will be the first to be developed in Britain. The primary fuel will be plutonium 239 or uranium 235, and this will be confined in a small central core round which a liquid metal coolant will be circulated. This primary fuel zone will be surrounded by a shell of the material to be transmuted, viz., natural uranium or thorium 232 and into which high-velocity fission neutrons will be projected from the core.

Type of reactor	Material used for "fuel"	Moderator	Uses
Slow	Any fissionable material, not necessarily pure.	Always used.	Experimental purposes and "breeder" work.
Intermediate	Usually "fuel" enriched in fissionable material.	Only sufficient to partially slow down the neutrons.	Small size power plants, i.e., for ships and submarines.
Fast	Primary "fuel" usually pure fissionable material.	None	"Breeder" purposes and power production.

Fig. 5.—Table summarising the types, characteristics and uses of nuclear reactors.

When the reactor is brought into operation the material from the shell will be removed from time to time so that the new fissionable material can be extracted therefrom and stored away.

Obviously, because of its compactness, inaccessibility of the primary fuel and the absence of moderators, this type of reactor is more unstable than the other types, for if the coolant should stop circulating the temperature would rise rapidly and the reaction might get out of hand. Presumably this is why the reactor is to be built on a remote site.

This slight hazard of reactor instability is more than offset by the improved efficiency of this type of reactor over the other two.

Some fast reactors use a liquid coolant which is circulated throughout the primary fuel, thus bringing about a better transfer of heat.

Supply and Design Problems

The development of atomic energy reactors has only been achieved after many technical problems have been overcome. New materials have had to be found which would withstand continuous bombardment by all types of nuclear radiations and particles. It will be recalled that in some types of reactors, particularly those which use natural uranium as fuel, it is necessary to slow the fission neutrons, and to do this effectively moderators are used in which the neutrons are slowed down without absorption. Very few materials are suitable and those that are have to be prepared in a high state of purity, for small amounts of other materials can absorb a high percentage of neutrons. Graphite, heavy water and beryllium are three of the most widely used moderators.

In most reactors the atomic fuel is "canned," i.e., placed in sealed containers which serve the double purpose of preventing contamination of the fuel or contamination of the cooling medium by the fission products from the fuel and also act as a moderator for the neutrons. Originally, aluminium in a high state of purity was used for these containers, but this meant that the operating temperature of the reactor could not be very high—usually 200 deg. C. was considered the maximum safe operating temperature. Clearly, this was much too low to enable the reactor to be used as an efficient "boiler" to power a turbo-generator.

Much work has gone into the search for suitable moderators and container materials which would allow reactor-operating temperatures in the 500 deg.-800 deg. C. region to be attained. Beryllium has been found suitable here, but it is a dangerous material to handle, being highly poisonous.

The most favoured metal for containers to-day is zirconium, for this is very stable towards bombardment by nuclear particles and can withstand high operating temperatures. But although zirconium is relatively simple to obtain from its ores, it is very

(*Continued on page 497*)

14 N.

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(*Continued from page* 494)
difficult to purify, being invariably associated with the element hafnium, which because it is a good absorber of neutrons and would, therefore, lower the efficiency of the reactor must be removed completely.

There is also the problem of efficient heat transfer from the reactor to the turbo-generator. Some reactors which have been built in America use water or heavy water as a coolant, this being circulated through the reactor and a heat exchanger, but these reactors were not really designed for power production. In another reactor of the fast type, called "Clementine," which used pure plutonium as fuel, mercury was employed as a coolant.

But for efficient power production it appears likely that molten metals will be used as coolants, so that temperatures of 500 deg. C. or more will be achieved. These liquid metals, particularly sodium and potassium, can be circulated round a closed circuit into a heat exchanger, using electromagnetic pumps which have no moving parts!

In addition to the careful selection of the materials which make up the reactor proper, the constructional materials have also to be carefully chosen, since the liberation of energy from the atom is invariably accompanied by harmful radiations from which the operator must be fully protected.

A basic factor in reactor design appears to be the heat exchanger, so that the coolant which is circulated through the reactor does not enter the turbo-generator. In this way the harmful radiations are kept away from the power generating equipment. Radiation shields adequate to safeguard the operators are usually made of concrete or lead, or both.

Another important factor is the method of controlling the reaction, for, unlike in atomic weapons, the reactions that occur in nuclear reactors must at all times be under control. Neutron-absorbing materials are, therefore, an integral part of reactor design and provision has to be made for their automatic insertion and withdrawal from the fissionable material. Cadmium and boron carbide are used for this purpose.

Finally, there is the by no means insignificant problem of the disposal of the waste components of the "burnt" fuel, which are strongly radio-active and harmful to health. Elaborate storage facilities have to be provided for these materials to allow the radio-activity to decay to such an extent that they can be safely disposed of.

Future Developments

The recent announcement indicates that the Atomic Energy Authority will process the naturally occurring materials and thus prepare the primary nuclear fuels. Industrial and civil users will be able to purchase these fuels from the Authority and sell back any secondary fuel that may be produced during the liberation of energy from the primary fuel.

It is hoped that within 10 years nuclear reactors will be paying their way and that British industry will be ready to exploit to the full these important developments. If we promote with vigour the development of nuclear power generators we may open up a new era of industrial expansion and prosperity, for fuel supplies are second only to food supplies in the well-being of a nation.

Points About Scissors

With Notes on Their Sharpening and Adjustment

THERE are many points about the construction of scissors which it is well to know if they are to be put to any special uses. A good pair of scissors will, of course, cut better than an inferior pair of the bazaar type.

One of the first things to look for is whether the cutting edge on each blade is properly "set"; that is, it should "stand up proud," as the cutler calls it. Not only should the two surfaces of the blades that cross each other in the act of cutting be hollowed slightly, as arises from the curvature of the grinding wheel on to which they had been pressed, but in addition the edge can be "set up" by a blow from the setter's hammer, correctly given to increase the rising up of the edge.

Hold an ordinary pair of scissors by one handle, vertically; open it by lifting the other handle, which you then release. The pair of scissors will shut of its own accord, but the point of the test is, how far does it shut? A cheap pair of scissors will practically close itself, for the simple reason that the binding of one blade upon the other is so slight and loose, that the scissors close almost to the tip. Try the test on a better made pair of scissors, and it will be found that the edges are in such contact, from the very start near the screw, that the scissors remain open. In other words the cutting action has no slackness, due to the nature of the workmanship.

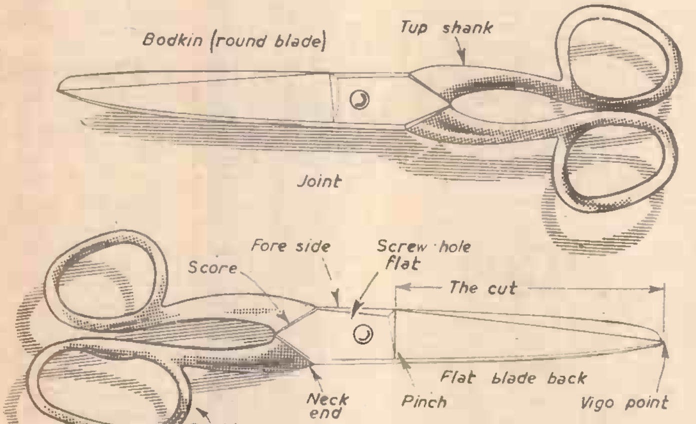


Fig. 1.—Two types of scissors.

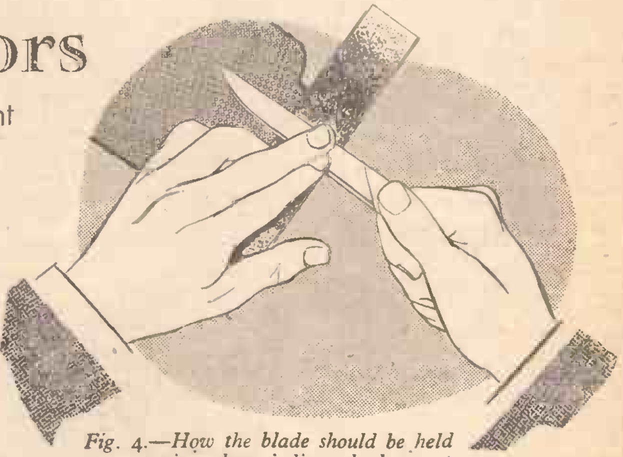


Fig. 4.—How the blade should be held against the grinding wheel.

Description of Parts

In Fig. 1 are shown two types of scissors; the Bodkin, distinguished by its round blade, and the Double Bow, used for heavier work, where a two-finger grip is needed.

The following is a description of the various parts, shown in Fig. 1.

Bodkin.—Type of scissors having one blade with rounded point.

Double Bow.—Large enough to allow two fingers instead of one. This is chiefly seen in tailor's scissors to give extra leverage.

Fore Side.—Edge of screw hole flat.

Neck End.—Where shank joins the blade.

Pinch.—The step down between the screw hole flat and the thin portion of the blade.

Score.—A line or nick scored on scissors sometimes with a file to give a little decoration.

Tup Shanks.—The parts growing out of the blade to join the bows, like the horns of a tup or ram.

Vigo Point.—Straight or strong point. Probably from Latin: *Vigor*—strong. Chiefly used on tailors' and heavy scissors.

The blades should be slightly hollowed and curved towards each other, so that when nearly half open they appear in side view as in Fig. 2. The pivot at the base of the blade should hold them together closely. Fig. 3 shows an enlarged section of a blade that has become worn in this way, the dotted line A indicating the original section.

To sharpen, therefore, the curved faces of the blades must be ground until the cutting edge is restored to its original condition. This is best done with an emery wheel (or carborundum), and must be done with a clean run

Fig. 2 (Top).—Side view of correctly adjusted scissors.
Fig. 3.—An enlarged section of a worn blade.

from end to end of the blade. (See dotted line B, Fig. 3.)

Separate the blades by removing the pivot and treat each one similarly. Fig. 4 shows how the blade should be held in the right hand and pressed against the wheel.

Unless the scissors have been badly treated so as to become notched on the arris, Fig. 3, there is no need to grind that edge.

When ground to your satisfaction, connect the blades again, screwing home the pivot till they meet on their cutting edges and work together smoothly and with some pressure.

The hollow grinding of the blades must be done by keeping them moving over the wheel with a steady movement from end to end.

LETTERS TO THE EDITOR

The Editor does not necessarily agree with the views of his correspondents.

Modern Housing—New Ideas Wanted

SIR,—On viewing our contemporary housing programme it is my view that our building industry is being asphyxiated by a mixture of by-laws, economics and unimaginative architects. Although an architect can produce eye-pleasing and carefully designed houses with orthodox materials, he can do so only when the potential owner's liking matters more than the several hundred pounds extra required to produce a work of art as well as comfortable living conditions. The outside of the new terraced type of council house, in my opinion, with over 20 years weathering will take on the drab look of slums to be. Even if the interiors are far from such, the traditional brick and mortar walls are almost uncleanable.

To encourage attractive economical building, local authorities should allow the architect more freedom in his choice of materials, and research into modern, attractive and less costly materials should be encouraged. The tradesman should be trained in the use of these new materials and also new methods of construction.

Among the problems and ideas giving food for thought I suggest:

1. A light, flat or slightly pitched roof requiring less support, consisting of large light asbestos interlocking tiles (coloured) or suitable spray over "Celatex" board; a spray such as is used as underseal for cars.

2. A steel or reinforced concrete frame necessitating only the thinnest of walls, damp and heat resisting, instead of the usual 11in brick cavity wall.

3. One chimney, with gas or electric cooking, the heating and hot water being from steam or hot-water mains to radiators and a calorifier, from a high-efficiency boiler supplying an estate, with a heating and hot-water rate.—C. D. NORMAN (Cranbrook).

Rewinding Armatures

SIR,—Re your article "Small Wind Power Plants, 2—Rewinding the Dynamo Armature," in the June issue. Having had some experience in the winding of small armatures I feel that I can offer some useful suggestions.

In the first place I would not advise anyone to hammer the end windings, or to use undue force of any kind on the winding, as shorts are very easily caused by these methods.

Secondly, I should prefer winding the armature by using three similar coils at each stage instead of the two diametrically opposite which the writer recommends. By this method the end windings need only accommodate the thickness of seven coils, whereas the writer would need to fit in 15. My first coil would span slots 1-8, the second 11-18 and the third 21-28. It will be seen that none of these coils overlap and can be identical coils. The second series would span slots 2-9, 12-19 and 22-29, each coil overlapping one of the earlier coils. Again each coil can be identical with the other two of the series. It might be thought that this method is rather tricky, but the difficulty is more apparent than real, for each coil begins in the third slot from where its predecessor ends.

The winding of a heavy gauge wire, such as 18 s.w.g. and even 20 s.w.g., can present some difficulty, for the wire will not lie flat in the slots, but assumes a barrel shape, and as the coil which will fill the slot barrels in the opposite direction, the best use of the slot is not possible. This difficulty can be overcome if the coils are first prepared on a wooden former, which can be dismantled to remove the coil. The barrel shape which the coil will then possess can be removed by suitable pressure of the fingers on each turn of the coil. Unfortunately, a former of somewhat larger size is needed for each series of coils but, in my view, the trouble is well worth while. In making such formers, allowance should be made for the bend of the wire by making the former rather longer than the armature core and giving the corners a slight curve of about $\frac{1}{8}$in. radius. The width of the former should be such as to allow the coil to span from the base of one slot to the outer opening of the slot at the limit of its span. If the end winding is given a slight inward curve before the coil is placed in the slot, then the coil will have sufficient spring to pass into the slots and lie properly in its place. The depth or thickness of the former should be half the depth of the slot actually occupied by armature windings.

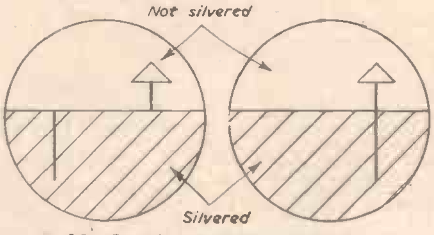
In conclusion, I heartily commend the use of tape on the end windings, though my preference is for a piece of empire cloth interposed, particularly when the end space is limited, as ordinary insulating tape appreciably increases the bulk.—GEORGE E. BRIDDON (S.W.3).

A Pocket Rangefinder

SIR,—On reading your article in PRACTICAL MECHANICS, June, 1954, on making a pocket rangefinder I would like to suggest an improvement.

The semi-transparent glass could be replaced by half mirror, half glass. This will make the instrument a split field, instead of a coincidence rangefinder.

Instead of having two images to coincide there would be one image split in two as follows:



Mr. Owen's split field rangefinder.

This arrangement would give a brighter view.—E. J. OWEN (Fleetwood).

Flying Saucers

SIR,—As I was referred to in Mr. P. F. Sharp's letter in your June issue on the subject of George Adamski's photographs of flying saucers, might I be allowed to add a few comments?

Many people who have disputed the authenticity of these photographs and those who have suggested that they are lampshades, humming tops, etc., have completely overlooked the fact that Mr. Adamski has claimed that the object was approximately 35 ft. across. In this context photographic experts have decided that whatever else it is, it is not a model and that the play of light and shade prove that the thing photographed is of the dimension claimed. All domestic utensils are therefore ruled out.

If Mr. Adamski has perpetrated a hoax, the sceptic will be obliged to admit that he has constructed a large object, has managed to get it into the air, and has then photographed it.

An undertaking of this nature would, I hold, involve a conspiracy and as I was able to rule out this possibility, I decided to publish the book. Subsequent events have gone far to confirm my judgment. During the last year, reports from Norwich, Coniston and, more recently, Bruton, Somerset, have told of objects seen in the air similar or identical to Adamski's photographs. Do the sceptics now claim that there is a world-wide conspiracy afoot? If so, let them produce *their* evidence.—WAVENEY GIRVAN, Editor-in-Chief, J. Werner Laurie, Ltd., Publishers.

Brake Stop Lamp

SIR,—In your April issue, there is a query about an indicator light for a Brake Stop Lamp.

I think a very simple solution to the problem would be to use a 1.5 volt flash lamp bulb for the indicator, and a standard 18 watt stop lamp of six or twelve volts, depending on the voltage of the car system. The indicator being shunted by a small resistance to carry the excess current required for the much larger stop lamp.

A suitable resistance value would be half an ohm for a six volt system, or one ohm for twelve. The resistance must, of course, be capable of carrying 3 amps, or $1\frac{1}{2}$ amps as the case may be, without becoming dangerously hot.

As the resistance is in series with the stop lamp, there will be a small loss of brilliance in the latter, but as a lamp under-run gives a higher proportion of red light, this will probably be quite unnoticeable through the red glass.—REV. C. J. P. COOPER (Haddington).

3-D Shadowgraphs

SIR,—Regarding the query in the June "Information Sought" column, as to how Harry Lester's Comedians Show is put on, I have not seen this turn and can only guess from the description how it is done.

The turn consists of shadows thrown on to a translucent screen by red and green lights from behind, viewed through red and green spectacles by the audience. This must be a variation of the anaglyph method of producing stereograms that has been well to the fore recently. Using shadows cast by living bodies it should be very effective, and the effect of shadows jumping out of the screen, very mysterious. The idea, in my opinion, is a credit to its originator.

It is easy to suggest a means by which a result could be obtained, but probably a good deal of experiment would be required to get really good results. The essential apparatus would seem to be a translucent screen, two lanterns giving a point-source light with red and green filters, and, of course, the actors and the audience with their coloured spectacles.

The lanterns would probably be ordinary transparent projectors to give an intense focused light. The filters would be one green, the other red, these two colours being complementary. The lanterns should be about 10ft. or 20ft. behind the screen and about 6in. apart sideways; they should be at the same level. The shadows will overlap on the screen, and this overlap should not be more than 1/25th part of the distance of the nearest member of the audience. Such an arrangement should give some result, and experiment with the distance apart of the lamps and their distance from the screen, and the position of the distance behind the screen of the actors and

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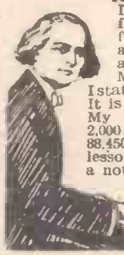

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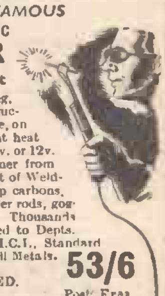

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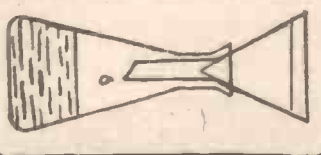

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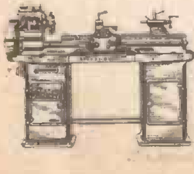

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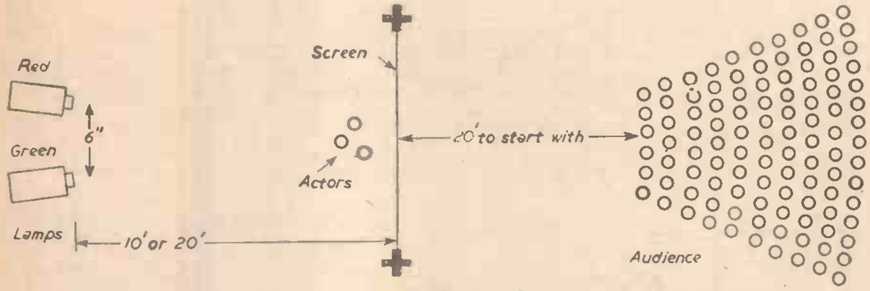
their varying range should lead to something near perfection.

The closer together the lamps, the closer the actors to the screen, and the more distant the audience from the screen, the more easy it should be to get results.

The red and green filters for the spectacles and the lamps may be the same material. If commercial samples are available, a piece of each colour put together, one on top of the other, should appear almost opaque. The colours are not restricted to red and green; any two complementary colours could be used, such as orange and blue. For home make, dyed gelatine on glass could be tried. As an alternative to colours, polarising filters could be used, but would be expensive and possibly less effective as a mystery show.

To a practical stereoscopist, Harry Lester's turn sounds very attractive.—STEPHEN MOXLY (Hants).

SIR,—I note that in the June issue of PRACTICAL MECHANICS, in the "Information Sought" column, a reader asks for details of the "3-D" shadowgraph show which Harry Lester includes in his show.



Mr. Moxly's theory of how Harry Lester's Comedians Show works.

I have arranged several such shows for local concerts and would offer the following advice.

Two lamps are required, and to obtain sharp shadows these should be 36 watt or 48 watt 12-volt car headlamp bulbs, preferably of the type having a Vee form filament, thus giving a small size high-intensity light source.

The lamps can be operated from a transformer or car battery and should be fitted in batten type holders with *no reflectors*, preferably fixed at approximately 6in. apart in a box with a dull or matt dark interior, arranged so that the light from the lamps can fall on the screen only.

A wooden box approximately 12in. × 9in. × 9in. deep with, of course, no lid, and standing on one of the long sides on the floor of the stage, is best.

The open top (now the side) of the box is covered over one-half with green Cinemoid and over the remaining half with red Cinemoid, which is the filter material used for coloured lighting effects in cinemas. A small offcut of each colour could, no doubt, be obtained from the local cinema.

Any object which is now held between the lamps and the screen will cast one green and one red shadow, and by moving the object slowly from the screen towards the lamps, the two shadows are made to move farther apart, thus giving the illusion to the audience of three-dimensional movement.

The small plastic "space ships" sold in the sixpenny stores can be suspended by thread from a short cane and will make very realistic diving attacks. Table tennis balls thrown at the lamps will also produce shrieks.

The coloured spectacles are obtainable approximately one penny each from W. Walker and Sons, Ltd., 3, Woodstock Street, London, W.1.

The screen should, of course, be of the translucent cotton or linen sheet type.

The position (left or right side) of the green or red Cinemoid is determined by trial in accordance with the instructions printed on the spectacles.—A. M. PEARSON (Yeovil).

Trade Notes

Bondaglass

GLASS fibre is a comparatively new material, which is already being used in industry as a replacement for steel and aluminium. Car bodies, yacht hulls, dinghies, safety helmets, fishing rods and many other products where lightness and strength are necessary, are some of the items for which this material is being used. Now Bondaglass, distributed by Messrs. P. Smith (Croydon), 40a, Parsons Mead, Croydon, brings this material into the hands of the home craftsman.

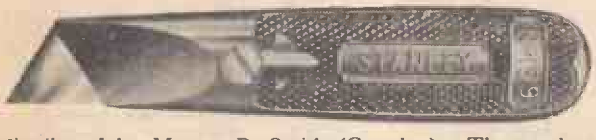
Bondaglass is a cloth, woven from spun glass fibres, which is laid to the shape required and then soaked in a special synthetic resin plastic. This is prepared just before use and quickly sets rock hard, binding the glass fibres together to form a reinforced plastic moulding of great strength and lightness. Where extra strength is required, several layers of glass cloth can be laminated, and once the resin has set it can be sawn, drilled, tapped, filed, sanded and polished. Metal components can be moulded right into the material, which, weight for weight, is stronger than aluminium or even mild steel. It is an electrical insulator, is distortion-free, heat resistant, and also resists acids, oils and many chemicals.

Model makers will find that it makes tough and endurable boat hulls, car bodies and aircraft fusilages, and the aircraft modeller will find it useful for wheel spats, engine cowlings, exhaust stubs, etc.

In the garage, for repair purposes, it is ideal for mending leaky roofs, rusted bodywork, cracked mudguards, radiator hoses, etc., and in the home the list of uses is practically endless, ranging from the repair of children's toys to burst pipes, from broken china to split cycle mudguards.

The Stanley No. 199 Trimming Knife

STANLEY WORKS (GREAT BRITAIN), LTD., announce that the No. 199 Trimming Knife—the handy knife with 101 uses in the home, office, factory and garden — has changed its coat, and now, in addition to the standard metallic grey enamel finish, it is being offered with blue, green, red and buff enamel finishes. These coloured knives are packed in individual transparent envelopes, while the standard knives are packed in individual cartons printed blue and orange on silver-covered board.



New Shell Easing Oil for Rusted Fittings

SHELL-MEX AND B.P., LTD., are launching a new easing oil, designed to free rusted fittings.

Shell Easing Oil is a high quality graphited product containing special ingredients giving it highly penetrating characteristics.

It is designed to free quickly, rusted fittings such as nuts and bolts, door and gate hinges, window catches, taps and pipe joints, rusted-in screws and springs, etc.

Shell Easing Oil is not a general purpose household oil. The graphite it contains makes it black. It should be used with care and not for purposes where it may stain or damage. Users are advised to shake the tin thoroughly and apply the oil liberally to the rusted part. After a short while the part will free easily. In difficult cases it may be necessary to apply the oil a second time.

Shell Easing Oil will be marketed in handy 8oz. tins, with a special pourer spout, at 2s. 6d. a tin, and will be obtainable only from ironmongers and other retailers normally handling this type of product

Attachments for an Electric Drill

(*Continued from page 475*)

Drilling Fixture

The makers of the saw set also sell a drill stand base which can be assembled with the bench clamp and pillar (both of which form components of the saw set) to form a neat and efficient vertical drilling machine. The reader may be interested, however, in the design of a home-made vertical driller which, although not nearly as neat in appearance as the Wolf Cub set, being made in wood, has given complete satisfaction over many years. Certain advantages in this design will be recognised, among them being its capacity to accept wider work. The Wolf Cub bench clamp will fit the slide of this machine, which is now being used with this make of electric drill.

Fig. 7 shows the leading particulars of this set-up. The base, back board and slide were made out of mahogany, as also were the two dovetailed guide strips. The slide edges were shod with sheet brass facings screwed on and the guides with steel strips also screwed on. The holes in the guides for the screws attaching them to the back board were slotted slightly to allow the guides to be tapped sideways when the screws were backed off a little, to achieve and maintain a nice running fit without backlash. The stroke of the slide is 4in.

The adjustable angle-plate on the back board can be set to stop the descent of the slide at any specified depth, such as when preparing a mortise by drilling a series of holes to the depth of the tongue.

B. Elliott & Co's Brazing Attachment

The June issue carried an advertisement for Messrs. B. Elliott & Co. Ltd., inadvertently captioned "Sanding Machine"; this should have read "Brazing Attachment."

Your Queries Answered

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

Making a Black Mirror

PLEASE give me a formula for making transparent mirrors that can be seen through when illuminated by an electric lamp enclosed in a box. Also, a transparent medium for spraying on the back of same.—G. Noble (Cirencester).

WE presume you are referring to what is known as a black mirror. Make up the following solutions:

Solution A.—Dissolve 10 gms. of thiourea in 1 litre water.

Solution B.—Dissolve 40 gms. lead acetate trihydrate in 1 litre of water.

Solution C.—Dissolve 20.2 gms. of sodium hydroxide in 1 litre of water.

First clean the glass surface upon which mirror is to be produced with caustic soda, then with soap and water and, finally, water. Protect one surface with Scotch tape or the like. Then immerse the glass plate in a mixture of 100 c.c. of solution A; 25 c.c. of solution B; and 50 c.c. of solution C (larger quantities if needed). Heat the mixture to 40-41 deg. C. and maintain at this temperature for a period of 15 minutes, when a black mirror will have been produced.

Any clear cellulose varnish can be used for spraying back of mirror.

Curing Creaking Stairs

I LIVE in a modern house where the stairs squeak abominably; it is quite impossible to ascend them silently.

Can you tell me the reason for this, and an effective method of curing it? The underside of the staircase is the pantry and is plastered.—D. Hurst (Cardiff).

EACH stair has two parts, the horizontal tread and the riser, which is upright. The ends of these fit into grooves in the sides of the staircase and are secured by glue and wedges. The treads and risers are held together by nails or screws and also by small triangular blocks glued to the inside angle of each stair. These are usually the places from which squeaks emanate.

If you examine these you will probably find that the nails are pulling out as the weight of the body presses on the tread. Replace these with screws. The glued blocks also may be loose. These want scraping free from old glue and gluing up again afresh. Attention to these points will cure your trouble, but it would seem that you would have to strip off the plaster under the staircase.

Electrically-fired Flash Powder

I HAVE been taking flash photographs, using the "open flash" method and igniting the powder with touch paper. Although some good results have been obtained no control over the flash can be made once the touch paper is ignited.

I am wondering whether you can suggest a means of igniting the flash powder by an electrical method, either by using a dry battery or mains current (230 A.C.). I had in mind something in the nature of an Ever Ready gas igniter, but I doubt if the filament would last more than once if the flash powder were heaped over it and ignited.—F. Mummery (Grays, Essex).

ELECTRICAL firing of ordinary flash powder is possible by using a thin wire "filament" and a source of current sufficiently powerful to fuse it. A transformer could be used with A.C. mains. Direct operation from the mains would be possible, of course, but the usual care would be necessary to make the unit safe.

For battery use it will be found that an accumulator is best, but fairly large celled dry batteries in good condition can be employed.

For the filament, a short length of 42 s.w.g. copper or tinned copper wire between two stout wires of terminals can be used, if 2 to 3 amps are available. The D.C. resistance of leads should be kept as low as possible, or an increase in the voltage applied will be required. The 42 s.w.g. wire requires to be renewed each time, but this is little difficulty if suitable terminals or clips are provided.

A push type switch is suggested for firing. The powder is heaped over the filament, and should ignite with no delay.

Infra-red Photography

PLEASE could you explain how photos are taken by infra-red rays? I saw some such photos taken inside a cinema of the expressions on children's faces during a thriller.—S. H. Doe (Stowmarket).

Readers are asked to note that we have discontinued our electrical query service. Replies that appear in these pages from time to time are old ones and are published as being of general interest. Will readers requiring information on other subjects please be as brief as possible with their enquiries.

THE photographs of cinema audiences to which you refer, which are taken in apparent darkness, are produced by flooding the interior with infra-red rays, which latter are not visible to the human eye, but which are able to affect certain types of plates and films. The photograph is taken by an ordinary camera using an infra-red sensitive plate or film and the photograph is then developed up in the usual manner. The interior is "lighted" with infra-red rays merely by the aid of a number of lanterns carrying electric lamps whose rays are deprived of all visible light by being filtered through screens which permit only infra-red rays to pass through, but which withhold all visible light rays. Because of this the interior still appears dark to our eyes, although it may actually be well "illuminated" by the invisible infra-red rays.

Blackening Aluminium

CAN you please advise me how to blacken aluminium castings, as I am building an enlarger and wish to get a good black matt finish, preferably by a chemical process?—Wm. Bradley (Stockport).

TO obtain a black coloration on aluminium the clean and grease-free metal should be immersed in the following bath for 30 minutes at a temperature of 175 deg. F.:—

Potassium permanganate ...	1½oz.
Nitric acid	1/3oz.
Copper nitrate	4oz.
Water	1 gallon

After blackening, rinse the components, dry them and then protect the surface with a clear lacquer.

Another method of blackening aluminium is to immerse it for 15 minutes in a solution made by dissolving copper carbonate in ammonia.

One of the best blackening processes for aluminium is the electrolytic one of "black nickel plating." For this the following bath is required:—

Nickel ammonium sulphate ...	8oz.
Zinc sulphate	1oz.

(Continued on page 504)

Sodium thiocyanate (sodium sulphocyanide)	2oz.
Water	1 gallon

This solution must be kept nearly neutral by additions of zinc carbonate. A nickel anode is required, the work itself constituting the cathode. The bath is operated at an e.m.f. of 1 volt at 1-2 amps per sq. ft. of metal surface undergoing treatment.

A good proprietary paint deserving your attention is Johnson's Dead Black paint for instrument use.

Calculating Lens f Number

I HAVE bought an ex-Government lens for an enlarger I have made. It is 1½in. diameter and 3½in. focal length. It works very well, but can you tell me of any method of finding the f value of the lens ?—R. A. Hall (Leics).

THE f value of a lens is the ratio of aperture to focal length ; thus, if the full aperture of the lens in question is 1.5in. and focus is 3.5in., the f value will be : $\frac{3.5}{1.5}$=f2.33.

The formula is $\frac{F}{A}$ = f, where F is the focus, A the aperture, and f the stop value or f number.

Thus $\frac{F}{A}=\frac{3.5}{1in.}$=f3.5

$\frac{F}{A}=\frac{3.5}{\cdot77in.}$=f4.5 or $\frac{3.5}{\cdot75\ (\frac{3}{4}in.)}$=f4.66

$\frac{F}{A}=\frac{3.5}{\cdot625(\frac{5}{8}in.)}$=f5.6

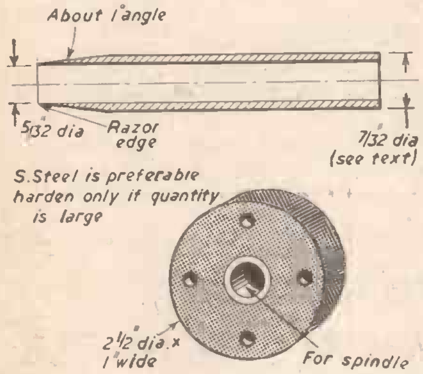
$\frac{F}{A}=\frac{3.5}{\cdot55in.}$=f6.3 or $\frac{3.5}{\cdot5\ (\frac{1}{2}in.)}$=f7

$\frac{F}{A}=\frac{3.5}{\cdot4375(\frac{7}{16}in.)}$=f8

The f numbers are the actual diameters of the apertures in the stops used to sharpen the definition of the lens.

Drilling Holes in Rubber

I WOULD like to cut holes of about 3/16in. diameter in rubber rollers 1in. wide. I think the rollers are made of synthetic rubber. Can this be done with an ordinary twist drill or is there a tool I can buy for the purpose ?—M. H. Benning (Wales).



At the top is shown the suggested tool and underneath is the reader's sketch of his requirements.

THE simple tool we have illustrated in the sketch enclosed will, we believe, drill these rubber discs, though you will appreciate a little experimentation is necessary.

For instance, the outside diameter is given as 7/32in., but this figure is only approximate, and you may try ¼in. on a scrap piece of rubber, grinding this dimension until you arrive at the exact size. The material tends to close in after the drill has passed through.

Another difficulty we can foresee is the removal of the slugs from inside the drill, but unless you have large quantities to machine, pushing a small piece of steel rod through the hollow centre after each hole is finished is the obvious solution.

Finally, some care is essential when starting the drill otherwise you may experience difficulty in commencing the cut on the appropriate spot. A jig is the answer if the number justifies making one.

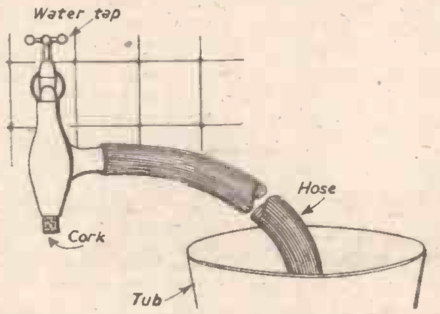
This reply appears to place all manner of difficulties in your way, but these are not really serious—the drill will carry out the operation successfully once you have determined the above-mentioned figure. Use a little water and ensure the cutting " edge " is sharp—almost a razor edge is what we have in mind. You cannot machine rubber with a twist drill, nor can you cut it as " swarf " ; our method removes a series of slugs and we believe you can achieve a perfectly smooth hole once the sizes and angle are perfected.

A Water Ejector

I HAVE seen in a shop an article for emptying a bath, washtub, etc. Also for filling same if required.

It is a T-shaped tube, with a length of hose from the centre tube leading to tub, etc., to be emptied, the down piece attached to water tap.

When water is turned on it empties tub. Could you tell me how to make one ? Below is drawing of same.—A. Hastings (Leicester).



THE T-shaped arrangement to which you refer is an ejector. It is attached to a water tap and when the cork at the bottom is taken out and a hose attached to the side branch, it will raise water through the hose through an injector action ; that is to say, there is a jet in the interior which, being below the hose branch, creates, by the rush of water through the jet and the tap, a vacuum sufficient to lift water through the hose. Obviously it is wasteful of water whilst in action. If now you plug the bottom opening with the cork and again turn on the tap all the water will now pass down through the hose in the reverse direction. We doubt if you could make one of these cheaper than you could buy one.

An Ice-box

I WISH to construct an appliance that will enable me to keep food fresh for short periods.

The food will be mainly fresh fish, which I should like to be able to keep with confidence for two to three days. I believe there are " ice-boxes " in use which involve the use of " freezing salts " and ice ; can you make any suggestions on the subject, or advance any economical alternative ?—M. Hollywell (Lancs.).

THE principle of the ice-box is very simple. It consists of a wooden cabinet, metal lined, in which there is an inner metal compartment surrounded with chopped ice, suitable drainage being provided for the slowly melting ice. The material to be cooled is placed in the inner box or compartment and, provided that you are able to get adequate supplies of ice, the cooling which is thus effected is usually very satisfactory, although, of course, by no means as intense as that obtained in a mechanical refrigerator. You could make an ice-box of this type for yourself very easily. The metal used in the box is usually zinc sheet or heavily galvanised sheet steel.

Freezing salts are expensive in use and there is no need for them in connection with an ice-box. These salts are of varying compositions, being mostly mixtures of common salt and calcium chloride.

Another very simple cooling device works on the evaporation principle. A close-mesh wire frame of adequate proportions has placed over it two or three folds of an open-textured fabric such as muslin or ordinary cotton cloth. A corner of the cloth is allowed to dip into a vessel of water. The folds of cloth are well wetted with water and, if possible, the whole assembly is placed in a strong draught. Now, the water will evaporate from the cloth. In evaporating, it must obtain energy to change its state from that of liquid water to that of water vapour. It obtains its energy from the heat of its surroundings. Hence, its surroundings lose heat and the quicker the water evaporates the more heat its surroundings must give up. Any material placed within the frame under the fabric folds will be cooled in proportion to the speed of the water's evaporation. Of course, under practical conditions, the temperature-lowering derived from the use of an evaporation-cooler is not very great—say, 6 or 7 deg.F. Such cooling, however, is often sufficient to keep foodstuffs fresh on a hot summer's day. The advantages of this cooling device are that it can be worked at zero cost, and it is quite possible that it may suit your particular purpose quite adequately.

Information Sought

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

Mr. G. Louden, of Midlothian, writes : I have just started a Youth Club and would like to build a table tennis table for these young people. Can you help me in this matter by telling me where I could obtain details of the table construction ?

N. H. Beall, of Newark, wishes to construct some musical notes as used on small ice cream vans when selling in the streets, etc., and asks : Could you suggest a suitable set-up ?

They would, in my case, have to be driven from the 12-volt battery.

Mr. S. Webber writes : I wish to make an electric fence unit, which runs from the mains (250 volt). Can you please give me constructional details ?

We quote from a letter from Mr. M. Bryant, of Birmingham : I am interested in making an ultrasonic drill, and should be grateful if you could furnish particulars and if possible a diagram.

Mr. A. Cooke, of Yate, writes : I wish to construct a water softener :

(a) Coupled direct into the mains—i.e., operating at mains pressure—for domestic use.

(b) Fitted with two softener cylinders—one in operation while the other is being rejuvenated.

(c) To cope with 150 gal. of water per week.

Can you help me ?

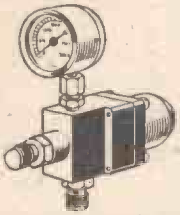
Would the softened water be suitable for drinking and making tea ?

All items carriage paid and Money back guarantee.

TWIST DRILL SET

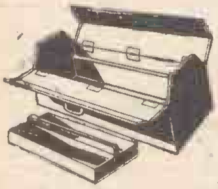
9 drills 1/16in. to ¼in. complete with plastic case and stand. Brand new. **4/6**

HIGH PRESSURE REDUCING VALVE



Complete with 0-3,000 lb. per sq. in. pressure gauge. Suitable for Compressors, Cylinders of Gas, etc.

Brand new and boxed **12/6**



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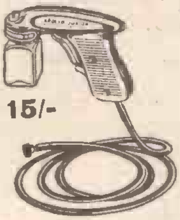

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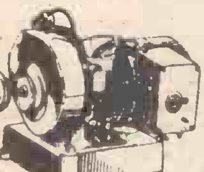

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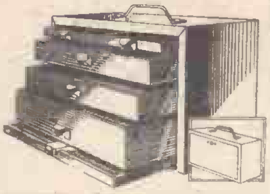

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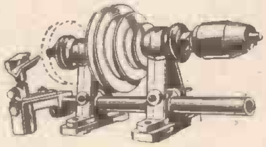

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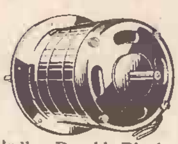

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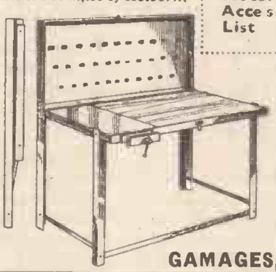

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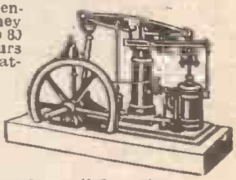

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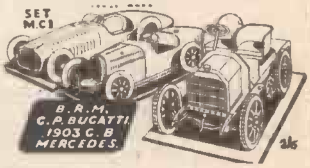

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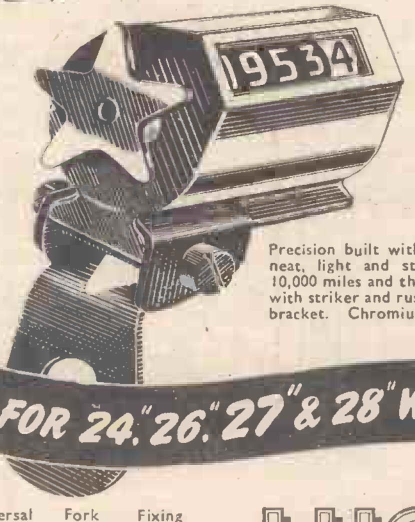

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THE Cyclist
Editor : F. J. CAMM
VOL. XXII AUGUST, 1954 No. 387

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COMMENTS OF THE MONTH

By F. J. C.

Motorised Bicycles

IN "Road Research, 1953," published for the Department of Scientific and Industrial Research by H.M.S.O., it is stated that road accidents are increasing as the number of vehicles grows. The Road Research Board fears that this trend will continue until active and sometimes drastic steps are taken to ensure that existing knowledge is applied and fullest use made of research.

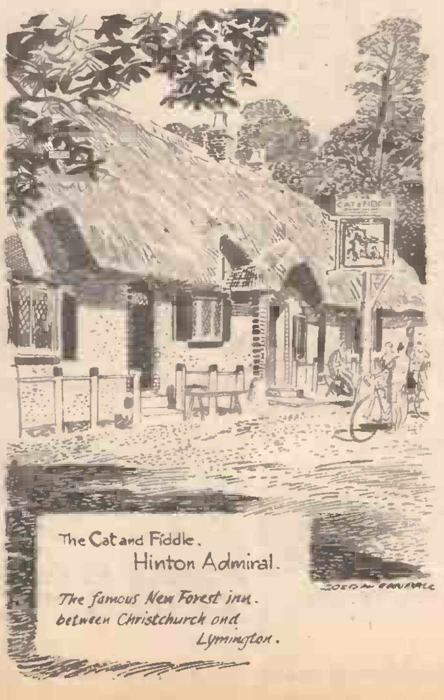
The book includes some new facts about the danger of some types of motor-assisted bicycles. In wet weather, those with rim type brakes take from two to four times as great a distance to stop as does a car, and this long stopping distance introduces risks for the riders. It was also found that lamps supplied or recommended are unsuitable for machines moving at 20 miles per hour. Some of the controls of motor-assisted bicycles can be improved and in some cases the starting of the engine requires efforts which are highly undesirable for elderly people. Over a quarter of the riders of these cycles who were killed or injured were over 50 years of age.

A feature of the road accident figures for April, and which is becoming increasingly noticeable, is the number of casualties to riders of motor-assisted bicycles. In April these casualties numbered 208, which, although small in relation to other casualties, is 40 more than in April, 1953. From this it would seem that the motor-assisted bicycle needs to be redesigned, and that the standard bicycle frame is unequal to the stresses of even these tiny power units, which are mostly much under a half horse-power. There is no evidence, however, that the accidents have been due to any structural failure, and although attention is drawn to the greater stopping distance required, no evidence is given as to whether the accidents were largely due to this, nor to the inadequacy of the lighting. It is not a difficult problem to improve the braking efficiency. Rim brakes, in our view, are unsatisfactory for power-driven vehicles because of their tendency to slip in wet weather. This points to the need for hub brakes, and therefore stronger spokes. This is a problem for frame designers, however, because if brakes are made too efficient, skidding will occur on wet roads when they are applied. Perhaps some entirely new braking system needs to be designed, applying less braking force to the front wheel than to the back. The tractive resistance of a bicycle is very low. The contact area of the tyre with the road is small and this must be the basis of brake efficiency, since the vehicle must be brought to a standstill without locking the wheel, and with a small tyre contact area braking efficiency must be less than with heavier vehicles.

These problems have always been encountered in the manufacture of motor-assisted bicycles. That is why so many manufacturers prefer to market a really lightweight motor-cycle properly so described; because if stronger forks, frames and wheels are incorporated in an ordinary bicycle the weight increases to a point where the machine ceases to be a motor-assisted bicycle. Indeed, the very earliest motor-cycles were nothing more than strengthened bicycles with an engine clamped on to the frame. The original Werner, one of the first motor-cycles, had its engine over the front wheel of an ordinary bicycle with reinforced front forks. Manufacturers soon found, however, that such machines quickly collapsed. That may have been because the engines fitted (usually about 2½ h.p.) were too powerful. We have not heard of one case of frame failure with the new midget units. It is obvious that if the accident statistics continue to rise and indicate the weaknesses of these tractable little machines, the Minister of Transport will make regulations controlling their construction.

The lighting difficulty is one not easily overcome. A dynamo, generating sufficient current to provide motor-cycle lighting, would absorb more power than these tiny engines can generate. Recourse must then be had to batteries, either wet or dry. Wet cells are weighty and the rider can never be certain as to the number of ampere-hours still available. There is also the difficulty of recharging. Dry batteries to provide adequate lighting would be too bulky and certainly too costly. Possibly a return to acetylene lighting offers a solution.

The report says that there are differences in the manœuvrability of different types of motor-assisted cycle, and experiments are in progress to obtain numerical assessments of manœuvrability. One type of machine with the engine attached to the handlebar stem is much worse in this respect than other types; it has a relatively heavy flywheel which rotates in a direction which tends to produce instability. As the direction of rotation of this engine could not be changed it was replaced by an electric motor of the same weight to drive the flywheel; a considerable improvement in stability of the machine was obtained with the flywheel rotating in a direction opposite to that arranged by the makers of the engine.



The Cat and Fiddle. Hinton Admiral.
The famous New Forest inn. between Christchurch and Lymington.

Tests were also made with a number of cycle lamps of the dynamo type supplied or recommended for use with motor-assisted cycles. The machines were ridden on a dark night along a track on which objects had been placed, and the riders expressed their opinions on the effectiveness or otherwise of the different lamps. These trials were supplemented by measurements of the beam distribution of the lamps. The results clearly indicated not only the enormous differences in beam distribution between different lamps but also the unsuitability of the beam patterns for use on machines capable of 20 m.p.h. or more.

Skidding

DESPITE the general improvement in the surfaces of main roads the number of accidents in which skidding is reported remains high. The higher speeds of modern traffic demand road surfaces of even greater resistance to skidding, particularly on turns. Wet roads in summer, surprisingly enough, produce more accidents involving skidding than wet roads in winter, the proportion rising from about 6 to 16.

In the previous report it was stated that, in winter, casualties were generally fewer in dry than in wet months, whereas in summer they tend to be more frequent in dry months. A more detailed study of the effect of weather in winter has now been made, using daily personal-injury accident figures for weekdays during the winters of 1950-51 and 1951-52. This has confirmed that the number of accidents increases with increasing wetness, and shows that on the whole the same is true of icy road conditions. An exception to this is that on days with exceptionally bad weather conditions, with many wet and icy roads, the number of accidents tends to be very low, sometimes not much more than half of the usual figure. Similar variations occur in casualties to pedestrians, pedal-cyclists, motor-cyclists and other road users. For motor-cyclists, the reduction in very severe weather is especially marked.

Road wetness is a condition which appears to cause pedestrian casualties to increase, particularly at night; it was estimated that in some months of the year adult pedestrian casualties at night increased in frequency by about 130 per cent. when the roads were wet compared with when they were dry. This is no doubt due partly to the fact that rain impairs visibility.

Wayside Thoughts

By F. J. URRY, M.B.E.

The Right Way

I HAVE received a most enthusiastic letter from a Wallsall reader on the subject of cycling. He says, and truly, that desire is half way to cycling enthusiasm, the desire to be out and about, to see and hear and smell, and once that desire is impregnated all the rest follows in order, capability of riding and joy in the exercise. " I could not do without my bicycle, it is at one and the same time a tool and a plaything," he says. How true. These are not the words of a youthful convert, but a man of mature stature, with many years' road experience, who has enjoyed numerous touring holidays and dozens of week-end trips. On the utilitarian side, he says, it saves him money, time and inconvenience, keeps him fit, and scorns the suggestion that cycling is hard work. Indeed, he is rather intolerant of the folk who decry the pastime and resents the attitude of the younger folk who can only think of transport in the form of car travel.

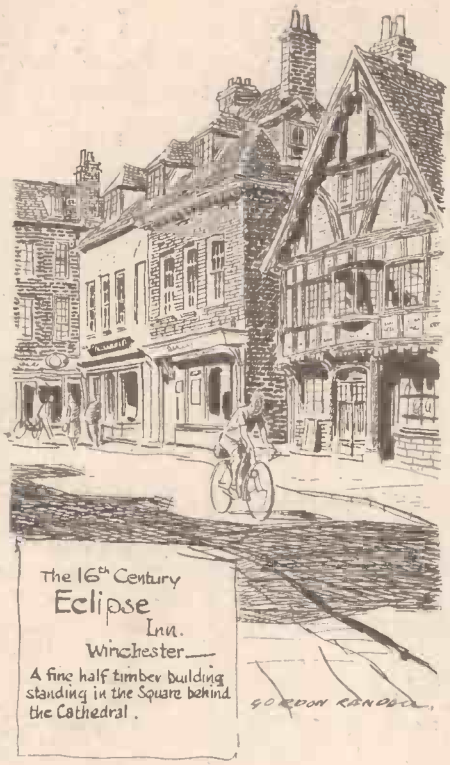
Each to his own notions on this subject; but how refreshing it is to get a letter full to the brim of wheeling praise. It makes a hard-boiled old pedaller like me remember his younger days and how he thought the flair of cycling would carry him into old age and be one of the great compensations on its arrival. It has; and I shall never be sufficiently grateful for the gift. It is not easy to express that gratitude in moderate words, and if you endeavour to ascend to hyperbole, then, to you, it is like trying to gild the lily. To the reader it is possibly like an attempt to over-compliment a common thing that rolls along wherever roads and tracks run.

That Little Leak

THAT slow leak in an inner tube is a nuisance, yet thousands of people just put up with it and use an inflator as a kind of daily exercise, rather than take the trouble to institute a cure. As often as not such an annoying leak is due to a perished valve sleeve, often at the base of the stem where the rubber makes the joint of the valve lock-ring, and is liable, after considerable service, to wear thin. It is always the first test I give a slightly leaking tube, and most frequently it is the source of the trouble.

If, however, the valve is tight, then up-end the machine and carefully examine the tyre tread, particularly for small thorns [which penetrate the casing and prick the tube slightly; it is astonishing how an undisturbed thorn-penetrated tube will hold air. It is always wise to examine the tread of the cover before detachment, for if you can find the cause of the leak by such a method the removal of a section of the cover and the repair of the tube is a simple matter. If a full detachment is necessary and the water test made, then not only dry the tube before repair, but slip your fingers round the inside of the cover to feel for any other matter that might lead to a similar perforation.

Tyre casings are tough these days and so are tubes, and it is remarkable what foreign matter they will resist before perforation, or hold that matter in their make-up, unless you are one of those careful souls who regularly examine tyre treads to remove foreign adherences. I confess to carelessness in this respect, until I am going on a long journey, or before a tour, when I do spend a few minutes examining my tyres, and if necessary replacing a doubtful cover, for I don't enjoy repairing punctures.



The 16th Century Eclipse Inn. Winchester— A fine half timber building standing in the Square behind the Cathedral.

The Idle Hour

TO sit in the sunshine at the feet of a great oak and watch the cloud shadows empurple the pool is a method of enjoying an hour which seems to have been forgotten or never learned by the present generation. Maybe I am a trifle severe on the folk who rush about and appear to think that is the way to live a full life and get the maximum of fun from it. It seems to me these quiet moments in the deep country on a perfect summer day hold more sustaining joy than the hurried miles many folk make to satisfy their fever for movement.

I rode out in the fore part of the morning when the shadows were long and the birds still at matins, to a house where a welcome waited me by a lake-side, a quiet friendly welcome from a lady quite content to say " Well, here it is; now smoke and rest while I get on with the work, and in due time we will lunch and talk." It was a perfect setting for such a day and I was grateful for the quiet hour, thinking of the luck I have had in life and how very much of it I owe to my love of cycling.

In the long ago this lady was one of a party of intimate friends, a touring companion of the years when motor cars were rare on the roads, some of which in the remote places were very rough. We talked of those times at lunch, of the days when we carried a spare cover on our long-distance tours, a miniature soldering iron and its accessories to mend frayed brake cables, knew very intimately the inside of variable hubs, cooked our meals on a Primus long before that was common practice, and took the shilling afternoon tea at the big Scottish hotels, satisfying appetites at the expense of proprietors because we could not afford the big evening meals.

The good lady told me that despite all the present amenities that follow in the train of success, there were no holidays comparable with those long tours of the early part of this century. I agreed—but then we were twenty-one, and could not tell ourselves these were the great days, and had anyone told us, we should not have believed them.

Not Sporting

IT will not surprise the British cyclist to know that our type of bicycle has captured the U.S.A. market, and ever-increasing numbers of our machines are crossing the Atlantic. It is not surprising because the British machine is a fine product and, in comparison with the American's, a light and lively bicycle as against the heavy and cumbersome vehicle often fitted with false tanks and various gadgets to resemble a motor cycle. Indeed the U.S.A. bicycle long ago descended to a toy for the use of children and teenagers until they became old enough to run their own car. There has been a change in fashion, and the lightweight British machine has been the reason, plus a few cycling enthusiasts like Hans Ohrt (the one-time amateur champion of U.S.A.), enthusiasts who have always been keen cyclists bestriding what we should term proper bicycles.

Naturally the American cycle manufacturers do not like this fashion change and are severely critical of the British machine which, after all, has not been reduced to ironmongery by mass-produced methods on the same style as in the U.S.A. For a bicycle is 10 per cent. raw material and 90 per cent. labour, and the U.S.A. wage-rate cannot meet our prices because of that fact. The American makers are trying hard to increase the import duties, but up to the moment without success. Indeed, it seems from returns in front of me that the British bicycle invasion has benefited the output of the American trundlers, and that is a stiff fence to take on the route demanding increased tariffs. I can understand the U.S.A. makers' point of view, but I would never have thought their association would have descended to a " smear " campaign by publicly stating the brakes on British machines were flimsy and unsafe. Yet this has happened; you and I know better. Certainly our brakes are light, but strength and stopping power for the job is undisputed among more than ten million riders in Britain. You ought to know this position in the U.S.A. market as a British cyclist, be proud of the fact and regret that jealousy " on the other side " has improvised so untrue a criticism.

The Great Fact

RIDING to and from town most days of the week I see a lot of curious road conduct, mainly imposed on drivers and riders by impatience. The general over-all picture seems to me to be better, for all types of traffic give more proper signals than was the case a few years ago, and many of our motoring friends are slowly learning the value of patience as applied to safety. It is the younger generation who more frequently over-step the mark and impose on other people and themselves that shadow of accident which may not be intentional but is nevertheless annoying, particularly when it is accompanied by the blast of the horn. There is no need for this fracture of the rules because congestion of our roads at peak hours of traffic pressure is the same for all of us, and if we are wise we recognise the fact, keep our tempers, train our patience and proceed safely without undue lapse of time. That roads need urgent attention in city areas cannot be denied, but that desirable condition will only come slowly, and in the meantime the greatest value to traffic safety is undoubtedly the exercise of patience when congestion is at its heaviest.

AROUND THE WHEELWORLD

By ICARUS

On Cleaning a Bicycle

I AM asked by a newcomer to our pastime which is the best method of cleaning a bicycle. My first advice to a beginner who has just acquired a sparkling mount is not to "kill it by kindness" by overcleaning it. In the first flush of pride of possession there is an understandable desire to maintain its pristine condition, by flicking off every speck of dust, and continually polishing the frame, mudguards and plating. This can be as disastrous to the finish as neglect, and will soon remove the sheen from the finish. I have seen cyclists by the roadside with polishing cloths and oil cans giving their machine a dry shampoo, after perhaps a run of 10 miles. Except in special circumstances, it should not be necessary to clean the machine more than once a week. At the same time, insert a few drops of oil in the lubricators. A little and often is better than infrequently and too much. For cleaning the frame, I can thoroughly recommend the new "Three in One" silicone polish marketed by E. R. Howard and sold in small bottles at 2s. 6d. It is obtainable from most cycle stores. This remarkable polish not only imparts a brilliant lustre with the very minimum of effort, but the polish lasts for months, and the rain simply falls off it. It is the best polish I have yet tried. It is only necessary to flick the dust off, apply a mimimum of the polish and rub it off when dry. You will be amazed at the result.

To clean a bicycle properly it is really necessary to remove the chain and wheels so that dirt and mud and dust-laden oil can be removed from under the mudguards, and between the forks. The machine should, of course, be inverted and an inspection carried out for loose nuts, etc. Do not use metal polish on chromium plate. There are several excellent chrome-plate cleansers sold specially for the purpose.

Once every three months dismantle the hub and bottom bracket bearings and clean them out with paraffin. Also, soak the chain in paraffin giving it several immersions until the paraffin stays clear. Then carefully inject a little oil into each link. Looked after in this way, a bicycle will retain its new appearance and its second-hand value for years.

The A.C.U. Competition

THE Auto Cycle Union is to be commended for organising a competition for models of motor cycles, choice being left to the competitors in the three groups, extending from the earliest motor cycles to those of to-day. Entries are to be exhibited at the forthcoming Cycle and Motor Cycle Show. It seems a pity, therefore, that the Bicycle Manufacturers' Union did not also organise a competition for models of bicycles, which were responsible for the development of motor cycles. I am glad to note that Mr. F. J. Camm's model of MacMillan's Bicycle, the father of the bicycle and the motor cycle, is to be on show. The very first motor cycle was indeed nothing more nor less than a motorised bicycle. It had the engine mounted over the front wheel and drove by means of a belt fixed to the spokes. It was an engine of about $3\frac{1}{2}$ h.p., there were no gears and one had to either run and jump on after the engine started or pedal it until the engine came to life. I hope to see a model of this machine at the Show.

The prizes awarded cannot be said to be on the generous side—£20 first prize in each of the three classes. A scale model of a motor cycle would be worth at least £100 and will take months of spare time to build. I do not think, therefore, that the number of entries will be large, for if the models are to be of exhibition standard they would need to be constructed by skilled competitors. The prize would not attract, and the honour and glory attaching to a win is negligible. The difficulties which will be encountered are great. There is a dearth of information on early motor cycles, particularly dimensioned drawings. The Science Museum at Kensington has plenty of motor cycles on show and competitors will have to make their own drawings from those. The models will not be strictly to scale. Another difficulty will be in obtaining tyres, and I imagine that the construction of the wheels and hubs will occasion some difficulty, especially if the rims are to be of correct Westwood section. Great advantage will be taken of the museum's exhibits by those who are modelling early motor cycles. Those who elect to model a modern machine may find some difficulty in obtaining general arrangement drawings from the manufacturers. Such are not too helpful in giving away drawings.

A Little More Dignity, Please!

HAVE you noticed how some of the periodicals, when reporting cycle races or other functions, are more and more adopting the practice of referring to the riders by their Christian names, and usually diminutives of those Christian names? It is Al Brown, or Lew Smith, or Jack Robinson. This method of reporting gives a sort of cheapjack atmosphere to cycling and whilst the use of Christian names may for purposes of vanity provide an artificial aura of popularity for the riders concerned, I see no good reason why the initials of their Christian names should not be used. This too free use of pet names is associated with the hooligan side of cycling, as demonstrated at the Albert Hall Concert year by year, by the uncouth contingent from the North. There has been a general lowering of the dignity of the cycle movement during the past 20 years, and this tends to drive away or to fail to attract middle and upper class cyclists. How different was it in the early days of the present century, and even before that, when cycling was the pastime of the well-to-do. Take the Wheel Club, which was formed in 1896, and was one of the first-class clubs of London. It originally started with a list of patrons composed of heads of noble families and within eight weeks over 1,500 members enrolled, including many famous names in literature, art and finance. At one meeting there was Princess Henry of Pless, Duchess of Sutherland, Earl of Portarlington, Lord and Lady E. Churchill, Sir William Marriott, Lord Napier, Countess of Warwick, Madame Patti, to mention but a few. It would be practically impossible to run such a club today. There should be a move on the part of the associations to improve the status of cycling. As it is, they are merely concerned with cycling sport, which is only a very small part of a very great whole.

Even the clubs have deteriorated in the quality of their memberships. Committees forty years ago were very choosey before admitting a man to membership. They did not hesitate to invoke the rule relating to prejudicial conduct on the part of their members. To-day they will allow in any Tom Tug, or kerbstone wheeler, who will probably leave the club when his subscription becomes due. Such gamins have brought great discredit on the sport by their conduct in public places such as restaurants, and a move should be made to stop it. Club cycling and boisterous and rowdy conduct seem to go together.

MARLOW.

The elegant church and suspension bridge at the entrance of this lovely Thameside town . . . .

We Want to Know...

WHEN is the Bath Road Club Limited going to organise an event in which its own members enter, and with distinction? As it is, it exists to organise events for other clubs! Just look at this year's Bath Road 100. The late C. R. Smith must be squirming in his narrow cell!

Too Many Events?

A glance at the cycling calendar each year suggests that there are far too many competitive events to enable each to be properly supported. Some of them attract a very small field, and club handicaps have reached the level of a farce. A few years ago, club members supported their own handicaps. Now they desert them for more spectacular events with larger prize awards. A smaller number of opens would place less strain upon organisers and help to swell individual fields. The Sunday club run, which used to be such a pleasant feature of club life, has almost reached vanishing point. The whole accent to-day is on sport and cycling politics, which are packed with intrigue, petty jealousies and hates.

Sojourn in Salop

AN old friend of Dunlop days has very kindly invited me to spend a little holiday with him in his Shropshire home and, because I have always loved Shropshire and have happy memories of its serene towns, with their black-and-white timbered houses, I am inclined to accept the invitation, and tour with my old colleague around the beauty spots of a county which, to my mind, is one of the loveliest in all England. My friend lives not far from Bridgnorth, with its ancient castle ruins, and its curious leaning tower. I visualise pleasant rides to the area around Much Wenlock, where, I recall, there are some ancient portable stocks. The particular glory of Much Wenlock, of course, is the Priory. The remains are now in private grounds, and they consist of the prior's hall, the kitchen, and some interesting fragments of the priory church. Yes, a September sojourn in fair Salop seems an alluring prospect indeed !

Yorkists and Lancastrians

THE Derbyshire dales, and particularly, of course, glorious Dovedale, are favourite week-end haunts of cyclists from Sheffield, Manchester and the cluster of Lancashire towns where Cotton is king. During August, when so many of these towns hold their famous "Wakes," my Derbyshire countryside, so near to the Peak, is invaded by happy bands of riders, and I never tire of listening to the homely accents of Yorkshire and Lancashire, accents which one may hear wherever one may roam in the wide world !

The BELL, STILTON. Huntingdonshire. A great road house of the past. It dates from the 17th century.

CYCLORAMA

By H. W. ELEY

The other Sunday, a mixed party from the two counties rode from Beresford Dale into Ashbourne, and spent some time looking round this ancient place, where old Doctor Johnson was a frequent visitor and where the noble church of Saint Oswald—a glorious building known affectionately as "The Pride of the Peak" dominates the scene. I chatted with these lads and lassies in the old "Green Man and Black's Head," the inn with the sign which spans the roadway and, within which, one is shown the very seat in which Doctor Johnson was wont to sit and drink his ale, and regale the company with his wisdom and philosophy. Our topics of conversation ranged from the prospects, in the coming season, of Bolton Wanderers, Preston North End, Sheffield Wednesday and other famous football clubs, to the succulence of tripe as cooked in Lancashire, and Japanese competition in the cotton industry.

Fields of Deepening Gold

WHILST Derbyshire is not, mainly, a "corn county," there are a fair number of fields within my vision where the wheat and oats are ripening fast, making vistas of deepening gold, awaiting the September days when cutting will be the order of the day, and the good corn will be garnered against the winter days. I look in vain for the splashes of scarlet poppies which are such a feature of the cornfields of East Anglia—these flowers do not seem to grow at all profusely in this district, but nevertheless, I love the wide sweeps of gold, and shall hope, when cutting begins, to join a party of guns, and shoot some rabbits as they bolt from the narrowing squares of corn. Corn-cutting time offers good sport with a gun . . . and at the end of a pleasant day in the fields, it is good to adjourn, with my farmer friends, to the cosy bar of "The Haycock" or "The Ram's Head" and sup a tankard of ale, and muse upon the day's sport.

Friday Night is Cleaning Night!

FOR many years now, I have made a practice of setting aside an hour or so on Friday nights for cleaning up my cycle—oiling, adjusting, inflating tyres, and doing all those little jobs which make such a big difference to one's comfort in the saddle. "Your old bike looks as good as new" is a tribute I frequently receive from my village friends, and I always explain that the signs of old age are retarded just because I do not grudge the time spent in my cycle shed with cleaning-rags, oil-can, spanner, and pump !

Safety-first in the Countryside

IT is not only in the big congested towns and cities where the need for greater riding care is apparent ; the narrow winding lanes of this countryside can be as pregnant with danger as the busy streets of the thronged town. I am glad that our new school-master is putting into force a regular course of instruction in the principles of Safety-first, and seeing to it that his pupils are familiar with the Highway Code. Almost everyone here rides a cycle, for it is an essential in the country, and there have been accidents which have brought home to us the melancholy fact that there is still a tragic disregard of the rules of the road. So, it is good that our school-master is mingling with his teaching of the "Three R's" a modicum of sane instruction on Safety-first. "Make the child safety-first conscious, and in later years the lessons will not be forgotten," is the policy of our village headmaster, and I am sure that his teaching will bear good fruit.

A "Pen Friend" from the States

MY post-bag continues to contain welcome letters from cyclists who apparently like these rambling notes, and the other week I received an interesting letter from Boston, in far-away Massachusetts ! My correspondent was born and bred in Boston, in Lincolnshire, and by some turn of fortune's wheel, is now settled in that other Boston overseas ! And with what wistfulness he wrote to me of the famous Boston "Stump"—that ancient landmark which dominates the flat Lincolnshire land ! He wrote at length of the men of Boston who, as far back as 1633, left England's shores for conscience' sake, and founded Boston in Massachusetts. He referred to the Pilgrim Fathers, their hazardous travels, and to the faith which sustained them during their journeys, and in the days of their pioneering.

Call of the Sea

AUGUST is the traditional month for the English exodus to the seaside, and quite a number of villagers have temporarily deserted the fields and farms for the joys of beaches and rocks and sunlit seas. The postcards I have received tell of happy times, of family games of cricket on stretches of hard sand ; of fishing from the end of the pier ; of swimming in little bays in exotic Cornwall ; of "all the fun of the fair" at gay Blackpool or Margate or Scarborough . . . and as I gaze over the wide fields, and watch the cattle ambling to the cool stream, and the sheep grazing on the hill-sides, I feel the call of the coast, and find myself dreaming of a fishermen's inn in St. Ives.

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