• Making a Midget Camera •

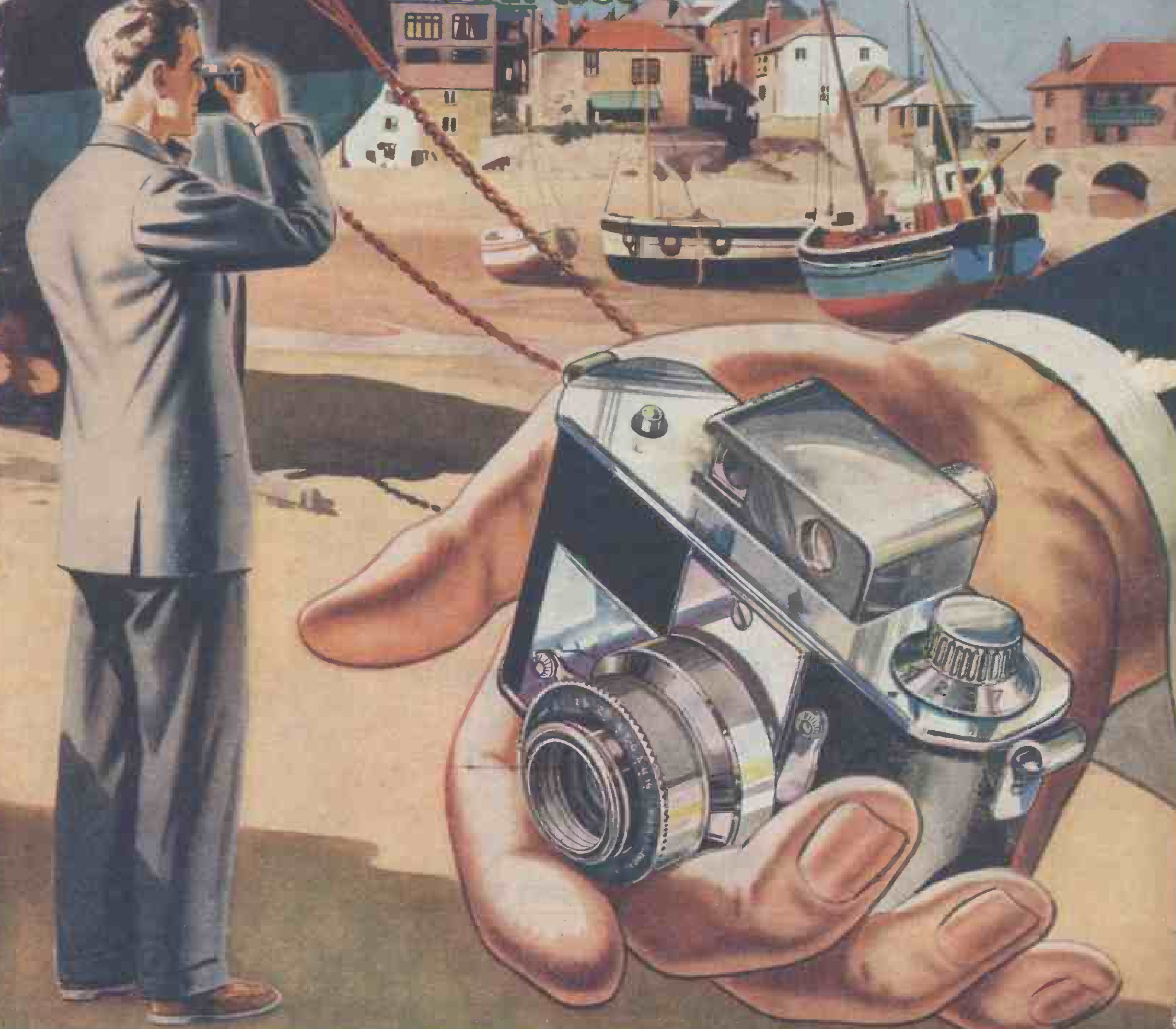
NEWNES

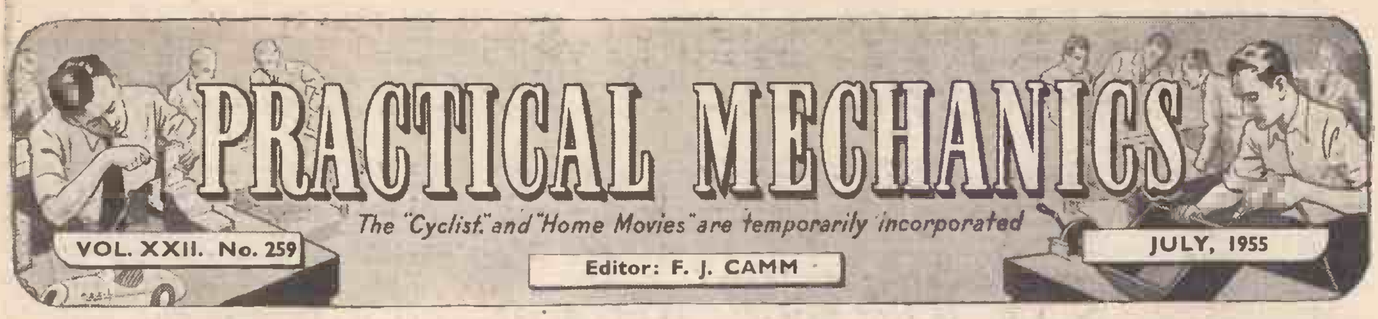
PRACTICAL MECHANICS

1/-

EDITOR : F. J. CAMM

JULY 1955





FAIR COMMENT

By

The Editor

Signals from Jupiter ?

THERE has been a lull during the past month in reports of sightings of flying saucers. It is significant that whilst the Governments of various countries have investigated the flying saucer problem, none of them has stated unequivocally that they exist. However, quickly following this lull came the startling report that signals thought to emanate from Jupiter have been received in this country and in America. These reports come from qualified scientists not likely to be misled. The signals have been received at regular periods, usually when a particular point on the surface of Jupiter is coincident with a particular point on the surface of the earth. The signals follow a regular pattern. It is known, however, that the atmosphere surrounding Jupiter is such that human beings as we know them could not live there, and if it is true that occupants of Jupiter, if any, are endeavouring to communicate with the earth, it is interesting to speculate as to the form and nature of these other beings. We have no right to presume that ours is the only planet which is inhabited, nor must we conclude that the human form as we know it is the ultimate and only form. Even if it can be established that these are signals from Jupiter, the language difficulty is wellnigh insuperable.

It seems probable, therefore, that these problems will go unanswered until space travel makes it possible for us to visit other planets. Space travel may be an accomplished fact some time during this century. There is no reasonable hope for believing that anything beyond preliminary experiments in that direction will take place during the next twenty years. One significant fact has impressed me. I have often commented on the flying saucer problem, but although most of my readers have scientific knowledge, none of them has written to me stating that he has sighted a flying saucer. This journal circulates in every part of the British Isles, and in almost every country in the world, and it may be thought odd that those readers residing in districts where sighting has been reported have not written to confirm the reports.

It would seem that controversy is now raging in America as to the accuracy of Adamski's flying saucer claims.

Industrial Arts Competition

A COMPETITION in which all readers of this journal will be interested is the Industrial Arts Bursaries Competition, organised by the Royal Society of Arts. Prizes totalling £2,600 are offered, and they take the form of travelling bursaries usually of £150 each, and are open to students who intend to take up industrial designing as a career. The closing date for entries is October 10th. Candidates in all the male sections must be British subjects between the ages of 17 and 30 on September 1st, 1955, and they must have studied with minor exceptions as full-time, part-time, or evening class students for not less than one term since September 1st, 1955, at an art, architectural, technical or other school or college approved by the Bursaries Board.

In the domestic gas, the domestic solid-fuel-burning appliances, the footwear, the jewellery, and the women's fashion sections, entries will also be accepted from any person within the above age limits and already engaged in these industries, provided that they are recommended as having sufficient ability to compete in a national competition by a responsible officer of the industry concerned. Candidates must also be recommended as having sufficient ability to compete in a national competition by the principal of their school or by a responsible officer of the industry concerned. Entry forms are available from the Royal Society of Arts, John Adam Street, Adelphi, W.C.2, and each must be countersigned by the principal or responsible officer. All candidates are required to enter for a set test and to submit examples of work. The set test will be carried out at the candidate's school or by special arrangement. In the domestic electrical appliances section they must submit three designs showing perspective and typical working details, for domestic electrical appliances. In the electric light fittings section they must again submit three designs, showing perspective and typical working details, for electric light fittings suitable for use in the home (using tungsten lamps), in offices, shops or showrooms (using fluorescent lamps). Three designs, showing perspective and typical working details, for domestic gas appliances, are required for the domestic gas appliances sections, while the domestic solid-fuel-burning appliances section requires two designs, showing perspective and typical working details, for domestic solid-fuel-burning appliances, and one design for a surround for an inset convector fire. Candidates must submit four designs for carpets for the carpet sections, of which at least one should be for a good Axminster and another for a Wilton. For the full list of the sections, readers should communicate with the Secretary.

Articles Required

WE invite readers of this journal to contribute articles on subjects of which they have experience. We are prepared only to consider articles submitted on practical subjects. Each article should be not more than 2,000 words in length and be accompanied by a list of materials, sources of supply, clear rough sketches, and photographs where possible. Articles should be clearly written or typewritten on one side of the paper only, with 1in. margins and adequate spacing between the lines for sub-editorial marks and corrections.

Articles must be original and all materials must be readily available. Our "Information Sought" feature often brings to the light of print information which other readers require. If you have built a piece of apparatus, a model or a piece of household equipment which you feel would be of interest to other readers, write and tell me about it. We shall, of course, pay for these contributions at our standard rates.—F. J. C.

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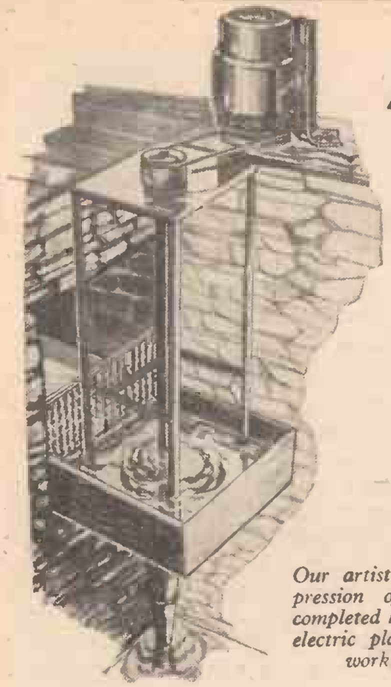


Our artist's impression of the completed hydro-electric plant at work.

MAKING AN EFFICIENT HYDRO-ELECTRIC PLANT

Notes on the Construction of a Water-power Unit for Supplying Domestic Electricity

By D. A. PARK

I WAS commissioned recently in my professional capacity to construct an inexpensive hydro-electric plant. Any person, with the facilities available, will find that this is a most absorbing subject, and the undermentioned details should help any person with this object in mind.

The turbine is of the propeller type and is capable of turning out two-thirds of a horse-power. With the dynamo coupled, it was turning out a maximum of 435 watts at 250 volts, although I must add that the voltage was beginning to drop rapidly. At 300 watts, an excellent light was obtained—this is really its comfortable working load. The dynamo was a redundant 480 volt 525 electric D.C. motor. This was run at approx. half speed and gave a steady voltage without too much frictional loss.

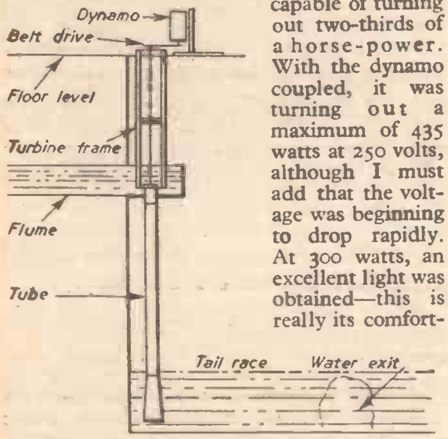


Fig. 1.—General arrangement of the plant.

I was fortunate as far as the site was concerned. A long disused threshing-mill water-wheel had been dismantled and there was a clear drop of 14ft. from the flume to the tail race. There was, however, an obstruction in the tail race and this reduced the working head of water to approximately 10ft. The old water-wheel was built below the floor of a farm building and, as I wanted the dynamo out of the " spray " area, it meant that quite a long body or frame would be required to bring the mechanical power above floor level. As this unit would probably require a lot of adjustments it was decided to make the frame in one unit. This also has the advantage of easy access for cleaning rubbish from the blades. The general arrangement is shown in Fig. 1.

The Turbine Frame

This is constructed from angle iron and 3/16in. steel plate. The square plates are cut to 18in. × 18in., the lower plate of the turbine has a 6¼in. hole cut in the centre and the upper plate a 1¼in. hole. For quickness, the frame was welded together.

Next, I made the runner tube, which is the part in which the propeller or runner actually rotates. This was made to fit into the lower turbine plate and is welded into position. It is constructed from 18-gauge steel and it is 1ft. in length (Fig. 2).

The spider for holding the lignum vitæ bearing is made next. A piece of 2in. diameter malleable iron tube 2in. in length is cut, and three pieces of 20-gauge steel 2in. by approximately 1⅜in. These latter are welded to the boss of the pipe spaced out at 120 deg. (Fig. 2a). The lignum vitæ bearing is then fitted into the boss, and is drilled to 1in. diameter to take the shaft. It is advisable to have this on the slack side—I found that the bearing was inclined to swell when immersed in water. Now place the spider into the runner tube and insert the shaft into the bearing. Centralise the top end of the shaft by means of packing pieces; this will assure the alignment of the spider while it is being welded in position.

The fitting of the thrust bearing needs careful attention, and is situated on the top

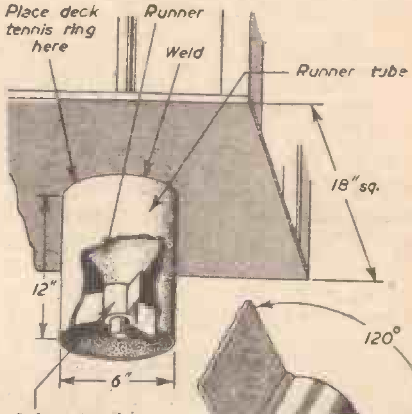


Fig. 2.—The runner tube with the spider in place.

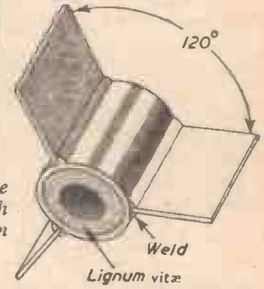


Fig. 2a.—Constructional details of the spider.

(Top) Vane guide removed revealing top of runner block.

Above) Water feeding the turbine, with trash gate in background.

Experimental runners.

The upper block bearing.

plate. In the writer's case the thrust bearing was once a tractor clutch thrust, and it was necessary to cut a piece of ¾in. × ¼in. strip steel to form a ring to fit snugly around the bearing, as in Fig. 3. The seating of the bearing rested on the top plate and the ring was then tacked in position by welding. To the underside of the top plate is fitted a block ball-bearing race. This is to take the side thrust to the dynamo.

The Shaft

The shafting is 1in. in diameter and was fitted with the runner or propeller just below the top of the runner tube, see Fig. 4. The shaft was drilled to take an Allen screw, fitted in the thrust bearing collar.

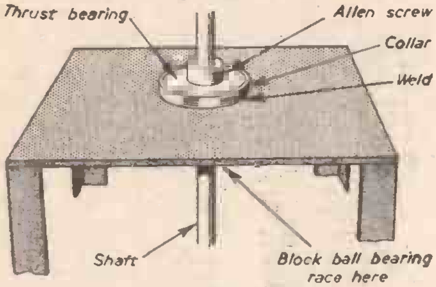


Fig. 3.—The thrust bearing.

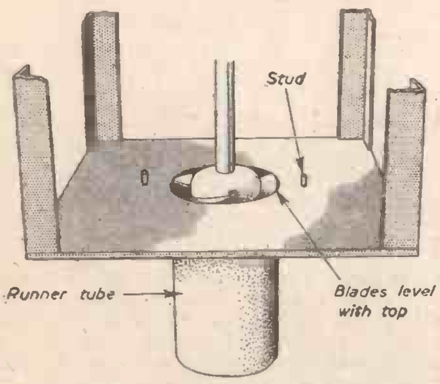


Fig. 4.—Fitting the runner.

The dynamo in action and the water feeding the turbine.

The Runner

This is made from hardwood and sheet steel. A block of wood 6in. × 4in. × 4in. is obtained, put in a lathe and turned to shape, as in Fig. 5. To ensure accuracy drill the 1in. hole to take the shaft first then slip the boss over a short length of shaft and insert this in the lathe chuck.

The next problem was the marking of the blades position accurately. The boss was marked with three lines spaced out at ¾in. intervals, then with the aid of a pair of dividers scribed into four equal sections and marked freehand, as in Fig. 6. Saw cuts were made along the pencil marks and the four slots were then ready to receive the blades.

The blades, it will be appreciated, were more than the boss diameter and a pair of callipers gave a near enough measurement for the marking out of the blades, as in Fig. 7. It was found that for the 4in. boss a 4⅜in. diameter blade was required. Mark out a circle on 20-gauge iron 4⅜in. diameter, then move the compasses to a radius ½in. less, make a second scribe, reset the compass to 3 3/16in. and scribe once more. To ensure accuracy, both discs (making four half blades) are marked simultaneously. The blades should be cut and trimmed, as in Fig. 8, to provide two small tags on each, and prepared for the boss. After the blades are entered into the saw slots they should be secured with small wood screws.

At this point, to ensure that there was sufficient clearance, the runner was slipped on the shaft and tested in the runner tube. After a small amount of filing it was running true and free. As the thrust bearing was in position it was possible to proceed and fix the boss to the shaft. A ¼in. hole was drilled through the shaft at an angle, as in Fig. 9, and a 2½in. wood screw was inserted and driven home.

Vane Guide

The object of this part is to help the water to swirl in the direction of the blade rotation and, at the same time, to prevent air being sucked down the tube (if this happens there will be a noticeable fall of power).

The vane guide was 13in. in diameter and 3in. high, as shown in Fig. 10, and was made from 20-gauge steel. First, the two discs were cut after being scribed by compasses, then a 6¼in. diameter circle was scribed and cut in one, which is the lower plate of the vane guide. The upper plate was scribed with a 1¾in. diameter hole and cut with the aid of a small chisel. The vanes were cut from the same sheet material, in the form of rectangular pieces 4in. × 5½in., and then scribed with two lines ½in. from the edge. The edges are turned at right angles in a vice, as shown in Fig. 11. The positions on the lower plates are marked, and with the aid of a drill brace and a piece of heavy iron held in a vice to make an anvil, the vane guides are riveted in position one by one. The top section of the vane assembly is then fitted in position and drilled and riveted in the same manner. Two studs are inserted in the "frame base" to locate the vane guide in position. This is to afford easy access to the turbine blades should the runner become choked with rubbish.

The dynamo in action.

(Centre) Runner tube, showing spider and Lignum vitæ bearing.

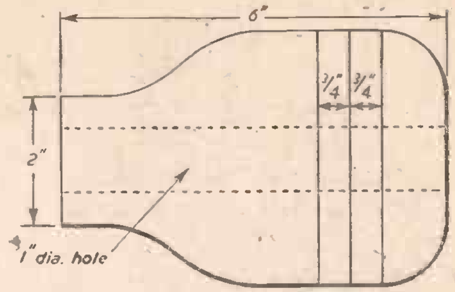


Fig. 5.—Details of the runner block.

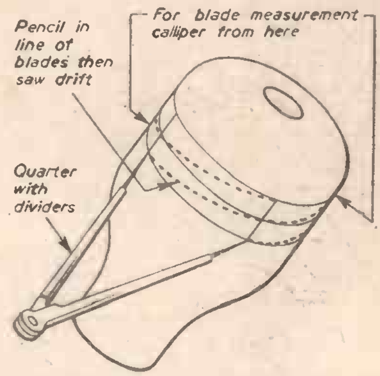


Fig. 6.—Details for positioning the blades.

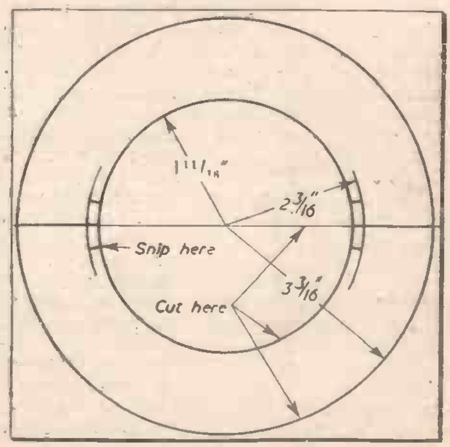


Fig. 7.—Marking out the blades.

The Tube

Now comes the part which governs the amount of power which is going to be available. At low heads, the tube or pipe may be made of any type of cast iron, asbestos or sheet galvanised iron. I chose asbestos, but the lead into the pipe was made of galvanised iron, as shown in Fig. 12, the reason for this being that the turbine was liable to be moved about in the tube by vibration. This was liable to start chafing and wear away the asbestos material.

The flange was cut 18in. × 18in., and a 6½in. diameter hole was cut in this. A length of pipe was made 18in. × 6½in. diameter . This is inserted into the flange plate and hammered over at the edge to a width of ½in. A few rivets, followed by a soldering, to seal all the joints, completed the flange. Once this section was made it was inserted in the floor of the flume end on a bed of putty and securely nailed down. The lengths of pipe were joined on below the flange, held away

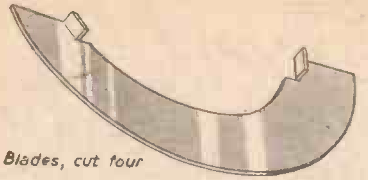


Fig. 8.—One of the completed blades with tags for fixing.

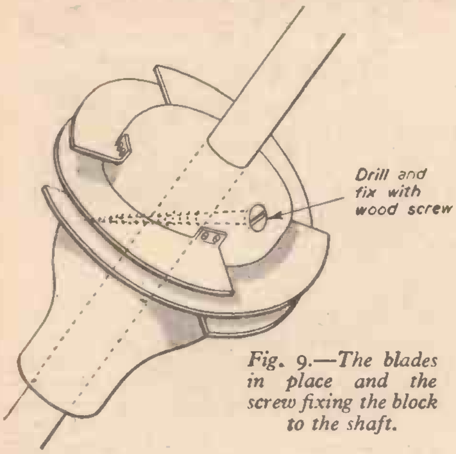


Fig. 9.—The blades in place and the screw fixing the block to the shaft.

from the wall by pipe clips, constructed as shown in Fig. 14.

The lower part of the tube was also made of galvanised sheet iron, see Fig. 13. The object of this part is to slow up the speed of the water before it leaves the tube. If this part is not fitted, it will be found that back pressure will build up, introducing a loss of power. The joint was riveted and soldered and secured to the asbestos pipe by means of four gutter bolts.

The joints of the pipe must be made with care. First, plumbers' hemp is rammed into the joints, followed by a good coat of paint; putty is then rammed in until you see the putty begin to bulge at another point. A liberal coat of paint followed by a wrapping of canvas tied in with brass wire completes this section.

The bottom of the tube must be clear of obstruction and the tube end should always be under water.

Now the turbine was complete and ready for testing. A deck tennis ring was placed over the end of the runner tube to act as a gasket. The turbine was lifted into the tube and the top portion of the turbine frame secured to the floor. The bearings were a little tight, but a few flicks of the shaft and the turbine rapidly gained speed, running at around 2,000 r.p.m. At this stage the dynamo was added. A wooden frame was made on which to mount the dynamo in a vertical position and a "V" pulley was turned up to give a suitable ratio speed as it was found that the turbine ran at around 1,000 r.p.m. to 1,200 r.p.m. under load.

There were no governors employed. The dynamo, it was found, overran the 230 volt mark by five or 10 volts when on a light load, but this is a point that can be gone into more at a later date.

There is no particular reason why the frame should not be made of wood or that the lignum vitæ bearing should not be dispensed with and a ball race under slight head of oil pressure used in its place. I suggest that it be situated on the vane guide cover or mounted just above water level. This should not give rise to any undue whip on the shafting. In the case where there is excessive sand in the stream bed, I think that an oil pressure bearing would be advisable.

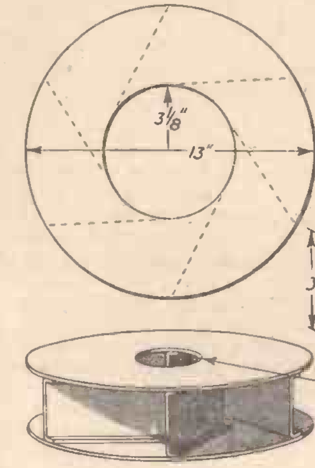


Fig. 10.—Two views of the vane guide.

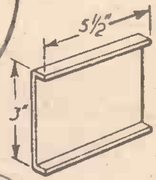
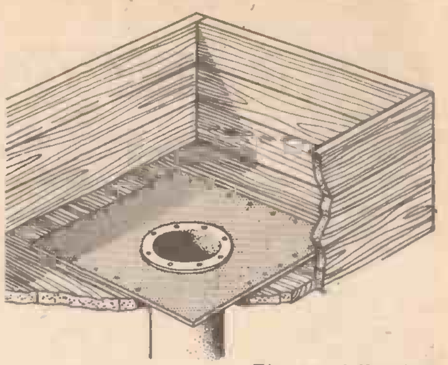
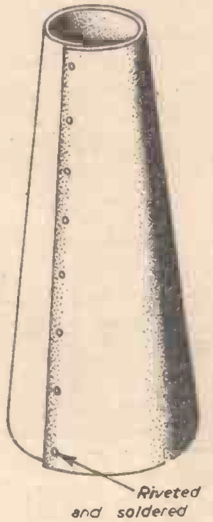


Fig. 11 (Right).—One of the vanes.





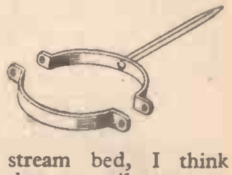


Fig. 12. (Above).—The pipe fixed in the flume.

Fig. 13. (Left).—Lower part of the tube.

Fig. 14 (Below).—One of the pipe clips.

The length of the frame will vary with each individual requirement. The shorter the better. The vane cover should have 3in. to 4in. of water covering it when the turbine is in motion. If only a small drop is employed, then a larger quantity of water will be required to generate the same power and the size of the tube and turbine alter accordingly. The pipe need not be a sheer drop. A stream bed could be employed provided a large enough pipe was employed.

The only word of advice I offer is do not be over optimistic about the water supply available, it is surprising how much water even a 6in. pipe can take under siphonage.

Exploitation of Titanium

ALTHOUGH titanium was first discovered at the end of the 19th century it is only during the past 10 years that its properties and uses have been fully understood and exploited.

The manufacture of titanium sponge on a production basis has been confined to the United States and Japan with some pilot plant production in this country, but with the first full-scale plant for the production of titanium in this country coming into operation this year with an annual output of some 1,500 tons of sponge titanium, the use of the metal in Britain is expected to be greatly increased. Considerable advances have been made here during the past few years in the fabrication of titanium and progressive development has been carried out for some time in the aircraft industry.

The bulk of the titanium handled so far in this country has been imported from America and Japan. America, the world's main source of sponge production, has an estimated production for 1955 of 10,000 short tons of titanium sponge—a sixfold increase on last year's figure. The planned production of producers scheduled to commence operation this year would bring this figure up to 30,000 tons per annum.

Japanese production for 1954 was about 600 tons of sponge and is expected to be increased this year. It has also been recently announced that Krupps have started making titanium in Germany, while it is known that Sweden, France and Italy are becoming interested in the metal.

Properties of the Metal

The outstanding properties of titanium are its light weight, high strength, high fatigue ratio (high ratio of fatigue strength to the ultimate strength) and corrosion resistance. The strength/density ratio of alloy titanium compares favourably with other alloys.

The titanium produced in the past few years has been mainly absorbed by the aircraft industry. The metal is now, however, assuming increasing importance in chemical engineering, atomic energy engineering, mining engineering, in the construction of guided missiles and military ordnance, and in other industries where a lightweight material with a high resistance to corrosion is required.

The price of titanium is still high, although several reductions have been made in recent years—the most recent price cut being on April 1st, 1955—to bring it more into line with other metals. The light weight of titanium and its long operational life in corrosive environments are two important factors that should be taken into consideration in any evaluation of its cost, however. The use of titanium can save much idle time and labour by obviating the need for frequent overhauls of equipment and renewals of components.

Titanium, which is only slightly heavier than aluminium and has a strength comparable with that of alloy steel, could effect an ultimate saving of some 1,500lb. in the total structure weight of a modern jet fighter. Its incorporation in the airframe of an airliner would considerably reduce its structural weight, thereby increasing its operational range or passenger load. Titanium has been used in the structure of the Britannia and there are undoubtedly few civil or military aircraft now at the drawing board stage for which the use of titanium is not being considered. In the United States titanium is now replacing many of the alloys formerly used in the compressors of gas turbine engines.

The physical properties of titanium are now known and the supply situation has been stabilised. It now remains for the potential users of titanium products to fully explore the applications of this modern metal and to plan where it could be employed in preference to other existing metals which have not proved adequately suited to their individual requirements.

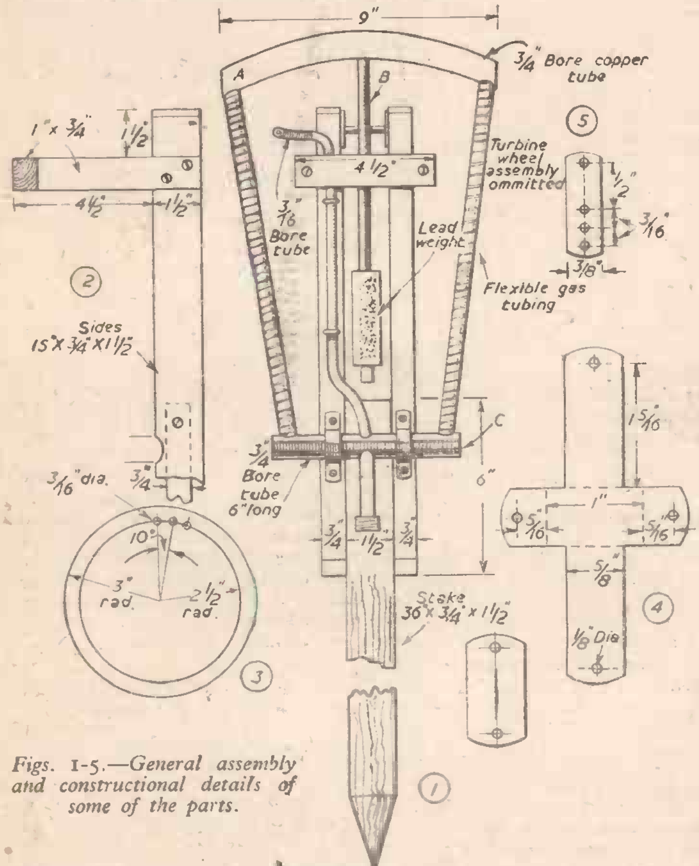
An Automatic Garden Sprinkler

Make this Apparatus for Use in the Garden this Summer

By G. F. PAYNE

HAVING used a rotary type garden sprinkler for a number of seasons and finding that this type is relatively inefficient as regards to the unevenness of water applied, I decided to construct a simple type of square area sprinkler, a commercial article of this type being too expensive.

The sprinkler here described is actuated by an impulse turbine wheel driving a rod, via a gear and crank, back and forth through an angle of up to 45 deg. each way; attached to the rod is a curved jet tube.



Figs. 1-5.—General assembly and constructional details of some of the parts.

Fig. 2a — (Right) The centre rod.

The Frame

This is constructed of 1½in. × ¾in. timber. The centre piece is 3ft. long sharpened at one end in the form of a stake; the side pieces are 15in. long with a ¼in. hole drilled for the pivot bar ¾in. from one end, the sides of the turbine bracket of 5½in. × 1in. × ¾in. are screwed to them 1½in. down (Figs. 1 and 2).

The Jet Tube

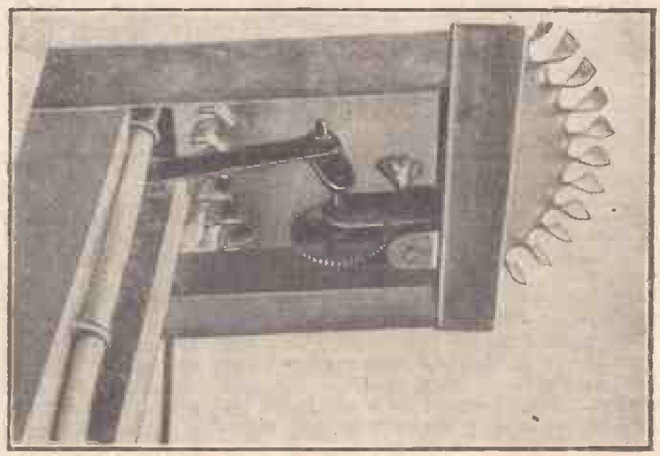
This (A in Fig. 1) is a piece of ¾in. bore copper tube, 9in. long, bent in a curve of about 9in. radius; a plumber would supply this ready bent as required. The ends are blocked with pieces of sheet copper, cut to size and pushed in and soldered. In the centre is drilled a 5/16in. hole right through to take the centre rod and a hole near each end on the inside curve for the two flexible gas tubes. On the outside curve and evenly spaced are drilled 14 jet holes 1/32in. diam. These are drilled as accurately as possible to ensure a fan of water jets. Before soldering the ends, drill at least one of the holes to allow expanding air to escape.

The Centre Rod

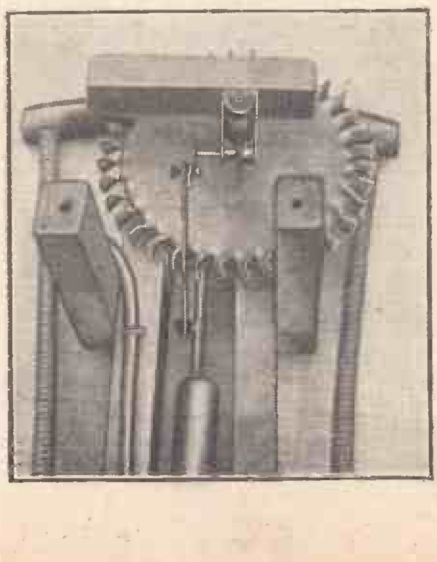
Fig. 2a gives details of this rod, which is made of 5/16in. brass rod 11in. long and has a pivot bar 2in. long × ¼in. diam., which is pushed through a hole drilled 3in. from one end and soldered in place. 1½in. down from the pivot is a short pin for the connecting rod. This rod is marked "B" in Fig. 1.

The Turbine Wheel

This is of 16 gauge copper sheet 6in. diam., and has 36 blades formed on it by drilling 3/16in. holes at 10 deg. intervals, cutting and bending, see Fig. 3.



(Above) An underside view of the turbine wheel showing crank and linkage. (Below) A view with the turbine wheel lifted off the bracket to show crank and linkage.



Gearing

The worm gears are made of brass and give a ratio of 50 : 1. The bracket is cut from sheet brass as shown in Fig. 4, drilled and bent to shape along the dotted lines and the fixing plate soldered in place, as in Fig. 4a. The crank plate, Fig. 5, is cut from sheet brass and soldered to the end of a short spindle, which passes through the gear wheel; the worm is attached to the spindle for the turbine wheel. Spacers are used to centralise both gear wheel and worm. Fig. 4a is an exploded view of the assembly.

The Connecting Rod

This is cut from sheet brass and has a hole drilled at each end. Over one of these is soldered a nut to receive a bolt for pivoting it to the crank plate, a further nut being used for locking purposes (see Fig. 4a). Only an approximate length can be given for the

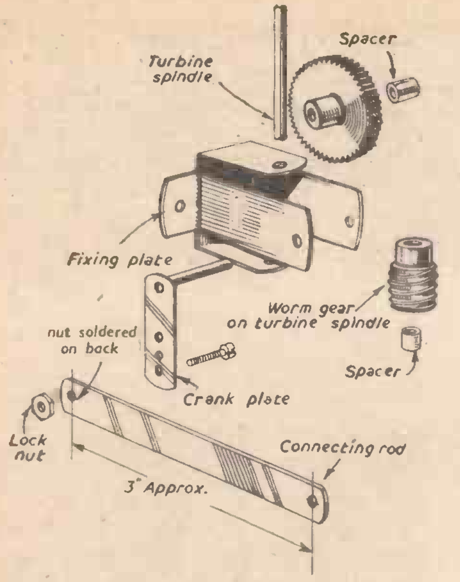


Fig. 4a.—An exploded view of the transmission.

connecting rod, as there may be slight errors during construction; it should be found by trial and error (a piece of card being used for this purpose) to ensure that the movement of the centre rod is equal either way.

The Turbine Jet

A length of 3/16in. bore copper tube is bent to a suitable shape as shown in Fig. 1; one end is filled in with solder and a 1/32in. hole drilled through for the jet.

The Cross Tube

Marked C in Fig. 1, this is 6in. of ⅜in. bore copper tube with the ends blocked off, as for the jet tube, and has four holes of suitable size, as shown. The hose coupling tube is at an angle to the other three.

Pivot Plates, etc.

Cut from sheet brass or copper, the pivot plates are 1¼in. square, drilled centrally for the pivot and at each corner for screws. The cross tube clips are cut to length, bent to shape and drilled for screws.

Assembly

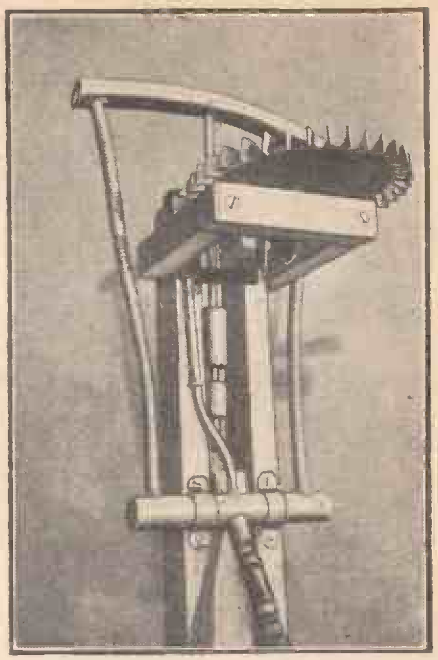
The centre rod and two pieces of gas tubing are soldered in place in the jet tube. Screw on the pivot plates and one of the sides to the stake with a 6in. lap, fit the jet tube assembly, using tubular spacers on the pivot bar and screw on the other side. Next, solder the cross tube to the flexible tubes, adjusting their length so as to stretch them slightly when the cross tube is fixed down; these expand under water pressure. Fit the turbine jet tube and solder. Screw the gear assembly to the front cross bar of the turbine bracket and this in turn to the side pieces. Solder the turbine wheel to the worm spindle.

The lead counter balance weight is approximately 3in. long × ⅞in. diam., and should just balance the jet assembly when full of water. When the balance weight has been adjusted, solder in place. Finally, fit the connecting rod to the centre rod, retaining it with a small washer soldered onto the pin, and connect it to the crank plate with a bolt and locking nut.

The complete sprinkler should be painted to preserve it, with the exception of the flexible tubes.

The area covered by this device depends, of course, on the water pressure of the district in which it is to be used, the area covered by the prototype is about 60ft. × 20ft., using the longest crank throw and about 20ft. square for the shortest.

When storing the sprinkler for the winter it is a good plan to push a cork into the hose coupling tube to prevent insects, especially earwigs, from making their nests in the tubes and thus causing trouble with the jet holes when it is used again.



General assembly of the completed sprinkler.

Blueing Steel Pieces

A Rust-proof Coloured Finish

THE appearance and utility of small steel gauges is often improved by a reasonably rust-proof, coloured finish after their completion. This also applies to small components which receive excessive handling. Any gauging faces must, of course, be left bright, and it is usually possible to remove the gauge blocks or pins and treat the holder or base separately. Parts may be finished mottled, grey, brown, blue or black, as required, by various methods of heat treatment, and these colours can be varied according to the temperature used, time taken and strength of solution if used.

Preparation of Work

Before any form of heat treatment is carried out, however, the parts must be highly polished and free from oil or grease. They should be handled only by using felt or cloth prior to the heating process and during heating they should be supported by a wire threaded through a convenient hole, or by placing on a heated plate.

Processing Hardened Parts

Where a black finish is required on a hardened part it should be tempered in heavy cylinder oil after hardening and placed, still covered in oil, in an oven at a temperature of about 175 deg. C. After eight or 10 minutes it can be removed, when the black finish will be baked into it. The temperature is not high enough to effect the previous tempering process. This method has limited applications as most hardened parts are finish ground.

Methods

A blue or black finish is generally used on gauge work and, where the materials and equipment are available, either of the two following methods may be adopted.

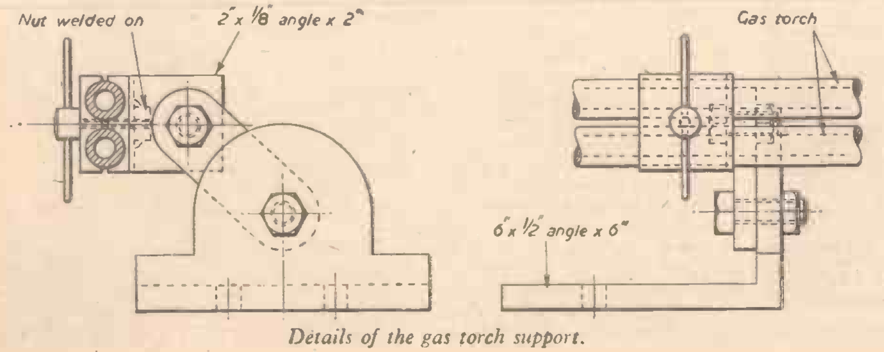
1. A bath of saltpetre is heated to about 315 deg. C. At this stage the saltpetre melts and the parts may be immersed in it. After a few seconds, when a uniform colour of the desired shade is obtained, the parts are removed and allowed to cool. After washing in water, oil should be applied to prevent rusting.

2. A mixture of eight parts of saltpetre and one of black oxide of manganese (by weight) is heated in a bath to 400 deg. C. and the work is immersed until it is the desired colour. It is then cleaned and oiled as before.

When these materials are not available, however, a good blue-black finish can be obtained simply by heating the work slowly and uniformly until it acquires the required depth of colour. Further colouring is then checked by immersing in quenching oil.

Equipment

The usual equipment for this form of treatment is a gas torch and a sufficiently large container for the oil. Small workpieces tend to change colour rapidly, so the time taken in transferring them from the flame to the oil should be kept to a minimum. Where any number of pieces have to be treated, some form of support should be made for the torch, and the pieces can then be suspended in front of it and moved slowly about in the flame. A simple type of support is shown in the sketch and the torch clamp can be modified to suit existing equipment.



Details of the gas torch support.

A VERSATILE SAFELIGHT

Constructional Details of an Easily Made and Efficient Safelight for the Amateur Photographer

By R. S. H.

MANY amateur photographers give little consideration to the efficiency of their safelight, and often the amount of light available could be substantially increased, without risk of fogging, if a different pattern were used. The less expensive commercial safelights are generally small, but for even distribution of light the filter screen should be fairly large. Unfortunately the larger types are expensive to buy, often costing several pounds, but the essential filter screen may be purchased very reasonably. The safelight described uses a filter screen measuring 10in. × 8in., costing about 10s., and even if all necessary materials have to be bought the total cost will be under £1. Most amateurs, however, will already have sufficient odd pieces of wood, etc., available.

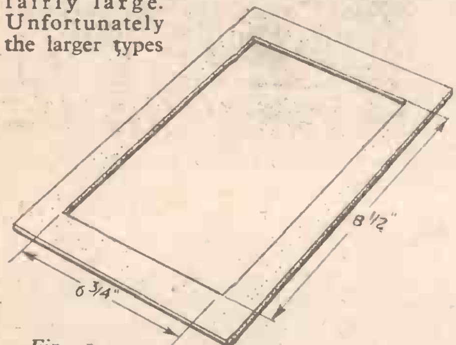


Fig. 1.—Mask for safelight screen.

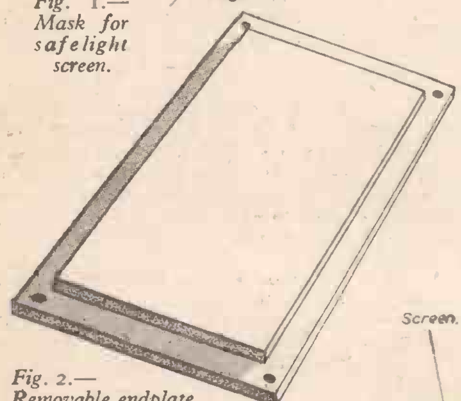


Fig. 2.—Removable endplate.

Since amateur photographers are not necessarily expert cabinetmakers only normal household tools are required, and the constructional information is given in some detail. The design is, however, easily modified to incorporate the dovetails and rebates favoured by the enthusiastic woodworker.

Materials

In the prototype the sides and fixed end were constructed of ⅜in. laminated board, the bottom, mask and light baffles of ⅛in. hardboard, and the removable end of ⅛in. hardboard on ⅜in. laminated board. It is not essential to use identical materials, providing the dimensions dictated by screen size and lamp clearance are adhered to. The batten holder, flexible cord and rubber feet were purchased from the usual household store.

Construction of the Box

Lay the safelight screen on a piece of hardboard about 1ft. square, and using the screen as a template draw a pencil line around it.

Cut the two sides to size as given in Fig. 4 and square off all edges.

Screw strips of wood or hardboard about ⅛in. to ¼in. thick to each side (Fig. 4). Care should be taken to ensure that the strips fitted along the top edge of the side, and forming the slides upon which the screen will rest, are 3/16in. from the edge, so that the screen may slide freely into the completed job.

Pin and glue the sides into position on hardboard base, ensuring that the inside edges are about 1/32in. outside the pencil lines.

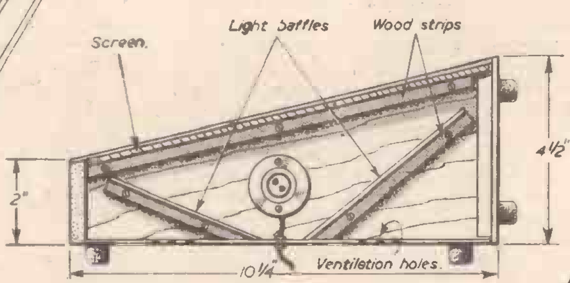


Fig. 4.—Strips supporting light trap and screen, also position of lampholder and ventilation holes.

The safelight with screen withdrawn and endplate removed.

Using the assembly as a template, and taking care that the sides are square with the hardboard, mark and cut out the fixed end. Pin and glue into position and check that the screen fits freely on its slides.

Again using the assembly as a template cut the removable end from ⅜in. material to be a snug fit inside the larger end of the box, and from ⅛in. hardboard to fit the outside. Pin and glue the two pieces together as shown in Fig. 2, but do not fix in position.

Cut the light baffles to size and lay in position. Ensure the lower edges make close contact with the hardboard bottom, and draw pencil lines on the bottom along these edges. Remove the baffles.

Bore a series of ⅜in. holes through the bottom parallel with the pencil lines, about 1in. from them and outside of the two lines (Fig. 4).

Using the box as a template mark and cut out the mask. Cut out the centre portion with a keyhole saw, as shown in Fig. 1.

Paint the whole area under the light traps, the back of the mask and the inside of the removable end with flat black paint.

Pin and glue the light baffles into position, taking care to make a light-tight joint between the edge of the baffles and the bottom of the box.

Paint the whole of the area above the light trap with high gloss white enamel.

Fit the batten lampholder in position as shown in Fig. 3, using a 25-watt lamp to check exact position and arranging the bulb of the lamp to be about ½in. from the bottom of the box.

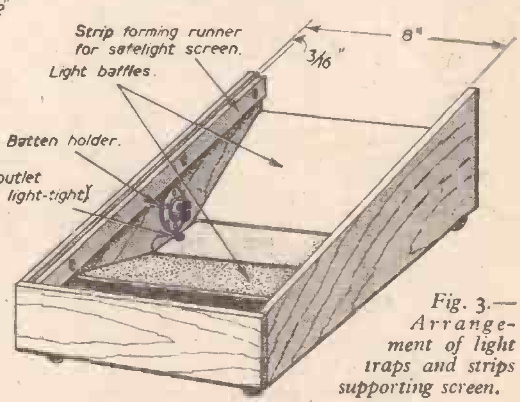
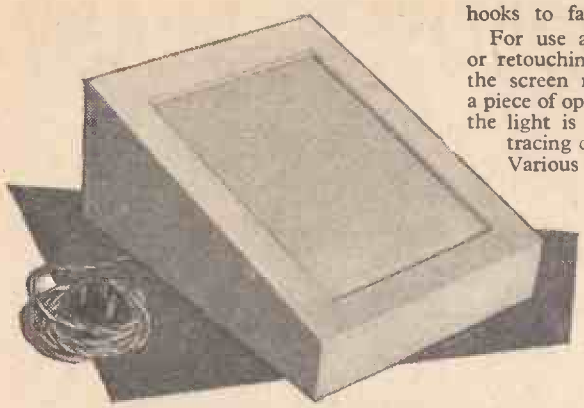


Fig. 3.—Arrangement of light traps and strips supporting screen.

Pin and glue mask to the top edge of the box and check that the screen slides freely into position. Check that the removable end fits snugly when screen is in place.

Trim off edges of bottom and mask and



The completed safelight.

glasspaper all over. Paint outside to taste.

Fit rubber feet to end and bottom with woodscrews. The feet fitted to the bottom should be at least ½in. high to permit free circulation of air.

If the safelight screen is unlikely to be changed frequently the open end may be secured with four woodscrews. If, however, the light is to be used with a variety of materials requiring frequent changes of screen it may be secured by means of two small hooks to facilitate the changes.

For use as a negative viewer or retouching desk for negatives the screen may be replaced by a piece of opal glass. So arranged, the light is also most useful for tracing drawings or diagrams. Various positions for its use are shown in Fig. 5.

The lamp may be hooked on to a wall by means of one of the ventilation holes in the back.

Suitable Bulbs

For table use, a 15-watt bulb is adequate, but when the safelight is hung on a wall a 25-watt bulb may be fitted. In either case the small pigmy indicator type of bulb is the most suitable.

Filter Screens

A variety of 10in. × 8in. safelight screens may be obtained from any of the larger photographic dealers. The particular screen selected will, of course, depend upon the sensitive material in use, but it should be purchased before starting construction, as there may be some variation of size.

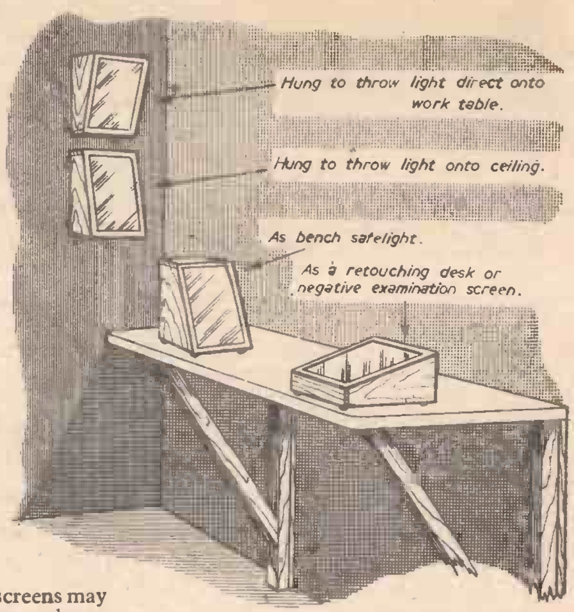


Fig. 5.—Positions for using the safelight.

Science and Observation

By Prof. A. M. LOW

Voyagers in the Stratosphere

BY now we are quite used to the idea of flight into the stratosphere by man but not, I think, by insects. A few years ago a small "Scientific Army" explored the upper air in order to find out how certain insects, fatal to the well-being of man, spread out all over the world. The aircraft used were equipped with special insect-catching traps.

Spiders were found three miles above the earth and mosquities as high as five thousand feet. That menace to the world's cotton crops, the pink bell-worm moth, was caught more than a mile above our earth, and numbers of ants, sand-flies, lady-bird beetles and various small insects were found in the traps at a height of 15,000ft.

It was obvious to experts that these "travellers" took advantage of favourable wind currents. They do not like high winds and will not set out on a sky trip when there is a calm. But with the winds as they want them, insects use these aerial routes to distribute themselves around the world.

On investigation it was also discovered that there are actually insect "tramps" which crawl on to the backs of other insects and squat there, travelling in perfect comfort. It is strange that while man is so proud of his flights into the "stratosphere," he forgets that insects have been using this route for centuries!

New Travel

It is strange that we still specify the testing of machinery by distance. "Drive slowly for the first 500 miles," we say. Now time and distance, if not the same thing are closely connected, and in the aircraft world we mix distance and time almost indiscriminately. The fact is the faster the travel the more time matters instead of distance.

I was at an exhibition of flying models recently and saw an improved type of skimmer, part aeroplane and part high-speed seacraft. Think for a moment of the problems of science in connection with boats, waves and ocean-going liners.

This is my point. On a small outboard boat when air is passing gaily under the hull, slight ripples in the water do not matter terribly. If the boat were a model 1ft. long the least ripple would swing it. Supposing it were a quarter-mile long, would it not by the same argument skim over quite large waves simply because it covered sufficient of them to produce what we call smoothness?

If so, it suggests the possibility of fast skimming ships for carrying freight across the Atlantic, leaving it to aircraft to take expensive passengers or to refuel at a floating island in the middle, before the days when space ships take the air. Or rather, not the air, for these 5,000 m.p.h. vessels which we shall undoubtedly have in the far future could not possibly travel where our atmosphere exists. Rockets work far better in a vacuum.

Beware of the Night

One has to be very careful to avoid self deception. The cinema is the most famous of all deceivers, for it gives something stationary the illusion of movement. Even a radiogram gives an illusion of sound, for it is no more than a mechanical instrument in the early stages of operation.

The old rumour that cars run better at night is, of course, due to a reduction of visual distance and seldom on account of moisture in the air. Moisture used even to be dripped into the inlet pipe of motor-cars in early days, but it should really be injected as liquid against the side of the cylinder, if it is to do good by absorbing unwanted heat, instead of heat which even modern engineers can use to drive the car.

But there are other more tempting illusions. When a car is running forwards on the level with throttle closed preparatory to braking, it often seems to leap forward when it is put into neutral. The cause is not that of driving downhill using the engine as a brake and partly opening the throttle with the clutch in to increase the work done by the engine in stopping the car.

This forward leap on level ground is simply an illusion. The reason is that deceleration is decreased because unless power is given to the car it cannot jump forward or increase its pace violently.

The retarding effect of an engine, however, is very considerable, for mechanical efficiency is never high. After a general overhaul we are often told not to exceed, say, 35 miles per hour, and although it is not a good thing to achieve high cylinder temperature by a wide open throttle the main reason is not one of explosion pushing the piston too hard but of the terrific forces, amounting to many tons, exercised in the engine by the reversal of reciprocating parts.

Self Promotion

Doubtless, you will have witnessed the trick of lifting the heavy man. He is sat in a chair and four people put their hands under him in various places, then find that they cannot move him an inch. The person who is carrying out the trick instructs two of the audience to put their crossed first fingers under his armpits and two others their crossed fingers under the bend of the knee. He seriously checks that fingers are crossed; he warms his hands, rubs them on his coat and puts them close together not quite touching as if he were trying to feel some tension between them. He explains to his audience how friction generates electricity, talks of clouds rubbing together and producing lightning, or the simple experiment of drawing sparks from dry brown paper and of attracting chips of wood by rubbing a piece of vulcanite on the sleeve.

He tells the audience that he can electrify the man and thus reduce his weight by interfering with gravity. They will believe anything if it is said convincingly enough. Having "electrified" the man by placing the rubbed hands behind his head, he very solemnly and slowly tells his lifters all to lift together on "three." Count one, two, *three* and up will go the man like a rocket. The reason, needless to say, is that never before do they with confidence lift together. You try it!

Making a VENTRILOQUIST'S DUMMY

Make Your Own Doll with Moving Head, Eyes and Mouth

By FREDERICK GILLSON

A VENTRILOQUIST is much sought after, and can be the "lion" of any party, providing he knows how to manipulate—and converse with—the doll on his knee!

A professional ventriloquist's dummy is expensive to buy, but the one to be described is both inexpensive and easy to make (Fig. 1). The most complicated part of the dummy is the head, because in it is the mechanism that works the eyes, mouth and head. But, if it is made in easy stages, it is not a difficult problem.

An artist's impression of the dummy in use.

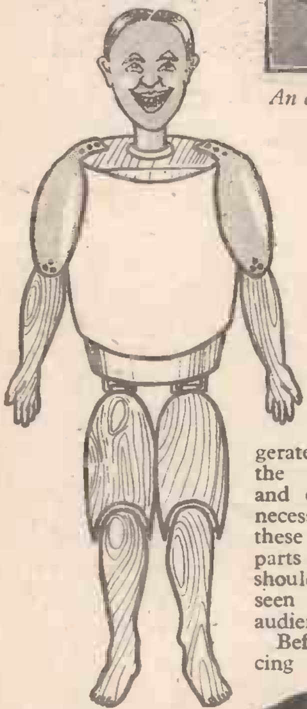


Fig. 1 (Above).—The completed dummy.

First, take a lump of plasticine about the size of a baby's head and carefully mould it to form a face. It is advisable to exaggerate in forming the nose, mouth and eyes, as it is necessary that these important parts of the features should be readily seen by the audience.

Before commencing the actual moulding of the features, you should decide upon the character the dummy is to represent. If you desire a cheeky boy, then fashion the face accordingly—with a large mouth, nose and eyes. The same thing applies to a jolly sailor, soldier or policeman. An important thing to remember is—whatever you determine the character of your dummy — let the features be cheerful, so that your audience will be sympathically disposed towards it (Fig. 2).

Fig. 2 (Right).—An example of cheerful features.

When you are satisfied with the appearance of the dummy's face, cover the head with small pieces of newspaper that have been dipped in flour paste. Plenty of paper will be required, because layer upon layer has to be put on, until a thickness of about ⅛in. is obtained. (See Fig. 3).

An easy way to arrive at the thickness required is to use alternately a piece of plain newspaper and a coloured layer. This will enable you to tell at a glance when the head is covered. Allow each layer to dry before putting on the next; about twelve layers should prove sufficient.

When the paper is thoroughly dry the plasticine has to be extracted. To do this, neatly cut the head vertically in half and gently scoop out as much of the plasticine as you can conveniently remove. Now carefully cut out of this papier mâché head two slots for the eyes.

There are three mechanisms to be made—one to cause the mouth to open and close; another to move the eyes from side to side; and a third that will enable the head to be turned in different directions.

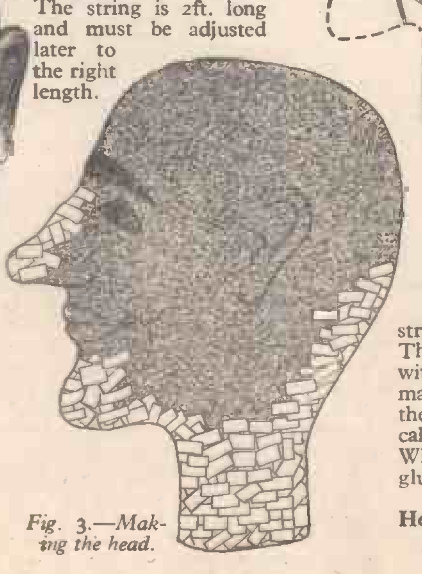


Fig. 3.—Making the head.

The Mouth

Cut away the lower part of the mouth and chin, as shown in Fig. 4, and then re-set it, glued on a hinged wooden strip attached to a spring, as in Fig.5. It is essential to glue inside a semi-circular wooden bracket (A) in order to support the strip (B). For opening the mouth string is used, at the end of which there should be a wire ring large enough for the finger. The string is 2ft. long and must be adjusted later to the right length.

The hinged mouth will need to be supported from above and here string is used, in the middle of which a spring is to be placed (Fig. 5). Make a small hole in the top part of the head, and from underneath push the string through it. Secure it by tying a knot in the end.

The papier mâché needs to be strengthened at this point with a small piece of tinplate glued to the head. If this is not done the string will be pulled through the head. The small cavity, caused by the movement of the lower jaw, can be hidden with a small piece of chamois leather. When the movement is completed test it by gently pulling the string.

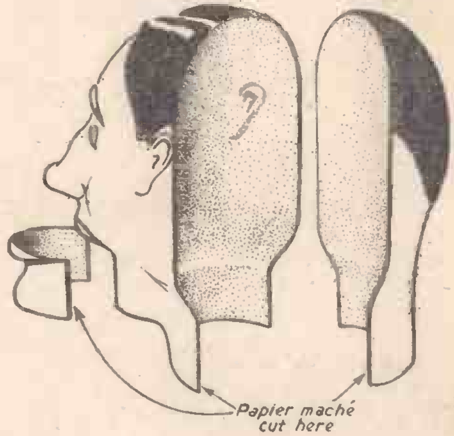


Fig. 4 (Above).—The head cut vertically and the cut away jaw.

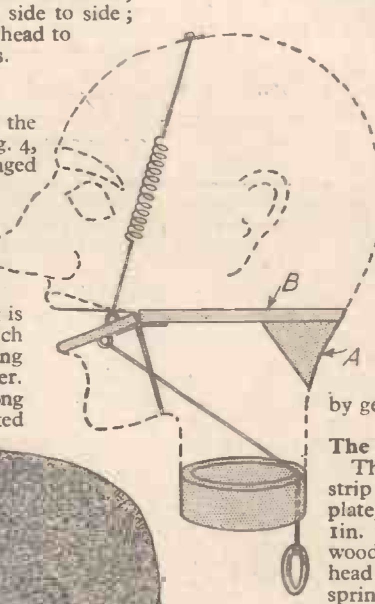


Fig. 5 (Left).—The jaw mechanism.

The Eyes

The eyes are painted on a strip of white painted tinplate, about 3in. long, and 1in. wide. Glue a piece of wood at each side of the head and insert two small springs, as shown in Fig. 6. Also glue a thin strip of soft leather above and below the eye-plate, at the ends indicated by the shaded portions.

A pull on the string will move the tin horizontally to the right. The length of the string should be about 2ft. until adjusted later. Then carefully paint blue circles for the eyes, with black centres. Pull the string gently, to make sure the eyes will move far enough to the right. Making this essential mechanism calls for much care, attention and adjustment. When the mechanism is working satisfactorily glue the two parts of the head firmly together.

Head Movement

Push part of an ordinary broomstick into the neck and glue around it a 1in. thick wooden disc. It must be wide enough to fit the neck, to which it has to be glued, see Fig. 7. A small lever is then screwed to this stump in order to work the eyes. This is accomplished by tying one end of a piece of string to the lever and the other end to the tin eye-plate.

The body of the dummy is hollow. Make a shoulder-piece, with a hole for the neck (Fig. 8 (A)). Then carve a wooden seating-block (B). Connect this to the shoulder-piece with a portion of tinplate bent around (C). Take care, however, to leave an opening at the back large enough to allow your hand to be inserted easily. You will need to grasp the stump in order to turn the head.

Then the head, on its broomstick, is let down through the neck-hole. Cut off a piece from the end of the stump otherwise the neck will be too long. Glue to the seating-block a 1in. thick circular disc of wood with a hole in it to receive the stump (Fig. 8).

The Arms

The lower part of the arm is to be carved in wood. This is then nailed to the upper part which consists of a small linen bag stuffed with cotton wool. Leave an inch or so of the linen at the top so that it may be nailed to the top of the shoulder-piece (Fig. 9).

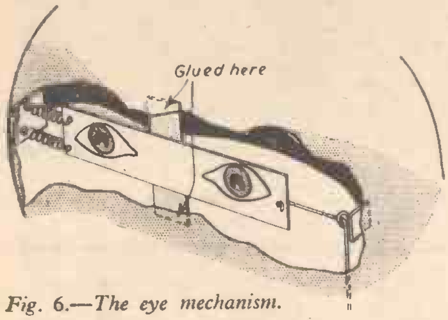


Fig. 6.—The eye mechanism.

The Legs

Both the legs and the thighs are to be carved in wood. Prepare the thighs first, and scoop out a U-shaped opening at the knee to receive the leg.

At the top of the thigh insert a leather strip, which is to be wrapped around a wire staple and fixed to the seating-block (Fig. 9).

Painting

Cover the entire head with a light coating of Alabastine. It should be mixed to a creamy paste and put on with a stiff brush. When dry rub down well with glasspaper to make it smooth. Apply under-coating two or three times before the final painting.

Use pink paint for the face, arms and legs. When dry, rosy cheeks and lips can be obtained with vermilion. For shadows under the eyes use Prussian blue mixed with cream paint to make it paler. Do not make the mistake of "over-painting" your dummy. The nose and cheeks should not be too red, or they will appear clownish.

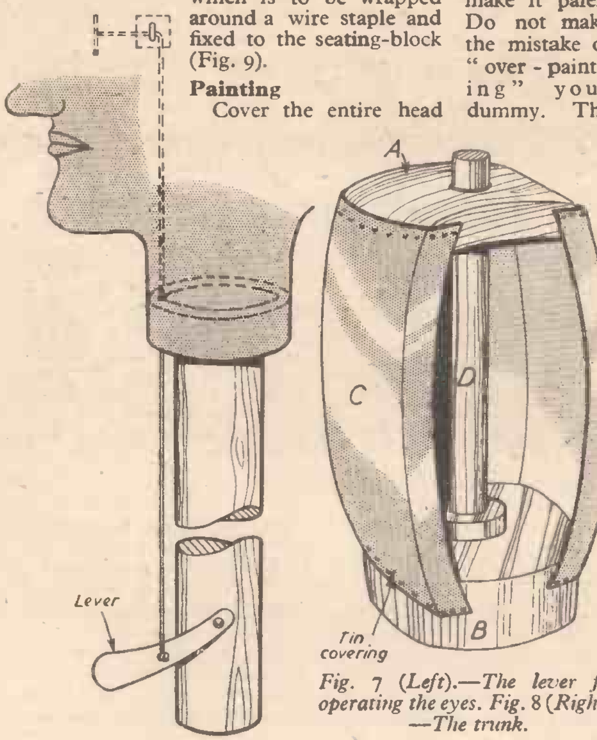


Fig. 7 (Left).—The lever for operating the eyes. Fig. 8 (Right). —The trunk.

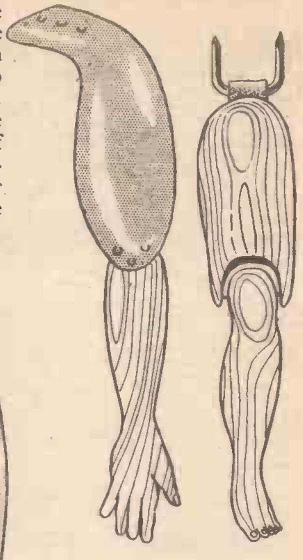


Fig. 9.—The arm and leg details.

When the paint is dry add a wig made of crepe hair. You will dress the dummy, of course, as you desire. Bright colours are more attractive than dull ones.

Entertaining

Make a collection of good jokes, but ignore the old "chestnuts." Then prepare your patter, with appropriate remarks—and suggestions!—from the cheerful little figure on your knee, who is sure to interest and amuse those you seek to entertain.

Steam Turbo-generators

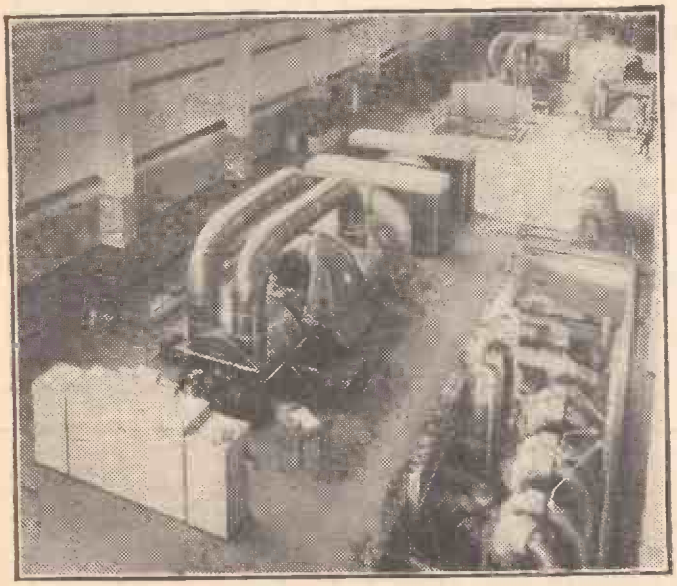


Fig. 1.—The two hydrogen-cooled sets at Uskmouth.

THE total capacity of plant commissioned for the British Electricity Authority has exceeded that in any previous year and includes three 60 MW hydrogen-cooled sets, two at Uskmouth (Fig. 1) and one at Ince Power Station. Two 30 MW sets are in service at Doncaster, and the first of two 30 MW sets for Huddersfield.

Three 30 MW sets have been delivered to the Orlando Power Station, Johannesburg, extensions to which will increase its capacity to 337.5 MW. Generating sets have also been delivered to Bloemfontein Municipality and to the Demerara Electric Company, British Guiana.

A number of industrial sets are on order to provide process steam, and include plant for the Steel Company of Wales and the National Physical Laboratory. Over fifty marine turbo-generator sets are on order (Fig. 2).

The G.E.C. is the main contractor for the complete power station for the £20 m. iron and steel project at Motherwell ordered by Colvilles, Ltd. The contract includes buildings, civil engineering work, boilers, generating plant, turbine-driven blowers, back pressure turbines and cooling towers, together with switch and control gear, transformers, cables and lighting installation.

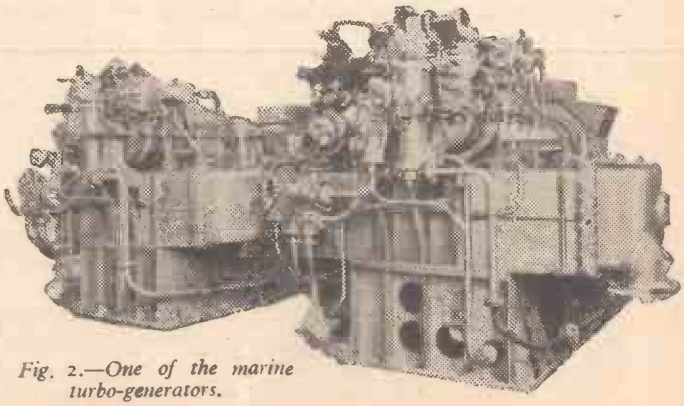


Fig. 2.—One of the marine turbo-generators.

A simplified ORRERY

Constructional Details and a History of the Instrument

By FRANK W. COUSINS, A.M.I.E.E., A.C.I.P.A., F.R.A.S.

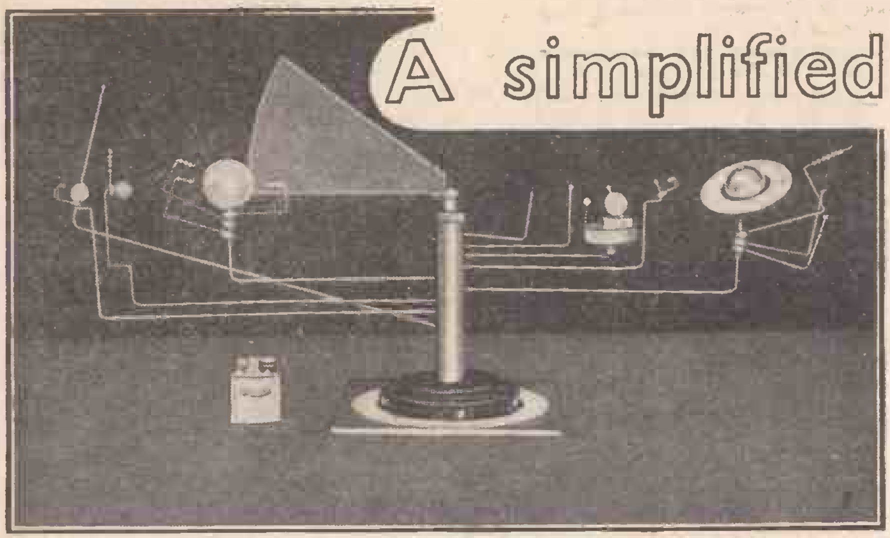


Fig. 11a.—The completed orrery. The cigarette lighter gives some idea of the size.

IF you take up a reliable work on astronomy, which contains all the modern data, you will notice that the solar system comprises nine major planets, having between them 31 satellites. How are all these bodies arranged about the Sun ? To understand this question fully and to give a satisfactory answer requires a detailed understanding of astronomy. In these articles the full details will be presented so that the amateur may make an accurate model and use it with advantage and enlightenment.

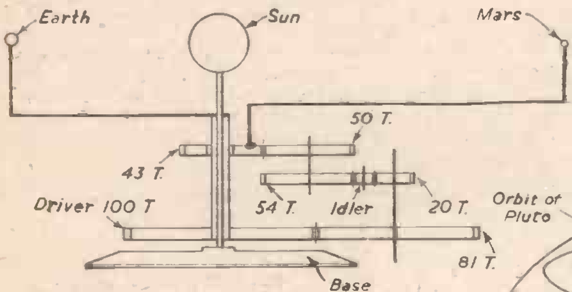


Fig. 1.—Gear train for Earth/Mars system.

The History of the Orrery

Firstly, models of the solar system are not new. In early days skilled workers in metal had produced magnificent armillary spheres to demonstrate the geocentric system of the Universe of Ptolemy and later the heliocentric system of Copernicus.

There is a legend to the effect that Archimedes possessed an instrument or model to reproduce the motions of the planets. In 1682 the skilled clockmaker Johannes Van Ceulen de la Haye made what was called a planetarium after a design by the astronomer Christian Huygens. This remarkable instrument is still preserved at Leyden. In it the motions of the planets are shown with their proper relative speeds about the Sun. Eight years after this George Graham made a similar model and this was improved by John Rowley in an instrument for Charles Boyle, the fourth Earl of Orrery. This instrument which showed the solar system was called by the famous essayist Sir Richard Steele an " orrery." This is the genesis of the name by which all such models are now known. Some very excellent clockwork orreries are on show at the Science Museum ; some are of Continental manufacture and others by English makers.

David Rittenhouse, of Philadelphia, produced some remarkable orreries, one of which is now at the University of Pennsylvania. It shows on a central panel the relative motions of the planets from Mercury to Saturn with great accuracy ; other panels show the movement of the Moon, an eclipse computer, the year, month and day of eclipses being given for 5,000 years before and after 1769.

A monster orrery was constructed at the Deutsches Museum, Munich, in 1920. A circular room of over 30ft. diameter had a centrally illuminated Sun about which the planets moved on electric carriages. A similar orrery has been made in the famous Hayden Planetarium at New York.

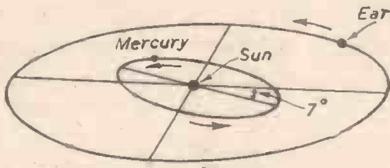


Fig. 4.—Inclination of the orbit of Mercury.

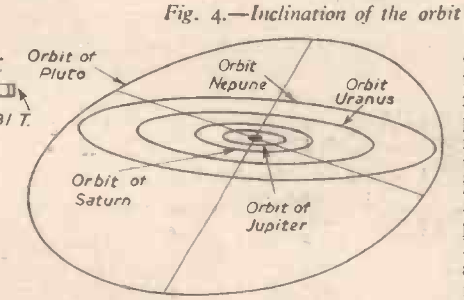


Fig. 2.—The small innermost circle represents the orbits of Mars, Earth, Venus and Mercury. The sun is at the centre.

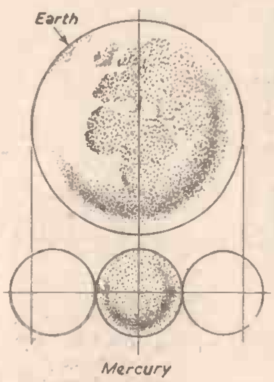


Fig. 3. — Earth dia.—1 ; Mercury dia.—0.39.

Problems of Construction

In wheel-work orreries complex problems have to be solved in the design of suitable gear trains. An example has been given by R. K. Marshall.

The planet Mars requires 1.88082 years to revolve about the Sun. The problem is to devise gears which, when properly matched in train, will give a ratio between the motion of Mars and that of the Earth very nearly equal to the true ratio as above. By the use of suitable tables* or extended fractions we find that :

$$\frac{43}{50} \times \frac{54}{20} \times \frac{81}{100} = 1.88082.$$

We are thus able to use these numbers : 43, 50, 54, 20, 81, 100 in six gear wheels which will produce the motion of Mars relative to that of the Earth with an accuracy of one part in almost 200,000. In other words, a model using such a gear train would permit Mars to make more than 500 trips round the Sun before it was in error by a single degree.

The problems associated with gear trains of this kind were very fully analysed by Camus in his classical work *Cours de Mathematique*, published 1752.

A gear train for moving the planet Mars is shown in Fig. 1.

A number of ingenious orreries have been disclosed in the last fifty years, and the following British patents may be of interest to those who wish to study the subject in detail : 342023, 384048, 414268, 425108, 460463, 530730, 700680. The last mentioned patent is for a tellurion, a model of the Earth to show the effect of the diurnal rotation and annual revolution and obliquity of axis in causing the alternations of day and night and the successions of the seasons.

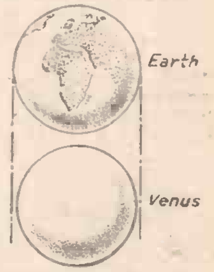


Fig. 5.—Earth dia. —0.1 ; Venus dia. —0.97.

The Simplified Orrery

While such orreries excite the imagination, there is a great need for a simplified orrery which is able to demonstrate all the salient features of the solar system.

A simplified orrery was produced in 1947 by D. and K. Bartlett and described in a booklet, *The Planets and Us*, published by George Philips. This orrery is of simple construction and is of little value other than to show the order of the planets outward from the Sun. At that time (1947) the designers of the Bartlett Orrery were not aware of the inclination of Pluto's orbit to the Ecliptic. The twelfth Moon of Jupiter, the fifth Moon of Uranus and the second Moon of Neptune had not been discovered.

The writer believes that a simplified orrery, to be of any use, must show four main features :

(a) The inclination of the orbit, if in excess of 3°.

* *Gear Trains*, by Dr. Merritt, Pitman, 1947.

(b) The inclination of the planet's axis.
(c) The size of the planet to scale.
(d) The satellite system of the planet.

In order that the reader may better appreciate the construction of the new simplified orrery, the following description of the solar system may be of value.

Fig. 6.—Earth dia. —1. Mars dia. —0.53.

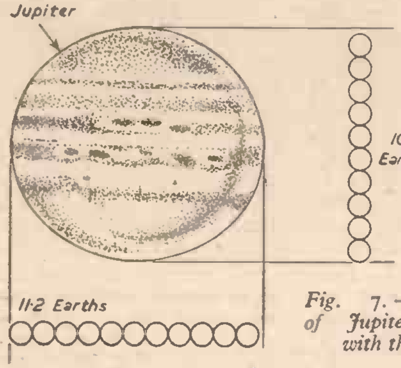


Fig. 7.—The size of Jupiter compared with the Earth.

Fig. 2 shows the solar system looking down from the North Celestial Pole. The planets, in order from the Sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. All these bodies move about the Sun anti-clockwise, and rotate on their axes in a similar manner. The orbits of Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune are substantially coplanar. The orbits of Mercury and Pluto are inclined to the plane of the Earth's orbit (the plane of the Ecliptic) by an angle of 7° and 17° respectively.

Let us consider the planets individually in order from the Sun.

Mercury

Size: 3,100 miles diameter.
Distance from the Sun: 36×10^6 miles.
Axial rotation: 88 days ? 24 hours ? (uncertain)
Tilt of axis to orbit: 20° (uncertain).
Inclination of orbit to the plane of the Ecliptic: 7° 00′ 14.0″.
Period about the Sun: 0.24085 tropical years*.
Satellites: None.

In Fig. 3, Mercury is compared with the Earth. If the Earth's diameter is considered to be unity then Mercury's diameter is 0.39.

As previously noted the inclination of Mercury's orbit to the plane of the Ecliptic is in excess of 7° and this phenomenon is clearly illustrated in Fig. 4.

Venus

Size: 7,700 miles diameter.
Distance from the sun: 67.2×10^6 miles.
Axial rotation: 225 days (uncertain).
Tilt of axis to orbit: 20°, 50°, 75° (uncertain).
Inclination of orbit to plane of Ecliptic: 3° 23′, 39.1″.
Period about the Sun: 0.61521 tropical years.
Satellites: None.

In Fig. 5 Venus is shown compared with the Earth. On a basis of the Earth as unity Venus has a diameter of 0.97.

* Tropical year is 365.24 days (equinox to equinox).

Earth

Size: Polar 7,900 miles.
Equator 7,927 miles diameter.
Distance from the sun: 92.9×10^6 miles.
Axial rotation: 23 hours 56 minutes .04 seconds.
Tilt of axis to orbit: 23° 27′.
Plane of orbit is plane of Ecliptic.
Period about the Sun: 1.00004 tropical years.
Satellites: One only (the Moon).

Mars

Size: 4,200 miles diameter.
Distance from the Sun: 141.5×10^6 miles.
Axial rotation: 24 hours 37 minutes 22.654 seconds.
Tilt of axis to orbit: 24°-25°.
Inclination of orbit to plane of Ecliptic: 1° 50′ 59.9″.

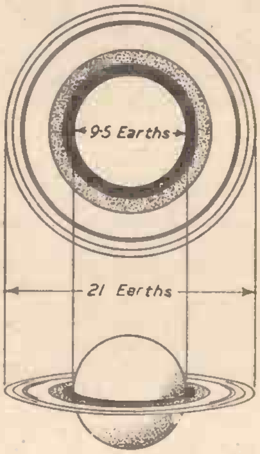


Fig. 8.—The size of the planet Saturn compared with the Earth.

Period about the Sun: 1.88089 tropical years.
Satellites: Two.
In Fig. 6 Mars is compared with the Earth as unity. Mars is rated at 0.53.

Jupiter

Size: Polar 82,800 miles.
Equator 88,700 miles diameter.
Distance from the Sun: 483.3×10^6 miles.
Axial rotation: 9 hours 50 minutes.
Tilt of axis to orbit: 3° 6′.
Inclination of orbit to plane of Ecliptic: 1° 18′ 20.3″.
Period about the Sun: 11.86223 tropical years.
Satellites: Twelve.

In Fig. 7 Jupiter is shown compared with the Earth. Taking the Earth's diameter as unity, Jupiter is rated at 11.2 and 10.4 for the equatorial and polar diameters respectively.

Saturn

Size: Polar 67,200 miles.
Equator 75,100 miles diameter.
Distance from the Sun: 886.1×10^6 miles.
Axial rotation: 10 hours 14 minutes.
Tilt of axis to orbit: 26° 44′.
Inclination of orbit to plane of Ecliptic: 2° 29′ 25″.
Period about the Sun: 29.45772 tropical years.
Satellites: Nine.

In Fig. 8, Saturn is shown compared with the Earth. Taking the Earth's diameter as unity, Saturn is rated at 9.5 and 8.5 for the equatorial and polar diameters respectively.

Uranus

Size: 30,900 miles diameter.
Distance from the sun: $1,783 \times 10^6$ miles.
Axial rotation: About 10.8 hours.
Tilt of axis to orbit: 8°.
Inclination of orbit to plane of Ecliptic: 0° 46′ 22.9″.
Period about the Sun: 84.01331 tropical years.
Satellites: Five.

In Fig. 9 Uranus is shown compared with the Earth as unity; Uranus is 3.9.

Neptune

Size: 33,000 miles diameter.
Distance from the Sun: $2,793 \times 10^6$ miles.
Axial rotation: 15 hours 40 minutes.
Tilt of axis to orbit: 30°.
Inclination of orbit to plane of Ecliptic: 1° 46′ 27.1″.
Period about the Sun: 164.79345 topical years.
Satellites: Two.
In Fig. 10 Neptune is shown compared with the Earth as unity. Neptune is 4.2.

Pluto

Size: 3680 miles in diameter (uncertain).
Distance from the Sun: $3,666 \times 10^6$ miles.
Axial rotation and tilt of axis to orbit unknown.

Fig. 9.—Earth dia. —9. Uranus dia. —3.9.

Fig. 10.—Earth dia. —1. Neptune dia. —4.2.

Inclination of orbit to plane of Ecliptic: 17° 08′ 38.4″.
Period about the Sun: 248.4302 tropical years.
Satellites: None known (1955).

Modifying Scale Distances

If this great wealth of data is analysed it will be readily obvious that some compromise must be made if a successful model of the solar system is to result.

First the distances of the planets from the Sun are immense. The Earth is 92.9×10^6 miles away from the Sun. If we take the Earth's diameter to be 8,000 miles and use this as a unit, the Earth is found to be $\frac{92.9 \times 10^6}{8000} = 11612$ approximate Earth-units from the Sun. In our model orrery the Earth bead is to be ⅛in. diameter and this will have to be, if we make the model correctly, $\frac{11612}{8 \times 12}$ft. = 121ft. from the centre of the model.

Pluto, the planet at the greatest distance from the Sun, 3666×10^6 miles, will have to be placed about 4,800ft. from the centre, a distance equal to nine-tenths of a mile. In view of this the distance of the planets from the Sun *cannot* be utilised to scale unless the beads representing the planets are made so small that they would only be readily visible under a powerful lens.

In the model the planets are made to scale, but the distances of the planets from the Sun are ignored.

The Earth's diameter is made to be ⅛in. and on this unit the model is constructed. A detailed drawing of the orrery is shown in Fig. 11 and a photograph is shown in Fig. 11a.

Constructional Details

Referring now specifically to Fig. 11, it will be seen that the orrery comprises a central column 10 secured to a base 11. The column has a washer for each planet orbit, and in the case of Mercury and Pluto the washer which carries the orbit wire has two inclined washers co-acting with it, providing a tripartite washer assembly: this permits the planet to move in an inclined orbit about the Sun.

The tripartite washer assembly for Mercury is showing in Fig. 11 at 12, 12a, 12b. The washer for Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune are respectively shown by the numerals 13, 14, 15, 16, 17, 18 and 19. The tripartite washer assembly for Pluto is shown at 20, 20a, 20b.

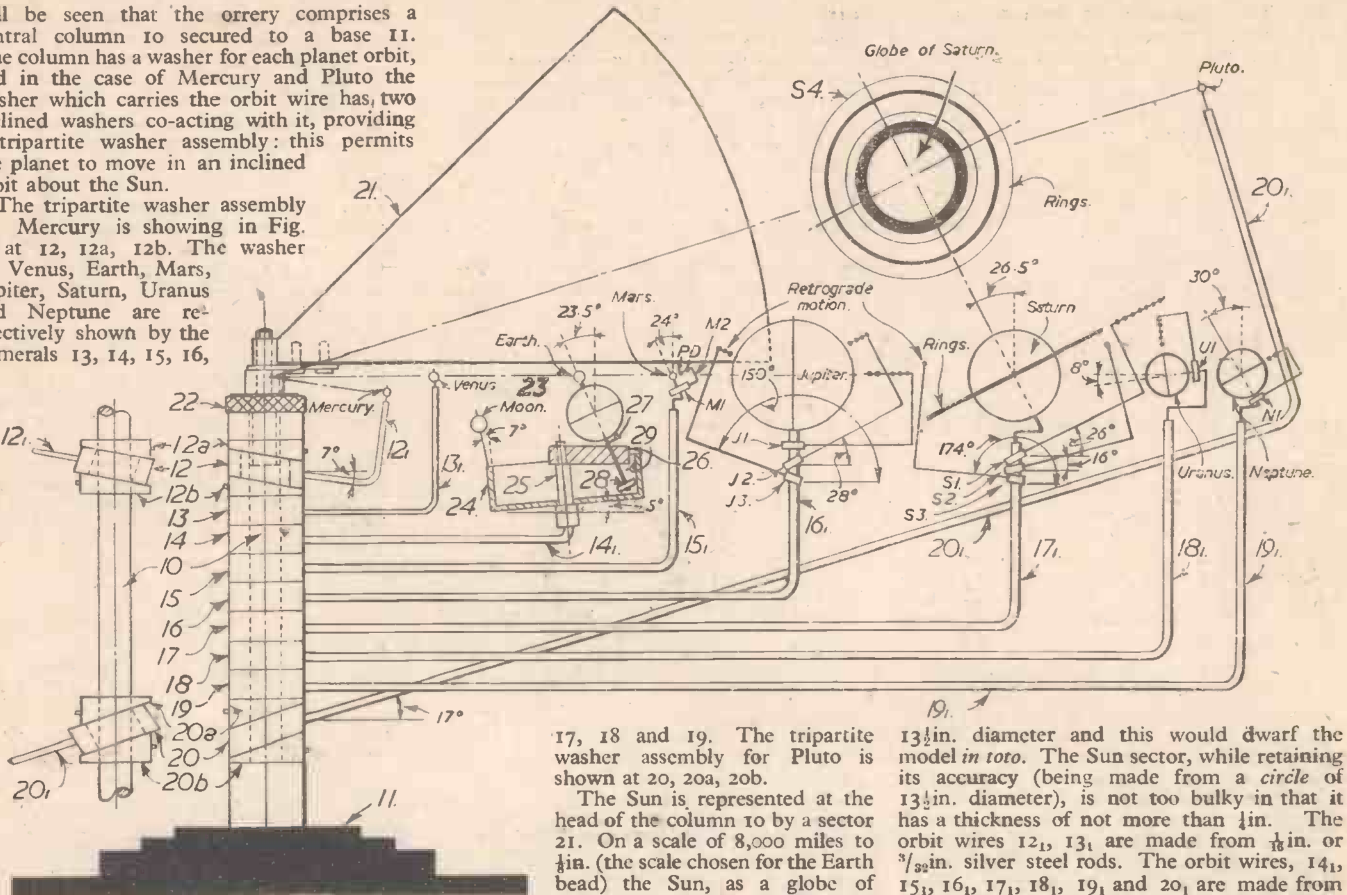
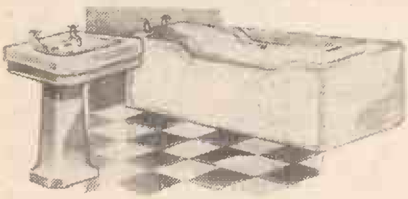
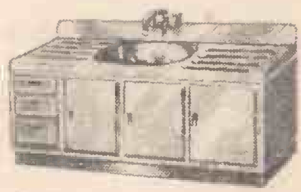


Fig. 11.—A detailed diagram of the orrery. This is 4/10ths. full size. The diameter of column washer is unit one inch.

The Sun is represented at the head of the column 10 by a sector 21. On a scale of 8,000 miles to ⅛in. (the scale chosen for the Earth bead) the Sun, as a globe of 864,000 miles, is $\frac{864000}{8000 \times 8}$ in. diameter. The globe would be 13½in. diameter and this would dwarf the model *in toto*. The Sun sector, while retaining its accuracy (being made from a *circle* of 13½in. diameter), is not too bulky in that it has a thickness of not more than ¼in. The orbit wires 12_1, 13_1 are made from 1/16in. or 3/32in. silver steel rods. The orbit wires, 14_1, 15_1, 16_1, 17_1, 18_1, 19_1 and 20_1 are made from ⅛in. silver steel rod. The ends of the rods are force-fits into holes drilled in the individual washers. *(To be continued)*

A Home Built Hot Water System





Build and Install this Domestic Amenity Yourself

By S. SIMPSON

SOME years ago the writer moved into a country cottage in which the facilities were somewhat primitive. Among the improvements contemplated was a hot-water installation, but after paying for other work, finances to install an orthodox system were unavailable.

After some experimenting, the device described in this article was evolved and has proved efficient, reliable and economical.

Operating and Performance Details

Capacity: 12 gallons, raised from cold to 140 deg. F. within approximately 75 minutes.

Temperature control: Thermostat, immersed in tank.

Current: Full load is 3 kW. A.C., reducible to 2 or 1 kW. with consequent lengthening of heating time. (Important note: The power capacity of the existing electricity arrangements should be checked by an electrician to ensure that the heater may safely be added to the power circuit.)

Delivery: Approximately one pint per 10 seconds.

Lagging: With current off, the tank will hold the temperature up to about 120 deg. F. overnight.

Quantity: Approximately 8 gallons before dilution reduces temperature to 100 deg. F. Restoration to 140 deg., approximately 20 minutes.

Heaters: Three standard electric kettle elements of 1 kW rating.

Indicator: A neon indicator is a useful accessory, enabling a faulty element or thermostat to be detected.

The actual form of the device can, of course, be varied to suit individual requirements; so long as the main principles are adhered to, no trouble should arise.

Materials Required

One 12-gallon tank, galvanised iron, with zinc cover. The cover should provide an overhang of ¾in. all round.

One zinc sheet, 3in. by 6in. by ⅛in. thickness. Sufficient tubing or piping to reach from the existing cold water supply to the base of the positioned tank.

Unions and nipple to suit the required cold water run, also one through-cock (hereafter termed "feed-tap").

Sufficient ¾in. copper pipe to reach the required point of delivery. This run must be as short and direct as possible.

Outlet gland to suit hot-water feed.

Suitable brackets to support the tank. These should have 1in. turned up projections at the extremities to keep the tank in place.

Three 1 kW. kettle elements, complete with washers and shield.

Three kettle connectors, side cable-entry preferred.

Thermostat control to carry 3 kW. This is of the simple rod type, with sheath.

Sufficient cable to connect the three elements, the thermostat, and, if required, the indicator individually to a junction-box placed near the tank. This cable may be rubber-covered twin, as used in kitchen appliances, but must be capable of safely carrying 1 kW. for prolonged periods.

One four-way bakelite junction-box.

Sufficient three-core (or twin with lead sheath) cable to connect the junction-box to the control switch; also from the switch to the point of supply, current capacity, 15 amps.

One double-pole switch and fuse, to break 15 amps.

Lagging material, applied as a paste. The mixture of textile mill-dust and cement as used by the heating engineering trade is most suitable, economical and easy to apply.

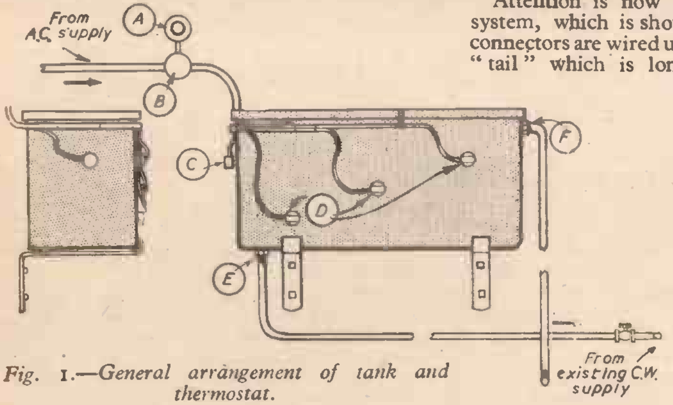


Fig. 1.—General arrangement of tank and thermostat.

The Brackets

The work commences with the fitting and cementing in of the brackets at a point which allows the hot-water outlet to be conveniently placed above the sink; the horizontal run of the hot-water feed pipe must be as short as possible and this partly determines the tank location.

Preparing the Tank

While the cement is drying, the tank can be prepared, the parts fitted and the tank tested for leaks. Start by cutting out the holes for the elements (D) and the thermostat sheath (C) located as shown in Fig. 1. Where the tank differs in shape the main points to observe are that the elements are placed in steps above and to the right of each other; except at the mounting stub, the elements must not touch the tank at any point; the upper element must be well under water when the outflow has stopped; the thermostat shield is located approximately 4in. below water-level at the far end from the hot-water outlet. Should an element be encountered at this depth, go deeper to ensure that the body of the water is adequately heated before "cut-off" occurs.

Having fitted the heaters and thermostat, the tank is now checked for leakage. The seepage around and inside the heater shields can be very slight, and ample time should be allowed for moisture to gather. When proved satisfactory, the tank is emptied and the cold-water and hot-water outlets cut. At this stage, fit near the top left corner of the thermostat end of the tank a small ¼in. screw and nut with washers to form an earthing terminal.

The Cold-water Entry

The cold-water feed (E) enters the base of the tank, about 2in. from the back wall and remote from the hot-water outlet. Before fitting the cold-water inlet nipple, a baffle plate is prepared. Mark a centre line along the 6in. length of the 6in. by 3in. zinc plate; cut on the centre line a clearance hole to take the cold-water nipple. Now bend the sheet into U-shape with the drilled leg 2in. long and the base of the U 1½in. deep. Fit the nipple into the tank, place the baffle over the nipple and tighten up the securing nut. It will be seen that the incoming flow will now diffuse over the plate. Details of this fixture are given in Fig. 2.

The hot-water outlet pipe (F) is now fitted and the tank is ready for mounting. Its final position should leave a 1in. gap between tank and wall for the application of lagging. When mounted, the cold-water feed-pipe should be run and connected, with the feed tap in series, to the tank and to the existing cold-water supply. This may or may not be a job which the reader feels he can safely undertake himself; in any case, the local water authorities should be informed that the work is required.

Wiring to the Junction box

Attention is now turned to the electrical system, which is shown in Fig. 3. The three connectors are wired up, each with an individual "tail" which is long enough to reach the wall-mounted junction-box (B) placed near to the tank at the thermostat end. All three tails are then paralleled. One lead (or group of leads, to be precise) is taken to the nearest terminal in the junction box and the other group to an adjacent terminal. The thermostat is also connected to a tail and the tail taken into the box. One leg of the tail connects to a terminal carrying a heaters group, the other leg goes to an adjacent free terminal. If visual indication is to be added, connect a tail to a batten-fixing lampholder (A) and mount the holder close to the junction-box in a position which will be clear of the main cable run, still to be fitted into the box. Now take the tail into the box and connect one leg to that terminal carrying the thermostat and heaters connections; the other leg goes to the terminal carrying heaters only. Fit the connectors into their respective sockets and, using waxed twine, bind all the tails into one cableform. Support for the cables can be adapted from clips fitted over the lip of the tank.

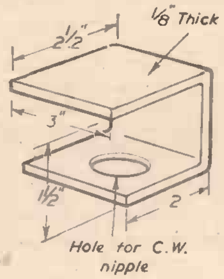


Fig. 2. — Cold-water baffle plate.

Wiring to the Control Box and Earthing

The main cable is now run and connected to the control switch. If lead-covered cable is used, connect the sheath to the earth screw on the switch case; if three-cored, connect the green lead to the screw. Whether or not the switch has been previously connected to the main supply, withdraw the fuses and put them in some safe place, apart from the switch, before starting the connection; this is a practice to be followed at any time when the work takes one away from the switch.

Now connect the green lead at the tank end of the cable to the earth screw on the tank. The remaining leads are cut to suitable lengths and connected:

Red lead to that terminal carrying a thermostat connection only;

Black lead to that terminal carrying heaters and an indicator connection together.

Checking Insulation and Continuity

The control switch is now ready to be connected to the house mains, if not already connected. DO NOT replace the fuses; the installation must first be checked for insulation and for continuity, preferably by the electrician who connects the switch to the mains. If the reader has sufficient experience, the necessary meters and the desire to do the job himself, he should proceed as follows:

(a) Remove all connectors from the heaters and the indicator from its holder;
(b) Check for resistance between the feed terminals for the circuit; this should be infinity;
(c) Replace one connector and check the resistance of the circuit; this should be about 50 to 60 ohms;
(d) Remove the connector; repeat the test with each connector in turn. In each case the readings should be very nearly the same.
(e) Using a "Megger," measure the leakage between each leg of the feed lines and earth; if the resistance is much below infinity, the circuit must be broken up and checked in parts until the faulty section is found. Remove the connectors before making this check.

Filling the Tank

When the circuit has been proved satisfactory, fill the tank. It is advisable to stay near the cold-water tap as the level approaches the hot-water outflow; the cold water enters under pressure, whereas the hot-water flow is by gravity only. It is possible, therefore, for the tank to flood if filled too quickly.

Applying the Lagging

When full, set the thermostat to its lowest figure, fit the indicators in their holders and switch on the electric supply. The indicator will immediately glow and remain so until the temperature of the water has reached approximately that set by the thermostat. During the heating period the lagging mixture may be prepared. Into half a bucketful of the mix add sufficient cold water to form a thick paste, somewhat like prepared cement. Wait for the tank to cut off, then switch off the A.C. supply. Now apply the lagging to the warm tank, using a trowel and finishing off with a soft distemper brush. Allow each layer to dry before applying the next and continue thus until at least 1in. thickness is built up. The element and thermostat fittings should be kept clear for future maintenance. In the writer's version no lagging was applied to the lid as it proved very useful for drying off kitchen towels and other "smalls." The back of the tank is lagged by temporarily blocking off the lower edge and then, from above, filling up the space with the lagging.

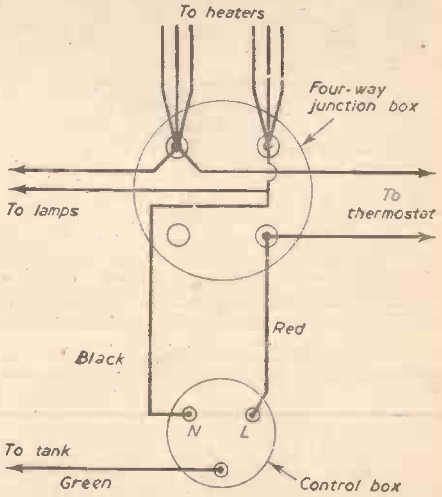


Fig. 3.—The electrical connections.

When the lagging has dried set the thermostat to the desired temperature and close the mains supply. The indicator should go out after about 40 minutes and the tank is then ready for service.

Building a Home Workshop

3.—A Bench Tool Grinder

By "TUBAL CAINE"

(Continued from June issue)

NO workshop is complete without a small tool grinder for sharpening lathe tools and small drills, and though there are several commercial designs on the market the construction of this equipment is well within the range of the average home shop.

Few amateurs find it convenient to have a pedestal machine, principally because the cost is too high, and they prefer to use their money in perhaps the purchase of some necessary hand tools; thus the bench type grinder illustrated at Fig. 1 is a welcome accessory and will soon repay the time spent on it.

As only one is required a pattern is unnecessary for the base and fabrication is adopted. If no welding torch and cylinders are available, a garage which undertakes welding repairs will for a reasonable sum soon fabricate this base.

Ball races are perhaps the most serious problem, and anyone contemplating the manufacture of this grinder should obtain them first and if necessary modify the design slightly to accommodate any which are not quite the same as those shown in the drawings.

Next, the size of the grinding wheels should be decided and before finish turning the main spindle obtain a pair and use them to ensure the shaft is a good fit in the wheel bore.

The Design

The cross-sectional drawing of this grinder (Fig. 1) does not include any guards over the wheels—an essential provision, as everyone acquainted with full-size engineering shop practice knows—but this is intentional and a separate drawing will remedy this omission.

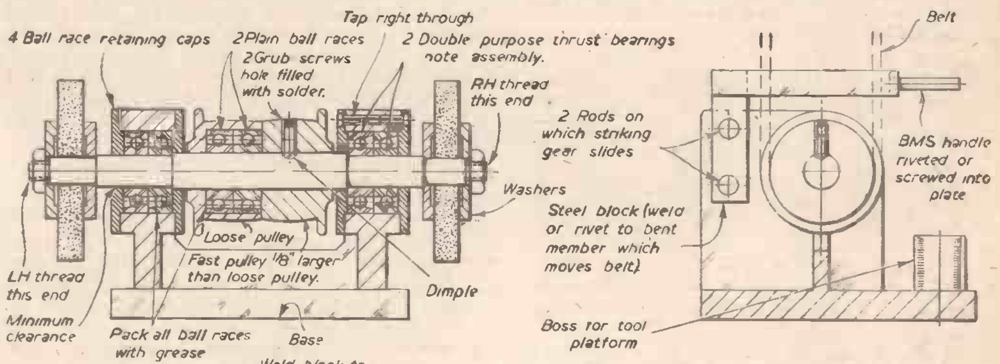
The base is of mild steel with two pieces standing at right angles and shaped as seen in the end elevation. Bosses are attached each side of these plates, and these are simply discs of black or bright mild steel. A stiffening web is a useful feature because it adds support to the side members and also to some extent prevents the base from warping when this is machined.

All these details which go to make the base will not require much cutting out—the web and the side members only have an "irregular" form, and the squaring up process is easily performed if the parts are clamped to the boring table of the lathe.

The web also is a straightforward milling job and needs only another cut as shown in the elevation at Fig. 2. The side webs are milled to the 1⅞in. radius, half the boss diameter, by first drilling, say, a 1in. hole at a centre corresponding to the boss centre and using this as a pivot when rotating it round the cutter.

As this base is going out of your workshop for welding you must make sure whoever carries out the work knows exactly where the side members are secured. Admittedly marked lines is an easy way out of this problem, but all readers are aware how easily such instructions are misunderstood, and if one side is perhaps ⅛in. too far from the opposite end, or has been welded out of square, the reader is left to make the best of a bad job.

However, you can make such a mistake impossible, and this is accomplished by attaching each side member to the base by screws or even simple pins driven into both details. Then the welder just runs his torch along the base corners, and he cannot misplace the two parts. There is no need for extreme accuracy—the pieces if set down to within, say, 1/32in. will ensure that the faces clean up correctly when the machining operation is carried out. There can then be no reason to blame the garage hand, because the welded base is exactly to the dimensions you require.



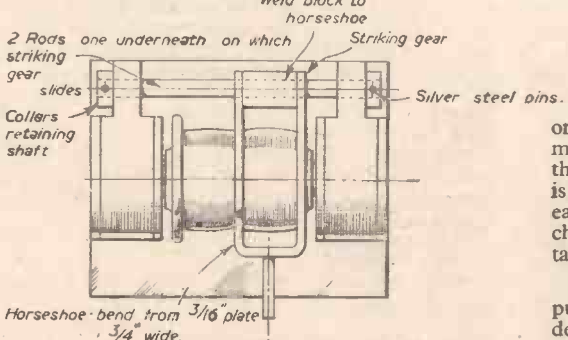


Fig. 1.—Cross-sectional, plan and end view of the grinder.

The Ball Races

Two bearings are inserted into each of these side members and they are a type known as double-purpose thrust bearings. They serve a dual function—they act as ordinary roller races, but due to their design they are also able to take end thrust in the same way as the orthodox flat thrust bearing. Four of these bearings are necessary and they are assembled in such a manner that the load is taken in one direction by one bearing while the other end receives the pressure when in the opposite direction.

I had four of these bearings, hence they were included in the design, but if two plain rollers are available and two double purpose members this arrangement will serve provided the latter are assembled at opposite ends of the shaft and opposed to each other.

Caps hold the bearings in place and these are turned from either brass or bright mild steel according to the available metal, and each is spigoted about 1/16in. into the side pieces of the body. Screws secure them to the faces and the tapped holes pass completely through the body. This is a necessity as you cannot drill, of course, from the inside as the opposite side piece is obstructing the drilling head.

Tapping the holes right through ensures that the caps tighten. One can use a socket wrench from the inside, but the pitch circle of the screw holes must match closely. For this reason readers are advised to drill them together by first placing them back to back with a short mandrel through the hole. If one has already been marked out the other must, of course, match perfectly. To drill the tapping holes accurately one of these caps is applied as a simple drill jig—first spotting each hole with the clearing drill and then changing that tool for another equal to the tapping size.

Two larger bearings are used for the fast pulley, and the turning and boring of this detail is a simple job, needing little description. One point which may escape notice is the edge where the two pulleys meet. I advise the reader first to turn the above-mentioned item and then, when turning the rim diameter of the fixed pulley, to make the edges match; this will then ensure the leather belt is not cut every time the tool is ground. Do not forget, however, that there is a difference of ⅛in. in the diameters of these pulleys; this is to ensure that when running on the fast member no stretch is possible and a positive drive is obtained as the belt is changed to the fixed member.

This fixed pulley is secured to the wheel shaft by a substantial grub screw, and at least 5/16in. Whit. or ⅜in. Whit. is suggested. Drill the crosshole and tap it. It may be contended that the threads will become damaged, but unless you prefer to do this operation on assembly—and it can prove a little awkward—then tap the pulley at this stage.

An important factor with this type of design is the locking arrangement, because if this is not provided continued vibration will cause this grub screw to slacken. The problem is solved quite easily. One grub screw is first inserted and " bites " hard on the dimple countersunk into the shaft, and for this a screw with a matching point is required. Next a small screw is again screwed down hard on top of this member, and to make certain they both do not become loosened the remaining ¼in. is filled with solder and smoothed off to correspond to the pulley diameter.

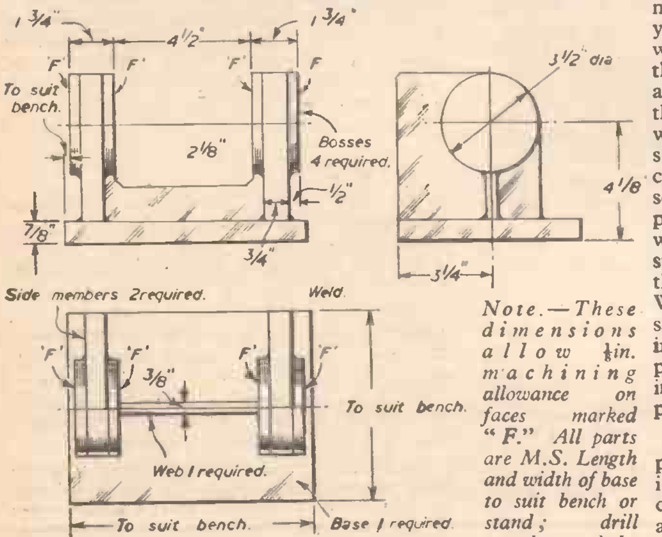
This assembly prevents vibration from causing the initial grub screw to become slack and so allow the pulley to rotate on the shaft. It may appear an elaborate precaution to take, but once set this pulley will possibly go on working for years without further attention.

The Wheels

This design has one extremely useful feature in that wheels of different grades are introduced on the spindle and will permit the reader to use one for the grinding of lathe tools while the other end is used for the sharpening of tiny drills.

Alternatively if you undertake a fair amount of polishing, then one end is modified from the design illustrated in these notes and made to suit a polishing bob. Note particularly that the threads are opposite hands, as shown in Fig. 1. In all the drawings, normal English projection is used.

Incidentally, underneath the grinding wheel locking nuts there appear some rather large washers and identical parts are also seen on the opposite side of each wheel. The actual diameter of these will depend on the grinding wheel, but they should not be made too small, as they lend considerable support, especially when side grinding.



Note.—These dimensions allow ⅛in. machining allowance on faces marked "F." All parts are M.S. Length and width of base to suit bench or stand; drill securing holes for ¼in. Whit. bolts where needed.

Fig. 2.—Details and dimensions of the base, side members and web.

Wheel Speeds

The maximum r.p.m. at which to run the grinding wheel is stamped on the label attached to the wheel, and this figure must never be exceeded. If the label becomes torn off a close estimate is achieved by using the following formula. A surface speed of about 5,000ft. per min. is desirable, and assuming the wheel as 6in. dia., then:

$$\text{R.P.M.} = \frac{S \times 12}{\pi \times D}$$

where S = surface speed in feet per minute and D = the wheel diameter. Substituting values we have:

$$\frac{5000 \times 12}{\pi \times 6} = \frac{5000 \times 2}{\pi \times 1} = \frac{10000}{3.14} = 3185 \text{ or}$$

3250 approx.

As a matter of interest you can check this against any information printed on the label of a wheel, but you must never exceed the number of r.p.m. stated by the manufacturers.

The Assembly

Those experienced in this class of work will take one quick look at the assembly drawing and proceed to put all the parts in place without further explanation from the author, but others may appreciate a few words of advice.

First attach the two inner ball race caps to the vertical " brackets," using for preference socket head members—these are tightened with a wrench and not a screwdriver. Put two races on one end of the shaft and then push it through the hole in the plate, threading on the pulleys while doing so. You will, of course, have inserted the races in the fast pulley beforehand, and you must take particular note which way round you offer the shaft. Remember the left-hand thread must appear on the left-hand side viewed as you stand in front of the machine—this is important, and failure to observe this rule means the nuts will become slack due to wheel rotation, and there is a risk they will fly off.

Next push the two remaining ball races into the hole and secure the outside retaining plates, making sure, of course, as you should have done with the previous pair, that the races are opposed and are thus able to resist the thrust brought about when you grind on the side of a wheel. You must check as you go along to see that the races are perfectly free to rotate without any trace of stickiness, as this indicates they are being distorted. When everything appears satisfactory drill the dimple in the shaft, using, as previously stated, the hole in the fixed pulley as a pilot.

Cover over the parts to prevent any swarf entering the ball races, but if care is taken the small amount from this operation should not create difficulties. Merely turn the pulley carefully and tap it gently, and the swarf will drop out.

Drill a good dimple and see that the grub screw point matches the countersink. To make certain of this first drill a trial point on a scrap piece of material and offer the screw to it.

The Tool Rest

This detail is a simple affair and no attempt has been made to elaborate the design from what, after all, is only a tee piece. The commercial grinder may specify a pivoting arrangement to allow angular tool grinding, but from the author's experience these gadgets have a limited appeal.

Two rests are needed and these fit into holes bored in the bosses welded to the base. The shanks should slide fairly easily, but without too much shake. Cut out the centre where the tools rest on the plate and allow each side to extend round the grinding wheel slightly. This provides a platform for the tool when side grinding.

The Striking Gear

Moving the belt from the loose to the fast pulley is accomplished by simply sliding the horseshoe-shaped steel bracket along the two pins situated at the rear of the grinder; an action which is quite easy if the pins are not a tight fit in their respective holes.

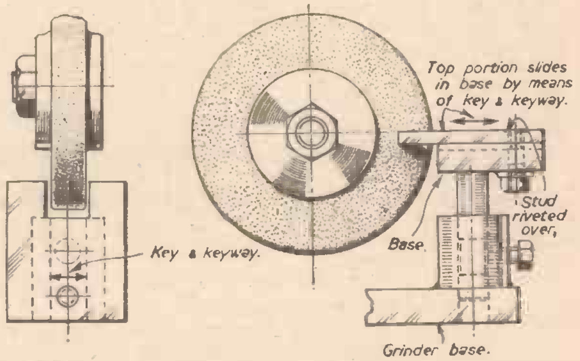


Fig. 3.—Details of the tool rest.

The bracket is made in two parts, the horseshoe being bent from 3/16in. steel plate, and a rectangular block of steel inserted between the ends. A brazing or welding operation will hold both details together, whereupon the holes are then drilled. There is no need to ream these, and if a drill 1/64in. larger than the rod size is used then the bracket will slide without sticking.

The rods are made from lengths of bright mild steel faced off to bring them flush when the retaining collars are placed in position. The latter are pinned as shown by two short pieces of silver steel.

At the top of this horseshoe a hole is drilled and reamed and another pin or handle is inserted and riveted over. Alternatively, instead of reaming, a tapped hole is provided and the last thread is used as a countersink for the riveting process—the end of the handle being turned over into the tiny depression.

Making the actual gear is not difficult, but one operation needs a little care if an easy belt shifting is desired. Two holes in each end bearing bracket are necessary where the rods pass through and so secure this assembly to the base. Correct linearity is essential. I would not advise drilling these with a long extension drill as there is a possibility that after the first hole has been pierced the second member will wander from a true path. One edge of the base is machined during the initial stages and this is used while boring the main holes and other sundry operations. One hole is drilled while this face is located against a strip clamped to the boring table of the lathe, and on completion of this stage the base is turned round 180 deg. and again pressed to this strip. The resulting two holes are then in line.

Again a tight fit is not really necessary and a drilled hole will suffice, though I prefer to ream such holes as these. It takes longer and is perhaps more difficult to ensure they are perfectly in line, but too much slackness gives the appearance of poor workmanship, so endeavour to ream them if you have the necessary tools.

The Guards

Wheel guards are not a luxury but essential details which you must provide for your own and other people's safety. Flying dust striking the face is not a pleasant experience, and a piece of grit in the eye is occasionally awkward to remove. Secondly, wheels are known to break, and though a guard will perhaps not stop all the fragments it can prevent a nasty accident.

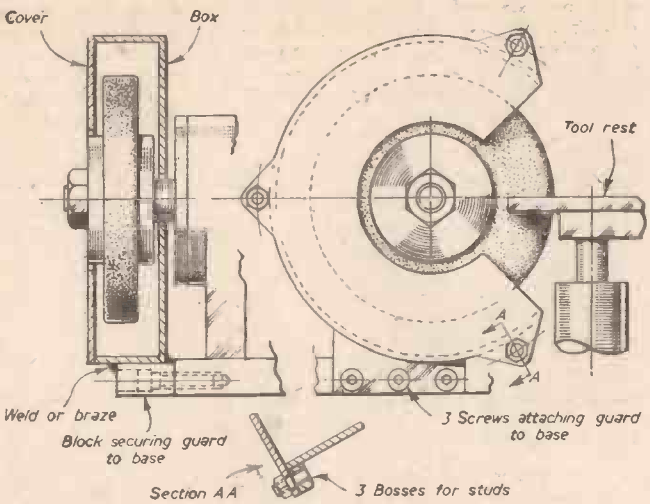


Fig. 4.—Details of a simple shield

The drawing at Fig. 4 illustrates a fairly simple affair made up from ⅛in. steel plate. The "box" consists of two pieces brazed together round the floor, and three small bosses also brazed to the side walls provide the metal through which the studs securing the cover are fitted. The latter detail is also made from ⅛in. steel plate and cut to the outline as shown on this drawing. A small wheel is drawn in this example to draw attention to the fact the inside of this guard must clear the outside diameter of a new wheel; an obvious fact when pointed out, but one which the tyro reader is liable to overlook unless he has that new wheel already to hand. Therefore obtain the grinding wheel before commencing the construction of these guards and make the inside diameter of each "box" about ⅛in. larger than that detail; adequate clearance is then achieved. Do not, however, forget that these members are "handed"—the bottom bracket used for attaching them to the base is reversed for the guard on the opposite side, otherwise you cannot fit it correctly. This bracket is merely a piece of mild steel shaped to suit the curvature of the box, and brazing will again hold it in place.

Do not make these guards until the tool rests are completed and then you can observe whether there is enough clearance for that item. The drawing at Fig. 4 shows the gap in the cover and box as being well clear, but if you decide to fix another type of tool rest, then obviously this question of clearance will arise and need attention.

General Notes

No holes are shown in the base for fixing the grinder to the bench, but these you will space according to your own requirements. Three are sufficient and to avoid bolt heads protruding use socket-head screws, counterbore the plate and hold the grinder with nuts underneath the bench.

Some readers may criticise the distance between the grinding wheels as being excessive and assert that a reduction here is feasible. This is correct, but only by reducing the pulley widths and outer bearing thickness. In the case of the latter it will mean using only one double-purpose thrust bearing at each end (a feature in the design I would not favour) and a reduction in the belt from 1¼in. to 1in. This is a matter of personal opinion, but I prefer the wider member and fitted it on my grinder.

Dust exclusion is another point which may raise some doubts, and on this type of grinder is not easy to include. If the end caps are bored just to clear the wheel shaft (about .002in.), then this eliminates dust in the outer bearings.

For the bearings in the pulley readers can fit if they wish a thin sheet-metal cap about ⅛in. thick on the side adjacent to the fixed member. If this is turned to fit the recess only a push fit is required; then it will prevent dust entering down the gap between the two pulleys. The recess for the ball races will require deepening another ⅛in. for this arrangement.

Finally, when all the parts are made and assembled to your satisfaction, give the base, side brackets, end caps and the sides of both pulleys a coat of paint, matching the general colour scheme of your workshop or lathe. Incidentally many machines are painted battleship grey, but I prefer a dark green, as oil seeping down the castings, as it does occasionally, will not look so unsightly. But this does not mean you must not keep your machines clean; a weekly wipe over of this grinder and lathe will preserve their good looks.

(To be continued.)

Aluminium Exhibition

THE Aluminium Development Association recently staged an exhibition at the Royal Festival Hall in London to show British industry's part in developing the many uses of aluminium.

An aluminium double-decker bus designed by London Transport engineers was shown. A prototype, and still undergoing tests, it is 6in. wider and 1ft. longer than the standard London bus.

Also on view were railway coaches, one of which has been in service on the London Underground system.

French Train Travel at 87 m.p.h.

FOLLOWING recent train trials in France, it is said that, by 1960, people will be travelling at 87 m.p.h. with a robot engine driver in control.

Trains would not be without an engine driver, in spite of the recent experiment when there was no driver, but his work would be reduced to a very simple routine. Starting the train, speeding it, slowing it up and stopping it would be done by people outside the train at different points on the line.

During the recent trials, it was a man stationed some 10 miles away who by short-wave control started the train, and it was slowed up and stopped by another man many miles farther on.

"Atomic Boiler" for U.S.

IT was suggested at the annual meeting of the Institute of Boiler and Radiator Manufacturers in New York recently that it should be possible by 1958 to start producing home heating and cooling systems operated by baby nuclear reactors. These reactors would be about twice the size of car batteries.

Mr. Ferry, general manager of the institute, said that the only thing that might hold up the manufacture of "atom boilers" was an inadequate supply of fissile material at economic prices.

A single charge of fissile material hermetically sealed in the reactor would last for six years and cost about £100. When the charge was exhausted the reactor would be replaced with another sealed unit.

The reactor would be connected with a boiler which would be situated in the basement or garage. The entire installation for a new house would cost about £500 and this would be less than the cost of a conventional heating system, because the chimney and flues would be unnecessary.

Car TV Set

MR. ARTHUR PARKES was issued recently with the first private "mobile" TV licence in Britain. It cost him £3.

The TV receiver is installed in his van and employs the ordinary 9in. screen.

It is run from the car battery. The aerial is a single pole fixed to the side of the van.

Plastics Exhibition

SURGICAL jackets which can be made and fitted within two hours were displayed at the third biennial British Plastics Exhibition held at Olympia. Bones made from the same plastic have been used in a number of surgical operations.

Tunnel Record

THE world record for tunnelling has been broken on the huge Snowy Mountains hydro-electric project. Men drove 420ft. of tunnel, 24ft. in diameter, into a mountain in six days. Previous record, in California, was 363ft.

New Patrol Boat

THE first of the Navy's new fast patrol boats to be powered by Deltic diesel engines was recently accepted into service. A number of this craft are being built for the Admiralty by firms throughout the country.

Three types of fast patrol boats are being produced under the present programme—the Bolds, each 117ft. long, and the Gays and Darks, which are smaller. In the Dark-class boats, of 64 tons, aluminium alloy is used for the framing and deck. Their length is 71ft., beam 19ft. and draught 6ft.

They can be armed either as motor torpedo boats or motor gunboats. As gunboats they mount either a 4.5-in. gun and a single Bofors, or two single Bofors. As torpedo boats they have four single above-water torpedo tubes and one small gun.

New Rifle

A NEW Swiss automatic rifle, the Sig-am-55, has been demonstrated to military experts. It is said to be better and lighter than the FN weapon used by NATO troops.

£3,000,000 Egyptian Refinery

LT. COL. NASSER, the Egyptian Prime Minister, recently laid the foundation stone of a $3,075,000 oil refinery near Cairo. The refinery, which is being built by a Milan firm, will process locally produced crude oil carried by pipe from Suez.

Making a MID

Fully Dimensioned Drawings
16mm. Size Camera

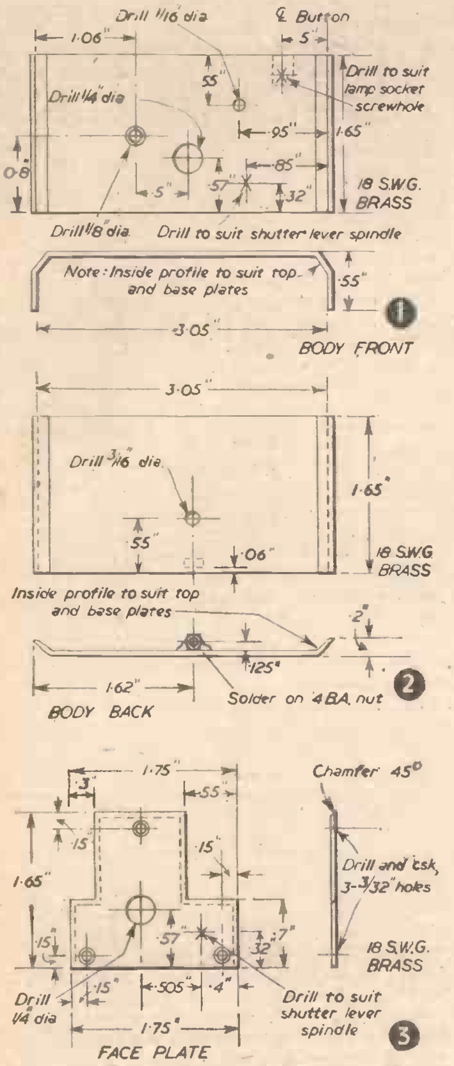
ALTHOUGH I am not a camera "addict," I have always wanted to own a really small camera capable of taking pictures under practically any conditions—the finished pictures also had to be cheap.

With these objects in mind, I made the 16 mm. camera described below, with only limited facilities and no lathe or expensive workshop equipment.

Having made the camera, I completed the outfit by making an ever-ready case, a developing tank from a plastic shaving-stick holder (see photographs) and an enlarger.

The results from this equipment exceeded my expectations, and I can get grain-free enlargements up to 6in. × 7in., using fine grain film and developer.

The camera in ever-ready case and the developing tank.



Figs. 1, 2 and 3.—Details and dimensions of the body front, body back and faceplate.

The overall inclusive cost of a finished quarter-plate print works out at about a penny allowing for film (seven exposures for a penny), developer, fixer and printing paper.

Details of Construction

The following instructions are given as a guide only. As the original camera was made from available scrap parts, certain substitutions may have to be made by individuals, whilst those who possess a lathe will obviously be able to make modifications.

It will be noted that the external parts of the camera are matt chrome plated. This can be done by any electroplating firm at quite a small cost.

Camera Body

Make up the main body sections shown in Figs. 1 to 5 from 18 s.w.g. brass. Check the fit of the top and bottom plates into the body side profiles. Solder the top plate flush with the body front and clean off all excess solder.

The complete shutter mechanism is now made up on this chassis.

Shutter Button

This is made from one of the plunger pins from the base of an electric light socket. Use the wire clamp screw to attach the unit to the camera front by drilling through to suit the shutter button hole in the top plate. The body of the button should be flush with this plate, as shown in Fig. 25.

Shutter Catch

This is attached to the body front by a 1/16in. diameter pin soldered in the hole in the body. Solder a capping disc on this pin and fit a 30 s.w.g. piano wire spring to hook up with the stop pin "A," as shown in Fig. 25.

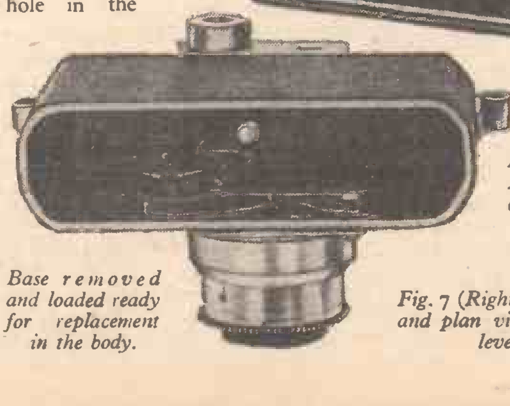
Shutter Assembly

Build up the shutter leaves, as shown in Figs. 15 and 16. It is essential that they are perfectly flat and have no sharp edges.

The position and size of the flywheel bracket is given only approximately, as it depends on the diameters of the gearwheels used.

Before final assembly of the shutter, fit the flywheel (Fig. 13) and main leaf, and ensure that they run smoothly together without lubricant.

To assemble the shutter, thread the main leaf on to the capping lever spindle, with a thin brass shim washer between them. Insert the spindle through the hole in the body and solder on the cocking lever (Fig. 10A) in a vertical position with the shutter leaves in their rest position against the stop pin "D" (Figs. 23 and 25).



Base removed and loaded ready for replacement in the body.

Check that the main leaf catch plate engages with the shutter catch when it is carried up to the cocked position by the capping leaf, and that when the shutter button is depressed it allows the main leaf to return to stop "D."

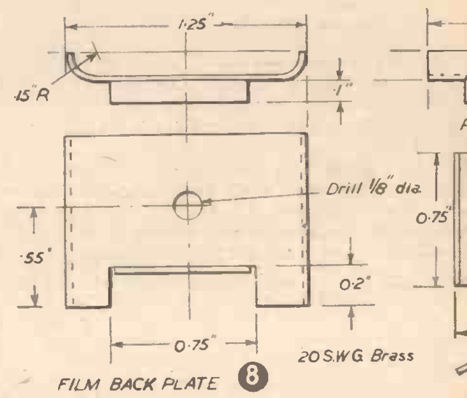
Solder on the spring pegs B and C approximately as shown in Fig. 25. Make up a 30 s.w.g. piano wire return spring for the capping leaf, and wind on over the head of the shutter spindle (Figs. 23 and 25).

Shutter Linkage

Make the links shown in Figs. 11 and 12 together with the spindle shown in Fig. 7. This spindle can be made from a radio terminal shank, in which case the hole diameters in the main lever and camera body should be made to suit the particular terminal diameters.

Connect the short link to the main link and rivet over the pin, ensuring that the links are free-moving. The long pin on the short link engages with the short length of brass tube soldered to the main leaf gearwheel shown in Fig. 15.

Assemble the main lever and spindle with the shutter spring. This spring is made from two coils of 30 s.w.g. piano wire, one end



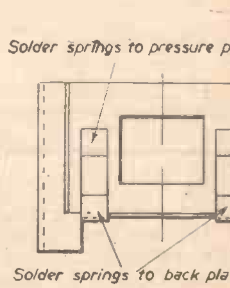


Fig. 6 (Right).—Assembly of film carrier and details of the springs.

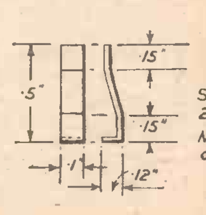


Fig. 7 (Right).—Side elevation and plan view of the shutter lever spindle.

being anchored in the hole in the spindle, the other bearing on the lever, as shown in Fig. 24.

This spring is of critical stiffness and may have to be modified as regards turns and gauge to obtain a satisfactory shutter speed range, depending on the friction of the completed shutter system.

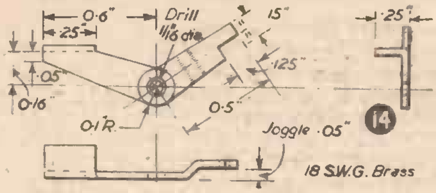
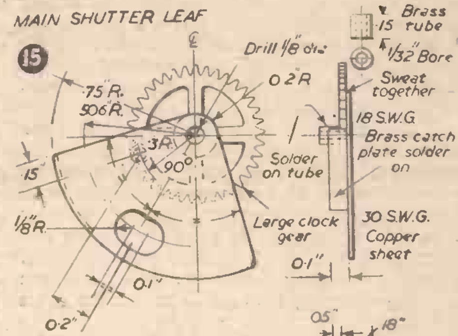
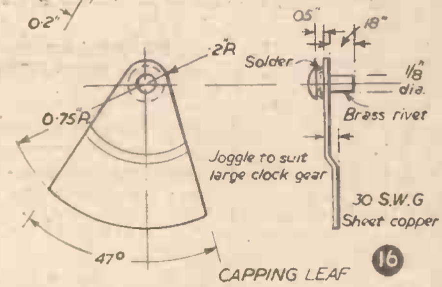


Fig. 14 (Left).—Details of the shutter catch.



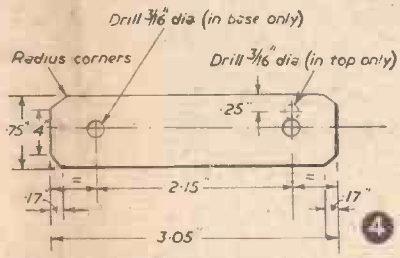


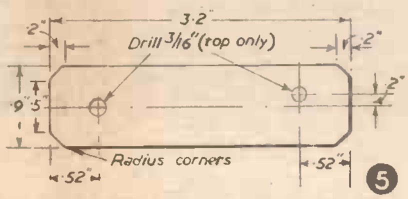
Figs. 15 and 16.—Main shutter leaf and capping leaf details.

...GET CAMERA

...and Notes on the Construction of a

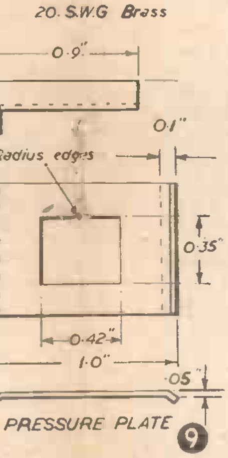
By P. G. MOBSBY





(Left).—View of the completed camera.

Figs. 4 and 5.—Details and dimensions of top plate and base plate and top and base cover plates.



It should be noted here that none of the shutter mechanism should be lubricated, as the changes in viscosity will upset the speeds. All bearings should be dry and free fits.

The time exposure catch is shown in Fig. 19, and is mounted as shown in Fig. 25, being positioned so that when the shutter speed lever is just below horizontal the small lug "L" (Figs. 24 and 25) pushes the catch base upwards, thus causing the beak to move across and stop the main shutter leaf when the shutter aperture is open.

To complete a time exposure re-cock the shutter.

Figs. 8 and 9 (Left).—Details and dimensions of the film back plate and pressure plate.

Camera Base

Sweat the base and base cover plate together (Figs. 4 and 5) as shown in Fig. 10, then solder in the spool pillars. Drill the ⅛in. diameter hole through the base for the base securing screw which engages with the nut soldered on the body backplate (Fig. 2).

Make the parts shown in Figs. 8 and 9 and assemble as in Fig. 6. The pressure plate and backplate must be absolutely smooth to prevent scratching the film as it passes through.

Solder the above assembly to the base as shown in Fig. 10, ensuring that it is square with the base and parallel to the camera front.

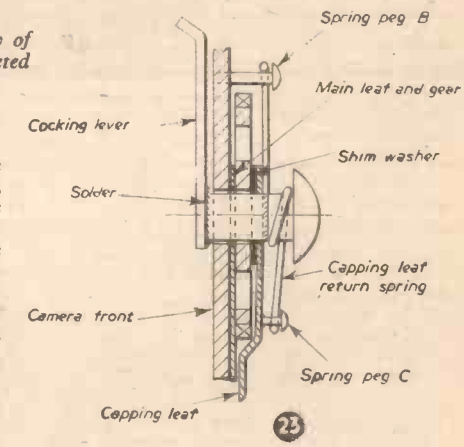
A large-headed chrome screw is used to attach the base to the camera (one from an old cigarette lighter is ideal).

Film Spools

Alternative methods of making these are shown in Fig. 17, depending whether a lathe is available.

Winder Assembly

The winder knob may be turned up or made from scrap with a 4BA nut soldered in the base.



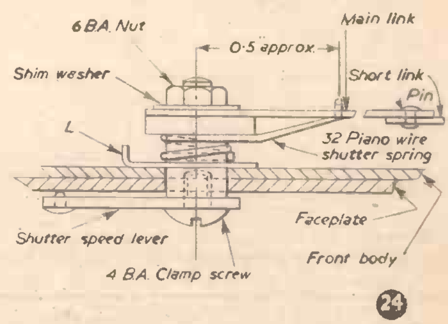
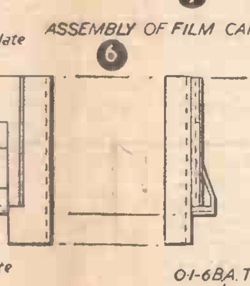


Fig. 23.—Section through shutter assembly.

Fig. 24.—Section through shutter speed spindle.



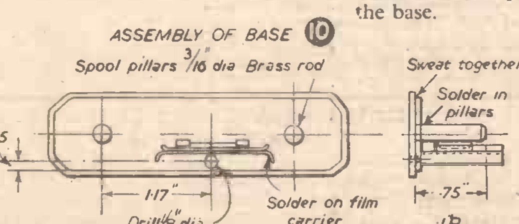
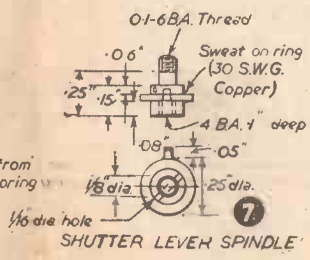
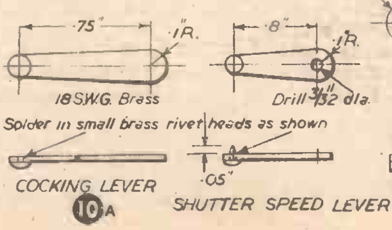
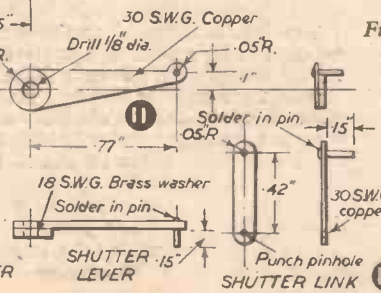
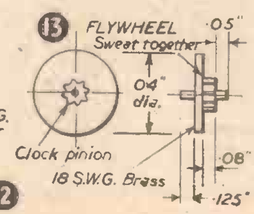


Fig. 10 (Left).—Assembly of base. Figs. 10A and 11.—Details of the cocking lever, shutter speed lever and shutter lever.









Figs. 12 and 13 (Left).—Shutter link and flywheel details.

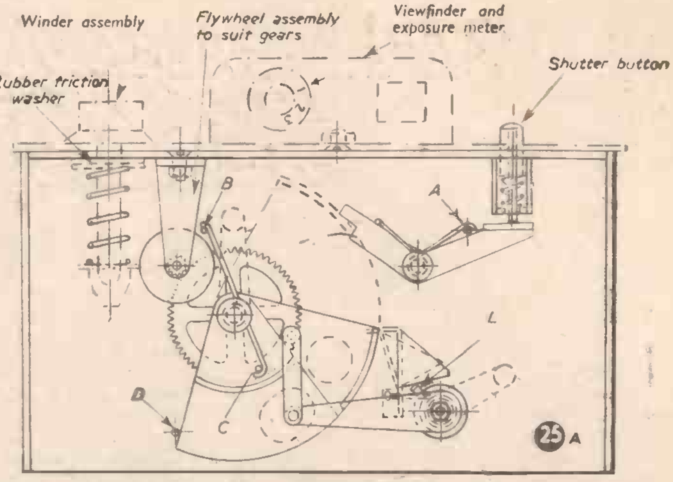


Fig. 25A.—A view of the camera with back and base removed.

The winder shaft can be made from a 5 amp. electric plug pin which has a 4BA shouldered end. Use pin slot to locate the winder key and solder it in position as shown in Fig. 20.

When the winder is finally assembled in the camera, a rubber washer, two metal washers and a 22 s.w.g. piano wire spring are required, as shown in Fig. 25.

The winder numbering shown is used, since one-half turn of the winder turns on one exposure. Thus, by using two counting pointers (a dot and an arrow on the camera top cover plate), one has only to remember the tens, i.e., starting with 1 on the arrow, one counts off 1, 2, 3 up to 0 (0 signifying 10). Transfer counting to the dot. Wind 1 to the dot (representing 11) and so on until 0 is on

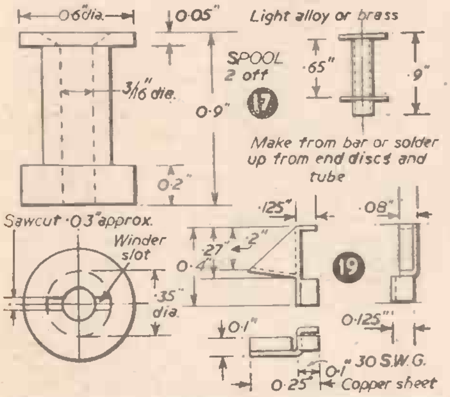
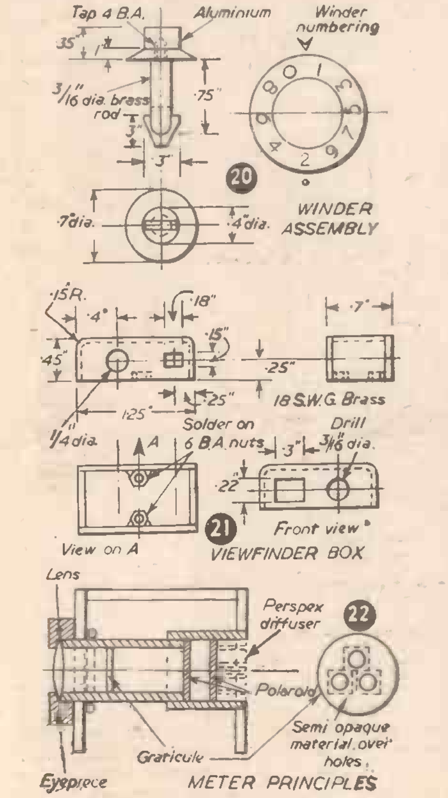


Fig. 17.—Two methods of making the spools and Fig. 19.—Details of the time exposure catch.

the dot (20), then begin again on the arrow with 1 (21), and so on.

Viewfinder Box

Make up as shown in Fig. 21. After plating, cover the viewfinder apertures on the inside with Perspex sheet attached with Bostik adhesive.



Figs. 20, 21 and 22.—Winder assembly, viewfinder box and meter principles.

Exposure Meter

This item is optional, but a description of its construction is given below.

Fig. 22 shows a diagrammatic section through the unit which comprises two short lengths of brass tube sleeving together. The front tube contains a disc of roughened Perspex to act as a diffuser. Stuck to the back of it with Durofix is a disc of polarised gelatin from a pair of the 3-D spectacles issued at cinemas.

The other tube has a similar disc of polarised material stuck to its front end. The other end holds a small lens extracted from a toy microscope.

At the focal length of this lens is a small graticule made of copper sheet with three holes punched in it with a needle and the burrs filed off. These holes are covered with one, two and four thicknesses, respectively, of

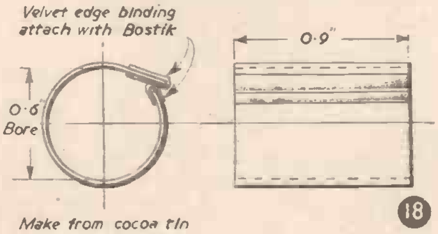


Fig. 18 (Above).—Details of the cassette clip.

Fig. 25B (Right).—A plan view of the camera with top removed.

translucent material. (Cigarette paper can be used for this.) This is a particularly tedious job, but it can be done.

By rotating the eyepiece the amount of light falling on the graticule is varied by the polarising effect. Three positions of the eyepiece are marked such that the minimum, mean and maximum amount of light are transmitted. There are thus nine different intensities of light visible as a dot through the eye-piece and this enables it to be used as a conventional extinction meter by reading the lowest visible dot when pointed at the subject.

The meter must be finally calibrated against another meter, suitable speed-exposure ranges being chosen to suit the shutter and lens.

Lens and Mounting

The camera lens must be of 1in. focal length with a built-in iris diaphragm. A 16 mm. cine-camera lens can be bought from about £3 second-hand.

The lens is attached to the camera front cover plate by a suitable adaptor ring. This can be bought from a camera dealer.

Attach the adaptor ring to the front cover plate with four countersunk 6BA screws, and the plate to the camera body with three self-tapping screws. These should be filed flush inside the camera body.

Assembly

First give the inside of the camera body a thin coat of matt black cellulose, taking care that none is put on the gear teeth and only on the backs of the shutter leaves and links.

Solder on the body back ensuring that the base is a snug fit into the body and that the base screw engages with its nut.

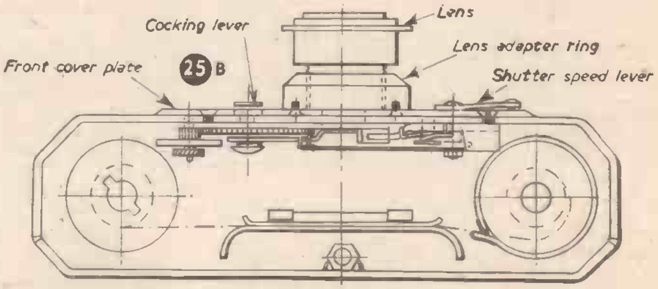
Attach the top cover plate and viewfinder assembly to the top of the camera, using Bostik adhesive. Assemble the winder into the body.

Check that the body is light tight around the seams. Pinholes may be filled with Bostik.

Lens Adjustment

Place a short length of unexposed film into the film carrier to act as a screen, and insert base into camera. Screw lens into adaptor ring and open shutter on "time."

Examine the image of a distant object through the hole in the back of the camera



with a small magnifying glass. Screw the lens in and out of its ring until the sharpest image is found. Mark this position.

The final position is found later by taking a series of pictures with the lens in various positions around the first found one. Pick the sharpest negative and permanently mark this position on the lens and adaptor ring.

Final Finish

Touch up the black cellulose inside the camera where necessary.

Cover the camera body with a piece of black leathercloth (the cover of an old diary is large enough), attaching it with Bostik adhesive.

It should be noted that the end of the flywheel shaft must be protected from rubbing on the leathercloth by blanking it off with a small disc of brass shim before applying the Bostik. Trim off the excess cloth round the camera with a razor-blade.

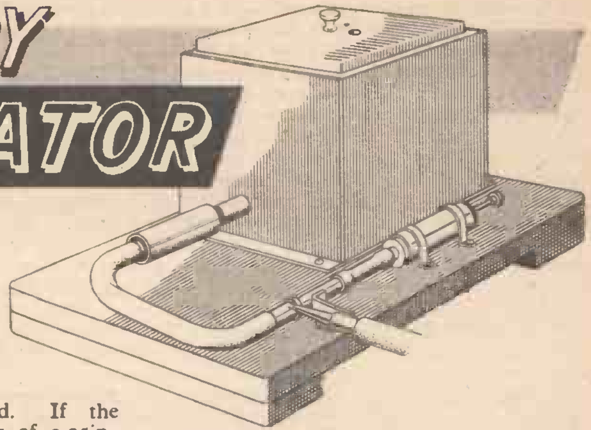
Shutter Speeds

It now remains to calibrate the shutter speeds and to mark them on the faceplate.

The method of calibration depends on the facilities available, but the principle of photographing an object moving with a known velocity, and measuring the length of blur on the negative, is probably the easiest.

(Continued on page 459)

A SIMPLE LABORATORY REFRIGERATOR



A Small Unit Operating on Compressed Air for the Home Laboratory

By J. E. CRAWFORD STRINGER

IT not infrequently arises in the course of experimental work that a refrigerator can be a useful piece of equipment to have on hand to employ for certain jobs. Unfortunately, a refrigerator of the conventional compressor or absorption type is fairly expensive, and the budget of the small or amateur establishment may not be able to support such an expenditure. It is also true that should the need for a refrigerator only arise very occasionally, it may not be considered worth while to instal a costly piece of equipment, which may well be idle for 95 per cent. of its time, even if the outlay can be afforded.

The following is an example of this kind of occasional work needing a refrigerator: some time ago it was desired to make a few determinations of the average molecular weight of some waxes, using the cryoscopic (or freezing) method, where a small weighed portion of the sample is dissolved in a solvent and the change in freezing point caused by the addition of the sample is employed as the basis for calculating the molecular weight.

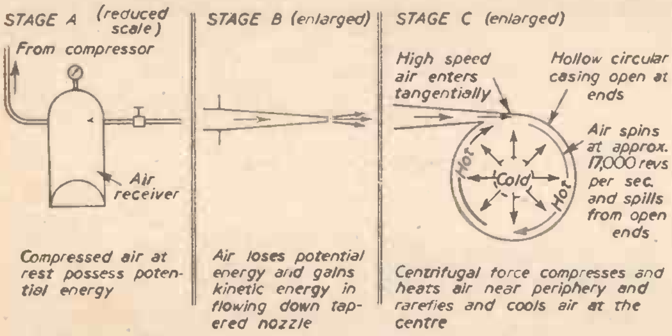


Fig. 1.—Basic principle of Ranque tube (diagrammatic only).

The Ranque Tube

It may not generally be known that there exists a pneumatic cooling device designed originally by Ranque, which can be used to provide the cooling unit for a simple refrigerator. This device is operated by compressed air.

The principle of this simple and elegant device may be understood by reference to Fig. 1. Compressed air at rest has potential energy (A). If allowed to escape to atmosphere through the medium of a gently tapering nozzle, this potential energy is converted into kinetic energy in the fast-moving jet of air (B). In the Ranque tube this air jet is directed tangentially into a hollow casing (tube) as in C, where it is deflected and guided round the inside of the casing. Thus the kinetic energy of the jet is used to create a spinning mass of air inside the casing, rotating at an extremely high speed.

Speed of Rotation

Some idea of the speed of rotation will be obtained if it is taken that, under average conditions, compressed air at from 60 to 90lb. per sq. in. will issue from a tapered nozzle of suitable proportions at approximately the speed of sound, viz., 760 m.p.h., equivalent to 13,350in. per second. If the casing has an internal diameter of 0.25in., its periphery will be 22/7× 0.25 = 0.785 in. and the rate of rotation of the air mass inside the casing will be 13,350/0.785, or 17,000 revs. per sec. At this extremely high speed the centrifugal force operating on the air mass is large and causes the air around the inside surface of the casing to be compressed and the air at the centre of the casing to become rarefied. Associated with the compression there is a heating effect, and with the rarefaction a cooling effect. Thus the spinning mass of air may be considered as divided into two zones, a compressed and heated outer shell and a rarefied and cooled central core. With the sizes and conditions given and using a suitably designed nozzle, the hot air may reach a temperature of 135deg.F., and the cold air may fall to −5deg.F., the compressed air supplied being at 65deg.F.

In order to be able to utilise the cold air core as a refrigerating medium, the nozzle is mounted tangentially at one end of an elongated casing (body-tube), provided with a diaphragm placed close beside the nozzle, as in Fig. 2. At the far end of this tube is fitted an adjustable flow-restricting valve, see Fig. 3, constructional, and Fig. 4, layout. In use, this valve is closed sufficiently to create a slight positive pressure, with respect to atmosphere, inside the body-tube, so that the cold core of air is expelled through the central hole in the diaphragm, leaving the hot shell inside the body tube, where it flows in a spiral path down to the restricting valve and escapes to atmosphere. By fitting a suitable duct to the body-tube at the nozzle end, the cold air may be led into a thermally-insulated box or cabinet and circulated over objects placed inside to refrigerate them.

Practical Layout of a Complete Unit

Fig. 4 shows the layout of a complete unit arranged on a baseboard. It will be noted that the drawing shows two silencers (not mentioned in the foregoing description), one, for the hot (waste) air and one, for the cooled air. These silencers take no part in the functioning of the apparatus as regards cooling, but a Ranque tube, when operating at full air flow, creates a nearly unendurable amount of noise which, while it may not be actually harmful, is decidedly unpleasant. Therefore the inclusion of the silencers is strongly recommended.

It need not be regarded as necessary to adhere rigidly to the materials of construction or the exact sizes indicated in the drawing for most of the parts, except in the making of the body-tube, nozzle and diaphragm assembly where departures from the proportions given may cause the unit to fail to give the best results. The conventional Ranque tube has a diaphragm with a plain central hole; however, referring to Fig. 2, it will be seen that a modification of the diaphragm has been introduced as the result of development carried out by the author. This modification consists in providing the central hole of the diaphragm with a sharp-edged tubular entry and exit, after the manner of the Borda orifice, familiar in hydraulic work. The object of the modification is to reduce the air pressure-head losses in traversing the diaphragm and thus to raise the overall efficiency; an appreciable lowering of the cold air temperature, amounting to up to 10deg.F., is obtained by its use.

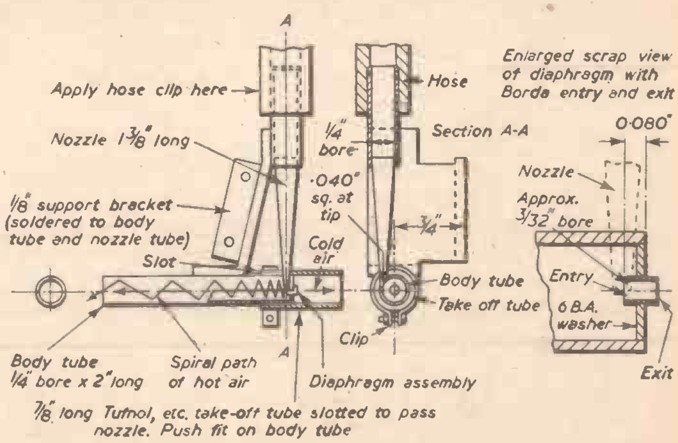


Fig. 2.—Body tube, nozzle and diaphragm.

Construction of the Parts

The object to be realised is to cause the air mass within the body-tube to rotate at the highest possible speed with the air pressure available. Consequently, pains should be taken that the nozzle sizes given in the drawing are carefully followed, in particular the small end of the nozzle should not depart from 0.040in. square by more than, say, ± 0.003in. Further, the soldering of the longitudinal seam should be effected using the minimum of soft solder, none being allowed to get inside the nozzle where it might obstruct the free flow of air.

The tangential slot in the end of the body-tube in which the small end of the nozzle is inserted should be made carefully with a jeweller's fine square file, the slot being made of a size so that the nozzle will push in and remain firmly in position to facilitate the soldering operation. The slot should be taken to such a depth below the end of the body-tube, say 1/64in., to allow for the thickness of the diaphragm which will later be soldered into the end of it, alongside the nozzle. It is an advantage at this stage to fill the nozzle with a pledget of soft, unravelled asbestos string to prevent solder from entering.

When the nozzle is soldered into position, the strengthening strut, which also forms the supporting bracket, should be added. Any portion of the nozzle that projects slightly into the bore of the body-tube may now be removed using a jeweller's rat-tail file or some very fine glasspaper rolled up into a pencil shape. The entry of the body-tube should be opened out, say, 0.001 to 0.002in., so that the diaphragm may be pressed in lightly.

The entry and exit tubes of the diaphragm may be formed in one piece from brass foil, 0.003in. thick, rolled into a tube round a drill-shank; matters should be arranged so that this tube is a tight spring fit in the hole of the 6 BA brass washer that forms the diaphragm. The amount this tube projects into the body-tube is important and for the best results it should project one-half to three-quarters of its diameter, say 3/64in. It may then be soldered in place. The completed diaphragm may then be fitted into the body-tube and lightly soldered into place, taking care to use the minimum of solder so that none enters the body-tube to form blobs that might interfere with the smooth rotation of the air inside. The asbestos string should, of course, be removed.

Cold Air Take-off Tube

As any transfer of heat from the body-tube to the end where the diaphragm is represents a loss of cooling effect, the take-off tube should be made of a poor heat conductor such as ebonite, tufnol, etc. A slot is filed in the end that fits over the body-tube, to embrace the nozzle; a clip tightened by a 8 BA nut and bolt encircles this slotted end to fasten the take-off tube to the body-tube, otherwise the severe temperature changes will soon loosen the take-off tube.

Combined Flow-restrictor Valve and Annular Silencer

A neat form of flow-restrictor is shown in Fig. 3; it is also simple to make. The requisite length of 5/16in. copper or brass tube has one end annealed by heating to a dull red in a gas flame; a 2 BA steel nut is filed into a six-sided equi-angular pyramid and driven into the annealed end of the tube to open it out to a hexagonal shape to hold a 2 BA nut into which the 2 BA screwed stem carrying the fibre plunger fits. A side hole about ½in. dia. is made in the side of the restrictor tube and the edges dressed smooth. A knob should be fitted to the free end of the 2 BA stem so that the fibre plunger may be set to give any desired degree of opening of the side hole, as required, by rotating the knob.

The annular silencer shown is packed moderately tightly with domestic steel wool; this is restrained from blowing out as shown. The back pressure associated with this type of silencer provides part of the flow-restriction necessary to make the refrigerator work.

The Cold Air Silencer

It is desirable that this silencer should offer the minimum resistance to air flow through it as any pressure drop at this point represents, in effect, a lowering of the available head of the compressed air supply. For this reason a straight-through design has been chosen after several trials; this pattern also has the merit of being the simplest of those tried as well as being the most effective as regards low pressure drop and effective silencing. The same kind of steel wool as was used in the annular silencer, already described, is employed, but whereas in the annular one it was packed only moderately tightly, it must, for this straight-through type, be packed quite firmly. The best way to do this is to form the steel wool into a flat ribbon about ½in. x 1in. and wind it spirally on to the central slotted tube and then to compact the wool by applying the insulating tape sheathing spirally under moderate tension, two layers are used to make sure no air leaks are left. The completed silencer is then sleeved with a few layers of felt or wool cloth to afford heat insulation, the end turn seam is then neatly stitched.

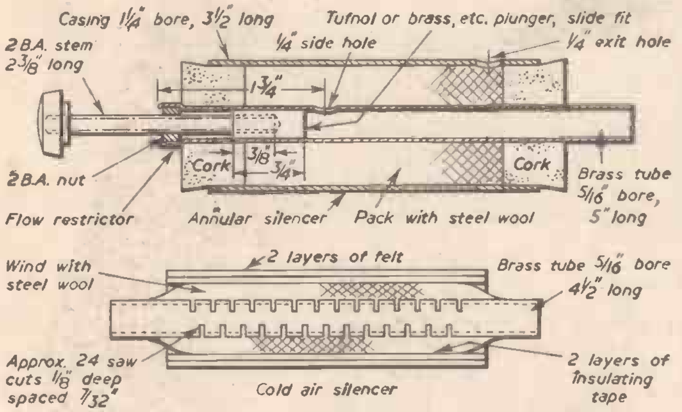


Fig. 3.—Flow restrictor, annular silencer and cold air silencer.

Refrigerator Chamber Construction

The general design of the cold chamber will be dictated by the requirements of the individual constructor, but a suitable design for small-scale experimental work is shown in the drawing, Fig. 4. The outer shell of the cabinet is made from hard-board sheet, 3/16in. thick, neatly sawn to size with a fine-toothed panel saw, then assembled with fine panel pins and balsa cement. The inner cold chamber may be of the same material. This inner chamber and the outer shell are joined together by a square wood ring, using wood screws; before assembling, holes for the cold air inlet pipe should be made and the space round the cold chamber filled with cotton wool. A simple lid is made from two squares of Celotex (or similar material), one cut to fit inside the cold chamber and the other cut slightly smaller than the overall dimensions of the outer shell, they should be cemented together, not nailed, to avoid heat conduction. A coat of good quality aluminium paint applied to the exterior surfaces will assist materially in preventing the ingress of unwanted heat.

Assembly

The components should be secured to a neatly planed and painted or varnished baseboard made of about ¾in. thick material, stiffened by two 2in. x ¾in. battens, fastened with screws from underneath. Four rubber feet of the type used for electrical meter cases will make a useful refinement. Details of the manner of securing the refrigerator cabinet to the base board are shown in the drawing. Whether to mount the cabinet vertically as in the drawing or otherwise is a matter of choice for the individual constructor, who will be guided by the shape and number of the objects he desires to refrigerate. The vertical position, with the lid on top, is to be preferred as it tends to prevent the entry and circulation of room-temperature air when the cabinet is opened, as compared with a cabinet fitted with a door in the side.

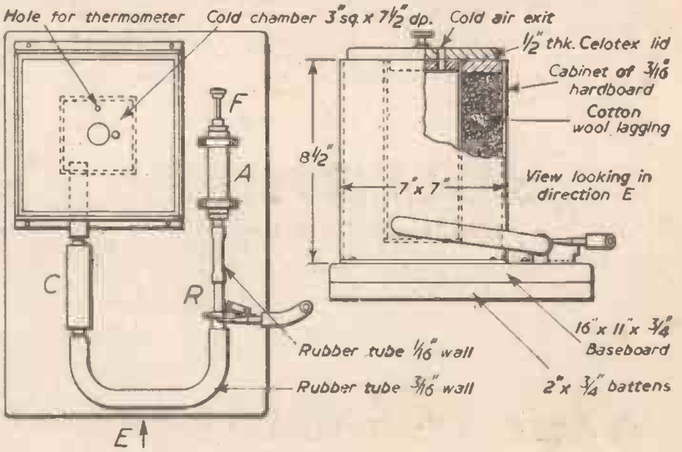


Fig. 4.—General layout and cabinet. R—Ranque tube; F—Flow restrictor; A—Annular silencer; C—Cold-air silencer.

The metal straps holding the annular silencer in position may be of 5/16in. x 1/32in. brass, fastened down with No. 6 woodscrews; larger screws should be used for the nozzle bracket, say No. 8, in order to withstand any accidental jerks on the air hose. This latter must be stout canvas-inserted hose and clips should be used to fasten the ends securely against blowing off.

Testing

To try out the assembled refrigerator, the knob and screwed stem controlling the position of the plunger of the flow-restrictor should be turned anti-clockwise to open the side hole in the restrictor tube fully. The stop-valve of the compressed air supply should then be opened sufficiently to give a moderate flow of air from the exit of the annular silencer. The flow-restrictor should then be closed sufficiently to cause some flow of air into the refrigerator cabinet; a thermometer should be placed in the hole provided in the lid and its reading should start to fall. The compressed air flow may then be turned on to its full value and consequent temperature fall indicated by the thermometer noted; adjustment of the flow-restrictor should be made to obtain the lowest temperature. It generally happens that

(*Continued on page* 451)

the very lowest temperature is given when a smallish volume of cold air is being produced by the Ranque tube. However, this may give too slow a rate of cooling of objects placed in the cabinet, so it may be advisable to adjust the unit to give a greater cold air flow at a sacrifice of perhaps 3 or 4 deg. F. Control of the cold chamber temperature is easily effected by regulating the air flow to the nozzle by means of the main stop valve.

Some Performance Figures

Air supply pressure	90 to 100lb. per sq. in.
Air supply temperature	65 deg. F.
Cold air temperature	−5 to −7 deg. F.
Hot air temperature	130 to 135 deg. F.
Measured volume of cold air produced	1.43 cu. ft. per min.
Mass of cold air at −5 deg. F. produced	7.2lb. per hr.
Theoretical refrigerating capacity.	−60 B.Th.U. per hr.
Equivalent rate of ice production	about ½lb. per hr.

Electrically-heated Driving Gloves

By A. C. SIMMONDS

These Details were Received in Reply to a Query Published in "Information Sought"

I MADE a pair of these gloves for use in a car a few years ago. The resistance wire was plastic covered and came from an ex-R.A.F. heated camera muff which yielded about 15ft. of wire.

I unpicked the wire, which was stitched to a fleecy lining, and cut off a length so that the resistance was about 4 ohms. This was about 4ft.

I then stitched the wire along the backs of the fingers of a pair of cheap cotton household gloves which were about one size too large for my hands. This is important because stitching the wire reduces the size of the gloves and they are useless if too tight. On the wrist of each glove I then stitched a miniature 2-pin plug as shown in Fig. 1.

The heated gloves were worn inside a pair of ordinary lambswool-lined mittens which I used for driving and which served to keep the heat in.

I prepared a short length of cable having an ordinary G.P.O. telephone jack at one end and which fitted a socket under the instrument panel on the car.

Two leads from a small junction box were taken down the sleeves of my overcoat to two small sockets which fitted the plugs on the gloves (see Fig. 2).

After preliminary trials I found that the two pairs of gloves were not convenient, so I stitched the wire between two small pieces of fleecy material cut from an old cotton blanket and stitched this to the inside of the original lined driving gloves.

I found this was much better as it was possible to slip any gloves on and off without disconnecting the plugs, allowing them to hang from the sleeves of my overcoat like children's gloves (see Fig. 3).

Note that the total resistance of the gloves is about 2 ohms, which allows a current of 3 amps. to pass when connected to a 6-volt battery. When I acquired a fresh car fitted with a 12-volt battery I merely altered the connections in the junction box so that the gloves were in series. They did not get quite so warm, but were still quite satisfactory.

I do not think it would be possible to have gloves heated by a battery carried in the pocket as the current would be excessive from a dry battery.

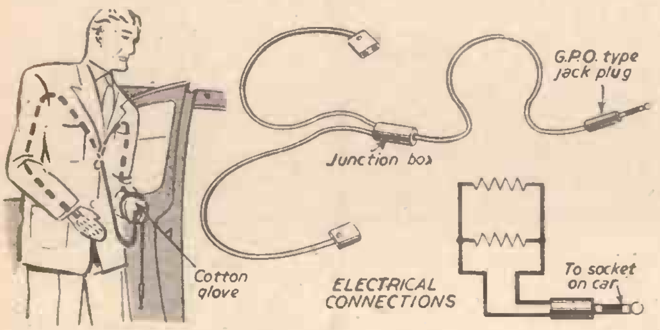


Fig. 2.—How the leads are arranged and the electrical circuit.

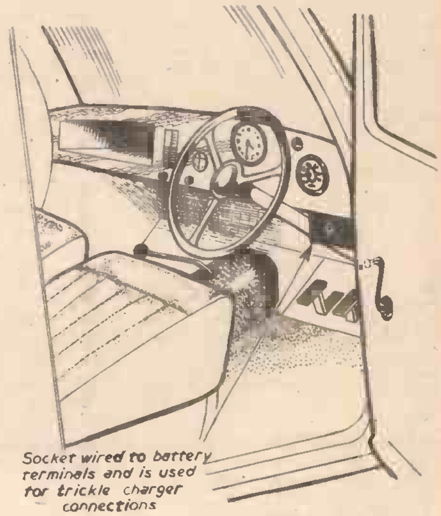


Fig. 4.—Point for connecting to car battery.

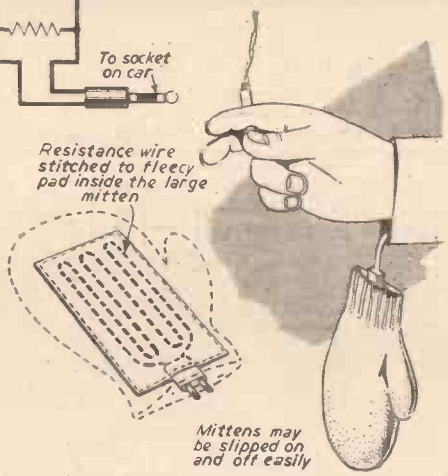


Fig. 3.—Alternative wiring system.

Fig. 1.—The wire stitched to the gloves.

A Vice-operated Punching Press

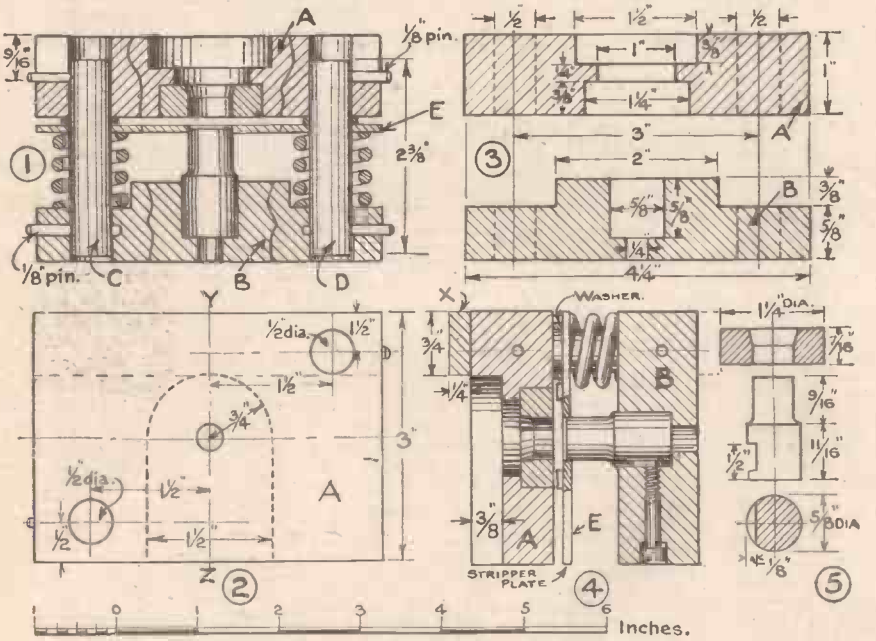
Constructional Details of a Handy Little Blanking Tool for Which a Variety of Uses Can be Found

FEW small workshops are equipped with a fly press; they are expensive machine tools, not capable of being used in a small shop to such an extent as to warrant their initial expense in purchase.

For small pieces a press tool can be made which can be used in the vice and can be fitted with punches and dies to suit any job in the way of small multiple parts. Such a tool is the one illustrated here. It can be made with the ordinary small machine. It is suitable for use with a parallel vice having jaws 3in. or more wide.

The bigger and more powerful the vice the better, since the size of the vice screw is the measure of its capacity in pressing or punching different thicknesses of blank material and different metals. Generally, the tool will be used for strip brass.

Referring to the diagram (1) is a sectional plan view, (2) a front view, (3) a transverse horizontal section, and (4) a vertical section. The two plates, A and B, are of iron, cast from a simple pattern, and both alike in shape and dimensions. The plates are held in the vice and prevented from falling down by the ledge at (4), one screwed to each plate.



Sectional and plan views of the press to which particular reference is made in the text.

The two plates are arranged to slide towards and away form each other in dead alignment by the two guide bars of cast steel, C and D. It will be noticed these are shown in the same plane as each other at (1) for clarity. But actually they are arranged one near the top of the plates and one near the bottom of the plates. Their positions are shown in true relation in the front view at (2).

The Punch Hole

The central hole is the hole for the punch. The holes for the guide bars are at opposite diagonal corners, one above the centre-line and the other below, the punch being on the centre-line. The castings for the plate are filed up on the adjacent faces and clamped together. It is a good plan to sweat them together after tinning their surfaces with solder. The three holes are then marked off. The centre-line, Y-Z (2), is drawn and two lines parallel with it at the distance apart shown in the drawing. The two holes for the steel guide bars are marked off equally to left and right of the central line, one in the top right-hand corner and the other in the bottom left-hand corner, and ½in. from the edge of the plate.

The two plates are then drilled through each of the three centres marked with a 3/16in. drill, taking care that the drilling machine table is dead square with the drill. This should be carefully done. The two holes for the steel guide bars and the central hole are then opened out by drilling with successive-sized drills until holes ½in. in diameter right through both plates are obtained.

The Guide Bars

Cast-steel guide bars are now turned to a driving fit in the corner holes and are driven in plate B, and ⅛in. transverse holes are drilled in the ends of the plates and through the bars to hold the bars secure by means of the ⅛in. pins. The holes in the other plate are then reamered so that this plate fits down a sliding fit, with no end-shake on the bars. Since the holes will be slightly larger than ½in., if drilled with a ½in. drill, a ½in. reamer will not open the clearance guide holes out, but this can be managed by putting a piece of very thin brass foil down one side of the reamer, which will then reamer the hole to a close sliding fit on the steel bar which has been turned a drive fit in the unreamered holes in the other plate.

The hole for the punch is ⅝in. and does not go right through, leaving a ledge in the ½in. hole on which the punch beds. This is recessed by chucking the plate on the face plate, centring it truly by the ½in. hole and boring out the ⅝in. diameter recess for the punch diameter. The punch has a flat at one side and a long 3/16in. screw (shown dotted in (4)) is screwed through the plate to enter the central hole and grip the flat on the punch. The cheese head of this screw is in a recess deeper than the screw head.

The Stripper Plate

The other plate, A, is similarly chucked dead to the hole already in it and the hole opened to 1in. diameter, and then, by an inside boring tool, to 1¼in. diameter for ⅜in. deep. This is to take a circular die of the same size. It is then reversed and opened out to 1½in., for ⅝in. deep and a slot 1½in. is cut down the back of the plate which allows the piece cut out to drop down. This is shown dotted at (2) and in section in (4).

To return the punch after each stroke as the vice handle is unscrewed, the compression coil springs shown round the guide bars are fitted. They are of round spring steel ⅛in. in diameter and just encircle the guide bars.

To clear the strip from the punch which would draw it back after each stroke and prevent the strip being moved on for the next cut, a stripper plate, E (1) and (4), is made in ⅛in. thick cast-steel plate. It has holes registering with the guide bars on which it is threaded. A washer (4) very slightly thicker than the strip being fed is placed between plate A and the stripper plate, the latter has a hole to correspond with the punch through which the punch passes easily. Altering the thickness of the packing washers, adjust the stripper plate for different thicknesses of strip fed through. The stripper plate has guides screwed along its rear face which are set for each job a width apart equal to just cover over the width of the strip being fed in. This ensures the strip passing centrally across the die. The stripper plate is slotted and ⅛in. cheese-headed screws hold the guides at the correct distance apart for feeding in the scrip stock. These, as well as the punch and die, are arranged for each job.

Punch and die, shown dimensioned in (5), are made of cast steel, hardened dead hard and then tempered to a golden-yellow colour and quenched.

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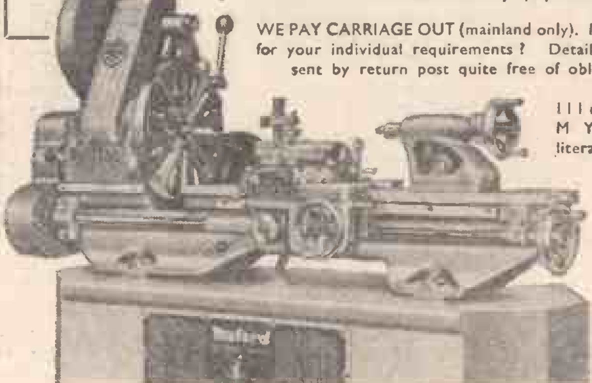

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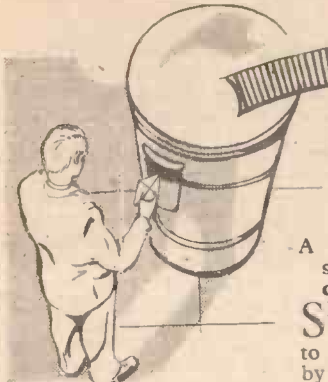
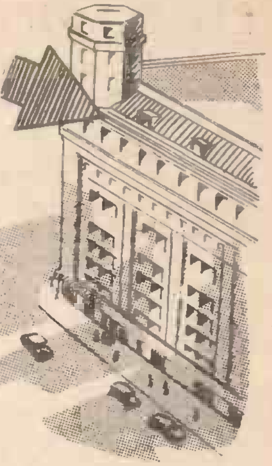


Letters to the Editor



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

A Compensated Pendulum

SIR,—With reference to the article by Mr. J. A. Roberts on the construction of a compensated pendulum, this is an old method and quite a good one if properly made, but Mr. Roberts has completely disregarded the laws of physics and by so doing has rendered the pendulum less compensated than if the bob were merely supported at its base by the rating nut.

The thermal coefficient of expansion and contraction of the compensating elements must be carefully calculated and applied in their true proportion. The thermal coefficient of brass consisting of 66 per cent. Cu and 34 per cent Z is 18.9×10^{-6} whilst Invar is made in three qualities with a factor of 0.3 to 2.5 ($\times 10^{-6}$).

It would therefore be necessary to discard the ½ O/D brass tube and replace it with an Invar tube which would rest on an Invar rating nut. The compensating brass pad would not be a thick brass washer but of a carefully calculated and machined thickness.

I might add that I constructed one of these pendulums years ago and to this temperature correction I added a modified "Hipp" device to counteract barometric variations, and very excellent timekeeping was achieved.—T. CRAIG, F.B.H.I. (Cheltenham).

Reflector Telescopes

SIR,—Why has no manufacturer of reflector telescope mirrors invented an alternative substance for glass flats, the laborious method of grinding out same, and the consequent high prices ?

In these progressive times these mirror flats should be able to be produced by moulding from master mirrors.

I think correct proportions of cement and plaster should be quite satisfactory, and with proper buffing machinery it should be possible to produce a high gloss, sufficient for aluminising in a hot oven.

I hope to see the day when we can purchase large reflecting mirrors, 1-2ft. in diameter, with the extra useful magnification, made available at a respectable price; especially in these days of advanced astronomy and "flying saucers."—E. S. H. (Romford).

Some Old Bicycles

SIR,—As a retired engineer I subscribe to your publication, PRACTICAL MECHANICS, mainly for the mechanical information it gives. At the same time, as an old cyclist, I always read "Wayside Thoughts," by F. J. Urry, M.B.E., as there is generally something that interests me. In May there were the remarks of F. J. Osmond (whom I remember well), stating that he could build a faster bicycle weighing 22-24lbs. than one of 18-19 lbs.

My racing experience supports this assertion.

Over 60 years ago I possessed a delightful racing machine weighing 19 lbs., but was not at all successful in winning on it. I later purchased a New Howe (I think it was) weighing 23 lbs. This proved in practice to be superior in speed.

Previous to this I had owned and ridden an ordinary, a geared kangaroo.

My first pneumatic tyred cycle was a Centaur. The finest finished machine was an R. and P. (Robinson and Price, Liverpool). The weak spot in this machine was the straight spokes. Owing to design it was quite easy to knock the heads off the spokes of the rear wheel.

I had two or three cycles specially built by John Nowell, a well-known racing ordinary rider (trading as Nowell & Gardner, Southport). All these machines were within the 22-24 lbs. limit.

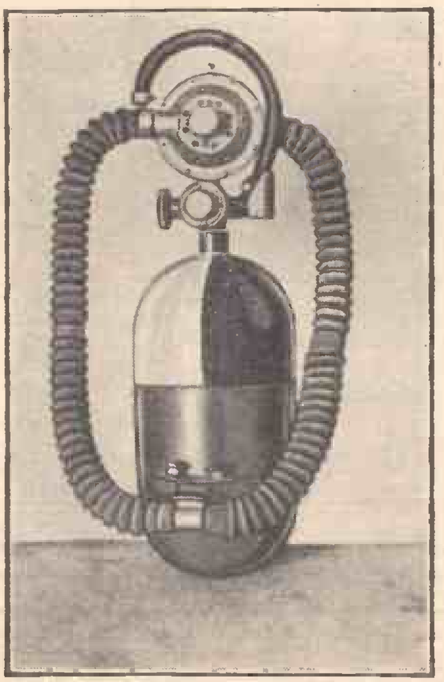
I also rode on many occasions a pneumatic tyred ordinary, lent me by my old friend John Tatham.—F. W. HUDLASS, O.B.E., M.I.Mech.E., M.I.A.E. (Richmond).

Making an Aqualung

SIR,—I have built the aqualung described in the January issue of PRACTICAL MECHANICS. The ex-Admiralty cylinder I used is being hydraulically tested, and certified by the Vulcan Insurance Company.

I have just read the specifications of the "Heinke" lung, and their bottle when new is tested to 2,700lbs. per sq. in., which gives a 50 per cent. safety margin with a 1,800 p.s.i. filling.

Below is a photograph of the aqualung I have just completed. All the parts are identical to those in your article, the modifications being that the 0-10min. gauge was dispensed with and the nut at the bottom was drilled out, threaded and a piece of ⅝in. hexagon brass screwed and brazed in. The top of this was threaded ⅝in. Whit. A piece of aluminium was welded to the bottom of the gas regulator to correspond; the exhaust valve is also welded to the top cover of the regulator. The mouthpiece was supplied by Siebe Gorman and Co., and the mouthpiece bracket tube was welded ⅜in. steel.—F. TURNER (Leicester).



Mr. F. Turner's aqualung.

Building a Home Workshop

SIR,—In "Tubal Caine's" article "Building a Home Workshop" in your May issue, Fig. 1 represents a cross-section of a workshop floor. The floor is apparently supported between concrete blocks by sawdust and the tongues of the floorboards.

The correct method of building a garden shed, insulated or not, is as follows:—

Dig trenches for foundations 9in. wide and down to firm earth. The width is just spade working width. Three trenches running the length of the shed will be needed for one 8ft. or 9ft. wide. Lay 3in. of concrete and build up with 4½in. brickwork to 9in. above ground, or cast walls in concrete. On top of the walls spread a layer of cement and sand and press on it a strip of heavy roofing felt 6in. wide. Allow the extra width to hang outside.

Timber plates of 3in. × 2in., tarred underneath, are laid on this dampproof course and nailed through into the joints of the brickwork; wooden plugs being built in every 27in. for this purpose.

The joists should be at least 3in. × 2in. laid on edge across the sleeper walls at 14in. or 15in. intervals. The length of the shed subdivided governs this spacing. Fix with 3in. nails skewed in from either side of joist.

The framework must be built directly on the plates and joists. To insulate the floor, split up any old boards or boxes into strips about 1in. × ⅜in. and nail them along the sides of the joists as low as possible. On these battens, any type of sheet or board can be laid to support the insulating material. Old oil drums split down and beaten out will do.

The insulation material can be sawdust, straw or even garden soil.

Thames mud is in the floors of most large London houses and is known as "pugging." The soil may not be such a good heat insulator, but it will stop the hollow drumming when hammering in the shed. The outer walls should be boarded down to the strip of roofing felt. Flat sheet asbestos is quite suitable, there is not much draught gets through that, and with insulation between it should be warm enough.

Lay the floor and sheet the inside walls afterwards.

The studs and noggins, i.e., uprights and horizontal wall members, can be of 2in. × 2in. and should be spaced to fit the lining sheets.—R. S. PERRY (Kerry).

I doubt whether the method advocated by Mr. Perry is the "correct" one and I wonder if there is a "standard" on which the construction of a garden workshop can be based.

The use of a brick wall is a matter of personal taste or perhaps whether the prospective builder of a workshop has the bricks in stock. Placing concrete piers at strategic intervals is just as effective—at least I have found it so. The inclusion of roofing felt is a point which not one builder in a thousand will use. I did not, and the workshop from which these drawings were made was perfectly dry after some nine years underneath a large tree. Any water was shed by the sides as I suggested.

Finally, the inclusion of the 3in. x 2in. plate is only adding to the cost of the structure.

With regards to the use of soil as a sound-deadening feature, this is also a matter of opinion —I have never tried it but I would prefer to use either sawdust or sand.

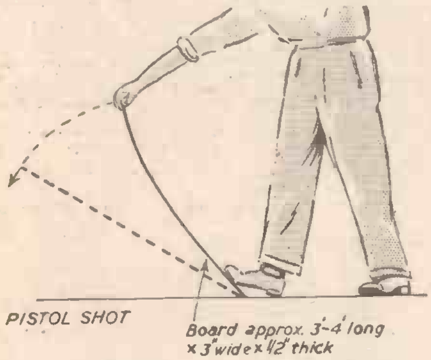
I cannot comment on the splitting of oil drums other than to say that this operation is not exactly easy and one which I think many constructors will not attempt because it happens to be a dirty and rather difficult task. Similarly, the nailing of the floor to the brickwork is a matter of opinion, but with my form of building and the fact that I think my machinery weighed some 15 cwt. I simply did not give this a thought —I knew the weight was sufficient to overcome movement.

I cannot say that the methods suggested by Mr. Perry are wrong, rather shall we say they entail more work and will thus cost more. Several of my friends have almost identical layouts including one who is a foreman with probably the largest firm of portable building makers in this country, and sheds, etc., have been supplied to special order, with only minor variations, etc., such as the spacing of the joists. To my knowledge no complaints have been received, so I think any reader can go ahead with this in mind, and he can, if his pocket is not overtaxed, incorporate any ideas in this letter. —" Tubal Caine."

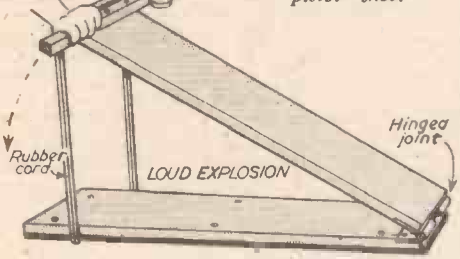
Boiler Explosion on the Stage

SIR,—Re the query by A. J. Jarvis, of Wellington, in the May issue, regarding stage " noises off " to represent : (a) steam ; (b) explosion ; (c) hissing (of steam), I offer the following as the most useful tricks of production.

Explosive noises of any kind can be produced by a sprung board slapping down on another board or on the stage floor. It is not good practice to use a starting pistol with blank cartridge for a pistol-shot. They misfire so often. The safest way for an off-stage shot is to hold a springy board about 3ft. to 4ft. long by 3in. wide and ½in. thick by the crook of the four fingers of one hand (no thumb) over one end, with the other end resting on the floor in front of you. If you use the right hand you place the right foot on the bottom end of the board so that as much of your weight as possible is tending to pull the board downwards out of the crook of the fingers (see Fig. 1). When the cue is seen or heard, you let the high end of the board slip from the fingers and hit the floor or the stage with a hard smack. For bigger explosions use bigger boards. Two boards should be close-hinged at one end, lying absolutely close or flat together when closed. The bottom board should be nailed to the floor. The upper board should have a crosspiece screw-nailed on top at end remote from hinge (see Fig. 2). Catapult rubber cord should be wound round the ends of both boards at the crosspiece (or handle) end. Prepare for the cue by lifting the top board by means of the wooden handle or crosspiece against the tension of rubber. The amount of noise will be determined by the height of the lift (and the strength of the operator). The degree of resonance will be found by trying different parts of the floor or by using crosspieces under the bottom board. For a really big explosion among buildings or at a distance, some additional resonance may be required and this could be provided by a gentle tap on the big drum the instant after the crack of the board. You must experiment with the above materials until you get the result you want.



Making a stage " pistol shot."



Making a loud stage explosion.

The hissing of steam can easily be simulated by using a cylinder of carbon-dioxide gas as used by the aerated waters manufacturers. These cylinders are supplied to the trade by The Distillers Co., Ltd., London, and, I believe, The British Oxygen Co., Ltd. The noise of the hiss can be varied from a gentle hiss to the roar of a steam engine letting off steam under a roof.

Making steam. A lot depends on the humidity of the atmosphere, but blowing CO_2 gas into the air, as above, can sometimes create a lot of " steam " by condensing the moisture in the air. A method which might be tried is to use a modern 3-element (3 kilowatts) tea urn as used in canteens. These urns can hold approximately four gallons of water when full, and when full, take 30-40 minutes to boil.

You could use a flexible pipe of appropriate diameter to pipe the steam to the point required. If CO_2 gas was blown into steam as it emerged from the pipe (or the urn) there would be large clouds of steam formed.

Incidentally, the firing of rockets as distress signals, as in the famous play " Rebecca," can be perfectly simulated by suddenly opening the nozzle of the gas bottle wide and then gradually closing the nozzle. —JAMES HOWAT (Greenock).

SIR,—I have just provided the effects A. J. Jarvis desires for a play entitled " Keep Calm."

The boiler explosion was made using a small size theatre maroon (Pains' firework) obtained from Messrs. Strand Electric and Engineering Co., Floral Street, London. This should be exploded in an old dustbin covered with wire mesh to retain flying particles. Alternatively, a maroon may be made by constructing a tube about 3in. long by ½in. diameter from paper coated with gum and rolled up. Two flexible leads joined with a piece of fine copper fuse wire are sealed in, and the whole gently packed with photographic flash powder. The ends are sealed with tissue paper and gum and allowed to dry. Any battery or transformer producing upwards of 4 volts may be used to fire the charge.

The sound of escaping steam was produced by pumping up a small air bottle to about 100lb./sq. in. and suddenly releasing the pressure. A car tyre could be used with a foot pump if the valve inside core is first removed. The air will then escape when the pump connector is removed.

Finally, the " clouds of steam " effect was produced by blowing air across a tray filled with french chalk or flour and aiming in the required direction, Actually, I used the air from the air bottle mentioned in the previous paragraph. I think this is simpler than using a chemical method.—T. STEPHEN (Wembley).

SIR,—I would suggest the following methods of obtaining boiler explosion effects.

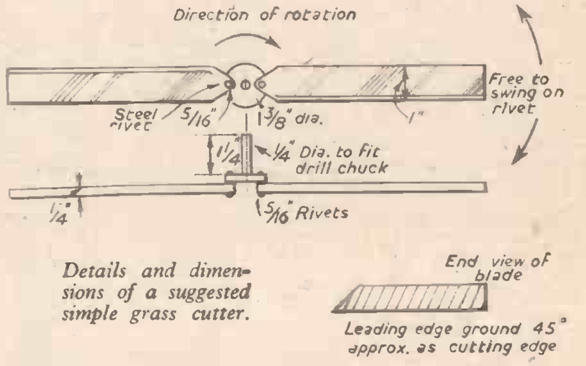
Clouds of Steam. If it is possible to obtain " Drikold " (solid carbon-dioxide) from local ice-cream shops not possessing refrigerators, tip lumps about ½in. cube into warm water. The disadvantage is that the vapour is heavier than air, but may be directed by means of jet such as a kettle spout.

Alternative method. Obtain some powdered ammonium-chloride from the local chemists (quite cheap) and place powder on two metal plates with electric iron element sandwiched between (one teaspoonful will last approximately two minutes and produce a large quantity of odourless white smoke within a few seconds of switching on current).

If a heating supply (gas or electricity) is available near stage, a pressure cooker, with slightly more water in than usual,and the largest weight on the safety valve will produce a strong hissing noise.—P. MAGINNESS (Stockport).

Garage Door Modification

SIR,—The drawing of the garage door shown in the letter by C. Buchanan (May issue) was, of course, quite correct. I regret that the drawing in the original article did not show the top brace end let into the ledge, but this was an oversight, as most readers probably realised, for other brace ends were shown let in and in the description I recommended that this should be done.—W. J. HARRIS (Salisbury).



Details and dimensions of a suggested simple grass cutter.

Power-operated Grass Shears

SIR,—The following details are of an accessory I have constructed and used with my ¼in. electric drill.

The purpose of the tool is that of a power-operated grass shears. The sketch above will, I hope, be self-explanatory.

The blades were made from two pieces of a worn-out 1in. wide flat file, and it is essential that they be left free to swing on the securing rivets as this avoids damage in case of striking stones, etc., in the grass, the blades assuming the extended position centrifugally.—G. MADDERS (Blackpool).

Removing Emulsion from Photographic Plates

SIR,—With reference to the article on lantern slides (page 295, April, 1955) it is quite easy to remove emulsion from plates with cotton wool soaked in sodium hypochlorite or 10 per cent. caustic soda.—E. WYLIE (Bucks).

SIR,—I think I can set Mr. Hough's mind at rest. Radioactivity is essentially a property of matter, whereas electricity is a

(Continued on page 459)

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"AQUALUNG" CYLINDERS, £2/2/6 ; Regulators, £1/16/9 ; Compressors, £4/10/-. Pryce, 157, Malden Rd., Cheam.

SAWBENCHES, plain, petrol, electric. Hogg & Pudsey, 10, Folly Lane, Leeds, 11.

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CHEAP GOVERNMENT WIRE ! ! ! Ideal for training fruit trees, peas, beans, roses, arches, greenhouses, tomatoes, raspberries, tying, etc. Strong, flexible, steel-stranded and waterproof covered. Several thicknesses. Postcard to-day for free samples. Greens Government Stores, 183, Albert Street, Lytham.

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TOY & GAME MANUFACTURE. The world's first journal specifically devoted to the manufacture of toys, games, sports equipment and amusement novelties. Annual subscription £1/10/-. Specimen copy 2/6. Techniview Publications Ltd., 125, Oxford Street, London, W.1.

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SAWBENCHES, all sizes from £10 ; motorised, £20 ; petrol portable, £32. Spindle Assemblies, from 27/6 for saws up to 36in. Motors, Engines, Bearings, Pulleys, Belts. Deferred terms. Send 1/4 for handbook-catalogue. Price list free. Beverley Products, Sturton-le-Steeple, 17, Notts.

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ELECTRICAL

NEW 100FT. COILS 1/22 P.V.C. WIRE, assorted colours, 1/8 per coil, 8/6 for 6 ; ideal for bells, indoor aerials, etc. Holderness, Wantage, Berks.

CABLE CHEAPER in small coils (25-49yds.). Prices per 100yd. lots (less supplied add 5%), twin rubber or plastic, 1/044 50/-, 3/029 64/6, 3/029, earthed, 78/6, 7/029 earthed, 135/-. Request lists, all cables, accessories. P.M., 591, Green Lanes, London, N.8.

BRAND NEW CABLES : TRS twin, 1/044 42/-, 3/029 62/- ; twin and earth, 3/029 73/-, 7/029 125/-; PVC twin 1/044 49/-, 3/029 63/- ; all per 100 yards. Lampholders 6/6, Switches 16/3 doz. All electrical goods, including Fluorescent fittings, at bargain prices. List. Jaylow Supplies, 93, Fairholt Road, London, N.16.

WITH NO DELAY POST TO-DAY ! For A.C., 250/1/50, cap. start, 1,425 r.p.m., silent, fully reconditioned and guaranteed Electric Motors, make : B.T.H., Delco, Remy, ¼, ⅓, 1/6 f.h.p., 88/-, 67/-, 57/-, or 25% deposit secures. Terms c.w.o.; carr. at cost. Surman, Chalgrove, Oxford.

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WATCH REPAIRERS, Hobbyists, etc., send s.a.e. for list of Watches, Movements, etc., priced from 9d. each. Loader Bros., Dept. P.M., 36, Milestone Rd., Carterton, Oxford.

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SACRIFICE PRICE, 4 cu. ft. portable Sprayplant, £39/10/- ; "Smiths" airline Filters, £1 each. Fraction manufacturing cost. Fans, Dust Extractors, etc., cheap. Bellangers, 306, Holloway Road, London, N.7 North 4117.

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The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order 1952.

A.M.I.Mech.E., A.M.Brit.I.R.E., City and Guilds, etc., on "No Pass—No Fee" terms. Over 95% successes. For details of Exams. and courses in all branches of Engineering, Building, etc., write for 144-page Handbook—Free. B.I.E.T. (Dept. 967B), 29, Wright's Lane, London, W.8.

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INVENTORS.—Send s.a.e. for particulars of our Service for profitably developing and marketing your Invention. Kelsey & Partners, Woodlands, Stroud, Glos.

(Continued on next page)

(Continued from previous page)

PHOTOGRAPHY

ENLARGER and Camera Bellows supplied; also fitted. Beers, St. Cuthbert's Road, Derby.

MISCELLANEOUS

TAKE A TIP! It may be "Wimet." Grind with "Diadisc" from Millett! 1¼in. diamond lap, ¼in. taper bore, 25/9. W. J. Millett, C.M.B.H.I., St. Ives, Huntingdon.

BUILD YOUR OWN REFRIGERATOR. all components available at reasonable prices. Frigidaire flowing cold units £5; small units, Kelvinator, etc., £4; ¼ h.p. heavy duty Motors, £3; Chrome Cabinet fittings, new, £1; money back guarantee; s.a.e. for list and schematic diagram. Wheelhouse, 1, The Grove, Isleworth, Middx. (Phone: Hounslow 7558.)

"FORTUNES IN FORMULAS," 900-page American book of formulæ. American technical hobby and other books covering every interest. Stamp for lists. Herga Ltd. (Dept. P2), Hastings.

EVERY conceivable item of workshop equipment readily available under our Personal Hire-purchase Plan. Write for details to-day to Garners, 6-8, Primrose Hill, Barnsley.

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DID YOU KNOW Hire-purchase need cost only one shilling in the pound? To reduce correspondence, only 5% will be charged on outstanding balance on "Myfords" or "Startrite" where customers remit deposit of not less than one-quarter of cash price and state exact requirements. Save your money by saving our time! Example: Myford Super 7 with Cabinet Stand, cash price £95/15/-, deposit with order £25/15/-, balance due £70, plus 1/- in the pound, total payable in 12 monthly instalments £73/10/-= £6/2/6 per month. Myford prices include carriage anywhere inland. Startrite prices include carriage Greater London. 5% H.P. Dept., 94, Camden Road, London, N.W.1. (Telephone: GUL 6006.)

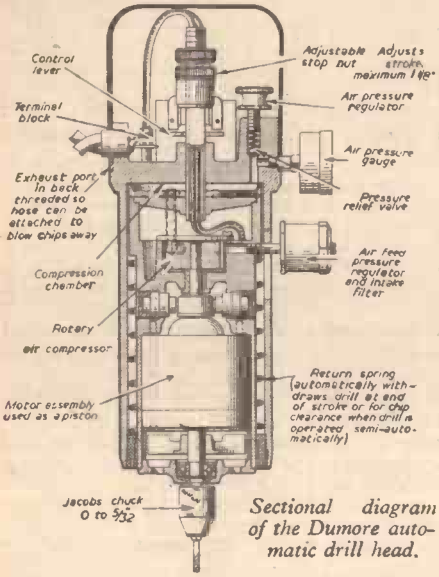
A SET OF OUR DRAWINGS at 8/6 will convince you that the P.B. Clutch Unit is a practical engineering job, specially designed for making in your home workshop. Leaflet free. P.B. Engineering, 86, King William Street, Coventry.

MONEY FOR WASTE MERCURY, highest prices paid; mercury containers supplied. Wilton Trading Co., Melling Rd., Southport.

Trade Notes

Dumore Automatic Drill Head

THIS is a compact motor-driven head with a self-contained air compressor for advancing drill. Sensitive and automatic control of speed and feed gives increased production and less drill breakage. The head can be operated manually, or automatically, with any number controlled from one master switch. Drill capacity is No. 80 to 3/32in. in steel and No. 80 to ⅛in. in zinc, aluminium, brass, etc., and No. 80 to 5/32in. in plastics and wood.



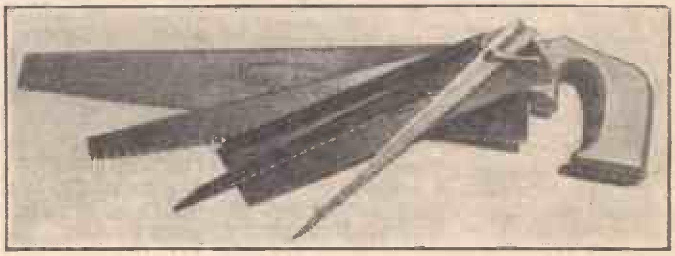
Sectional diagram of the Dumore automatic drill head.

The heads are suitable for use by small and large works in many industries where small drills are used. One of the secrets of success is claimed to be the built-in air supply that automatically drills each hole at correct pressure and speed. All the operator needs to do is to set the recommended air pressure, feed jigs and fixtures and press automatic feed button.

A complete line of accessories, including bench stand, repeat cycle timer and remote control switches are available. The diagram shows some of the chief features of the unit. Details of prices and supply are available from the makers, Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, London S.W.11.

Printed Circuits Layouts

FROM Printed Circuits, Ltd., Whadcoat Street, London, N.4, we have received a pamphlet giving details of "Plasmet" Continuous Copper Etched Wiring Circuits and hints in their preparation. This firm is now in a position to produce and design all forms of printed layouts, which, in their simplest form provide an accurate wiring harness to which components such as valve-holders, resistors, condensers, etc., are connected by mass soldering in one operation. In many cases the conventional chassis can be dispensed with. Using this system costs may be considerably reduced. Details and terms, etc., may be obtained from the above address.



The compact unit of five saws.

A Compact Saw Kit

THE latest line of Messrs. J. Bull and Sons, 246, High Street, Harlesden, London, N.W.10, is a unit of saws, consisting of five interchangeable blades on one handle. The five blades are a wood saw, pruning saw, tenon saw, key-hole saw and metal saw. The blade in use is held rigidly in a slot in the handle by a system of two locating bolts and a wingnut. The price from the above firm of the complete kit is 9s., plus 1s. postage

New Fungicide to Combat Paint Discoloration

RECENT surveys have shown that the discoloration of paint and the failure of the film, particularly in buildings of high humidity, is often due to attack by fungus rather than ordinary dirt.

The Nuodex organisation has carried out intensive studies on the subject, successfully isolating as many as 30 different fungi which flourish on paint films. The research has resulted in the introduction of a new fungicide, Nuodex 321.SS, which is completely soluble in mineral spirits and compatible with emulsion paint systems, and effectively precludes such premature decorative loss of the paint.

The Nuodex fungicide has already proved successful in industry and in the home, and recently in numerous industrial establishments with high humidity conditions—breweries for example. Normal emulsion paint lasting for about two weeks in the humid atmosphere had, with the incorporation of Nuodex 321.SS fungicide, raised this interval to nearly three months, with a corresponding reduction in repainting overheads.

The Nuodex fungicides are manufactured by Nuodex Ltd., Birtley, Co. Durham, and are distributed by Durham Raw Materials, Ltd., in the following areas: 1-4, Great Tower Street, London, E.C.3; 1, Booth Street, Albert Square, Manchester, 2; 180, Hope Street, Glasgow, C.1.

LETTERS TO THE EDITOR

(*Continued from page* 456)

force and not material but abstract. To say that electricity can become radioactive is on a par with saying that sunshine gets wet when it shines through a cloud!—E. WYLIE (Bucks).

Drilling Lamp Standards

SIR,—Seeing the query in the March issue about drilling wooden lamp standards I think I could give some hints. As a number are required it would be worth while taking a little trouble over the arrangements.

If the hole is to be a foot or so long, it would be a risky business to simply use a drill in the ordinary way as, apart from the necessity of withdrawing the drill frequently to prevent clogging, it is very difficult to ensure true direction.

It is a necessity to revolve the wood post that is to be drilled, whether the drill is revolved or not. The way I drilled a mahogany post was to put the post in the three-jaw chuck of a lathe, the far end of the post being centred on a makeshift back-centre (there was little strain on this, it was for holding the post opposite the chuck only) and then putting the drill through the hollow mandrel of the lathe, which kept it reasonably true to start with, the revolving post looking after the business after.

The drill was made from a long length of seamless electric light conduit, ½in. size with half a dozen sharp teeth filed on the end, these being fairly widely "set" alternately in and out and then case-hardened.

A tap-wrench was fixed on the outer part of the drill for holding it and applying pressure, while the lathe was set running. The hole cut well, leaving a core (like a dowel stick) inside; to get rid of the trouble of removing the drill to free it from sawdust, a rubber tube was fitted to the outer end of the drill and air pumped in from a Fletcher's Blower and this got rid of the sawdust in a continuous stream. The post was drilled from each end as the friction was less with the shorter lengths and in the end when the holes met they were so closely in line that it was only just possible to see the junctions.—A. C. HYDE PARKER (Abingdon).

Painting on Cement

SIR,—As you occasionally have inquiries for a suitable paint for cement surfaces, etc., I would like to inform you that I painted cement-faced walls in my kitchen with "Permoglaze Cement Primer" paint three years ago. I put a gloss paint top coat on top of two coats of the primer, which was painted on the cement as soon as the moisture was dispersed, and after continual damp and frequent scrubbing there is not the slightest sign of it flaking. In all respects I have found it perfect for the job.—D. ROSE (Birmingham, 27).

Doll's Head Repairs

SIR,—My young niece's doll's head, which is made of a form of plaster, kept breaking away at the neck due to the pull of the elastic on the card disc which held the head to the body. I tried many ways to remedy this and at last was very successful by the following method:—

I glued a short strip of bandage round the inside of the neck. Then I found a broken piece of plastic model aircraft propeller and melted this around the broken part of the neck. This was done by using a soldering iron and building it up as would be done with solder on metal. It has proved completely successful.—H. HARRADON (Surrey).

MAKING A MIDGET CAMERA

(*Continued from page* 446)

For example, a white spot on a gramophone turntable can be photographed at various shutter speeds, measuring the angle of blur. (The angular velocity is about 480 deg./sec.)

Loading

The camera must be loaded in the dark, and it is advisable to practise this in daylight using an old length of film.

The maximum length of film which can be wound on a spool is about 22in.; this will give around 40 exposures.

Attach one end of the film to the spool with adhesive tape, and wind on, leaving about 2in. free. Slip on the cassette clip to prevent unreeling and thread the other end through the film carrier and attach to the winding spool with adhesive tape. When inserting base into camera, turn winding knob until key engages with spool slot.

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.

Water-cooled Safe

I INTEND to construct a water-cooled safe of capacity nearly 1 cu. ft. A wooden framework is covered over with muslin and kept damp by means of water fed to it by wicks from a reservoir. The muslin is pleated to give a greater area.

Please could you tell me if the above will keep food cool enough to preserve it? I wish to enclose it in a cabinet (for protection). What should I make it of to allow air to freely circulate? Would you suggest a forced draught? If so, how would you arrange it?—G. Beale (Hastings).

THE system you suggest would not be effective in maintaining the temperature at a level sufficiently low to preserve food. Indeed, we think that there would be very little difference in temperature between the inside and outside of the muslin cage owing to the fact that the flow of air through the mesh would be too free.

It would be better to construct a cage of porous brick or porcelain and to feed the outside of this in the way you suggest. But even so, the difference in temperature would only be sufficient to prevent butter from becoming too fluid in very hot weather. The air confined within the brick or porcelain cage would be relatively static and would be cooled by radiation and conduction from the relatively thick walls of the cage. The "heat capacity" (in a negative or cooling sense) of a thickness of brick would be far greater than would be the case with a thin membrane of muslin, the specific heat of which is not comparable with that of brick or porcelain.

Electric Power from a Water Wheel

COULD you please inform me what electricity I could derive from a stream 14ft. wide, existing depth 9ins., but can be dammed up to 18ins., with a straight course 84yds. long? The speed estimated and timed by a table tennis ball is 2 minutes for this distance. I would use a 6ft. width for the water wheel, leaving the remainder for escapement. Would a water wheel with blades made from corrugated iron meet my requirements?—E. Smith (Chorley).

THE estimated speed at the surface of the water is 125ft. per min., but the speed of the water may be less at a lower depth. When ascertaining water speed it is advisable to use vertical floats which reach almost to the bed of the stream. Floats should be sent down the centre of the channel, and also near both sides, in order to find the mean speed of the water. Under the conditions stated in your letter, the average speed of the stream may be about 60ft. per min. if the bed of the stream is rough.

At an average water speed of 60ft. per min. and 6ft. width with 9in. depth the volume of water passing down the stream per min. will be 270 cu. ft., corresponding to 16,800lb. of water per min. In order to estimate the possible power output we should require to know the fall which can be obtained at the water wheel. For a 1ft. fall the work done per minute would be 16,800ft./lb., which roughly corresponds to 0.5 h.p. If the efficiency of the water wheel is 50 per cent. the power which could then be applied to the dynamo would be 0.25 h.p., which corresponds to 186 watts. If the dynamo had an efficiency of 55 per cent. the electrical output from the dynamo would then be about 100 watts. We should advise using flat or curved sheet iron vanes of $\frac{1}{16}$in. to $\frac{1}{8}$in. thick for the water wheel.

Painting Caravan Roof

I HAVE a canvas-topped caravan, and from the canvas the paint has badly peeled.

Would you please advise me how to clean off the rest of the paint, the best paint to use when repainting, and how many coats to apply to make it a really good job? The 'van is parked close to the sea for six months of the year.—D. Rutter (Aldershot).

THERE is really no effective way of removing old paint from a canvas roof other than by very carefully hand scraping with a blunt-edged tool. The trouble here is that if you use a paint solvent or softener it might injuriously affect the fabric of the roof, it might detach it from its base, or it might cause it first to swell and then to contract, thereby resulting in its tearing. In fact, any such removal of paint is fraught with these and other adverse possibilities, so much so, we think, that it would be by far the safest for you to remove the paint little by little by some hand method of scraping. If this cannot be done, the paint will have to be softened with a paint-softening preparation in small areas at a time, and then removed by careful scraping. There is, unfortunately, no other way.

Any paint will blister in the hot sun under the severe conditions which it is exposed on a caravan roof. This is best combated by laying down the paint thinly, and not using a high-gloss paint. We would advise you to paint the stripped roof with a thin coat of grey or a red oxide priming paint. When this has hardened, apply two thin coats of the paint of your choice. Some crazing and chalking (surface powdering) of the paint must be expected under the influence of sunshine and sea air. Any good make of paint will do, but it is far preferable to have a flat paint. If you write to Messrs. Pinchin, Johnson, Ltd., General Buildings, Aldwych, London, W.C.2, they will advise you of the best of their many types of paint for your especial purpose. In our opinion, a common grey priming paint would be as good as any, if you would have no objection to its rather dull, flat appearance.

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.

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

Binocular Vision in the Microscope

COULD you please inform me as to how binocular vision is achieved in a monocular microscope?—B. Gamble (Leicester).

BINOCULAR vision in the microscope is obtained by means of a prism which, cutting across the pencil of light rays from the objective, allows one half of the object to be seen by direct vision; the other half is passed through the prism, is refracted, and bent to pass up to the angularly inclined eyepiece. Thus there are two tubes joined directly together and making such an angle, one with the other, that their top ends, both containing an eyepiece of equal focus, have a distance apart of about $2\frac{1}{2}$in. equal to the distance apart of the human eyes. This is the modern way of obtaining stereoscopic vision in the microscope. There are other ways, all obtained by means of prisms, but most of them are now out of date.

The principle of stereoscopic vision is

(Continued on page 462)

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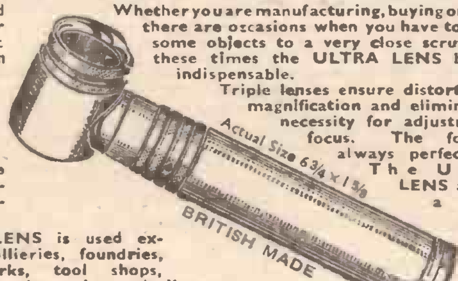

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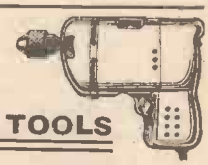

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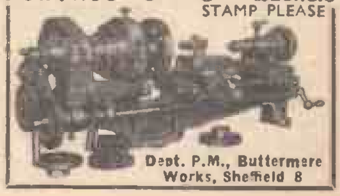


Dept. P.M., Buttermere Works, Sheffield 8 based on seeing an object from two view-points, and therefore the seeing must be binocular, not monocular.

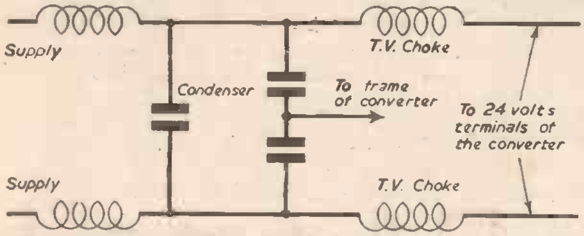
Suppressing the "P.M." Windcharger

I HAVE made one of the small wind-power plants, as per your articles in "Practical Mechanics," May to September.

I fitted it with a 24 v. dynamo and have 6.6 v.130 amp. batteries. I am pleased to say it works very well.

I have now obtained a 24 v. D.C. to 234 A.C. rotary converter. Will you please inform me how to stop radio and television interference ?—G. C. Bunting (Derbys).

A SUPPRESSOR unit consisting of condensers and choke coils could be connected as indicated in the diagram below,



Circuit for windcharger suppressor

the case of the rotary converter being connected to earth. Connect the suppressor as close to the D.C. terminals of the converter as possible. Messrs. Belling & Lee, Ltd., of Cambridge Arterial Road, Enfield, Middx, could probably supply a suitable suppressor unit if you send them full details of the machine.

Changing Telescope Object Glass

I HAVE a home-made telescope with a double concave eye lens ½in. diameter, ¼in. focus; the object lens is a slightly double convex spectacle lens, 1¼in. diameter, 15in. focus. Would it work if the object lens was a 3in.-diameter 20-30in. focus double convex ?—R. H. Unwin (Derby).

YOUR telescope would work with another object glass, or lens, of 20-30in. focus double convex, but we suggest that you do not have a 3in.-diameter lens; it will cost you much more and you will find that to obtain good definition you will have to stop down the aperture, i.e., you will improve the sharpness of the image seen by cutting a black cardboard ring so as to only have an opening in the middle of the lens of about 1¼in. diameter. This means that the remainder of the lens is wasted. It would be different if the lens were achromatic or if it were of extremely long focus. We advise you to go to an optician and buy an ordinary double-convex circular lens having a focus of 30in. and of the kind which is used in spectacles. You will find it an advantage to have a best quality lens.

For lenses try Broadhurst, Clarkson & Co., Ltd., 63, Farringdon Road, London, E.C.1.

Detecting Firedamp in a Coal-mine

I BELIEVE there is an instrument which a fireman uses to determine if gas is present in a coal-mine and should be very interested to know how this works. Also, what is the percentage of gas in the atmosphere it will detect ? Is there a metal or substance which is reactive to coal-gas ?—G. Cole (Bolton).

WE are assuming that when you refer to "gas" in a coal-mine you mean fire-damp or methane. This is the only gas that is of concern to the miner. A Davy safety lamp is used for detecting the presence of firedamp. This is an oil-lamp the flame of which is surrounded by a cylinder of wire gauze. The air necessary for the combustion of the oil passes in through the gauze. If firedamp is present it enters into the lamp and burns inside it with a bluish flame. But owing to the conduction loss of heat through the gauze to the base of the lamp, the temperature of the firedamp immediately outside the gauze never rises to the ignition point. Thus the flame cannot travel outside the lamp, and explosions are prevented. We do not know the percentage it can detect, but it is of a very small order.

We assume that you want to be able to detect leaks of coal-gas. It is necessary to select one of the common ingredients of coal-gas, which is always present, and which will give a reaction even in minute quantities. Carbon-monoxide is the ingredient in the coal-gas selected.

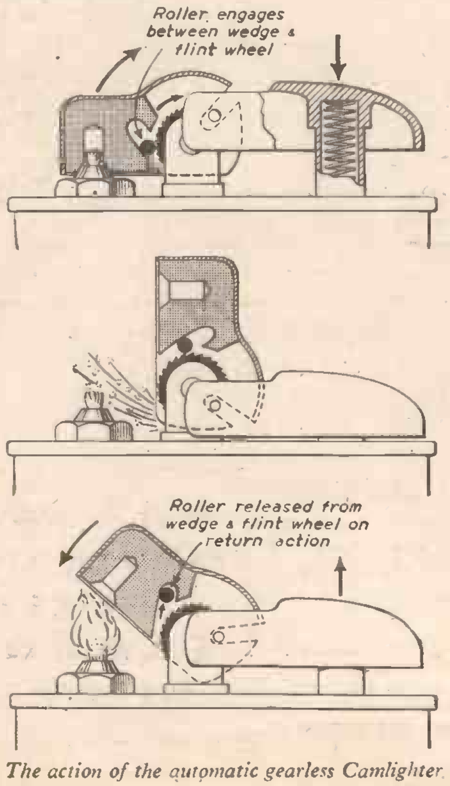
This substance decomposes iodine pentoxide into free iodine when passed through a tube of iodine pentoxide. In series with this tube you need another U-tube containing potassium-iodide paper, which should be maintained moist. As soon as carbon-monoxide or coal-gas passes over the first tube it is converted into free iodine. The iodine vapour then passes on to the second tube containing the potassium iodide paper and gives a brown tint to the paper (see *Partington's Inorganic Chemistry*, page 411).

The Gearless Automatic Camlighter

I UNDERSTAND that Mr. F. J. Camm invented the Camlighter, and that, although it is fully automatic it does not contain any ratchets, gears, pawls, or special springs. As it is patented is there any reason why you could not explain how it works ?—E. J. S. (Birmingham).

IT is true that the Camlighter which is fully automatic does not make use of any ratchets, gears, pawls, or special springs. Upon pressing the pressure bar the snuffer is lifted and the wick ignited. When pressure is released the snuffer automatically extinguishes the flame.

When the flint has worn down to the thickness of a piece of paper the last wafer is automatically ejected.



The action of the automatic gearless Camlighter

The action depends upon the principle of the inclined plane. (See diagrams.) An inclined plane is cut in the snuffer box which envelopes the wick nipple. Across this inclined plane is a small roller which drops by gravity into contact with the flintwheel. When pressure is applied to the pressure bar, this roller jams on the teeth of the flintwheel and thus as the snuffer raises it carries the flintwheel with it. When pressure is released the roller ceases to jam and the snuffer can be returned to its original position. The roller and inclined plane is a good example of a trouble-free free wheel.

In reply to your further question the cheapest model costs 17s. 6d.

Information Sought

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

A letter from R. D. King asks : "Can you supply constructional details of a home freezer using an absorption unit ? I want to build the unit myself."

Mr. M. Day writes : "I am interested in making a set of training rollers for my bicycle ; could you let me have any advice, particulars or preferably, plans of construction ?"

J. Thompson asks : "Can you supply me with some information regarding the construction of a wind-pump suitable for raising a small amount of water about 10ft. ?"

From Tolworth County Sec. Boys' School comes the following : "We are in need of a machine for folding paper. Would it be possible to make such a machine in our school workshop ? Where could we obtain a suitable design ?

The machine would be expected to handle single sheets up to 15in. by 10in."

E. N. Bartlett (Exeter) writes : "I own a Kodak "A" camera fitted with a F/4.5 Anastor lens, with a focusing range of 3-40ft.

I wish to fit a telescopic lens in order to take photos of car racing and motor-cycle scrambles, etc., where it is not always possible to get within range.

Can you suggest any way of modifying the lens, or where I can purchase a lens ?"

S. W. Coates (Finchley) asks : "Can you suggest material to use to make rocks, etc., for a tropical aquarium ?"

The following is from D. L. Laing (Dunedin) : "Could you give me some information on the design of a Sawdust Burner ? Fabrication presents no problem and I intend, if possible, to use the burner for space-heating (9,600 cu.ft.) in a small workshop."

From J. W. Clewett (Bristol) comes the following : "How can I obtain the surface with which some types of telephone message pads are finished on which marks can be made in pencil or ink and erased when necessary with a damp cloth ? I want to produce such a surface on maps, some of which are ink drawn on stiff card and others being Ordnance Survey maps mounted on hardboard."

Mr. L. Corder (Croydon) writes : "Could you please send me the circuit of the simple advertising mechanisms now used in various shop window displays ? The mechanism is usually clamped to a dry-cell and provides a continuous pendulum motion to operate various moving displays, usually built up on cardboard."

R. G. Sanders asks : "Can you please tell me how to make gelatine photographic filters, what dyes are used and a source of supply ? Can you recommend any suitable literature on the subject ?"

THE Cyclist

Editor: F. J. CAMM

VOL. XXIII JULY, 1955 No. 398

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

Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

WHAT I THINK By F. J. C.

Should the Speed Limit Be Abolished?

IT will be remembered that the Roadfarers' Club in a memorandum to the Ministry of Transport suggested that the Speed Limit in London should be abolished. In that memorandum it was stated that it shared the opinion of the Lord Chief Justice that the speed limit was not effective in reducing accidents. Indeed, an analysis of the accident statistics shows that speed is not the primary cause of accidents. It is illogical to presume that a motorist is driving safely at 30 m.p.h. and dangerously at 31 m.p.h. It was pointed out that the law at present is adequate to deal with any motorist who drives at a speed which is unsafe in relation to conditions obtaining at a particular moment, and that speed cannot be arbitrarily assessed. It might be any speed between 1 m.p.h. and 80 m.p.h. As the average speed in London is only 8 m.p.h., a motorist should be entitled, says the memorandum, to make up some of the time he has lost by travelling at a speed of over 30 m.p.h. where he can do so with safety. It is true that such occasions are few and far between. As the limit cannot be satisfactorily enforced either that is a further reason for its abolition. The abolition of the speed limit, if agreed upon, should be accompanied by a readjustment of stopping places for public service vehicles, removal of a large number of traffic lights, especially at comparatively unimportant crossings, all lights should be switched off at night, including pedestrian crossing lights; there should be more "No Right Turn" signs. "When a river is in spate, the sluices are lifted in order to prevent it from overflowing its banks. With the traffic stream the contrary policy has been adopted." Traffic lights are insensitive to the needs of the moment, and they cannot be pre-set for traffic control, so that the duration of the red or green lights comply with varying traffic needs throughout the day. If it is impractical to abolish the limit, especially on roads in which schools are located, it should apply to only certain hours of the day, and be abolished altogether at night. These are some of the main recommendations in the memorandum, which has been favourably commented on in the National and technical press.

Lovely tile hung cottages at Witley. Surrey.

We were not surprised, however, to learn that these views are not altogether palatable to some. Mr. F. W. Garforth, of Hull, for example, says, without producing any evidence, that "experience has shown both in this country and in the U.S.A. that a speed limit is effective in reducing the accident rate." This in our view is insupportable, although Mr. Garforth says that speed is a factor in road accidents and that the braking distances illustrated in the Highway Code show this clearly. We agree that some statistics do indicate that there is a close relation between speed and the severity of injury, but they do not prove that speed is responsible for the majority of accidents. Mr. Garforth goes on:

"It is suggested that the speed limit should be imposed only in certain areas, e.g., in roads where there are schools and in school hours. This seems wholly impracticable; children of primary age (five to 11) may have to walk up to two miles to school, crossing several roads en route—how many roads, then, should be restricted, and for what distance? and what is meant by 'school hours?'—for schools differ in their hours, as also in their holidays. And in some areas it is the holidays, not term-time, that are the more productive of accidents to children.

"Accidents to pedestrians occur most frequently among the younger (five to eight) and the older members of the population, both of whom are incapable of judging speed and distance accurately; the abolition of the speed limit would greatly increase the risk to these already highly vulnerable sections of the population.

"It may be true that the law is adequate to deal with the motorist who drives at an unsafe speed; but the law cannot operate without evidence, and I suggest that the evidence in such cases would be even more difficult to obtain than that for exceeding the present speed limit. In practice the only acceptable evidence would be an accident or near-accident, and this could hardly be regarded as a contribution to road safety.

"It may also be true that 'speed cannot be arbitrarily assessed,' the inference from which would be that each man must judge for himself what is a safe speed. But there are many drivers who are incapable of such judgment, either congenitally or because they are strangers to the district or because they are 'under the influence' or (and there are far too many of these) because they are plain selfish. Far better, surely, to err on the side of safety and have a universally enforced limit which good and bad drivers alike must obey.

"In recent months there has been a considerable rise in the accident rate, especially, I believe, in non-restricted areas where speeds are normally greater. Moreover, we have been authoritatively informed that road traffic may be doubled in the next 10 years. The present, therefore, would hardly seem to be the time for any experiment likely to add still further to road hazards."

Naturally the cycling and pedestrian associations are opposed to the abolition of the speed limit. We are in favour of it because we do not feel that it is an infraction of the rights of other road users and because we believe that it would make the roads in busy places safer. It is well known that congested roads where speed is slowest are the most fruitful source of accidents. We believe that if traffic is kept fluid and apart instead of being built up into clots of State-created obstruction, cyclists and pedestrians could benefit.

It is true that the accident statistics are appalling, for more than 200,000 people are killed or injured on our roads every year. This amounts to one casualty every $2\frac{1}{2}$ minutes. But with 186,000 miles of highways, which includes only 8,250 miles of trunk roads, it is obvious that traffic must be speeded up to accommodate the large numbers of new vehicles swelling the ranks of road users each week, and increasing at a greater pace than our road mileage. Otherwise, traffic conditions must eventually become quite chaotic. Traffic moves very slowly in Britain, with 31.1 motor vehicles to the mile, than any other country, and in our city streets speeds are back to the days of the horse and cart.

Another aspect of the matter is that more and more people are using the roads and deserting the railways and that movement will continue to expand. If a road policy is designed to consider only one section of the community—pedestrians—then the speed of all traffic must eventually be reduced to that of pedestrians. In busy places that speed is being approached now; it must be remembered, also, that pedestrians can use pavements as well as the roads and that they often elect to use the roads instead of the pavements.

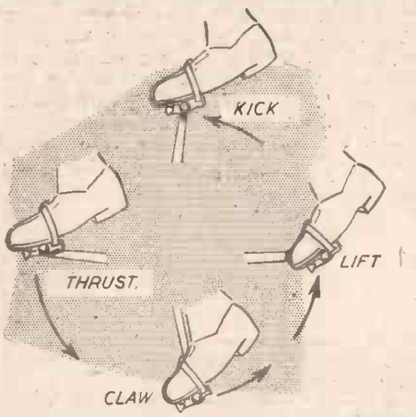
The Art of PEDALLING

By "STYLIST"

This Writer Advocates the "Ankling" Action as Best for Effective Pedalling

ON no aspect of cycling is there absolute unanimity of opinion and practice. Pedalling, to the casual observer, would seem to be such a simple process that it would not permit any divergence of views or procedure. Yet it is a fact that no two persons do it the same way.

For example, one expert rider may invariably twiddle a low gear. He may sit right on the peak of his saddle which is already right on



The position of the foot at four points of the pedalling circle.

the very end of an L-pin! He may appear to push more on the toe-clip than on the pedal, the soles of his shoes being practically unmarked. Moreover, he may put his feet so far on that the back plate of his pedal almost misses the sole. The methods of other equally fast riders may be almost exactly opposite; they may sit well back and put their feet only a short way on their pedals. Between these two extremes are spread a multitude of styles, though it will generally be found that the "twiddlers" sit farther behind the bracket than the pushers of big gears who tend to get farther forward as their gears increase. Each person must find out, by trial and experiment, what method is best suited to his own physical peculiarities. Once having found it, however, endeavour to stick to it for each particular style demands its own specific muscular development.

Method for the Average Rider

Over a period of some eight years I have endeavoured, by observation of the pedalling actions of the "cracks," to form a theory of pedalling, which, with slight modifications to accommodate individual idiosyncrasies, would suit the average rider.

The feet should be placed far enough on the pedals for the ball to come between the two pedal plates. This means that the mark left by the back plate should be about 1in. to 1½in. from the end of the sole. This position ensures that the maximum of downward thrust is obtained, and that the two most tender parts of the foot, the instep and the ball, do not bear any pressure. The toes should either be pointing straight forwards or else turned very slightly inwards. Personally, I prefer the latter as it seems to give more kicking power as well as keeping well clear of the top tube.

Old timers will tell you that the way to learn how to pedal is to chase the pedals round without toe clips, straps, or shoe plates. I have tried it and do not agree with them. It may make one deft, but it does not alter the fact that by using some method of ensuring that the feet stay in the correct position one can concentrate on acquiring the correct movements.

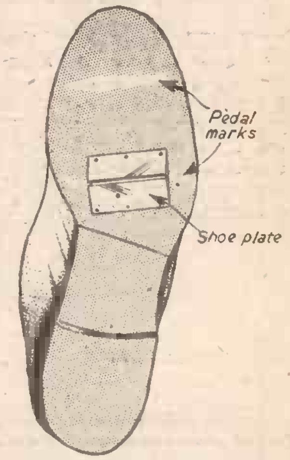
Use of Clips or Straps

In the days of the ordinary, rapid leg work was no doubt the most important aspect of pedalling, but in these days of varying gear sizes it is the power and the methods by which it can best be utilised to obtain the greatest effect that is of paramount importance. For this reason, I say, use clips or straps or both and, once you are satisfied that you have obtained the best position for your feet, fit shoe plates over the mark made on the sole by the rear pedal plate during the motions of pedalling. That the weight of the foot should be lifted off the rising pedal is a truth so obvious as to need no explanation. How this can be done properly without the aid of bars or straps I cannot conceive. Some riders go so far as to pull on their clips and straps as the foot comes up. This action requires a lot of practice and development of the front muscles of the thigh and, whilst realising its value up hills and into a head wind when the pedalling action is not too rapid, I have always found the upward pull took my legs so high that I was unable to get in as much forward thrust as the pedal became horizontal as I would have done had it just come up of its own accord.

"Digging" With the Toe

As the crank becomes vertical, kick forward as hard as you can with thigh, calf and ankle. Then, as the pedal goes on its downward arc, push with all the weight of your leg and, using your ankle as a pivot, "dig" with your toe, giving a final "digging claw" at the very bottom. The shoe plates will assist tremendously in every phase of this action. The last action will leave the ankle in the air, making the next motion of lifting the weight from the rising pedal an easy and automatic matter.

The mere rapid up-and-down motion of the legs is not the beginning and end of good pedalling. It does not necessarily follow that because a rider is fast on a very small gear, he is a fine pedaller. It merely shows that he has such a magnificent heart and pair of lungs that he can move his legs at a terrific speed without becoming in any way distressed. In fact very few men who show up well in a restricted gear event do as well in one in which unrestricted gears are allowed. The reason is that, in concentrating on rapid revving, they merely achieve short, jerky thrusts which, though sufficing for a tiny gear, make very little impression on a gear that requires to be pushed as far round as possible.



Shoe plate fitted with the slot along the rear pedal mark.

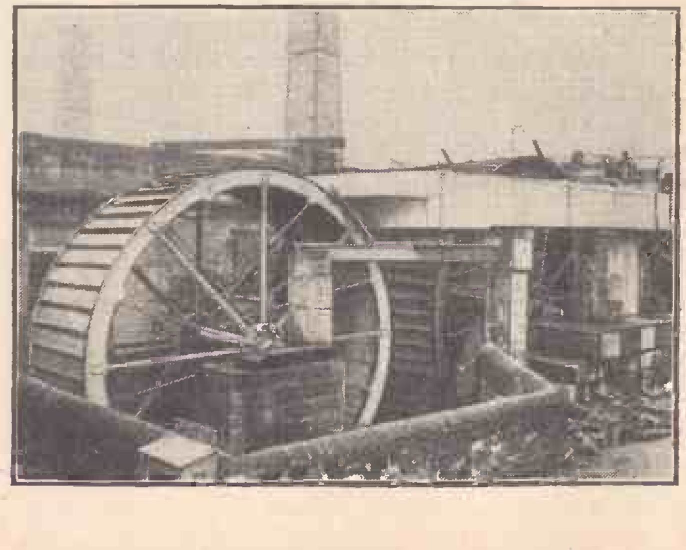
The Wheels Turn No More

AFTER more than 100 years of continuous service, two famous water wheels have turned their last and will no longer provide power for the D.P. Battery Co., Ltd.'s factory at Bakewell, in Derbyshire. Earlier this year a breakdown caused extensive damage and the firm has now reluctantly decided that repairs would be impracticable.

Such reluctance is understandable, for the wheels had come to be looked upon as one of the most interesting sights in the district, providing as they did a link with the earliest days of the industrial revolution.

The larger wheel (on the right in the photograph) dates from the year 1827 when it was installed to provide power for a cotton mill founded by the famous inventor Arkwright, later Sir Richard Arkwright, in 1777.

The smaller wheel (in the foreground) dates from 1852. It was built by Kirkland and Son, of Mansfield, and measures 21ft. in diameter by 7ft. wide. The output of the two wheels together was between 60 and 80 kW.



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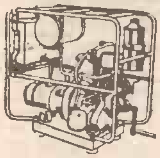

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PLANISPHERES. These determine star position and Azimuth. Each with four latitude sheets from N.25° to 65° complete in rexine case. 12/6 each. Post 1/6.

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MINE DETECTORS. A fine article with hundreds of uses for detecting concealed metal objects, £4.10.0. Carr. 10/-.
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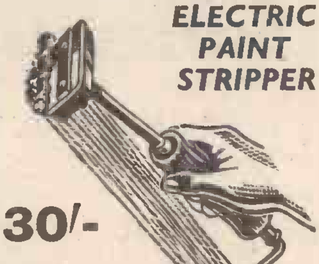

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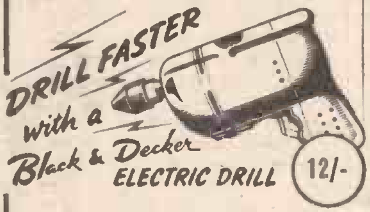

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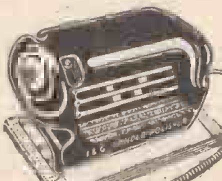

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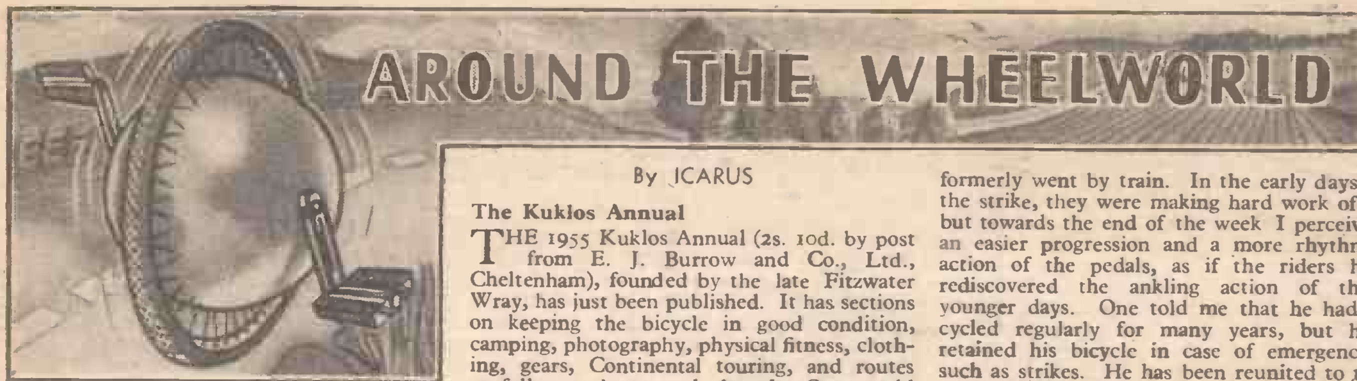


By ICARUS

The Ostrich at Colnbrook

APROPOS my comment on page 53 of the April issue, I have had a letter from the advertising manager of H. and G. Simonds, Ltd., of Reading, enclosing a picture (reproduced herewith) of the inn sign at present exhibited outside the inn. They stress that it is not their intention to remove this sign, which still swings in the breeze outside this famous old house. They also state that it is not the policy of their company to remove pictorial signs from their houses, although they admit that because of its recognition value they do erect their standard sign in the majority of cases. As readers know, some of the most delightful pictorial signs in the country appear on some of Messrs. Simonds' houses. That on the world-famous old "Sloop Inn" at St. Ives comes immediately to mind, as do those on the "Five Alls" at Marlborough, Wilts; the "Three Kings," Twickenham, Middlesex; the "Three Legged Cross," Warfield, Berks; the "Labour in Vain," Pontypool, South Wales; the "Queens," Newbury, Berks; the "Windmill," Windlesham, Surrey; the "Rose," Basingstoke, Hants; the "Pig and Whistle," near Totnes, Devon, and so on.

Messrs. Simonds have their own signwriting department, although some of their pictorial signs are painted by specialist artists.

What I was particularly referring to, however, was the *original* Ostrich sign. The present one, pleasing though it is, is not the original Ostrich sign, which did not have the name of the brewer superimposed on it. It is true that the sign shows an ostrich, but it does not mention the name "Ostrich." However, the old inn retains its great historic interest, and is daily visited by those interested in old inns.

Paris-Bordeaux Race Cancelled

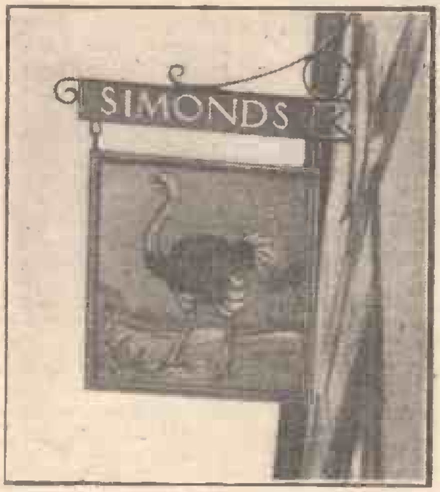
AT the last minute the Paris-Bordeaux was cancelled by its sponsors because some of the riders demanded a fee of £125 against the £100 offered. Thus, the modern strike disease permeates cycle sport—sometimes referred to as the "cleanest" sport. It is my view that the events which led up to the cancellation exhibited the antithesis of good sportsmanship, and it was a bad advertisement for professionalism. Shall we have similar strikes over here? In view of the guerilla tactics adopted in some industries, I fear that such methods will be imported into sport, since large numbers of trade unionists are also cyclists.

Covering the Tour de France

THE British Cycle and Motor Cycle Manufacturers' Union is providing facilities to enable British journalists to cover the famous Tour de France bicycle race by car. This assistance is being provided because, for the first time, a British team has been invited to take part in the tour, probably the world's greatest cycle race. It starts on July 7th and ends on July 30th. I congratulate the Union on making this move.

The Kuklos Annual

THE 1955 Kuklos Annual (2s. 10d. by post from E. J. Burrow and Co., Ltd., Cheltenham), founded by the late Fitzwater Wray, has just been published. It has sections on keeping the bicycle in good condition, camping, photography, physical fitness, clothing, gears, Continental touring, and routes to follow at home and abroad. One would have thought that in a book of 160 pages, dealing with such a picturesque subject as cycling, greater use could have been made of illustrations. The insertion of advertisements in the editorial matter (half-page advertisements and half-page editorial) should have been avoided. The two illustrations (one in half-tone and one in line) stand out as oases in a sandy desert. The late B. W. Best, who edited this journal until his death, did his best to improve certain sections. There is room for great improvement in the editorial presentation and treatment of this old-established cycling book. All the same, it is good value for half a crown.



The present inn sign at the "Ostrich" Colnbrook

Another Golden Jubilee

IT was in 1895 the firm of Mansfield commenced making saddles, and they have been in continuous existence ever since. The original address was at Bristol Street, Birmingham. Two of the founder's sons are still actively engaged in the business, which has had three changes of address in the course of its 50 years. I have a Mansfield saddle which is transferred to every bicycle I use, and when I order a new machine, it is ordered less saddle, so that my favourite perch is still part of the machine. It is now over 20 years old; is by now, of course, thoroughly broken in and seems good for a further 20 years.

Bicycles in the Strike

ON my daily journey to the office, during the recent railway strike, I saw many familiar faces pedalling along the highway, who formerly went by train. In the early days of the strike, they were making hard work of it, but towards the end of the week I perceived an easier progression and a more rhythmic action of the pedals, as if the riders had rediscovered the ankling action of their younger days. One told me that he hadn't cycled regularly for many years, but had retained his bicycle in case of emergencies such as strikes. He has been reunited to the cycling fold and intends to make a week-end jaunt a habit.

Roads and the Election

THE British Road Federation which is, of course, mainly concerned with road, and not necessarily with roads for motorists published some interesting data for electors to use as ammunition during the recent election. One pamphlet entitled "Road Facts for Voters" was particularly enlightening. It had been compiled with the help of the Conservative and Labour Party organisations and it shows that in the last 30 years the equivalent of only 18 per cent. of the millions collected (£3,079,000,000) in motor taxation has been spent on the roads.

Under the heading "The Record," the names of successive Prime Ministers, Chancellors and Ministers of Transport are listed, the disintegration of the Road Fund traced, and details were given of the four road programmes announced during the period but never completed.

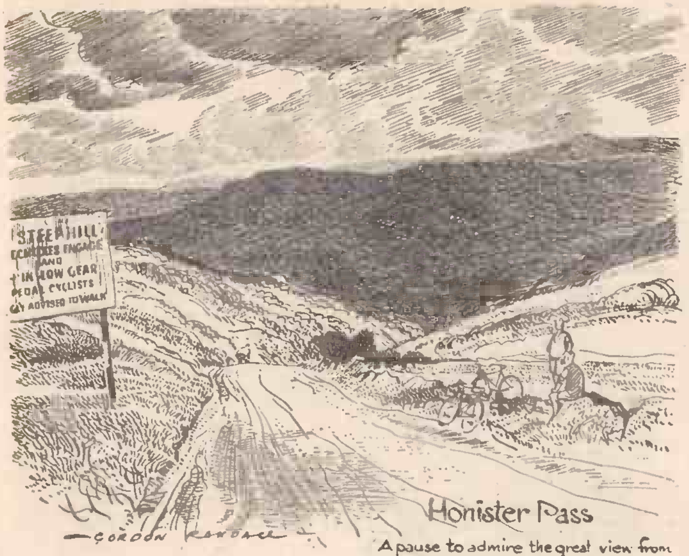
The Federation's election message said that the scale of the recent road proposals in Britain, while an improvement on those that have gone before, falls far short of the nation's urgent need brought about by years of neglect.

Candidates also received a questionnaire inviting their views on urgent road and road transport matters.

The Federation, which is not concerned with party political issues, said that "Road transport is essential to the efficiency of all sections of industry, and good roads are vital to the national economy. These matters cannot be ignored by the political parties during a General Election."

Wayside Thoughts

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



A pause to admire the great view from the top of the Pass. This steep road up from Seatoller embraces some of Lakeland's finest scenery.

Why Add to the Crowd ?

THE more I see of main road travel the more I marvel that so many cyclists use the highways when the lanes serve so well for the greater part of the distance they desire to travel. The flit of the cars past your elbow on the big roads during week-end riding is now almost continuous, and this over-population of a limited space can be uncomfortable. From a cycling point of view the use of main roads on wet days is justified, for then the sense of comfortable space returns to the rider. How different in my youth when all the lanes were rough surfaced and we seldom risked our expensive tyres along their ways. Then—and I am now thinking of the days of last century—how lonely the great highways were; the doctor's trap, the farmer's gig, and near the towns the butcher's and the baker's carts were the main vehicles one met or passed, and the peace of the highways then, is, to-day, a memory difficult to recollect. Not that I would wish to go back to that period, but I shall be glad when motor roads are in full swing, though I'm afraid that will not occur in my life-time.

A Comparison

I WAS recently in the company of several men who are great travellers, and we were riding bicycles. Out of an appreciation of a beautiful countryside in the early days of May, I was assured that no other country in the world could compare with Britain in loveliness, temperature or the quick variations and changes that so startle and delight foreign visitors; and, of course, I was delighted at that assurance. Those men talked of the Americas, of the East, of Australia and China, and bandied their wide experiences over a cup of tea, made all the more refreshing to me as a result of such talk. Actually we were in the lanes at a small cottage embowered in the fresh green of spring, and in the wood opposite was a wild cherry in full bloom, and my spouting of Housmann's verse:

"Loveliest of trees the cherry now
Is hung with bloom along the bough
And stands about the woodland ride
Wearing white for Eastertide"

started the conversation on our luck in being native to this heath. I do not think many of us thoroughly realise that good fortune, give ourselves sufficient time to get the taste of it or make ourselves articulate in a world that needs beauty to resave it from the daily imposition of work. Yet here is our reward waiting to refresh mind and spirit as the result of a little ride down a lovely lane, and to make a memory for to-morrow that will keep us going until the next time. It is a wonderful thing that cycling offers a community so many such opportunities to create those little sparkles in life. That I have thousands of such memories is good, but to get them confirmed occasionally by widely travelled friends gives this ancient advocate a thrill and a feeling of, "What more do I need to fill leisure with a quiet inside comfort."

The very nature of the road structure of Great Britain makes it a cyclists' paradise. America's wide highways are designed for the motorist as is the Poplar lined French road—straight and monotonous. In England there is something different around every corner.

The Lone Wolf

I AM just getting used to the natural slow-down dictated by the years, but it has been a difficult passage to admit the change. A couple of years ago speed in me had moderated, but I then said, "if I cannot ride the hills, I can walk them," and it was true. Now it is painful to walk them and I try to get out of it by using a very low gear, but even that has its limits. It, therefore, follows my riding has become a stroll, 10 miles or less, and a rest, and then another session until this leg of mine says "enough." I have, therefore, become a lone rider but not an unhappy one, for I find I can make the miles fit into the hour without hurt if I will remain content to go slowly. It is that slow habit I have found difficulty in accepting, for after so many years of care-free travel it is not easy to accept a naturally imposed handicap. This is not a complaint, but merely an experience that may come to any elderly rider. How unwise he would be to forego the pastime is what I am trying to explain.

I can yet roam in comfort for a dozen miles or more before the warning stiffness becomes acute; those furlongs take me to pleasant places and evoke a million memories of my youth. To feel regretful about it all is absurd, for up to now I've had a very good innings, and am still thoroughly enjoying my limited riding, and hope to go on with it for another year or two. But how grateful one now feels for all those vigorous years when Britain was yet to be explored, and the bicycle was the ideal vehicle, as indeed it still it. What a fine thing it is that we do not know what will happen to our elder age; and when it does happen some kindly philosophy tempers the trouble, and if we are lucky leaves us a leg and a half by which to proceed.

The Old Makers

AT the end of April I was one of a party of 30 riders forming a portion of the Centenary Club, that trade organisation of executives who ride their own wares in the spring and autumn, and on the Saturday—the last day of April—we were given a glorious day. We stayed at the Shillingford Bridge Hotel, and on that morning saw the mists roll off the Chilterns in grey smoke when we turned into the lanes beyond Wallingford to meander along the flank of the hills, and finally rise a spur before glissading into Pangbourne. We went gently, which is good for a covey of riders with an average age of nearly 50, and the speed suited me and gave me the full joy of the journey.

In a meadow bordering the Thames just south of Pangbourne, the hotel folk spread us a picnic lunch as generous in volume and variety as any I have tasted, including, may I add, a small barrel of beer to assuage thirsts which many of those unfamiliar with the exercise had induced. It was certainly a lovely spot, predominantly English in its outlook, gilded with sunshine as warm as a perfect spring day can be, and many of us were reluctant to make the homeward journey along the valley road, by now buzzing with traffic. The Sunday was wet and windy, but again 29 of the group rode over the secondaries to Brimston Manor, near Thane, for "elevenses," and the stiff tail wind was a real help to this scribing cripple. That he returned in the one car in the party was wisdom, for I do not believe in making my limited cycling less than happy travelling. But what a fine thing it is to gather together directors of the cycle trade in friendly activity twice a year, and find once more how keen they are, for this is the sixteenth year of their support of the fixtures which just marked the centenary of the bicycle, and even through the bitter war years there has always been a full house.

A Woodland Halt

I went out at the week-end and an old countryman told me we were having the Little Blackthorn Winter, which was true enough, for the wind was high and blustering, and when it brought up a bank of cloud across the sun the temperature slumped sufficiently to match the latter days of March. The shower passed while I crouched on the dry side of an elm bole, and then May returned warm and smiling if a trifle unruly. As is my habit, I travelled into the wind in the hope and expectation it would waft me home, and it did on this occasion with a deluge a mile or so away on the left which never reached me. In rather less than a dozen miles I dropped into a Keeper's cottage to share a pot of tea with him and hear how his birds were doing, if any wild pheasants had hatched, and had the partridge started sitting yet. For this country interest is still with me, although I can no longer take an active part in it. My old friend sadly deplored the terrible reduction of the rabbit population due to the ravages of myxomatosis, and considered the introduction of this method of extermination would play havoc with game and poultry, "for the foxes won't starve if they can help it, and the rat and rabbit were their main meat dishes. Their incursions of the game preserves and the farmyards—always a nuisance—will become a menace!"

Then I went home on the wind, a mile of woodland paths, a rough ford-rough, and then the lonelier lanes to within a few minutes of home, satisfied with the gentle ride and grateful that the years had left me so much to vary life and make it open to the air.

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