A PANTOGRAPH FOR COPYING DRAWINGS

NEWNES

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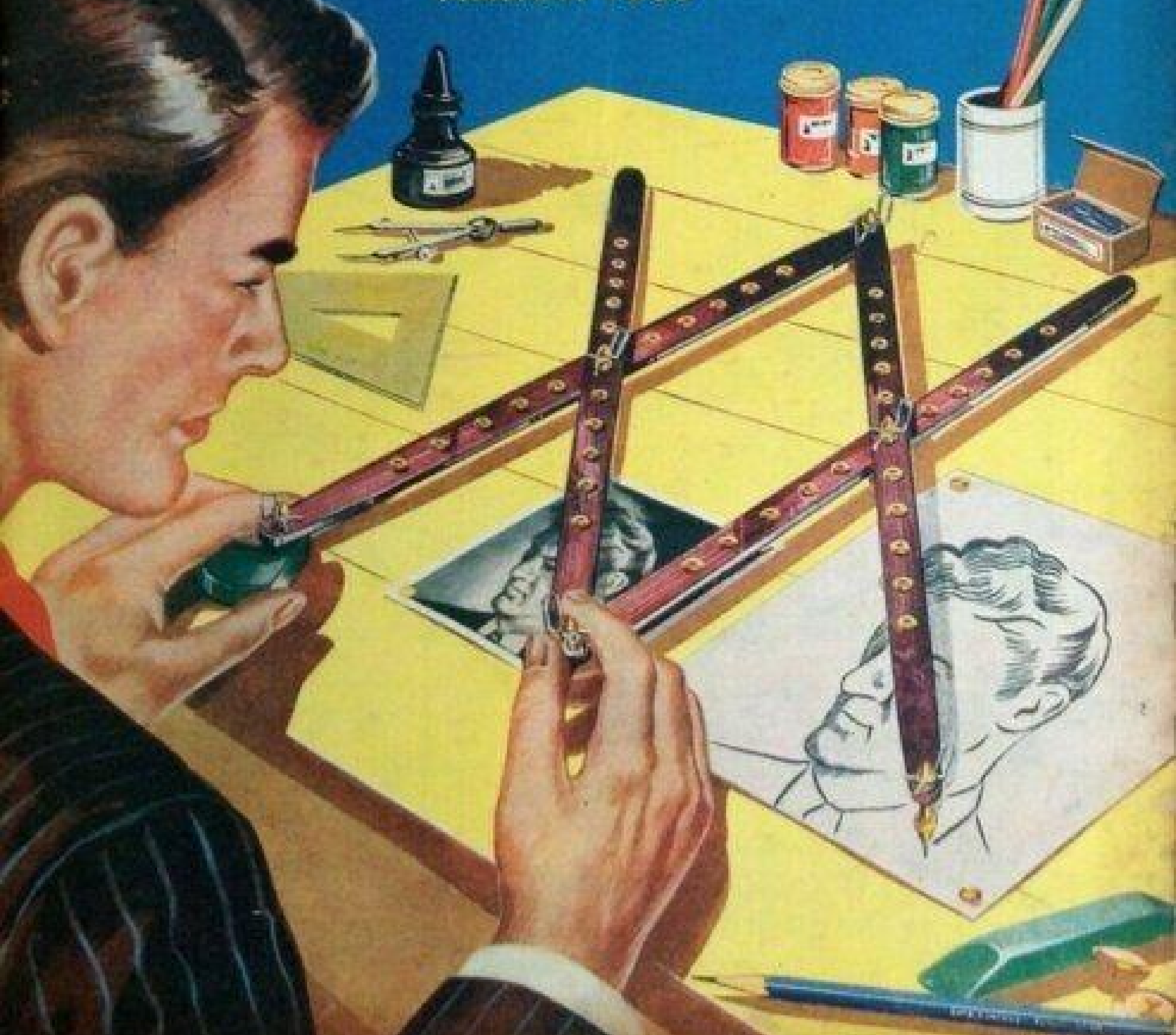
PRACTICAL MECHANICS

EDITOR: F. J. CAMM

MARCH 1953



MARCH, 1953
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PRACTICAL MECHANICS

EDITOR
F. J. CAMM

Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

FAIR COMMENT

By The Editor

Light Steam Engine Developments

THE National Research Development Corporation is to conduct experiments with light steam engines, a suggestion made by Sir Harry Ricardo many years ago. Since the introduction of the internal combustion engine the development of the steam engine has been neglected by every country. The discovery of petrol by Carless (who invented the word "petrol") enabled the work of Otto and Daimler to be carried to fruition. Between them they had produced the basic design for the petrol gas engine which, in its earliest form, had hot-tube (external) ignition. The fuels available in its early days had a low octane value, and ignition troubles were caused by a combination of the defects of the low volatility of the fuel and the uncertainty of hot-tube ignition. The development of the high-tension magneto by Simms, and the improved volatility of petrol enabled designers to produce engines with ignition systems where the occurrence of the spark had a precisely timed periodicity. It is not surprising that the steam car went out of favour. Whilst it was successful, and had achieved high speeds, it nevertheless was unreliable in the hands of any but the most skilled. Industrialists were not encouraged to invest money in its development. It is, perhaps, unfortunate that the petrol engine within a very few years achieved such a high measure of perfection and efficiency because of its simplicity. The steam engine has much to recommend it. A car using steam power can be gearless; it can use the boiler water over and over again by means of the condenser, and it is reasonably cheap to make. Its disadvantages are that pressures of at least 1,500lb./sq. in. are required, starting from cold even with a flash boiler is uncertain and, in any case, slower than with a petrol engine; heat and fumes are additional problems. With such high pressure, leakage at glands and unions presents an almost insuperable difficulty. Ever since the days of Dobel, Stanley and White steam car experimenters in this country have continued their efforts to produce a design of marketable quality—so far without success. It is fair to assume after half a century that an answer to the problem is not forthcoming.

The light steam engines to be developed by the N.R.D.C. are stationary engines for use in underdeveloped regions, and are operated off boiler plant fired by low-grade fuel. It is intended to take advantage of the developments which have taken place in light internal combustion engines. We know from recent correspondence following our article entitled "Will the Steam Car Return?" that there are some thousands of people still interested in steam road locomotion.

THE MYSTERY OF TIME

TIME, which never had a beginning and can never have an end, has been the subject of many scientific novels, such as Wells's "Time Machine" and Dunne's "Experiment in Time." In both of these novels time was used as the fourth dimension. Time is probably one of the least understood of our measurements. It is not always realised that we are always living in the past, since the present can only exist for zero time; the present has no duration. We live in the past since we cannot perform any action in the present. The fastest of our reflexes are in the past when we perceive them. The blinking of an eyelid is in the past, and by the time any act has become conscious to us it is a minute fraction of a second *old*. It is well understood nowadays that our nerve reactions are comparatively slow and, indeed, can be measured. A fifth of a second is considered rapid. When you observe the time by your watch you are observing the time that *was*, not the time that *is*, for with light moving at 186,000 miles a second there is a lapse of a small fraction of a second for the image on the watch dial to reach the retina of the eye. Whether you are listening to music or smelling perfume or performing any other act, all are in the past. An interesting theme!

A NEW FEATURE

WE often receive requests for information which is quite outside the scope of a postal reply. In such cases, where the request is general, we publish an article on the subject, but this method does not meet the requirements of the reader who needs the information urgently; and, of course, by this means we are only able to deal with a limited number of such inquiries. We intend, therefore, as from the next issue, to publish under the title of "Information Sought" a list of such requests, inviting readers to supply it. By this means we shall be able, through the post, to supply readers with solutions to their queries far more rapidly than hitherto.

Readers requiring particular pieces of apparatus, books which are out of print, or who wish to sell such items for which they have no further use, should take advantage of our new advertisement feature, "Readers' Sales and Wants," which this month appears on page 263.

NOTE TO QUERISTS

WE receive by every post a very large number of queries on a wide variety of topics, and in most cases we are able to reply by return. In queries of a specialist nature a little time must elapse between the receipt of the letter and the reply, and readers in these cases should not grow impatient. We are compelled to deal with queries in strict rotation. Some queries crop up with the frequency of a recurring decimal, and we may be pardoned a feeling of frustration when a query arrives which has been answered time and again before in these pages. The querist could, indeed, in some cases answer the query for himself by consulting a dictionary.

Querists could save themselves time if they made use of the indexes we produce every year at 1s. 1d. We can supply most of these going back to the first volume.

—F. J. C.

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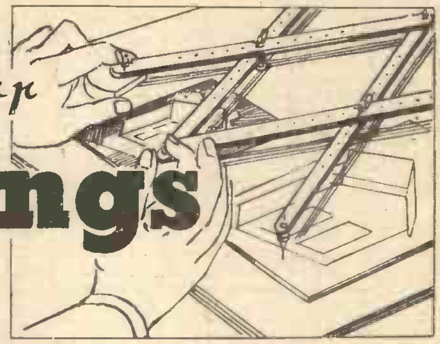
A Pantograph for Copying Drawings



Constructional Details and Instructions for Using This Instrument

By "ENGINEER"

THE pantograph is an instrument which can be extremely useful to the artist and cartoonist, to the maker of maps and plans and to a lesser extent, perhaps, to the architectural and engineering draughtsman. It provides a ready means of copying drawings, plans and intricate designs, either to exactly the same size, to an enlarged size, or to a smaller size. It does this by a direct method and obviates the necessity for ruling up into squares both the original drawing, sketch, or illustration and the paper on which the new drawing is to be made.

To those who are not familiar with the squaring-up method I may mention that the drawing from which, we will assume a twice full-size copy is to be made, is ruled up, both vertically and horizontally, with pencil lines, say: ½in. apart; the drawing paper is correspondingly ruled with lines 1in. apart. The lines are either lettered or numbered in both the original and copy, for identification of position and then the original is copied square by square and line by line. It is a somewhat tedious job, but in the case of big cartoons is unavoidable, first, because the work has to be done on an easel, vertically, and secondly, because it is impracticable to make very large pantographs to do the enlargement.

Limit Length of Bars

It is not for big cartoons or large maps that the pantograph can be reliably used, although I am aware that they are made with bars up to 4ft. long. My own experience is that in order to make enlargements with exactitude the bars must be very wide in proportion to their length and are consequently heavy. All joints and pins must make, when new, such perfect fits that the apparatus works stiffly with consequent flexing of the bars, and this, even if the bars are made of metal. I once made, for my own use, a 3ft. pantograph with bars of hard English oak, ¾in. wide by ¼in. thick. All the joints and pins were fitted, ground in, and lubricated; the weight was carried on carefully made little castor wheels, but, when finished, the instrument was not a success. The bars were too flexible, and the castors offered so much resistance to swivelling them, that they quite threw the drawing out. In the pantograph, which forms the subject of the accompanying drawings, I recommend that the length be limited to 18in. and that to enable the upper part of the instrument to slide about on the drawing board or paper, fairly large domed surfaces be provided instead of castors. There is then no tendency to thrust the instrument, and with it the pencil, to one side when the direction of movement is changed.

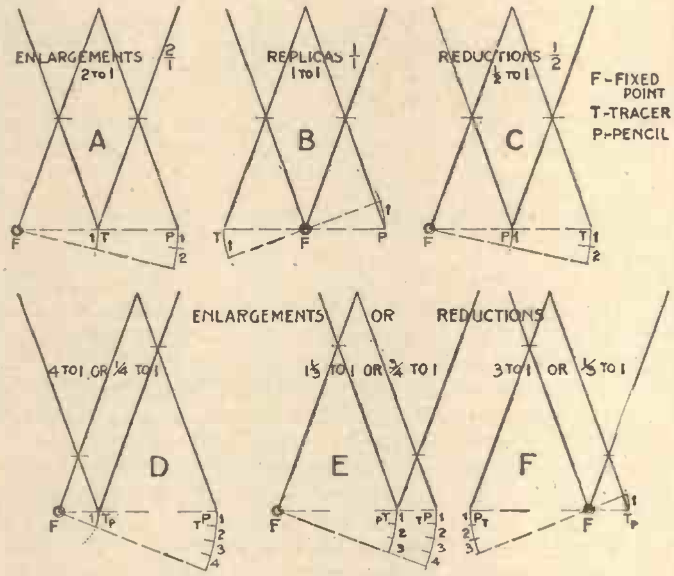


Fig. 1.—Diagrams illustrating the principle of the pantograph.

Arrangements for Enlarging or Reducing

Fig. 1 is a group of diagrams which are chiefly theoretical; they show alternative arrangements of the pantograph: for enlarging at A, full size copying at B and reducing at C, whilst D, E and F are either enlargements or reductions, according to the relative points at which the interchangeable pivot, tracer and pencil are placed. In all the drawings the pivot, or fixed point, is lettered "F," the tracer point "T," and the pencil "P." In addition to the interchangeability of these three, the swivelling points of the arms, one upon the other, can be changed, in order to provide for differing sizes of enlargement or reduction. It will be seen from D, E and F, that the multiple of either enlargement or reduction is always proportional to the distance that F T divides into F P or F P into F T.

The Arms

Fig. 2 is a detail of any one of the four arms, or bars; they are all exactly alike, excepting that those numbered 2 and 3, in the small sketch of the whole pantograph included in Fig. 3 need have no bushes in their upper ends. The bars should be cut from bone-dry and seasoned hardwood, such as the top of an old oak or mahogany table or a disused or damaged Tee square, Straight-grained pieces should, of course, be chosen. They must be planed straight and true and drilled exactly on a true centre-line to take the bushes which are turned from either heavy gauge brass tubing or brass rod. Before inserting the bushes, the bars should be given two or three coats of shellac varnish, made by dissolving brown shellac flakes in methylated spirit. There will be fifty bushes required and two more to be used as loose ferrules. Bushes should be a good push-in fit in the wood and the barrel portions may very well be slightly roughened, after turning, by rolling on a file; they are inserted in the wood with a film of adhesive on the roughened parts.

Whether the bushes are made from tube or rod it is most important that the bore in every one of them shall be of exactly the same diameter, for the pins or rods on F,

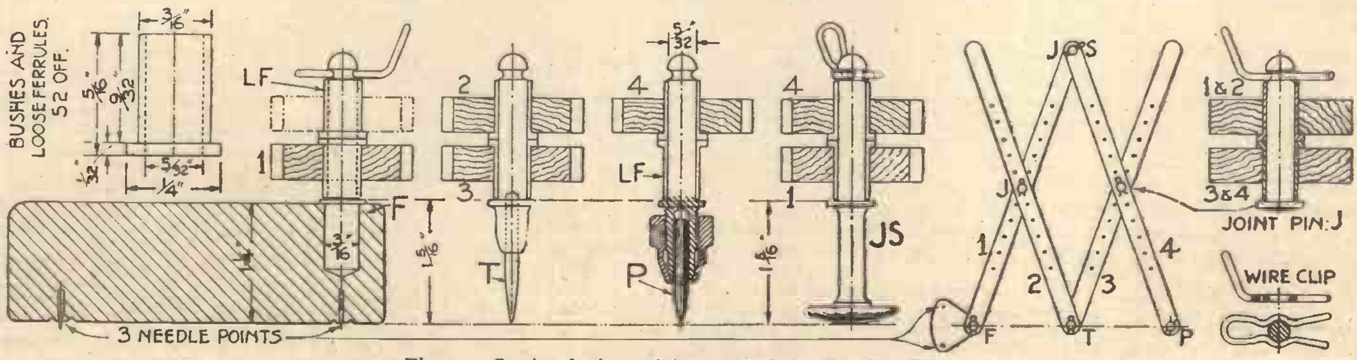


Fig. 3.—Sectional views giving general details of fittings.

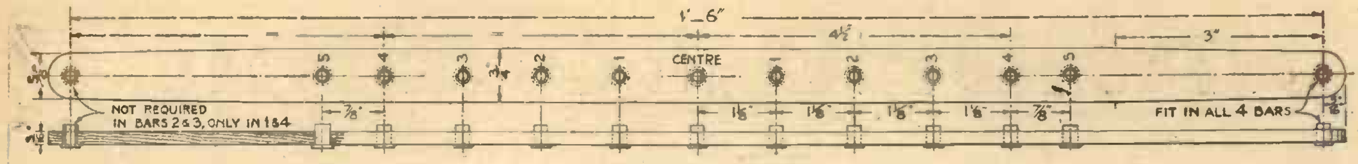


Fig. 2.—Details of the pantograph bars showing the bushes in position.

T and P, and the three joints, JS, J and J, in Fig. 3, must all make perfect fits in every one of them; otherwise there will be lost movement and the copied drawing will not be true to the original.

Details of Fixed Bushes and Pencil Points

Fig. 3 shows, at the top left-hand corner, an enlarged and dimensioned sketch of one of the bushes. This drawing also gives full details of F, T, P, and the joint pins. Pivot, F, becomes fixed by driving it into a drilled hole in a lead weight, which, in plan, is made of quadrant shape. On its underside this weight is drilled with three tiny holes in which needle-points are inserted and secured by punching the lead around the hole, thus closing the metal in on to the tapered point of the needle. A projection of 1/32in. should be ample to prevent the weight from slipping on the board or paper.

In the drawing both F and P are shown each fitted with a loose ferrule, LF; the first above bar 1 and the other below bar 4; but as all three points are interchangeable, all rods, passing through bushes and ferrules, must be the same length, for either of them may be required to be placed through both bars, 2 and 3, where I have drawn the tracer point T. The tops of all the rods are turned with a groove into which the arms of a security clip will spring. These spring fastenings can be formed from common wire paper clips.

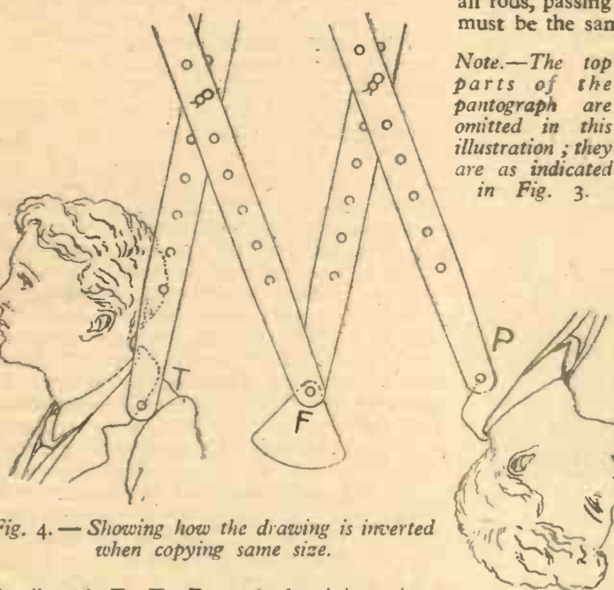


Fig. 4.—Showing how the drawing is inverted when copying same size.

Tracer Point

For the tracer point a gramophone needle can be used, knocked into a drilled hole in the rod T, and the sharp point removed and rounded off on an oilstone, so that it will not scratch or tear. The pencil, P, must be easily renewable, and this is best provided for by making a little chuck. In this the amount of projection of lead can be adjusted. The extreme lower end of the rod is given a slight taper, drilled to take the diameter of the pencil lead which is going to be used split into four divisions with a very fine jeweller's slitting saw and screw-threaded up to the shoulder. Then the outer part of the chuck is turned, tapped to the same thread and the largest part of its diameter either knurled in the lathe, or by hand with the corner of a fine file, so as to provide a finger grip.

Jointing Arrangements

The rod JS and the two joint pins JJ are simple turning jobs, and obviously the domed plate on JS can be a separate piece added on; there is no need for the whole rod to be turned down from ½in. bar; ½in. being the suggested diameter of the dome. It may be worth while to mention that under certain circumstances and with limited size drawing boards, it may be necessary to put the domed rod, JS, not at the top of the pantograph but in the middle of one pair of bars, in place of one of the "J" pins, which latter will then go to the top. The dome will not then be liable to drop off the upper edge of the board; but it must also be watched that it does not foul the edge of the drawing paper.

Reversed Picture

At first sight it may appear that in copying the same size as an original, with the point F in the middle, the copy will come out reversed, but this is not the case; it is not reversed but it is upside down and this point is proved in Fig. 4. If one wanted a reversed picture I am afraid there is no means of making it directly with a pantograph, and the only way would be to enlarge, copy or reduce with the instrument, then to trace on tracing paper and transfer, with blacklead, or carbon transfer-paper, on to the final drawing.

An Adjustable Skein Holder

A Particularly Handy Appliance for Use in the Home

By D. E. BALES

THE accompanying illustration gives details of a simple skein holder which is easily and cheaply made. The materials required are given in the table.

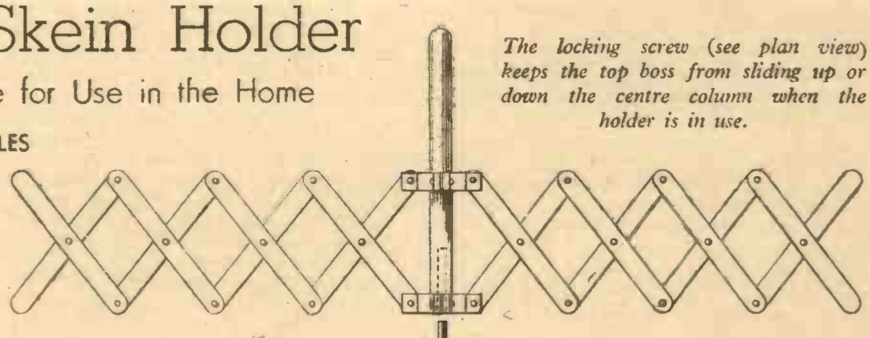
The clamp is first fixed to the table, then the holder is slid on to the ¼in. pin, which allows the holder to rotate freely.

Operation

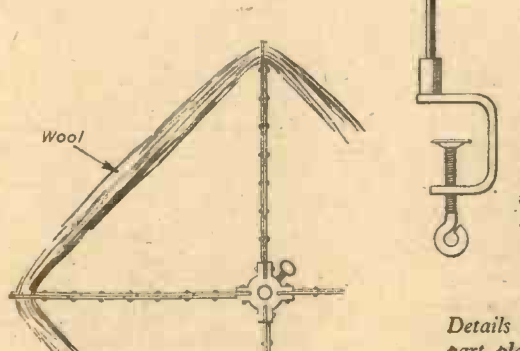
The top sliding boss locking screw is slackened off and the boss pushed down to the requisite distance so the skein of wool lays reasonably tight in the four V-ends of the lattice arms; the locking screw is then tightened.

The whole assembly slowly rotates on the steel centre pin as the user winds the ball of wool.

After use, the locking screw is again slackened and the lattice arms folded back to the centre, the whole device then taking up little space for storage.



The locking screw (see plan view) keeps the top boss from sliding up or down the centre column when the holder is in use.



Lattice strips 5" x 5/8" x 16 s.w.g. L.A.
Centre column 9/16" x 7½" M.S
Top sliding boss ½" thick (sliding)
Bottom boss ½" thick (fixed) L.A.
Rivets 1/8" aluminium
Table clamp. 1½" x ¼" pin at top to slide in drilled hole at bottom of column

Details of the lattice skein holder, and part plan view showing a skein of wool in position.

DIAMOND POLISHING

The Materials and the Tools Used, and Methods of Cutting Stones

SOME remarkably fine examples of working within close limits of error, where only the eye can be used to control the accuracy, are furnished by the methods in use for diamond cutting and polishing for jewellery, and it is proposed to refer in these notes to some of the more interesting and outstanding cases, where, for instance, a line must be correct to .001in., by eye alone, or an area must not be more out than perhaps 1/500th sq. in., in order to avoid a serious drop in the value of the finished stone.

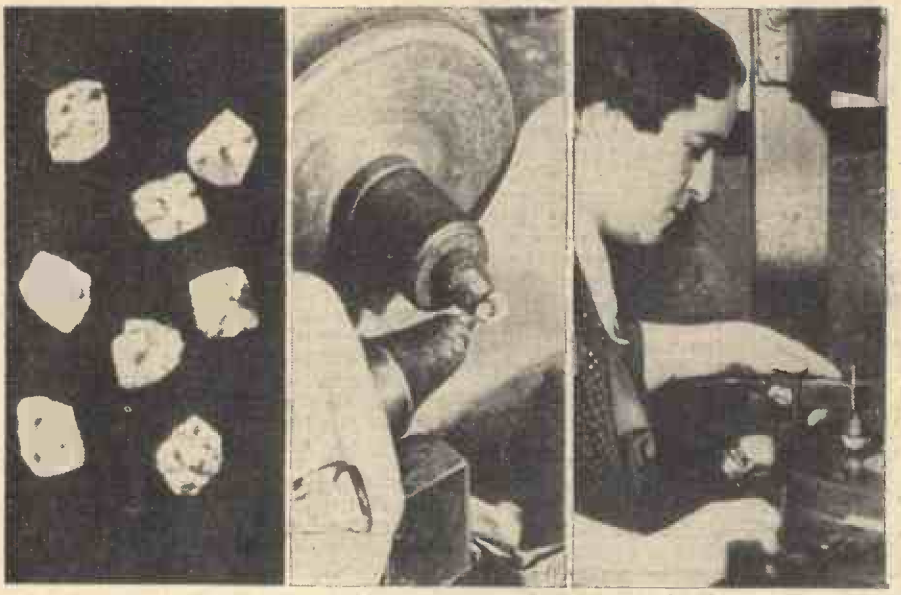


Fig. 1.—(Left) A large diamond sawn into several sections. (Centre) Each stone is placed into a rotating vice, and another sharp-edged diamond smooths off the rough edges. (Right) Covered with diamond dust, the stone is whirled on another disc to wear a facet.

Incidentally, it may be mentioned that these goods are cut entirely for export and bring a very considerable amount of foreign exchange into the country.

In order to understand how these results can be obtained it is necessary to know something of the material and of the tools used to work on it. The actual process of diamond polishing has altered very little in the last 400 years; it was discovered by de Berquem, of Bruges, about 1475, that diamonds could be shaped by grinding on an iron wheel charged with diamond powder. Since then various small improvements have been made, chiefly in the methods of holding the stone, but the basic principle remains the same: unsatisfactory diamond material is ground up, mixed with olive oil and rubbed into a porous iron wheel approximately 10in. diameter by $\frac{1}{2}$in. thick mounted on a heavy spindle, whose tapered ends run vertically in lignum vitæ bearings (any play being corrected by a gentle tap or two with a hammer!).

The Wheel

The wheel or schijf (pronounced sky-ve), shown in Fig. 2, is driven by belting to turn at 2,400 r.p.m. and the stone is mechanically held against it so that the appropriate part is worn away. The holder may be a solid "dop" or a mechanical "dop." The latter clamps it in position by means of adjustable claws, and is of recent invention, but in the solid "dop" the stone is set (by a specially trained setter) in a small brass cup filled with an alloy of tin and lead in such proportions that the great heat developed is not sufficient to loosen it. Both kinds of "dop" are provided with a stalk of copper wire which is securely held in special tongs, the base of which rests on the bench, while the other end holding the dop (and diamond) rests on the schijf, rotating horizontally $\frac{1}{2}$in. or so above the table level. The tongs are held in place by steadying pins at their sides and greater pressure (and freedom from vibration) is secured by loading them with lead weights. Between the dop and the tongs a short length of the copper wire, about $\frac{3}{8}$in., is left to allow for adjustment, the wire being stout enough to resist any accidental bending, usually about .1in. or .125in. The stone is, of course, set in the dop so that the part required to be ground is very approximately in the right position, but fine adjustments are obtained by slight pressure on the dop, thus bending the copper wire stalk a fraction of a degree.

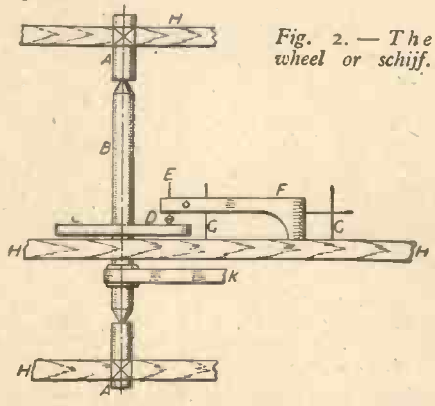


Fig. 2. — The wheel or schijf.

A, lignum vitae bearing blocks. B, spindle, C, schijf. D, "dop" with diamond at top. E, copper wire stalk. F, tongs. G, banking pins. H, framework of bench. K, belt to motor.

Technical Terms Used

At times, however, another motion is required, the dop must be twisted, sometimes through 90 deg. or more, to get the stone to cut successfully. Here it may be said that the grinding process is always spoken of as "polishing" only, since the result is a highly finished surface and no preliminary grinding is called for. "Cutting" in the diamond trade refers to the making of rough pieces approximately round, ready for the polisher. "Sawing" is slitting the rough material, and "cleaving" is splitting it.

By means of skilful cleaving much time may be saved since sawing is a very slow process and frequently a stone may be cleaved along its cleavage planes to a suitable shape in a few minutes, while sawing a small stone might take a day or more.

Grain of a Stone

The material of which diamond is made must also be given a little preliminary consideration, since it is the nicety with which the grain of the stone is adjusted to the schijf that determines whether it will polish well, slowly or not at all. It may sound strange to talk of the grain of a stone, but most crystals are harder or softer in different directions, and the grain of diamond is certainly a source of much worry in the polishing works. The material is, of course, pure carbon, crystalising in the cubic system, that is to say, the basis form of any single crystal will be a cube, but the stone may have the corners of the cube undeveloped so that an almost round 12- or 24-sided body may result, or two crystals may interpenetrate forming what is called a twin, and most complex shapes occur, but invariably through the system runs the grain and in the direction of this grain the stone may be cleaved; against the grain it will not polish and will, in fact, seriously harm the schijf, while when on its correct grain the stone will be found to develop the facet quickly and smoothly. Finding the correct grain is a matter of experience which often takes many years to acquire.

Accuracy of Eye

Another faculty which is indispensable and equally hard to come by is the accuracy of eye developed by a clever polisher. Errors which one would imagine must be completely invisible are not only seen, but seen immediately; one might almost say they stand up and call for attention!

Fig. 3 shows an ideal cube of diamond *a* and its four cleavage planes *c*, together with a typical crystal *b* as frequently found and the preliminary stages in cutting a stone from it, *e*, *f* and *g*. The cleavage planes extend, of course, right through the stone, and it may be split in any part parallel to any one of the four planes (which really constitute directions in which the atomic attraction is weaker). The typical crystal *d* also shows these planes and would be sawn through A, B; it cannot be cleaved in this direction. It is then set in shellac on a lathe and made round by the cutter, as in Fig. 3*d*, when it is ready for the polisher to commence operations.

The Table Facet

The flat part on top will obviously be the so-called table facet (or highest part of the stone when set in a ring). This is the large octagonal face which is most conspicuous.

In order to cut this truly octagonal a square must first be developed, and the accuracy of this square is of the greatest importance, since it forms the foundation for all the subsequent facets both above and below the girdle or centre part of the stone. It must not be assumed that these facets are put on according to the polisher's whim. They have to be strictly correct in order to get the greatest beauty from the stone. If any of the facets are too large or too small not only will the symmetry be destroyed, but the stone may be put out of proportion, and so lose its brilliance. Below the girdle the facets must be inclined to the horizontal at 40 deg. to 42 deg; beyond this limit the rays of light will strike the inner surfaces at less than the critical angle for diamond (24 deg. 26 mins.), and will escape through the back of the stone, causing it to look dull, and therefore drop in value. Above the girdle the angle is not quite so important, but the stone will not sell well if the top is too flat or too steep or if the table facet looks too large or too small, in proportion to the rest of the "crown" as this area is termed.

To return to our polisher, who is about to commence on the sawn stone. He sets it in his dop (unless he is using a solid dop, when it will be set by the setter) and puts the copper stalk in the tongs leaving some ⅜in. for adjustment. Holding the tongs (usually in his left hand) he gives the dop a preliminary touch, and, setting the base of the tongs on the bench, *very* gently lowers the other end until the stone just touches the schijf momentarily and very lightly. Any heavy pressure will seriously injure the schijf, since the bearing surface will, almost certainly, be a point for all practical purposes, and pressure of perhaps only 1lb. per sq. in. applied to an area of such small dimensions can be very high. (The force applied to the point of a nail by a hammer may easily be 10,000lb. per sq. in., and engineers usually push drawing-pins in with a similar pressure!)

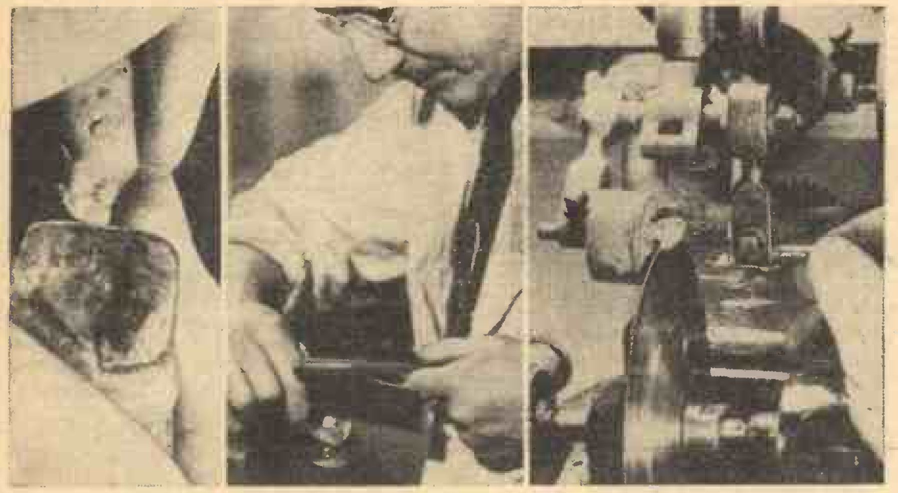


Fig. 5.—(Left) The first cutting stage of the stone. (Centre) An iron wedge, struck with a hammer, breaks the gem. (Right) The stone, weighted on a revolving disc, is sawn. It takes a very thin brass wheel to accomplish this work, which takes from one to three days to complete.

The "Loupe"

Picking the tongs up quickly and examining the stone with his magnifying glass, or "loupe," he notes exactly where it has touched by means of the black mark of oil and powder it has picked up from the schijf —a mark not as big as a pin's head. If, as is probable, the mark shows that the stone is touching in the right place, he tries it again as before, only leaving it on the schijf a little longer to feel if it is running well or not (very probably not), a twist of the dop to the right or left as his experience directs, followed each time by careful, but quick, inspection through the loupe, and in a short time the facet has started to develop, and may be allowed to run for perhaps 30 secs. before further inspection is advisable.

A great deal of a diamond polisher's time is thus seen to be taken up by inspecting the progress of the work, and very great quickness of movement is called for. Experienced men usually work with four tongs at once and pick them up two or three times a minute—perhaps 1,000 or 1,500 times a day —if only one second were saved each time a not inconsiderable increase might result. An experienced man is well paid, simply to be quick. A novice will waste a lot of time examining a stone through a loupe; the expert sees at once, decides at once, and has his stone running again. A novice may take half an hour or more before finding the best grain for a certain facet, but the old hand will generally get it very quickly. Another point regarding time is that while a certain facet may take, say, 40 mins. to develop completely, let it stay on only *one minute* too long, and it will be hopelessly too big, and all the others must be recut to suit, resulting in a great loss of weight for the finishing stone.

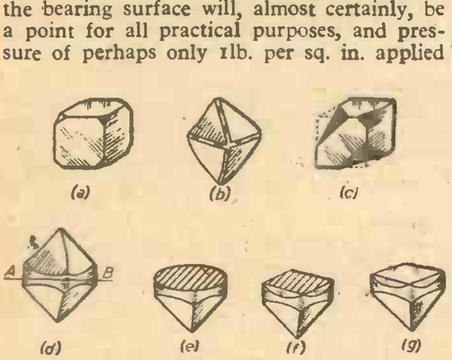


Fig. 3.—(a) A typical cube. (b) A typical stone. (c) Cleavage planes. (d) Cut, ready for sawing. (e) After sawing. (f) Four top corners done. (g) Four bottom corners done.

Picking the tongs up cleanly and quickly, and tucking the base under the left arm the stone comes under the loupe in the right hand, and we see the corner facet, it looks rather as in Fig. 4*a*.

Now we have three things to note particularly; in navigation they would be called the horizon, the azimuth and the altitude, but such terms are not used in diamond polishing! For the "horizon" we must see that the faint stripes left by the schijf run "horizontally" across the stone, otherwise we may be sure the stone is not on its best grain (although this does not apply to all stones). Secondly, the azimuth; the new facet must be forming so that its edge is, shall we say, true north and south when the edge of the adjacent facet is east and west. Remember, we have no gauges or squares to go by, we must simply see that it is, and make sure we see straight. Finally, the altitude; the angle of inclination of the facet to the horizontal must be just right, not too steep and certainly not too flat. Usually an angle of 40 deg., is right, but it may drop to 35 deg.

Adjusting the Dop

Having noted all these details the dop may need adjusting in one or more directions, and, this having been effected by bending the copper stalk, a little more polishing is necessary to get the facet bigger. If it is running really well it can be put in the best part of the schijf where the surface is sharp and well loaded with diamond powder, but a stone which is running badly will flatten down the surface, erode the diamond armouring and render that part of the schijf useless. The better a stone is running the hotter it gets, and the schijf under it, in this circle, develops a very attractive dark straw colour where it has been tempered with the heat and cooling action of the air. A clever workman's schijf looks very well, but a dull grey rough surface always indicates a series of difficult stones—or a novice. Frequently a stone will run so fast on a good schijf as to become red hot, a rather perturbing experience for the newcomer, but no harm results; indeed, the solid dops have frequently to be dipped in cold water, stone included, to prevent the alloy from melting and the stone from becoming loose, but the diamond withstands this drastic treatment, being, of course, partly shielded by the metal.

The First Corner

Now to return to our first corner. The object, of course, is merely to inscribe a perfect square in a circle, one side at a time (Fig. 4*b*). It is not correct to do a little to all four corners and then adjust them afterwards, but sometimes this becomes necessary. What is required is to polish the first correct size, shape and inclination to the table (this latter is polished at a later stage) and then to do the one opposite exactly similar, not too much from the girdle nor too far into the table, exactly parallel and the same length. Now comes the test; a good eye may not see anything wrong, but the expert will look at it from both sides (to avoid any false impression given by perspective or a loupe which distorts slightly), and then say, perhaps, "a little from the right' or "a little from the girdle." So the dop is very gently but firmly pushed so as to bend the thick copper stalk slightly and polishing is resumed. In spite of the comparatively heavy gauge of the copper wire stalk, a very slight pressure is sufficient to produce a quite definite result. It is frequently necessary to apply only a light passing rub or two with the ball of the

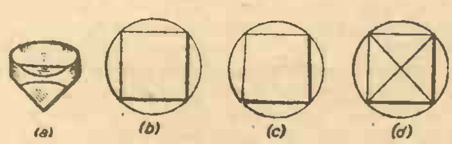


Fig. 4.—(a) First top corner. (b) Perfect square. (c) Imperfect square 3 deg. out of line. (d) Plan of stone with top and bottom corners finished.

thumb, no harder than is required to dial a telephone or stroke a child's head, yet the resulting inclination is quite obvious to the polisher, since a small facet will now appear at one end or the other and, if allowed to, travel, as it gets larger, right across the corner, giving it a new orientation ; but the stalk may be bent too much or not enough, or it may not be at the same inclination to the table as before (and in any case further work is bound to make the corner bigger, so that such corrections must be made in good time).

The Experienced Polisher

It is no exaggeration to say that an experienced polisher can easily see at once when the completed square is out of line to 1 deg., and much smaller errors can be detected and corrected (Fig. 4*c*). If the copper stalk has been bent 1 deg., a facet of 1 deg. will make itself seen. If this appears to be too much the dop can be bent back in the reverse direction very slightly, and the stone will then touch on the ridge dividing the two planes (these two planes are highly polished and the ridge shows very clearly at 1 deg.) so that the ridge itself is worn away and two minor ridges appear instead. By this means a reliable system of control is available: the direction of the ridge always indicates the directions of the two planes, and the angle between them can be seen by moving the tongs and catching the full reflected light first on one end and then on the other. When we remember that many diamonds are cut less than ⅛in. dia. we realise that we are seeing an error of 1 deg. in ⅛in., which worked out by similar triangles comes to something like .004in. Such an error would not pass, as already stated, since this square forms the whole foundation for the rest of the figure.

The Lower Corners

Assuming that our square is at last perfect, corners at right-angles, equally and correctly inclined to the table and all the same precise size (most important), we turn the stone over and do the four corners underneath ; but here there is no table (a slight flattening, called the culet, to avoid chipping, is made later) and all the four lower corners must meet in a point and be mutually inclined at 98 deg. as nearly as possible. This is attained not by gauges but by looking through the table and noting the exact disposition of the reflections. Gauges are available, but polishers know that when a certain effect is produced the side must be adjusted in a certain direction and the gauges are not time savers. Finally, the four lower corners must be brought to a perfect point—if one is made a fraction too big the point becomes a minute line—the stone must be turned and the line removed ; looking through the table (of course the stone must be out of the dop) the culet must be exactly in the centre of the square where the imaginary diagonals would intersect and the stone must be neither too thick nor too thin (Figs. 3*g* and 3*d*). In either case light would escape through the back instead of being thrown forward out of the crown in the direction of maximum effectiveness.

Bezels

The four top corners, top and bottom, having been perfected, the next set of facets (four bezels above and four pavilions below) are started. A bezel is like a top corner except that it is turned 45 deg. to right or left, making one side of the octagon. Now see what would happen if the initial corners were not at the same inclination—suppose one were 1 deg. steeper than another: when the polisher makes a bezel between them the two lines or edges bordering the bezel will not be equally inclined—one may be 2 deg. out and the other correct, or both 1 deg. out, in which case the lineal error over 1/16in. would be .001in. and still be noticeable since these ridges or edges must be radial to the centre of the stone and, if out, they cannot point to the centre, nor do they lay exactly over the edges of the corners underneath. Again, if one of the top corners should be a shade too big the bezel would not match on one side or the other, and a small percentage error seems much more noticeable than might be thought. Allowing a 10 per cent. error on a normal top corner of, say, .01 sq. in., gives a difference in area of only .001 sq. in., whereas smaller percentage error would certainly be detected by the practised dealer who habitually purchases from the polishers and quite possibly has done not a little polishing himself, thus knowing what to look for.

We thus see that in order to keep up the value of the stone the polisher must cut with very great accuracy and avoid any unnecessary loss of weight. Time must be saved as far as possible without sacrificing the quality of the work ; while this latter must be maintained by eye alone—the only gauges made are for testing the inclination of the facets to the horizontal—there is no means of ensuring that the other requisites are attained other than the polisher's opinion, which must be absolutely reliable, to exceptionally fine limits.

Motor-driven Westminster Chimes

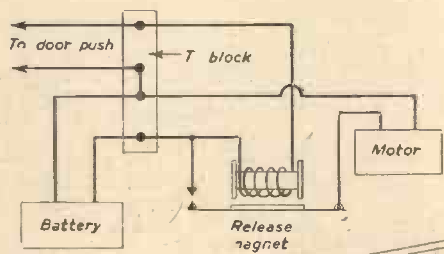
By R. BONNEY

THE accompanying sketch shows a modification I have made to the Westminster Tubular Door Chimes, as described in PRACTICAL MECHANICS for May, 1952. The chimes are driven by a small permanent magnet motor which works off a flash-lamp battery, and was obtained from Messrs. Gamage, price 7s. 6d., post free.

An extra cam is added to the shaft in the centre which is timed to press the pallet down at a certain time. The pallet has a weight, W, which on the rebound strikes the angular piece of brass, B, a glancing blow causing it to move sideways, thus releasing the "switch on" of the motor by means of the pivoted lever, L. A small notch is made in the lever in which engages a piece of clock spring which is in turn riveted to the magnet keeper. The contact screw, C, is adjusted until it just switches on and locks itself. Once the door bell-push is pressed and keeper locked, the magnet is dead, but the motor keeps on going until the eight chimes are struck.

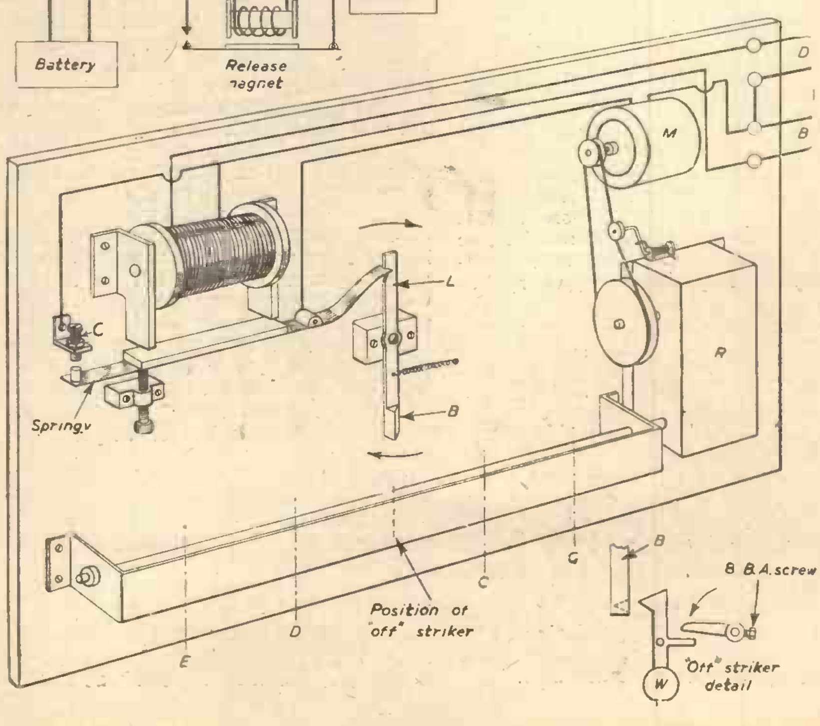
Reduction Gear

For the reduction gear, R, I used an old time-switch, but an alarm clock gear could be made to answer the purpose. A jockey pulley was fixed to the reduction gear casing to keep the belt sufficiently tight. I used three strands of cotton for the belt as I found that this made a better grip on the V-pulleys. The main shaft is directly connected to the gears by taking the main gear wheel off its shaft and substituting a longer shaft.



(*Left*).—*Circuit diagram.*

(*Below*).—*General layout of electro-magnet, switch, motor and reduction gear.*



MODEL STEAM LAUNCH "Vanesa"

A Free-lance Model Powered by a Twin-cylinder Oscillating Engine

By J. E. J.

(Concluded from page 204, February issue.)

The Boiler

WHEN searching around for suitable material, I discovered that some copper tubing I had in hand was of much too heavy a gauge to suit the present boiler, so it was decided to "roll" the boiler up from sheet, and as I did not possess sheet copper 20-gauge sheet brass was used instead. It was lap-joined and sealed with silver solder. Sunk-in end-plates were fitted, and other components include one central stay, filler (which also serves as a steam dome), safety valve, and two water tubes. (Fig. 7.)

The main steam pipe extends from the dome down the side of the boiler, then along over the flame to the engine, providing a simple superheating arrangement. The boiler is completely enclosed in 20-gauge sheet-iron casing, and is supported by means of the stay-ends which protrude through the casing end-plates and are bolted down. Ventilation is provided by drilling eight ¼in. dia. holes low down on either side of the casing. Both the engine and boiler unit are bolted down to an aluminium bed-plate, cut from 18-gauge sheet (Figs. 6 and 8). The bed-plate is held in position by means of a single bolt, and brackets soldered in the bottom of the boat.

A part sectional side elevation of the launch, showing the engine and boiler unit in position, is given in Fig. 9.

The burner is of the wick type, but instead of having wick nozzles the wick is laid in an open tray through which runs a pipe, connecting up with the container, which lies for'ard under the foredeck. The container was improvised from a tin which happened to be of suitable dimensions for its location, although its actual capacity is not quite up to the capacity of the full boiler. Although the burner unit, for its type, is satisfactory in every way, I am contemplating the construction of a vaporising burner, particularly in view of the fact that the buoyancy of the boat would still stand the addition of the little extra weight involved. This, apart from the fact that the vaporising type of burner is, of course, more efficient.

General Measurements:

Length of hull (overall) ...	37in.
Depth of hull	4½in. (amidships)
Beam	8in.
Height of cabin	2¼in.
Length of cabin	19in.
Total weight	12lb.

Engine and Boiler Unit:
Engine (weight): 2lb.
Motions: Twin-cylinder oscillating, single-acting.
Cylinders: ½in. bore × ¾in. stroke.
Boiler: 6¾in. × 2½in. dia.
Steam pipe: ⅛in. dia.
Exhaust: 3/16in.
Total weight of complete unit: 5lb. 2oz. (loaded for running).
Running time: Approx. 25 min. (with present spirit container).

Painting

With the constructional details all complete, the painting was taken in hand, the colours being silver-grey and green for the hull, with ivory-coloured deck, and brown for the cabin, with a white roof. First, the inside of the hull was given two coats of dark grey paint, the second one being applied about six hours after the first. This was mixed up from black and white and thinned down with turps, with about one tablespoonful of terebene dryers and goldsize added. Then the whole of the exterior was given one coat of under-coating consisting of a light grey, mixed in the same fashion. This was done on one evening, and by the morning they were bone-hard dry and ready to receive the final colours. These were flat, and by adding a proportionate amount of terebene dryers and goldsize, with a little boiled oil to make them flow easily, I ensured that each coat became "tacky" within the hour. Also I took good care to see that the "body" was solid in each and covered well. Having prepared all colours and strained through a double thickness of "silk stocking," they were placed under cover on a shelf. Then the boat was lightly rubbed down with a piece of wet, fine glass-

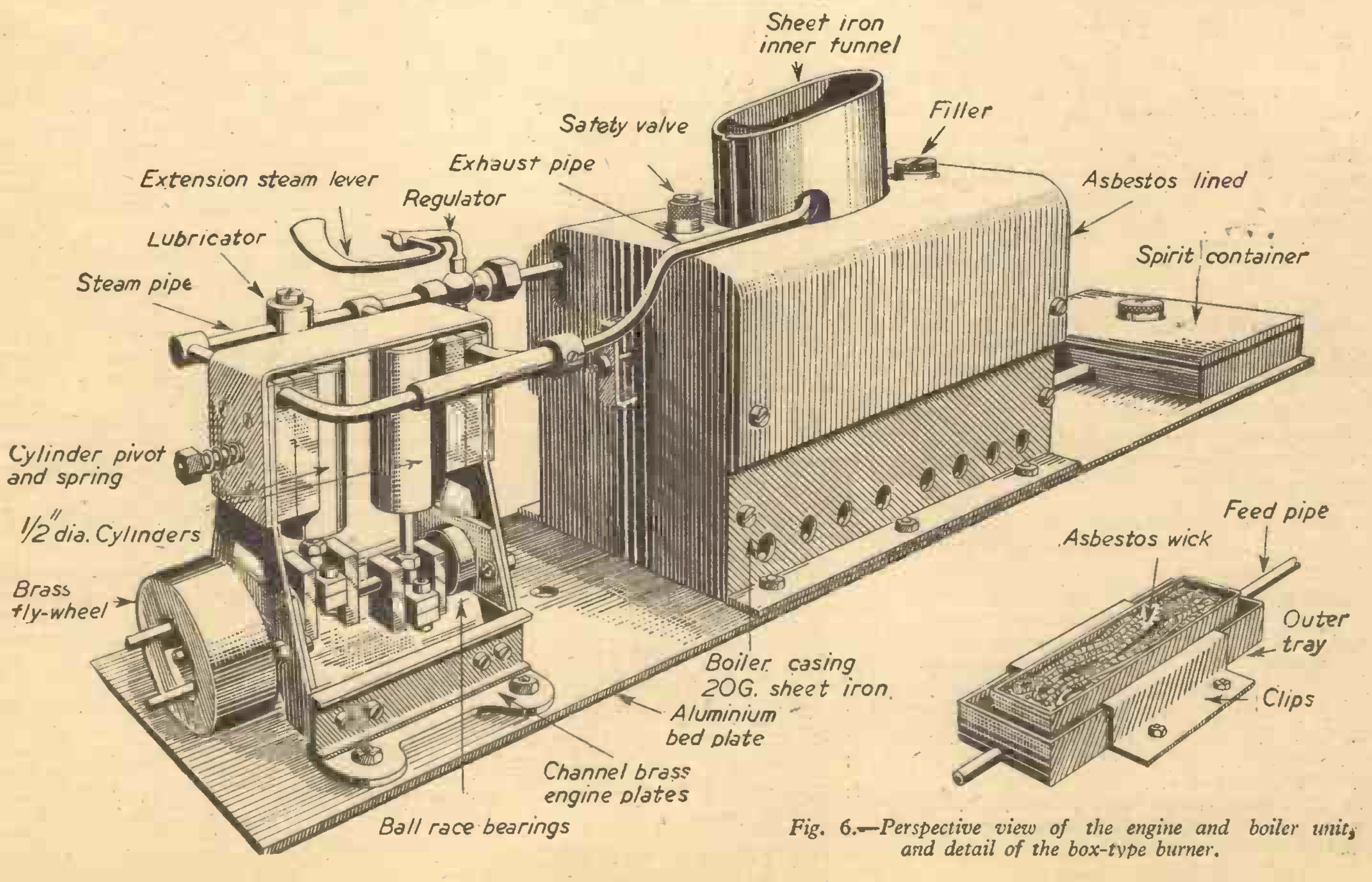


Fig. 6.—Perspective view of the engine and boiler unit, and detail of the box-type burner.

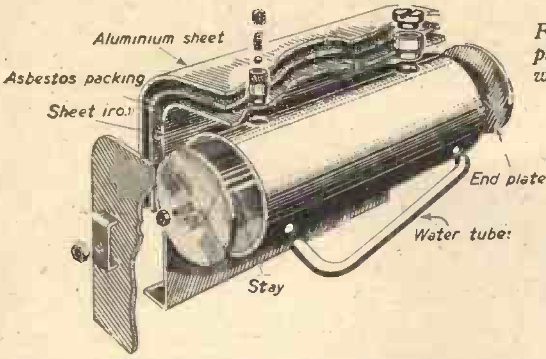


Fig. 7 (Left).—Exploded view of boiler, with half sections of casing.

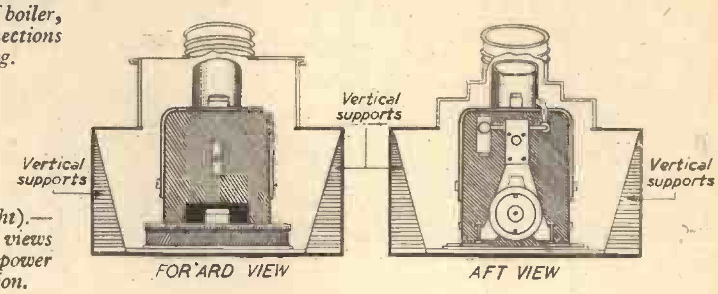


Fig. 8 (Right).—Sectional views showing power unit location.

paper, washed and dried with a piece of chamois leather. The bench was previously cleared and the workshop swept out, with a little water laid down to minimise dust. All colours were applied in the space of one evening, and in the following order: First the cabin was painted; waiting until this just became tacky, the deck paint was applied. Then, suspending the boat from a hook fixed to one of the rafters, the remainder of the hull was painted in a similar manner. The attached fittings, such as the roof, masts and skylight, etc., were treated next. The boat was then left suspended, and by the following evening all colours were bone-hard dry. Rubbing down lightly, washing and drying as before, it was then given a coat of white oil copal varnish, and after preparing a "shelter" consisting of a couple of lengths of board laid on some supports, the boat was placed under this and left to dry for 24 hours, after which the only detail left was the fitting of the rigging, which, not being excessive, was carried out in the space of a couple of hours.

Incidentally, I would point out that these colours were changed later, the hull now being white and red, instead of silver-grey and green. Also, due to one or two constructional modifications carried out quite recently, the drawings display the present design, while the photograph shows the boat in its original form.

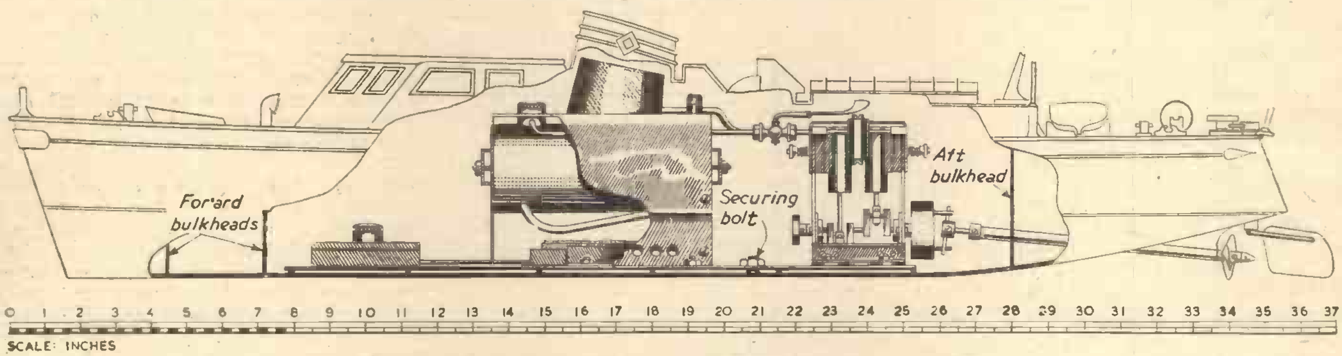


Fig. 9.—Part sectional side elevation showing the boiler and engine.

Cutting a Slot in Wood

A Method of Using an Electric Hand Drill and Cutter for the Purpose

By H. G. WRENN

An 8ft. length of nosing was required for fitting at the top of a French window to shed rain water away from the window.

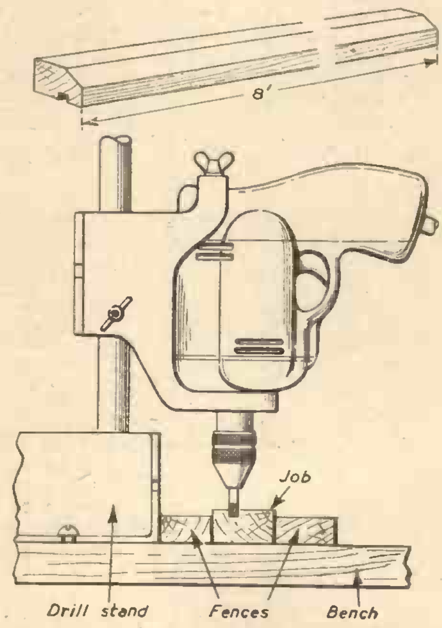
The usual slot about ¼in. x ¼in. was required on the underside to prevent capillary action. A suitable plane was not available, but a Wolf Cub drill and stand were to hand.

The drill was mounted on the pillar of the drill stand but turned the opposite side to the stand which was then screwed to the bench. Strips of wood were screwed to the bench to act as fences, as shown in the accompanying illustration.

The Cutter

A cutter was ground from the shank of a broken ¼in. twist drill and inserted in the chuck, after the job had been marked out.

Place the work between the fences and set the drill cutter to its position for distance between the edge of the work and the groove. Remove the work and lower the drill until the end rests on a small piece of wood, ⅞in. thick. Tighten nuts lightly by hand and insert wood between fences and adjust for longitudinal position; tighten nuts with wrench.



The electric hand drill mounted on the bench, and ready for slotting a length of wood.

Operation

Start the drill and feed the wood gently to the cutter and keep on until the whole length has been traversed. Reset cutter for depth, this time using a piece of wood ⅝in. thick. Again feed the wood against the cutter until the groove has been traversed again.

The groove made by this method was satisfactory in every way.

Automatic Sliding Doors for Factories

Doors originally designed for lift entrances by the Express Lift Co. Ltd. have been adapted to provide automatic sliding doors suitable for factories and warehouses. The doors close automatically, thus preventing draughts and facilitating the maintenance of a constant temperature within the workshop.

Two Sliding Panels

The doors consist of two sliding panels opening from the centre and run on ball bearing rollers on steel tracks. They are opened and closed by an electric operator which, to prevent excess torque being transmitted to them, incorporates a clutch.

Fitted to the doors is a sensitive edge that ensures their instant reversal should any obstruction be encountered. An adjustable time delay is embodied in the controller so that the doors are held open for any predetermined period within the limits allowed. The doors are opened by means of press buttons which can be fitted at any convenient point.

MORE WEATHERVANES

Three More Weathervane Designs Received in Response to Our Invitation in the November, 1952, Issue

Mr. R. B. Orme's Design

THE following description and chief dimensions of a weathervane suitable for erection in an average sized garden may be made with the usual materials to be found in a home workshop, with the excep-

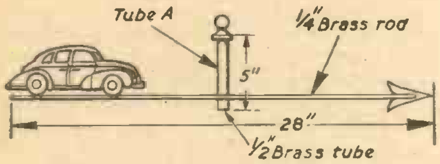
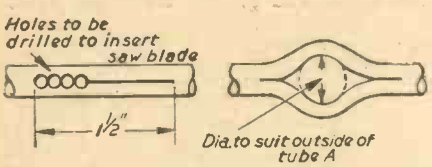


Fig. 1.—The arrow and car motif.



Figs. 2 and 3.—Method of slitting and opening out the centre of arrow arm.

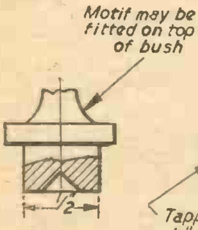


Fig. 4.—Detail of conical bearing piece.

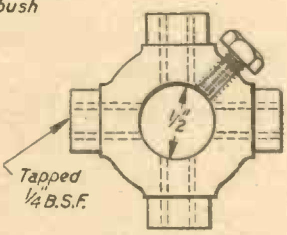


Fig. 5.—Plan of cross piece.

tion perhaps of the universal joint cross, and tubing for the mast.

Figure 1 shows the arrow made out of ¼in. brass rod, 28in. long, annealed in the middle and drilled to allow a hacksaw blade to be inserted to make a sawcut 1½in. long (Fig. 2). A taper drift is now driven into the sawcut and swelled out as in Fig. 3. This should be opened up and fitted to the bottom end of tube A (Fig. 1), and well soldered. This tube should be plugged at top end with a brass insert, the bottom of which is counter-

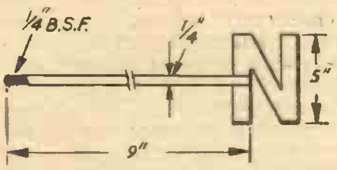


Fig. 6.—Detail of arm and indicating letter.

sunk, as in Fig. 4, to take a stainless steel ⅜in. ball on which the arrow rests. The top of insert may have any ornamentation the maker fancies, cut out of sheet brass and inserted in a sawcut and soldered. Similarly, the feather end of arrow should be fitted with a motif to the owner's idea. In the case of the writer this was a 2½-litre Riley. A photo was obtained and stuck on a piece of sheet brass and cut out, leaving two tabs at bottom of wheels to fix on the feather end of arrow. The point of the arrow consists of four pieces of sheet brass soldered on rod. It is, of course, very important that the arrow is balanced perfectly, solder being added to whichever end requires it.

Fig. 5 shows the cross piece which can easily be made from an old Hardy Spicer

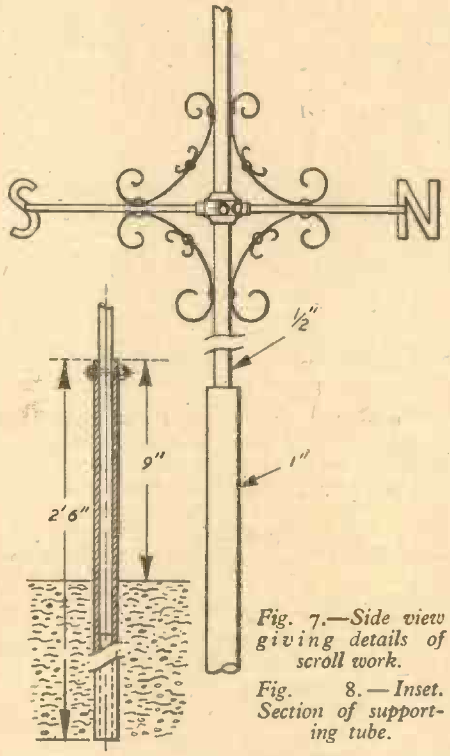


Fig. 7.—Side view giving details of scroll work.

Fig. 8.—Inset. Section of supporting tube.

universal joint centre (obtainable at any garage repair shop). Anneal and bore out to suit the ½in. dia. upright rod, then drill and tap ¼in. B.S.F. holes in the four arms. If the joint has a greasing hole tapped in it this will serve to take a set screw, usually 3/16in. B.S.F., to secure it to the upright rod. The four arms are made from ¼in. rod, 9in. long (Fig. 6), tapped and screwed into the cross piece (Fig. 5).

At the ends, letters N. S. E W., which are cut out of sheet brass 5in. deep, are fixed by slotting the rods ⅜in. down, inserting letters and soldering. The upright supporting rod is made from ½in. brass, 2ft. long, the top end being countersunk to receive the steel ball. Tubing A (Fig. 1) should be an easy fit on the brass upright. The balancing of the arrow may now be attended to. Ornamentation may be added to the structure, made from strips of sheet brass, as shown in Fig. 7.

In the writer's case the pole to support the apparatus was a 14ft. length of 1in. galvanised iron piping with a bush in top bored out to take the ½in. brass rod. A 2ft. 6in. piece of tubing to take the 1in. iron pipe inside it was sunk in the ground and secured vertically in cement, standing 9in. above the soil as indicated in Fig. 8.

When ready for erection the ball should be rested on top of the ½in. brass rod, and arrow tube A (Fig. 1) filled with thick grease to steady the vane. Too thin a grease will allow the arrow to oscillate too much.

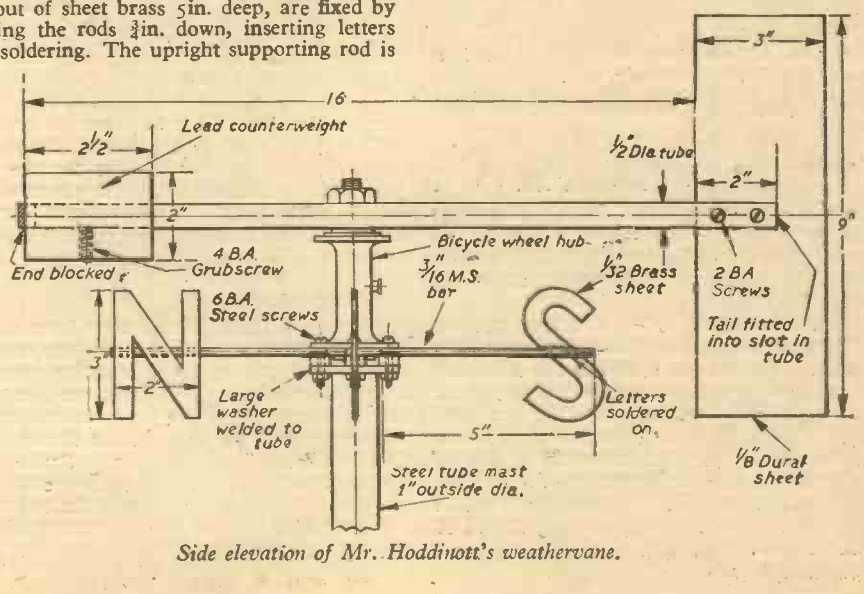
If carefully made the vane should indicate the wind direction quite accurately.

The writer found that the height (14ft.) of the apparatus was quite satisfactory, and even in a high wind there was very little swaying of the mast, and guy wires were quite unnecessary.

Mr. M. H. Hoddinott's Design

I CONSTRUCTED the weathervane shown in the accompanying sketch for my meteorological observations, and as it is based roughly on the Meteorological Office's designs, it is very sensitive. As it is made from workshop odds and ends, detailed contructional details are not given, but the main outline is clear from the drawing.

The moving arm is made up of ½in. dia. O.D. copper tube slotted at one end to receive the duralumin tail and secured by two 2 B.A. screws. At the other end a lead counterweight is fitted, and this is movable in order to find the balance position. The weight of this counterbalance and its size must be found by experiment. I suggest that the main dimensions are adhered to in order to obtain maximum performance. The bearing is a front wheel bicycle hub. The direction arms are flattened and drilled at one end with a



Side elevation of Mr. Hoddinott's weathervane.

No. 27 drill. Similarly four opposite spoke holes in the lower end of the bicycle hub should be drilled out No. 27 to receive the 6 B.A. securing screws. If these screws are allowed to project well down they can be further passed into four similar holes in an iron washer welded to the supporting mast, distance pieces being placed in between, thus holding the whole assembly rigid.

When everything is assembled it should be held in a vice horizontally to check for balance which can be adjusted by moving the lead counterbalance. When this position is found drill a hole in the tube for the grub-screw to grip in or, preferably, tap the tube 4 B.A. and secure it in position. This balancing adjustment is very important for sensitivity.

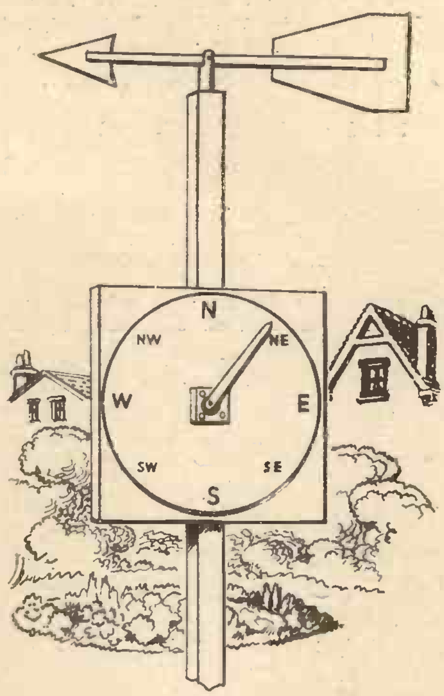
Finally, I suggest the head end of the vane is blocked to stop rain blowing down the tube and trickling into the spindle hole. A small cup-shaped cap can be placed over the central spindle to protect the ball race.

A Recording Weathervane

By H. A. ROBINSON

DESCRIBED here, is an unusual weather vane, for it shows on a dial the way the wind is blowing. The majority of garden vanes have to be set rather low and are difficult to read, but in this recording vane the trouble is overcome, also the whole arrangement is quite an interesting novelty.

The idea is that the rotating top bar operates, through a suitable gear, a pointer which moves over the face of the dial, marked with the cardinal and intermediate points. From the position of the pointer the direction of the wind can at once be determined.



Perspective view of the recording weathervane and dial.

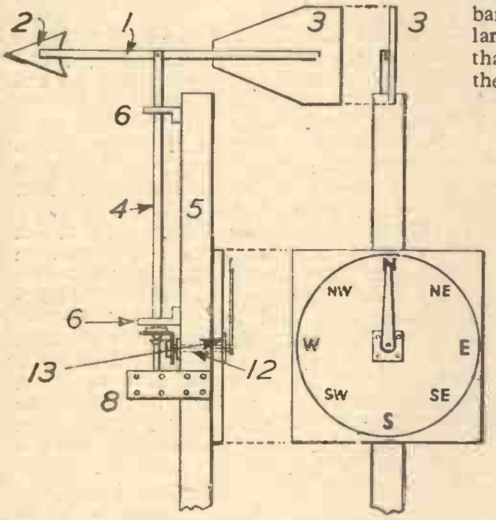


Fig. 1.—Side and front elevation of the vane and recording dial.

Construction

To make, first deal with the arm holding the arrow head and vane. This differs from the usual type inasmuch that instead of rotating on top of a vertical axle, the axle itself also rotates as the vane twists in the wind.

The cross bar (1) is 1ft. 6in. long, 3/16in. thick and ¾in. deep. This is deeper than usual as it has to fit firmly to the axle, and is made of wood. At one end is the usual arrow head (2) and at the other the vane (3). This latter is 8in. long and 6in. deep at the back, and can be made of tin or zinc, as can also the arrow head. A lighter job can be effected by using aluminium obtained from a discarded cooking utensil or other source.

The vertical axle (4), 1ft. 6in. long, should be a metal rod for easy turning in the bearings, but a length of stiff wooden dowel can be used. In both cases the top is flattened as shown in A, Fig. 2, and the cross-bar attached with a suitable bolt. Put a large washer at the bar side of the joint so that there will be a good bearing surface on the wood.

The rod is held to the main post (5) by the two brackets (6), which are just angles bent out of zinc or tinplate. Holes are bored in the horizontal parts to take the rod, and if this is of wood the places where it passes through the bearings should be well polished with black-lead to give very smooth turning.

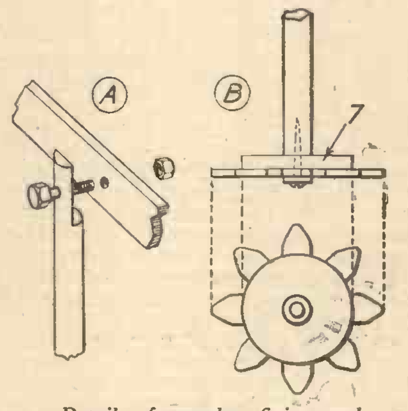


Fig. 2.—Details of cross-bar fixing, and cog-wheels.

The Cog-wheels

The main thing here is they have to be the same size so that a complete revolution of the vane gives a complete turn of the pointer on the dial. They are 2in. dia. and are cut out of tin or zinc reinforced at the one side by the circular blocks (7); this is shown in B, Fig. 2. Scribe out the cogs carefully first and then cut with clippers. It does not matter if the tin curls a bit in doing this, as it can be straightened out against the blocks.

To fasten the block to the axle, the end of the dowel or metal rod is squared and a similar hole cut in the block (7) which is then tapped into position and held by a screw over a washer in the case of dowelling, or a soldered-on end in the case of metal. If a screw is being used it should be of a round-headed variety.

All this work must be very light. Any bought bevel gearing could be used, of course, if particularly effortless in operation, but the made cog-wheels are quite efficient.

To take the weight of the vane, etc., and to keep the vertical axle in position, the block (8) is placed on the main post and into it a 4in. nail is fitted. On this rests and rotates the round head of the screw in the dowel end as C (Fig. 3), or if a metal rod is used, the top of the nail must be made into a point as D (Fig. 3).

Now prepare the spindle (12) for the pointer. On the end of this is fastened the second cog-wheel. A hole of greater diameter than the spindle is drilled through the post and this length then rotates in two thin plywood or metal bearings (13). The spindle is not finally fitted, however, till the dial is put in position. This is a square of wood, 12in. x 12in., upon which is drawn a circle having N. S. E. and W. and the intermediate points of NW, SW, NE and SE marked in some strongly contrasting colours. Thus, the board could be dark brown with the letters in white or yellow, or the letters could be dark against a light background. The main thing is they should be easily seen from some little distance.

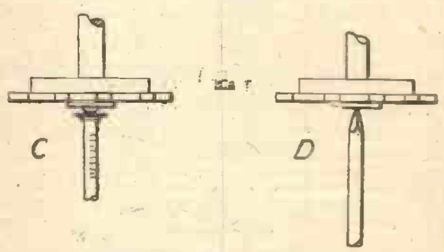


Fig. 3.—Details of foot bearings for vertical axle.

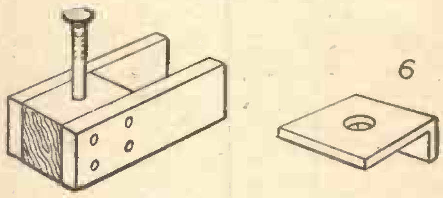


Fig. 4.—Supporting block and bracket.

This dial is secured to the main post with suitable screws and a hole larger than the spindle taken out in the middle, over which is fastened the small square of bored wood or metal which acts as a bearing. By careful adjustment of this a good setting of the cogs can be obtained. The pointer is a short length of light wood (the lighter and thinner the better) attached with a screw to the spindle. It must be so set that when the arrow of the vane points due north it points to N. on the dial.

All is now complete and if everything has gone well the finger will now show on the dial the exact direction of the vane above. The main post can be any convenient length of wood you have to hand. Its actual size in section does not greatly matter, but it should not be less than 2in. square, as allowance has to be made for the brackets and hole to take the horizontal spindle. The recording vane is most useful if placed at some point in the garden where the dial can be seen and read comfortably from a window.

A 12-volt Sump Heater

Constructional Details of an Inexpensive Electric Heater for Car Users

By S. RACE, A.M.I.C.E.

THE sump heater shown in the illustrations can be made very quickly from scrap materials. The heater has two filaments each taking 2 amps and is normally run on one filament only, the power being taken from the mains lighting circuit through a step-down transformer.

Materials

Materials needed are: a 3½in. length of 3in. bore asbestos-cement pipe; 12in. of 3/16in. galvanised iron wire; 3/16in. by ¾in. Whitworth bolts with nuts and washers; about 5in. of heater filament wire; two 4in. dia. circles of fine mesh wire and one 4in. dia. circle of ⅛in. mesh galvanised wire mesh; six ⅜in. by six brass screws and washers.

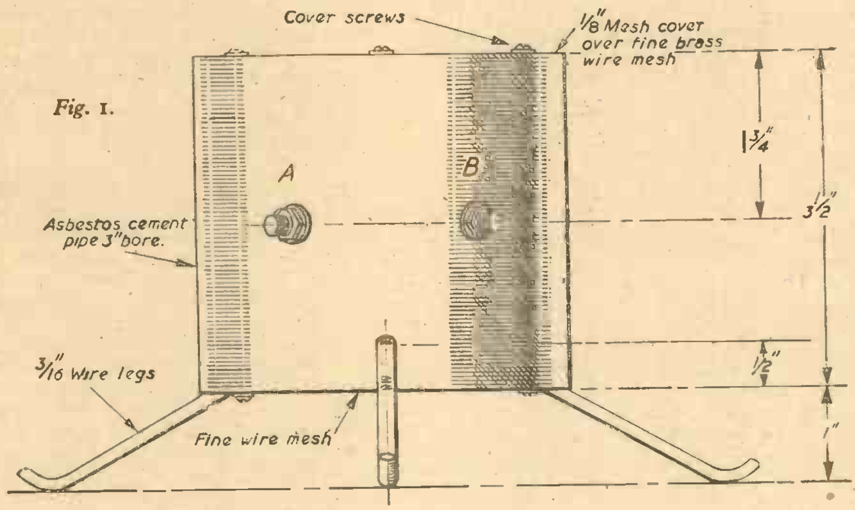


Fig. 1. Side elevation of the completed heater.

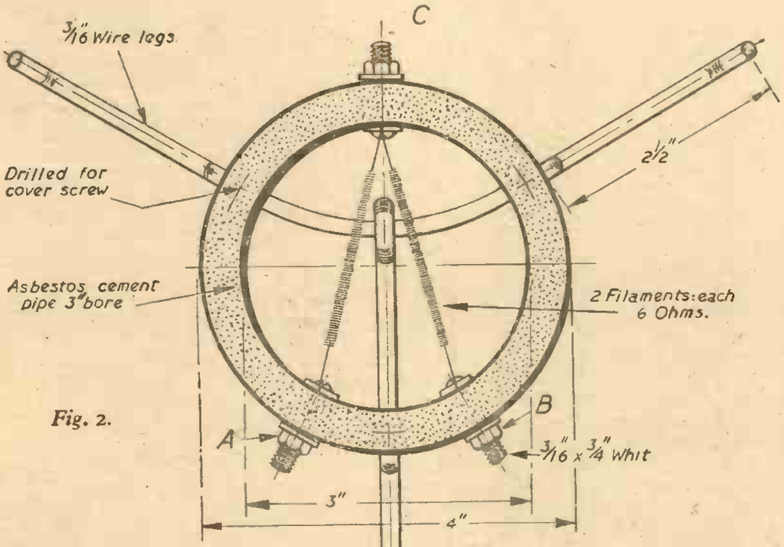


Fig. 2. Plan view showing the disposition of filaments.

Construction

The body, which consists of the asbestos-cement pipe, has three 3/16in. dia. holes drilled mid-way along its length, as shown in the accompanying illustration to take the filament bolts. Three 3/16in. dia. holes are drilled ½in. up from the bottom of the pipe, evenly spaced round the pipe to take the legs. Three evenly spaced holes are drilled into the top of the pipe and three into the bottom, each ⅛in. dia. and about ½in. deep, for the cover screws.

The wires forming the legs are passed through the appropriate holes, connected together and bent as shown in Figs. 1 and 2.

The Filaments

Each filament should be of 6 ohms resistance so that its consumption at 12 volts is 2 amps. The correct length can be gauged by connecting a 12-volt transformer (or 12-volt car battery), a length of the filament and an ammeter in series. If one connection to the filament is made by a "crocodile" clip, this connection can be moved to vary the length of filament in circuit until the correct current consumption of 2 amps is registered. This length in circuit is then the correct length required.

If an ammeter is not available a close approximation of the necessary length can be made by cutting the filaments from a 500-watt replacement coil which can be bought at most electrical shops. The length needed for each filament is 1/20 of the full length as sold.

The filaments are connected inside the pipe to the bolts, as shown at A, B and C (Fig. 2).

The Covers

Each end of the body is covered with a circle of fine brass wire mesh to make the heater safe from igniting petrol vapour. These meshes operate in the same way as the mesh in a "Davy" safety mine lamp. The top mesh is protected from damage by a cover of ⅛in. mesh galvanised wire mesh.

The covers are held in position by brass wood screws with washers, fixed into the holes on the ends of the pipe by means of plastic screw fixer, such as Rawlplastic.

The Heater in Use

The 12-volt output of the transformer is connected to the bolts marked A and C, to use only one filament. One filament will produce as much heat as the well-known paraffin sump lamp.

If additional heat is required in very cold weather A and B are connected together by a short wire to bring both filaments in parallel circuit. Current consumption is then increased to 4 amps.

The transformer used with the original heater was bought as scrap from A.R.P. stores and was originally used in air raid shelter lighting. Its output is a maximum of 5 amps at 12 volts.

This type of heater needs no attention as there is no wick to trim or reservoir to fill.

An additional advantage is that if the car has to be left out of doors in frosty weather, the heater can be placed under the bonnet and run off the battery. Its current consumption of 2 amps is no more than that of the parking lights.

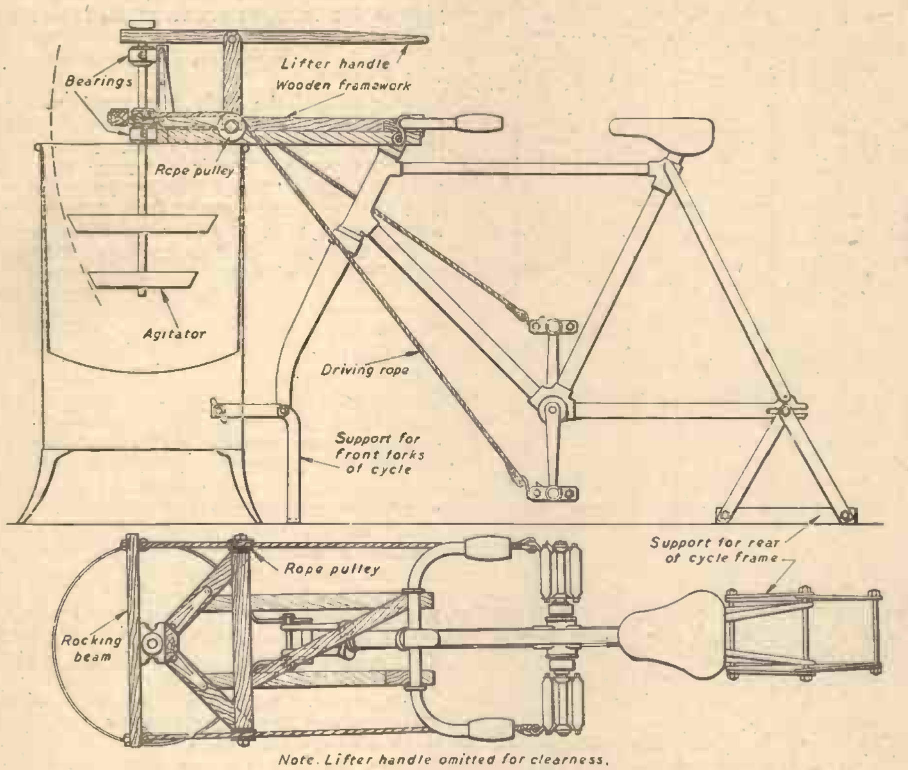
A Pedal-operated Washing Machine

A Novel but Useful Appliance for Domestic Use

By W. D. ARNOT

THOSE who are cyclists appreciate that power can be exerted by the legs over much longer periods without tiring than is the case when the arms exert the effort. Why should not the same effort-saving means be used to help with the laundry That was the thought which inspired the development of the washing machine here described and illustrated.

Use is to be made of whatever form of wash boiler is in service, and it may be power driven by fitting an old bicycle frame to it; many are available at a small cost, or if storage is the problem, the week-end cycle complete may be harnessed to the work. I will assume that a frame will be used and so fitted that it may be detached after use for handier storage.



Sectional side elevation and plan of the completed pedal-operated washing machine.

The drawings show a side elevation and plan of the appliance. In the plan the agitator raising and lowering means has been omitted in order not to confuse the rest of the construction. Timber has been indicated pricipally for the upper structure because more handymen have tools to work it rather than iron. The cycle frame supports are shown as simple ironwork, but they, too, may be made in timber by those accustomed to that material. There is nothing hard and fast about the scrap material that can be adapted for this job; it rests with the ingenuity of the constructor.

Constructional Details

Describing the construction as drawn, it is seen that the agitator is suspended in bearings, centrally over the boiler. A top and bottom bearing is secured to an upright post which is attached to an "A" frame by shelf brackets securely screwed to each. The "A" frame has also two backward extensions reaching to the handle-bars of the cycle frame. Bracing these and the "A" frame together, they being all in one plane, is the cross-member carrying the rope pulleys, nailed, screwed or bolted above the other members. A diagonal prop braces the two members reaching the handle-bars, and on the one with diagonal end remote from the handle-bar a block is secured to take the thrust on that side. This whole main framework is held to the handle-bars by wire hooks.

Returning to the upright bearing post, the bearings secured to it are those cheap die-cast "plummer blocks" branded "Picador." They can be easily obtained in most places, and have self-oiling bushes in them. Bearings of ½in. bore are used, and either wood screws or bolts will hold them. They are spaced to allow another such bearing between them to have a travel up and down of about 4in. This travelling bearing supports the agitator rocking beam, to the ends of which the ropes are attached by hooks or eye-bolts. The oil-hole of this bearing can be threaded to take a grub screw to lock the bearing to the agitator rod, which is ½in. diameter galvanised steel, for preference, but it may be of hardwood. If wood is used, 1in. diameter would be needed, with bearings to suit. Metal tube can also be used if plugged at the bottom.

The agitator arms are attached to the rod according to the material. They should be in wood in any case, and can be secured by galvanised "U" bolts or wooden clamps. Squaring the shaft with a file would make the drive positive. The arms are proportioned so that the whole top frame may be swung back around the handle-bars as a centre, clearing the boiler sides.

Lifting Movement

The lifting movement is effected by providing a central pillar on the pulley cross-brace, secured there by two shelf brackets, one either side. It is forked at the top or can be built up of three pieces to form a fork. In the fork swivels a lever reaching to the handle-bars and forward to the agitator spindle, on the end of which a disc of wood is secured by washer and nut. The lever bears underneath this disc to lift the agitator periodically. The rope pulleys may be sash pulleys attached by coach screws to the ends of the beam. Over them the ropes pass down to the pedals and are hooked one to each.

For compactness, the front forks of the cycle have been reversed and rest on a rod spanning the metal bracket bolted to the boiler casing. The bracket is provided with slots to make release easy. This bracket can be built up and bolted if no blacksmith is handy to bend it. The "A" frame rear support slides into the rear wheel spindle slots. It may need to be cross-braced against sway. This completes the structure.

For the metal parts old pram frames could be utilised. The timber used is mostly 1in. and 1½in. square.

Operation

The method of operation is simple. The boiler is loaded, the agitator swung down into it, with a sheet metal cover attached, if preferred, the ropes hooked to the pedals, and the appliance is ready for work. It will make a tiring job easy, and be well worth the time taken to make it.

It is pointed out that to allow the agitator frame to swing well over, the central lifter pillar may be offset to clear the top tube of the cycle frame, bringing the lifter handle to the right-hand grip where it is convenient to operate.

The "*Commander*" Motor Cycle

A Spectacular New Design for Lightweight Motor- and Autocycles

UNDER the name "Commander" the General Steel Group of Hayes is manufacturing and marketing a new series of Auto and Motor Cycles designed for comfort, economy, and performance, at prices within the reach of everyone. There are three models, all powered by the renowned Villiers engines.

Model 1 is a de luxe Autocycle which embodies both front and rear wheel springing, with Villiers 98 c.c. Mark 2F pedal start engine.

Model 2 is an Ultra-lightweight Motor Cycle with front and rear wheel springing and the Villiers 98 c.c. Mark 1F engine with 2-speed gearbox and kick starter.

Model 3 is a fully sprung Lightweight Motor Cycle with the Villiers 122 c.c. 10D engine and 3-speed gearbox.

"Commander" machines are styled to appeal to women as well as men. They are distinguished by eight outstanding construction and design features built into all models: these are the square tube patented beam frames which make for strength and stability; motor car front and rear suspensions and foam rubber saddles which ensure complete riding comfort; an easily removable bonnet which protects the engine, the rider and the passenger; powerful brakes with encased cable controls; ultra modern safety lighting, with increased front-rear visibility; a low centre of gravity, giving stability; unique riding protection in the form of streamlined, easy to clean cowlings and finally a two colour metallic finish.

The chromium plated grille round the front of the engine and the sheet steel cowling in other parts, particularly under the saddle and round part of the rear wheel, ensure almost complete protection and make it possible to ride in ordinary clothing—a point which should appeal to the lady rider. If it is required to carry a pillion rider, a dual seat, matching the colour scheme, may be obtained as "optional equipment."

Points contributing to the sleek look of the machine are that none of the cabling is visible, the battery and tool box are beneath the saddle and the curve is the predominant line used throughout the design.

Extensive chromium plating is used in the finish, while the main bodywork of the 122 c.c. machine is dark blue. The 98 c.c. Motor Cycle sports a maroon finish. The Autocycle has a light blue bodywork and in all three machines the "beam" is enamelled ivory. Several of the prototypes were passed to local clubmen for extended test and their reports were carefully studied.

The price of these new models, including purchase tax is, the "Commander" 1 Autocycle (98 c.c.), £74 19s. 6d.; the "Commander" Two-speed Motor Cycle (98 c.c.), £84 19s. 6d.; and the 122 c.c. "Commander" Three-speed Motor Cycle, £95 16s. 8d.

The 122 c.c. "Commander" Model 3.

Complete Specification of the 122 c.c. Model 3 "Commander" Motor Cycle

Wheelbase, 53½in.
Overall length, 84in.
Overall height, 39in.
Saddle height, 32½in.
Ground clearance, 5 in.
Handlebar width, 32in.
Weight, 175 lb.

Engine
Air-cooled Villiers Mk. 10D.
Capacity 122 c.c.
Bore 50 mm. Stroke 62 mm.
Horse power 4.80 at 4,000 r.p.m.
Sparking plug 14 mm. Lodge H 14.
Sparking plug gap .018/.025 in.
Carburettor Villiers type 3/4. Single lever.

Carburettor taper needle—No. 3 setting 2 9/32 out.
Contact breaker gap .015 in. maximum.
Lubrication engine. Petroil fuel mixture 1 : 16. Oil S.A.E. 30.
Lubrication gearbox and chaincase. Castrol "D" S.A.E. 140.

Transmission
Drive chain engine to rear wheel ½in. pitch. Renold No. 110044. Three-speed gearbox in unit with engine with foot pedal gear change. Gear ratios 19 : 1, 10 : 1, 7.18 : 1.

Frame
Special patented 4 girder beam design. Accles and Pollock ¾in. and 1⅛in. square tube 16 gauge all welded construction. Front and rear wheel spring suspension units. Centre stand. Welded with 1¼ gallon petroil tank.

Front Suspension
The front wheel spindle is bolted to link arms which pivot in bronze bearing bushes of ⅝in. bore by 1⅞in. length attached to the square tube front fork legs. Rubber dampers iron out all road bumps. Total vertical movement of wheel 4in. Trail 3in. Ball bearings in steering head.

Rear Suspension
The rear half of the frame consists of a patented swinging arm of square tube construction which carries the rear wheel and has a horizontal high tensile steel pivot spindle of ⅝in. diam. mounted in two bronze bearing bushes 1in. long. A steel coil spring 4in. long by 3½in. diam. irons out all road bumps.

Wheels
Fitted Dunlop 19in. by 3.0in. tyres. Hand operated 5in. front brake. Front speedo drive. Foot pedal operated 5in. rear brake. Rear wheel chain sprocket 38 teeth.

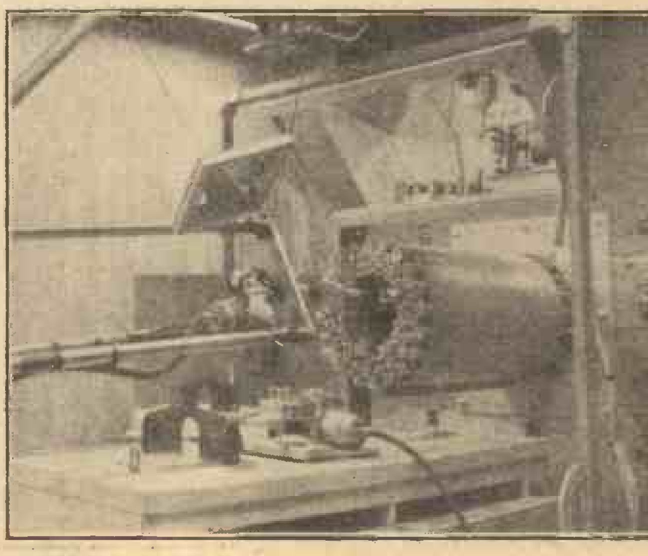
Ignition and Electrical Equipment
Villiers flywheel magneto and dynamo.
Direct lighting.
Headlamp 5½in. diam. reflector 6 volt.
Tail lamp full width 6 volt.
Electric horn and 6 volt dry battery.
For indirect lighting see: "Optional Equipment."

General Details
Foam rubber saddle.
Patented cowling protecting engine, frame, petroil tank, chains and wheels. Built-in accumulator carrier, tool box and inflator housing. Tool kit and inflator provided.
Finished in two colours and chromium plate.
120 miles per gallon. 55 miles per hour.

Optional Equipment
Indirect lighting 6-volt accumulator and rectifier.
Windshield.
Legshields and running-boards.
Carrier.
Dual seat.

Laboratory Stand-in for the Atom Bomb

"Cobalt 60" is a radioactive metal developed as a substitute for radium. Within one minute it can produce radiation burns of a sort greatly feared because little is known about them. Now scientists are using tubes filled with "Cobalt 60" as a laboratory atom bomb in studies to determine the effects of radiation burns in atomic explosions. The photograph shows a magnetic arm loading hot "Cobalt 60" tubes by remote control in a specially constructed lead-lined room.



A Weather Cottage

How to Make a Popular Novelty for Forecasting the Weather

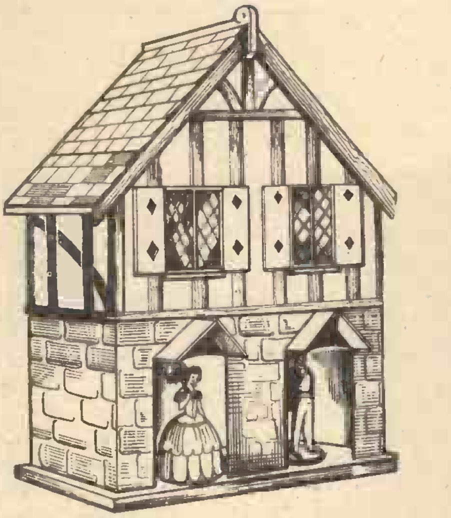


Fig. 1.—The completed weather cottage.

EVERYONE is, no doubt, familiar with the little weather cottage shown in Fig. 1. It never loses its popularity, and it will be even more fascinating to make one for yourself. As the outdoor season is approaching, for tennis, etc., it will be wise to consult the weather cottage before starting out, as, if the little lady is in the doorway, you may be sure of a fine time, but beware if the gentleman is out: "Take your mackintosh."

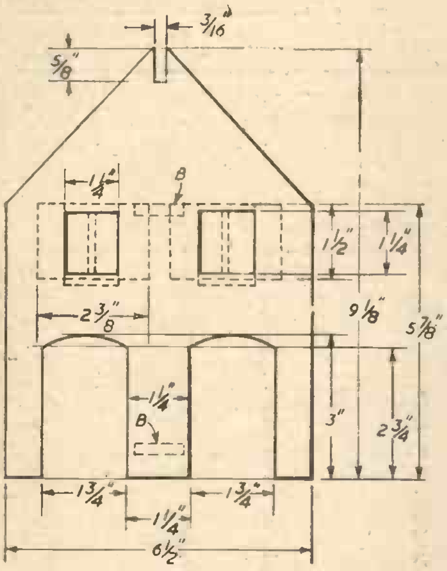


Fig. 3.—The marking out of the front.

The cottage is quite simple to make if you follow the diagrams carefully. Commence by cutting the base, as shown in Fig. 2, ¼in. thick; the dotted lines indicate the position of the back, front and ends.

The Front

Next mark out the front, as shown in Fig. 3; 5⅞in. from the bottom edge a line should be drawn across the wood and the window openings drawn ⅛in. below. They should be marked out next 1in. from each edge, the openings being 1¼in. wide by 1¼in. high. The dotted lines indicate the position of the overlays to hold glass in place, which are cut to the dimensions shown in Fig. 4, ⅛in. thick. Or, if preferred, a piece of transparent paper cut from chocolate boxes may be stuck at the back of the openings instead of glass. The window-sills are plain pieces, 1¼in. long by 3/16in. wide, ⅛in. thick; these are glued underneath the windows in the position shown by the dotted lines. The dimensions for the doorways are shown clearly; they have curved tops. The opening at the top is to take the ridge piece, the dotted lines "B" show the position of the supports to which the catgut is fixed.

The Back

This is cut to exactly the same shape as the front, 3/16in. thick, omitting all interior openings but having the opening at the top to take the ridge piece. The two ends are just plain, rectangular pieces, measuring 5⅞in. high by 2in. wide, 3/16in. thick. Having cut the parts mentioned, screw the ends to the back, and then the whole to the base, leaving the front off for the time being. Now cut the two supports "B" 2in. long by 1in. wide, 3/16in. thick, with a hole cut centrally ⅜in. from the front edge, just large enough to take the catgut. Screw these to the back centrally, the top one 5⅞in. from the bottom edge, and the bottom one ½in. from the bottom edge. Fig. 5 shows all these together.

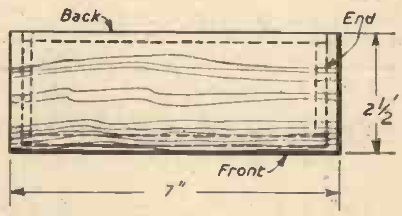


Fig. 2.—Dimensions of the base.

List of Wood Required

Base: One piece 7in. long, 2½in. wide, ¼in. thick.
Front: One piece 9⅛in. long, 6½in. wide, 3/16in. thick.
Back: One piece 9⅛in. long, 6½in. wide, 3/16in. thick.
Ends: Two pieces 5⅞in. long, 2in. wide, 3/16in. thick.
Roof slopes: Two pieces 5in. long, 2½in. wide, 3/16in. thick.
Supports "B": Two pieces 2in. long, 1in. wide, 3/16in. thick.
Ridge piece: One piece 2¾in. long, 1⅜in. wide, 3/16in. thick.
Gable overlays: Two pieces 4¾in. long, ½in. wide, ⅛in. thick.
Window overlays: Two pieces 2⅜in. long, 1½in. wide, ⅛in. thick.
Platform: One piece 4⅜in. long, 1¼in. wide, ⅛in. thick.
Two pieces ⅛in. thick for the figures.

The Figures

The figures should be coloured ones cut from magazines, measuring about 2½in. high; paste these to a piece of ⅛in. thick wood and cut to outline, leaving a tenon ⅝in. long by ⅛in. deep on the bottom edge, to fit into the mortice in the platform. Cut the platform, as shown in Fig. 6, ⅛in. thick, with a mortice in each end, 7/16in. from each edge, ⅝in. long by ⅛in. wide. Drill a hole

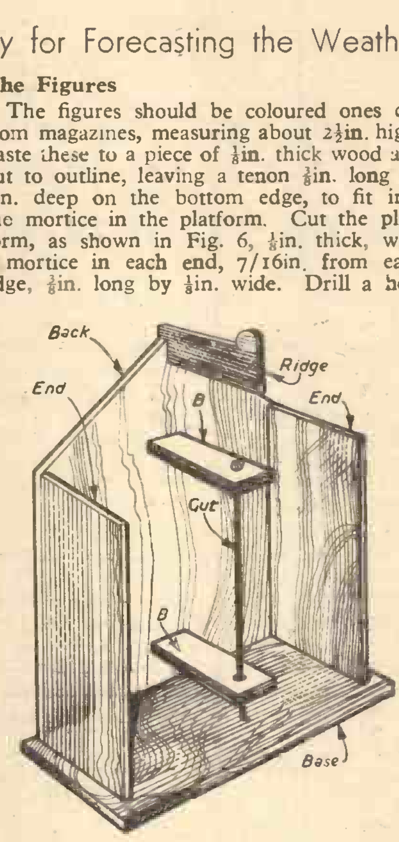


Fig. 5.—The assembly of the back, sides and base.

in the centre in which to fix the catgut. Glue the tenons on the figures into the mortices in the platform; to fix the catgut in the centre, pass it through the hole, glue it and tie a knot underneath. Then thread it through the two supports "B," adjust it so that the platform swings about ⅛in. clear of the floor of the cottage, fixing at the top as already described. Having fixed all the interior parts, the front may now be screwed in place. Next cut the ridge piece 3/16in. thick, 2¾in. long, as shown in Fig. 7, and glue this in the openings in front and back of house.

The Roof Slopes

Cut the two roof slopes 5in. long by 2½in. wide, 3/16in. thick; chamfer this on the top edge only to fit close to the ridge piece, and screw into place. Now cut the two gable overlays ⅛in. thick, 4¾in. long, as shown in Fig. 7. Glue and pin these to the roof slopes, front edge. The cottage is now complete and may be finished by covering with brick paper and the roof with tile paper, or, if a rough-cast finish is preferred, cover the house with glue and sprinkle with fine sand or sawdust.

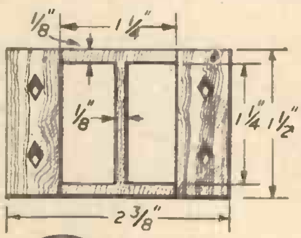
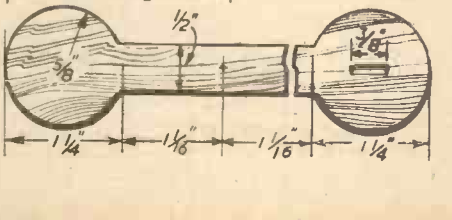


Fig. 4 (left).—The overlay for holding the window glass in position.



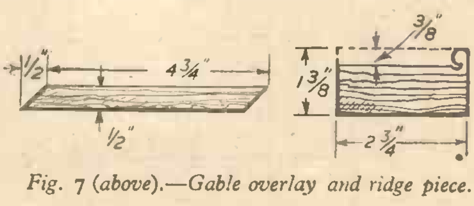


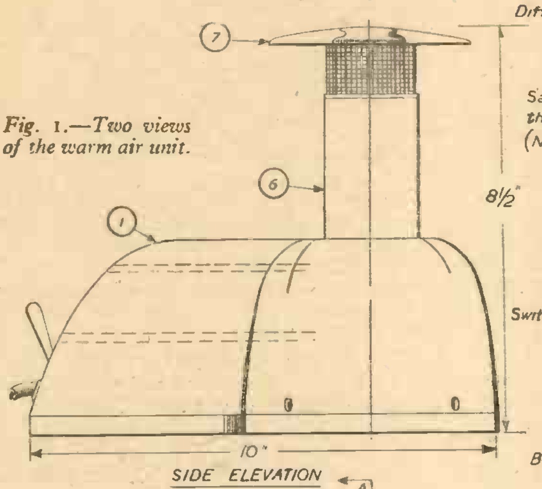
Fig. 7 (above).—Gable overlay and ridge piece.

Fig. 6 (left).—Details of the platform on which the two figures stand.

An Electric Clothes Drier

A Folding Appliance Which is Used in Conjunction With a Vacuum Cleaner

By R. DAVIDS



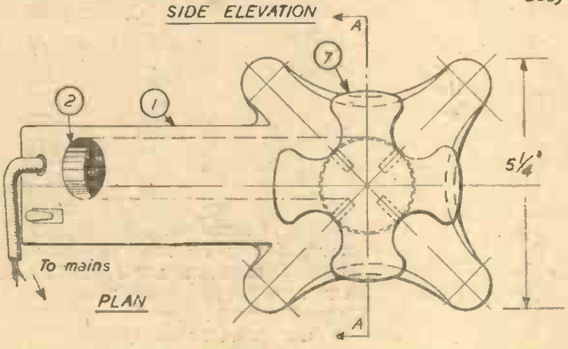


Fig. 1.—Two views of the warm air unit.

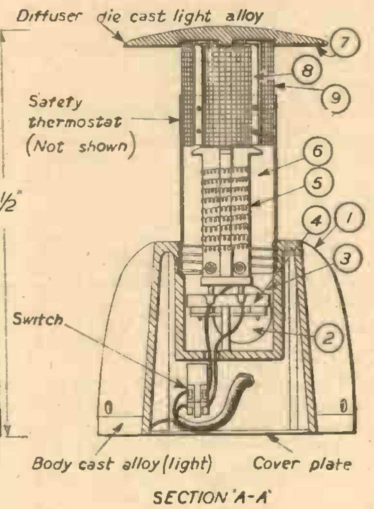


Fig. 2 (Above).—Section of the warm air unit showing the heater element.

Fig. 4 (Below).—The complete assembly in the open and folded positions.

THIS device consists of an assembly which enables a relatively large quantity of personal or household laundry to be dried quickly in a restricted space by means of warm air circulation. The device contains a built-in electrical element and means for adapting the normal household vacuum cleaner to provide the air current. When not in use it can be folded and stored in the corner of a cupboard, occupying a floor space of ten inches by eight inches, and a height of 4ft. 4in.

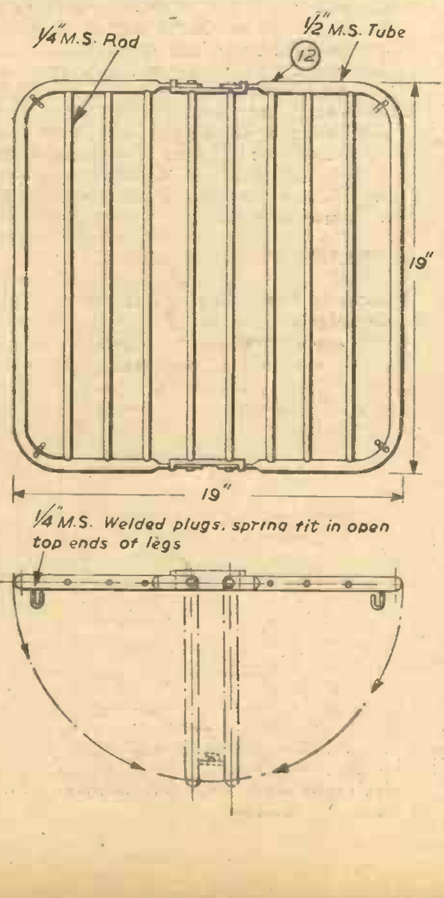


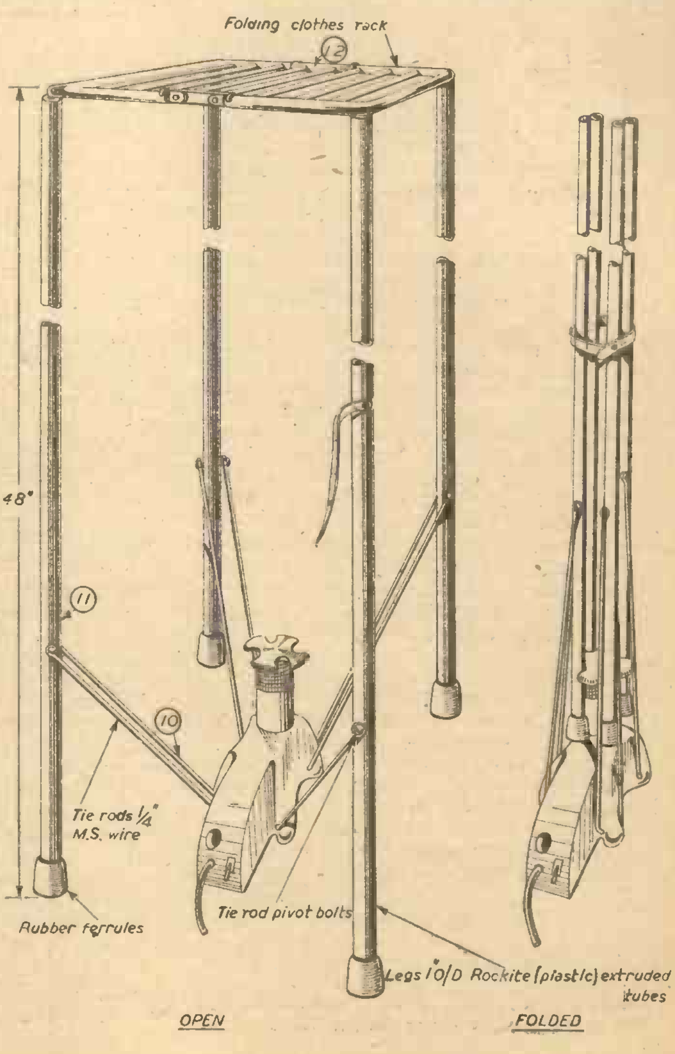
Fig. 3 (Left).—Plan and side elevation of the clothes rack.

Heating Element

The principal unit comprises a light alloy casting (1) in which is provided a tubular orifice (2) of a diameter and internal taper suitable for the introduction and retention by friction, of the nozzle of a vacuum cleaner hose (Fig. 1). This tubular aperture communicates directly with a hollow circular chamber (3) in which is housed a small, narrow plastic 2-pin electric socket (4) into which is fitted vertically an electrical heating element (5) loaded at 500 watts, similar to those used in portable hairdriers. The aperture is positioned tangentially to the circular heating chamber (3) in order to ensure complete encirclement of the heating element by the airstream delivered by the vacuum cleaner. The heating element standing substantially proud of the base member, is enclosed in a short length of 2in. diameter light gauge steel tube (6) which is designed to screw into the base casting by means of a swaged thread corresponding to a female threaded annular space at the top of the chamber (3) (Fig. 2). A length of three-core flex for connection to a wall socket, is connected to the heating element in series with a switch housed in the body.

Operation

In use, the vacuum cleaner nozzle is pushed into the appropriate aperture and switched on, the heating unit is then plugged into the mains and switched on, whereupon a current of warmed air is propelled upwards through the vertical tube, whence it impinges upon a flat diffusing surface (7) fixed at a height of one inch above the upper open end of the tube and at right angles thereto, the effect of which is to deflect the vertical airstream and spread it over a relatively wide horizontal area. This diffuser is held fixedly



in relation to the tube by means of four mild steel brackets (8) assembled to both members with self-tapping screws. In order to prevent accidental bodily contact with the live element, a woven wire screen (9) is introduced in the gap between tube and diffuser. A small bi-metal thermostat prevents the element burning out if the latter is switched on without the airstream.

Clothes Rack

The base member is designed with four cardinally opposed wings, in the base of each of which, and on either side, are provided holes for the retention of four pairs of mild steel tie-rods (10) secured pivotally at their opposite extremities to four 4ft. lengths of extruded rigid plastic tube (11) of one inch outside diameter, the upper ends of which are left open and the lower ends provided with rubber ferrules. In assembling the tie-rods, drill a ⅜in. hole through each leg 12in. from the floor ends. Thread one tie-rod loop on the bolt, and insert the bolt through holes in the leg. Thread on the second tie-rod, and hammer a drive screw in the open end of the bolt, after placing a washer under the head (Fig. 5). A rack (12) composed of eight 18in. lengths of ¼in. mild steel rod enclosed in a frame member of

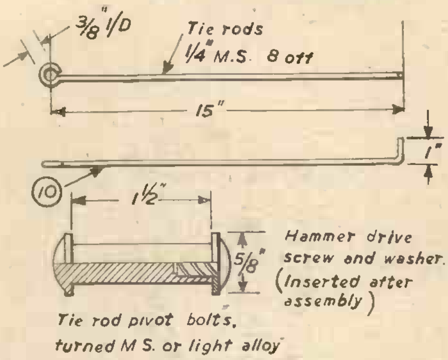


Fig. 5.—Details of the tie rods and pivot bolts.

½in. mild steel tube (Fig. 3) is fitted to the top of the plastic tubes by means of wire hooks, which are welded to the four corners of the rack and which are pressed into the open ends of each tube where they engage firmly by slight spring friction. A rigid upright assembly is thus obtained four feet in height by 19in. square with the hot air dispenser centrally located at floor level.

Folding for Storage

When not in use, the rack is removed and folded in half, the four plastic legs, pivoting upon the tie rods are lifted and grouped closely around the tube (6) fitting into recesses provided in the diffuser (7) and held together by a strap attached to one of the legs, the rubber shod feet then resting upon the upper surface of the base member (Fig. 4).

Steel parts can be either heavily chromed (if available) or galvanised and sprayed with white refrigerator-type stoving enamel.

Club Reports

Barry Miniature Railway Club

THIS Club has recently taken part in two exhibitions, one at Cardiff and one at Barry. The former was held in association with our friends, The Cardiff Model Railway Guild, and in conjunction with the Welsh Ideal Home Exhibition, when over 9,000 people attended.

Our two clubs were honoured by the presence of Mr. J. N. Maskelyne, who officially opened the Exhibition.

The club's "0" gauge layout was in full operation with its automatically changing colour light signals, and complete remote control. The Live Steam section and the "00" section were very well represented by both working and static models.

Anyone interested in joining the club should write for full details to the Hon. Secretary, G. J. WATKINS, 6, Lowdon Terrace, Barry.

Ilford and West Essex Model Railway Club

OWING to the illness of our Press Secretary, no mention of our activities has been published for some months. But we have, in fact, been particularly active. We missed the opportunity of seeing many friends, when, through lack of available space, we were unable to show our layout at the recent Model Engineer Exhibition. Considerable activity is in evidence at the club room, where renovations and alterations are taking place, layouts are being built and an old one redesigned and extended. We have been favoured with talks from old friends, including Messrs. Maskelyne, Skelton and Geo. Dow. New members, Seniors and Juniors, are always welcome.

Future Fixtures: March 4th—Annual Competition; March 6th—Annual Club Dinner at The Cauliflower Hotel; March 18th—T. S. Lascelles, Esq.

Hon. Secretary, R. L. RIDDLE, 36, Vernon Road, Seven Kings, Essex.

Ramsgate and District Model Club

THE Annual Film Social was again the most successful event of the social activities of the club. Members with their wives and friends attained a maximum attendance. During the first hour a running buffet was excellently served, and for the following two hours five films which were both instructive and entertaining to young and old were shown.

Programmes during February included Models Under Construction, A Lantern Lecture on Old Ramsgate by Mr. T. White and a talk on Paint Spraying.

During March a talk on his work as an Engine Driver will be given by Mr. Payne, and is eagerly awaited.

Badges with the club's Insignia, Hand and Wheel, will shortly be available to members, and an At Home Week will be held at the Club's Headquarters, Princes Street, Ramsgate, during September (date to be fixed). Visitors will be assured of a hearty welcome. Hon. Secretary, E. CHURCH, 14, St. Mildred's Avenue, Ramsgate.

Harrow and Wembley Society of Model Engineers

AT the A.G.M. of the above Society, held on January 13th, the following members were elected to hold office for 1953: Chairman, Mr. F. Sedcole; Secretary, Mr. K. D. Carter; Assistant Secretary, Mr. F. A. Cottam; Treasurer, Mr. S. A. Walter; Librarian, Mr. S. L. Brown; P.R.O., Mr. W. A. Harvey. Section Leaders: Mr. C. R. Jeffries (Loco.); Mr. T. H. Clarke (Marine); Mr. E. R. Uphill (General).

In addition, a track committee was formed to work with the loco. section leader. The members being, Mr. F. A. Cottam, Mr. A. E. Tyler, and Mr. J. Richardson.

Hon. Secretary, K. D. CARTER, 21, Stanley Road, Northwood, Middlesex.

Port Talbot, Neath and District Society of Model Engineers

IT has been decided to hold an Exhibition at the Town Hall, Neath, from August 31st to September 5th, 1953. An enthusiastic committee has been formed and given the full co-operation of all the members, the venture should prove a great success. The workshop is now in full swing, a new B.O.C. welding outfit was recently installed there, and it has proved its worth already. Work has progressed during the winter on the curves for the permanent track, and it is our intention of getting at least part of it erected in the spring. We have had several Film Shows recently through the kindness of a new member in the person of Mr. D. H. Jennings. These have proved very interesting and instructive. The membership is growing and any "lone hands" in the area desirous of joining should get in touch with the Secretary, D. ELWYN EVANS, "Bronelwyn," 6, Beechwood Avenue, Neath, Glam. (Telephone 726.)

Hitchin and District Model Engineering Club

THE A.G.M. was held at the Club Headquarters on January 22nd with a good attendance of members.

Mr. H. Wright, chairman, thought that the club had great opportunities and, with the acquisition of such suitable premises for headquarters, should be able to carry out its activities with even more enthusiasm than hitherto.

Thanks were expressed for the work accomplished by the previous chairman, Mr. R. Morgan.

Mr. E. Keith, secretary, reminded members of the work done during 1952, and of the enjoyable educational lectures, visits to other societies and work put in on the new headquarters, etc. The programme for the new year includes further lectures, work on the premises and on the passenger-carrying track, and "0" gauge system under construction. A new "00" gauge railway is to be commenced under the supervision of Mr. P. Downs.

The highlight of the year will be the Club's Exhibition at the Town Hall in October.

The officers in charge last year were re-elected en bloc: Mr. H. Wright, chairman; E. Keith, secretary; F. Granger, treasurer; O. Wilman, E. Peters, M. Frost, C. Thompson. Mr. A. Jenkins was appointed Clerk of Works. Secretary, MR. E. KEITH, 25, Heathfield Road, Hitchin, Herts.

Aylesbury and District Society of Model Engineers

THE Annual General Meeting was held on the 21st of January and many of the old faces will be back in office, with Mr. R. Eborn still in the presidential chair. Members and friends will be pleased to know that Mr. H. East has been appointed a Vice President, a small tribute for his unfailing service. His fellow Vice Presidents are Mr. Forest and Mr. Cleaver.

In his absence Mr. Forest was re-elected as Chairman, while Mr. Hasberry continues as Vice Chairman. Mr. Smith will again take up the secretary's pen, while keeping his other hand on the treasury box. No new faces are to be seen among the members elected to committee, their names being Mr. Darton, Mr. Gill, Mr. Gower and Mr. Horwood. It is hoped that with their experience the club will this year be steered to new successes. Hon. Sec., E. H. SMITH, Mulberry Tree Cottage, Devonshire Avenue, Amersham, Bucks.

AN ALL-PURPOSE CAMERA STAND

A Useful Appliance Contrived With Tubing and "Kee Klamps"

By H. V. TIPPER

THE usual amateur tripod is a rather flimsy affair in which variation of height is obtained by extending or telescoping one or more sections; or, to a lesser degree, by varying the spread of the legs. This latter is often a precarious business, especially on a polished floor, while the former usually offers but three or four variations.

The professional job, built with a central upright which can be racked up or down, gives any height within its range, to fine limits. It is normally heavy and its cost probably places it outside the purchasing power of most amateurs.

Neither of these, however expensive, will give you every possible position in which a camera may be needed; and to fulfil this rather ambitious project was my aim in making up the camera stand illustrated.

Tubular Construction

The tubular construction used is by The Geo. H. Gascoigne Co., Ltd., of Reading. It is designed for easy assembly and can be erected or dismantled in a matter of minutes. Tubing of various lengths or of various diameters is held firmly by means of jointed Kee Klamps, by means of grub screws through each arm of the klamp.

As the tubing can be cut to any length, and many different types of Kee Klamps are available, it follows that there is, literally, no end to the possible arrangements that can be made.

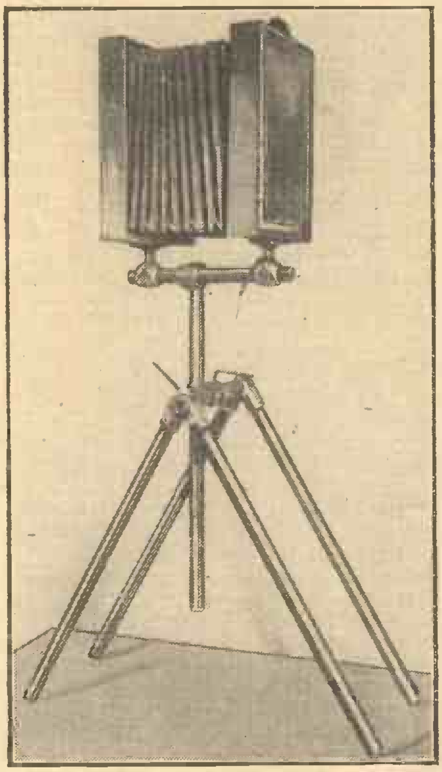
The system is a tubular "construction kit" on an industrial scale, and, in the larger diameter tubing, is used extensively or handrails on buildings.

To make up the camera stand tubing was obtained to the following lengths:—

Five lengths of 2ft.
Three lengths of 1ft.
One length of 3ft.

The total number of Kee Klamps used in the various positions depicted, is eight, and the cost of the whole assembly—in ¾in. tubing to take the heavy 10 x 8 camera—was approximately 45s.

Four 2ft. lengths and one 1ft. length make up the base stand on which everything else operates. The joints are two 60 deg. socket tees placed at either end of the short length.



Position for straight portraiture. Tubing: five at 2ft.; two at 1ft. Klamps: six.

This gives a four-footed erection instead of the more normal tripod, but making it stable on an uneven surface presents no difficulties. The stand is placed where required, one klamp is loosened, the stand is pressed firmly down and the klamp tightened again.

On the top bar it fitted a "cross-over" klamp. This takes the vertical bar, and allows it a movement of some 220 deg. from floor to floor. On this "horizontal" bar again, is fitted, by means of a single tee socket, a further bar which takes the camera, or anything else required. The various illustrations show different arrangements using the same limited assortment of bars and klamps.

Since the klamps hold in a vice-like grip even a heavy camera can be held firmly at an apparently crazy angle. Where there is any doubt, it is an easy matter to arrange a counterbalance with some of the unused pieces.

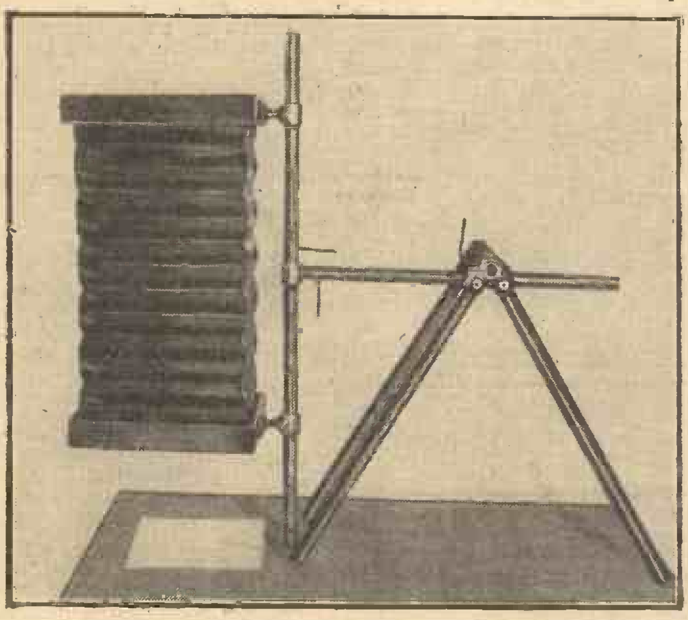
Various Uses

Using the heavy stand and lighter tubing for extension pieces, even more elaborate boom arrangements can be made to allow cameras, lighting equipment, screens, background cloths, etc., to be swung over the object to be photographed. Such an arrangement is essential when a plan view is required of a section of a large railway or industrial model where it is impossible to plant the legs amongst the scenery.

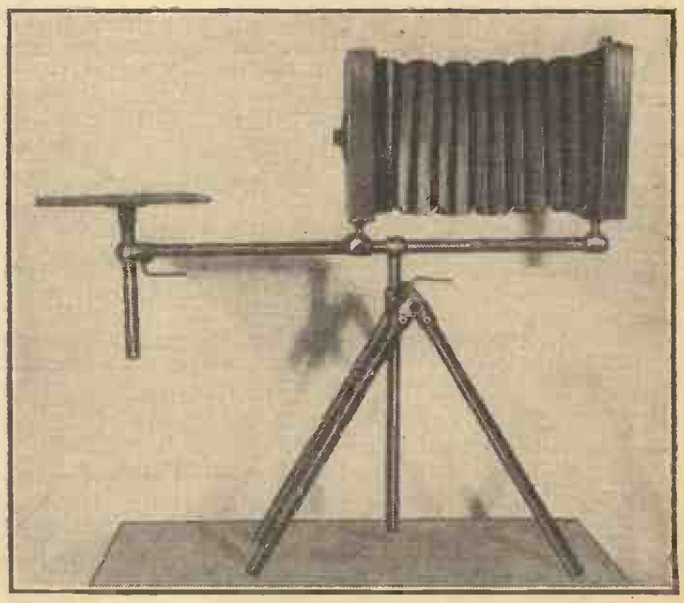
As the tubing can be obtained in sizes from ⅜in. to 2in., it will be seen that the stand represents only a fraction of the possible uses of this equipment, and the reader will, no doubt, see many further combinations applicable to his particular needs.

The 10 x 8 camera illustrated, which has a 24in. extension, is a very old, wooden affair which lay derelict for many years, until rescued and fitted up in the latest "mono-rail" fashion. It is fitted with an equally ancient 6in. lens, and the four times focal length extension enables close-ups of three or four inches to be taken. At this range, the slightest movement of camera or subject is fatal, but the stand handles such jobs admirably.

When "off duty" as a camera stand, it does faithful service as a print drier, or even household jobs such as airing and drying clothes.



Arrangement for vertical close-ups. Note that the 3ft. length rests on floor (or bench) giving complete rigidity. Tubing: five at 2ft.; one at 1ft.; one at 3ft. Klamps: six.



Arrangement for copying or for small models, complete with stand for the subject. Tubing: five at 2ft.; two at 1ft.; one at 3ft. Klamps: eight.

Making Kaleidoscopes

Constructional Details of Three Easily-made Instruments

By E. W. TWINING

THE Oxford dictionary gives the derivation of the name of the Kaleidoscope as: GK *Kalos*: beautiful + eidos: form + scope (to see, to watch, or to observe). So this instrument is one in which is it possible to observe beautiful forms and, it may be added, the changes of pattern and the colours in them.

Just who invented the kaleidoscope and when it was first made I do not know, but it is well over a hundred years old.

Recently I have been trying out two new ideas for kaleidoscopes, but I will first describe the making of the old-fashioned instrument which, considering the small amount of labour, and the trifling sum of money involved, is well worth making.

Constructional Details

The first thing to do is to obtain a piece of fairly stout cardboard tube of from ten to twelve inches long; it must not be less than ten because that is the shortest normal focus of the human eye. The diameter can be from 1½in. to 2¼in.; if it is as small as 1½in. make the length 10in., but if it approaches the larger measurement let the length be 12 or 13in. Having got the tube take a careful dimension of its inside diameter and, on a piece of paper on the drawing board, using a compass, draw a circle equal in diameter to that of the tube. In this circle inscribe an equilateral triangle having its points touching the circumference, as at the left-hand end of Fig. 1. This illustration shows a complete longitudinal section of the kaleidoscope with, on the extreme right, a cross-section. The triangle on the left represents the angles made by three long strips of looking-glass or mirror. It must not be thick plate glass; the thinner it is the better, and the three lines of the triangle, which the reader has drawn, will be the backs, or silvered sides of the mirror strips.

The lengths of the lines will give the exact widths to which the strips are to be cut by the glazier at the glass store.

In the cross-section, Fig. 1, the mirrors are marked M, M, M, and this drawing shows that the edges of each glass are bevelled on the face, so that the three will mitre together. This bevelling the reader can doubtless get done for him where he obtains the mirrors but, if he cannot, he can do it himself on a strip of emery, or carborundum cloth, glued down on a board, by rubbing the glass longitudinally on the cloth, holding it at an angle of 30 degrees and using turpentine as a lubricant.

Although mitring is the best way of fitting the glasses, there are two other methods which I have shown at A and B in Fig. 1; of these only the method shown at A is worth considering, but it will be obvious that in neither do the reflecting surfaces come into contact and that consequently there will be dark lines radiating from the centre, in which there will be no reflection; moreover, with B there is every possibility that the triangle formed will be slightly out of truth and have reflecting sides which are not exactly equal. This would not matter so very much perhaps with the simple kaleidoscope, but it would with the second of the two schemes I shall presently describe. If the glasses are bevelled the faces of the bevels should be polished as well.

At A and B I have shown the mirrors secured in the tube by thin strips of cardboard bent to form angles and stuck, with strong adhesive, to both mirror and tube, but the best fixing is by trianguar strips of wood: WS in Fig. 1, six being required, as shown in the complete cross-section.

Chromium Plated Metal Reflectors

Before going further I want to suggest an alternative to the use of glass for mirrors. Provided the plates can be cut, trued up and polished dead flat, it would be a great advantage to use sheet brass and have the three reflecting surfaces brilliantly chromium plated. There would then be no need to bevel the edges and they could be mounted as at A in Fig. 1, because there would be no thickness of glass between the reflecting surfaces and thus there would be no dark line or band of non-reflection. Obviously the success of this idea would depend upon the way the brass plates are prepared; they would have to be stuck to a flat surface of a piece of wood, rubbed down on a sheet of finest emery cloth, also glued to a flat board and finally polished on another cloth-covered flat surface with metal polish. After plating and receiving a brilliant finish it would be possible to tack them together with solder, as at C in Fig. 1, using a little strap at each end of each angle of very thin brass or copper. The whole assembly would then be passed into the tube as one unit.

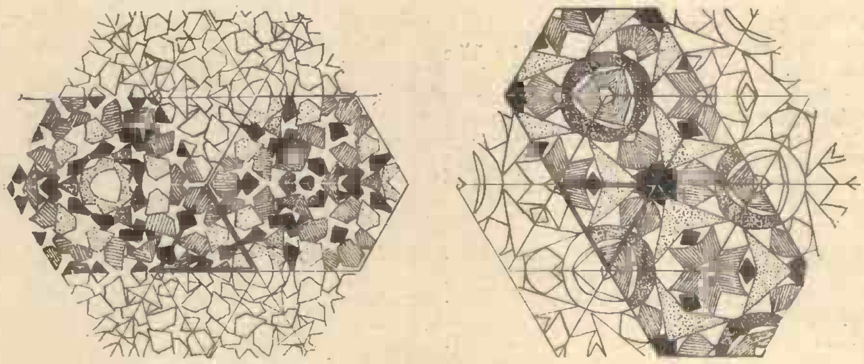


Fig. 2.—Two basic triangles and their repetitions.

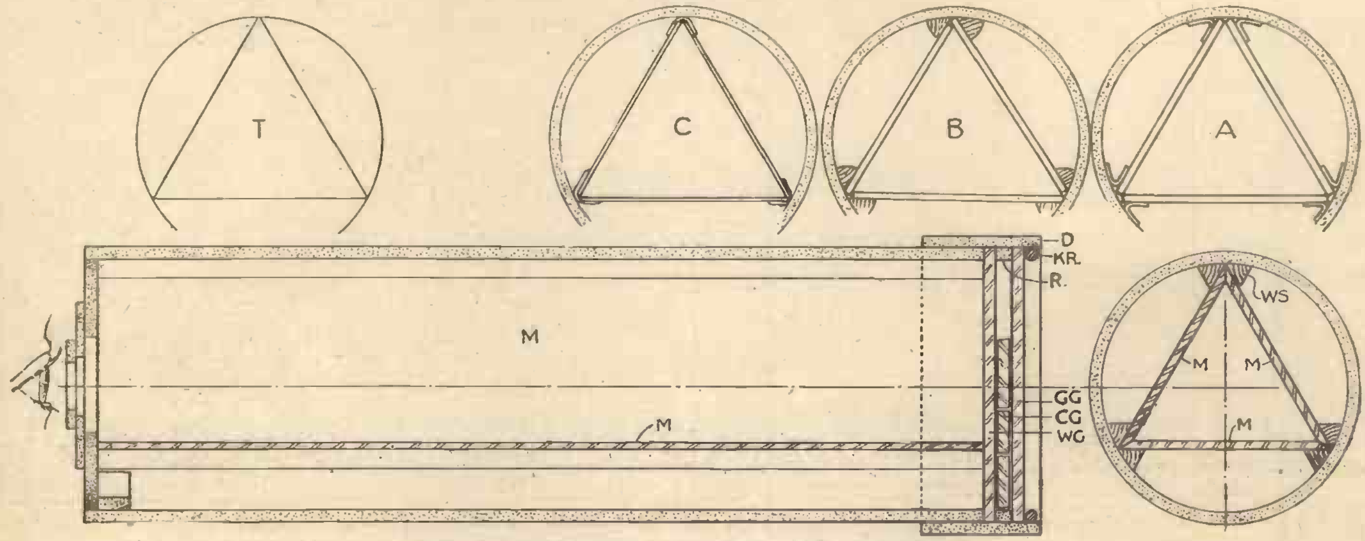


Fig. 1.—A kaleidoscope: longitudinal and cross-sections.

The reflectors will be held longitudinally, at the eye end, by a disc of thick card having additional circles added to it, all with holes in their centres, so as to form a spy hole. At the other end the mirrors will be flush with the end of the tube and abut against a disc of plain white glass, WG, having the same diameter as the outside of the tube. Before this disc is put on a cell must be formed by a band of cardboard, D, which can be made by gluing a long strip of cartridge paper, bound around the end of the tube, to make up a thickness equal to that of the tube. The depth of the cell so formed should be about half an inch. Then insert the disc of clear glass and secure it with a ring of card, R. The width of this ring is rather important, for it depends upon the greatest thickness of the coloured glass fragments which are to be used. In the old days the bits were always a gaudy blue, a ruby and a yellow, all of the same thickness, about 3/32in. Nowadays it is possible to procure hundreds of shades of very beautiful and delicate colours and in order to obtain them I suggest that the reader goes to, or writes to, a firm of stained glass artists, asking for an assortment of scrap bits—cullet, as it is called, stating what they are required for. The point is that modern glasses vary in thickness considerably, and for use in the kaleidoscope there must be no very great differences, so it will be best to obtain the coloured fragments at this point and let the width of the ring R be slightly greater than the thickest glass which is to be used; for all the coloured pieces must be quite free to slide about. At the same time it would be well to see that no two of them are sufficiently thin to overlap and wedge each other, so that they will not move. When received the pieces of glass will probably have to be broken up into smaller bits, for no fragment should measure more than half an inch across except perhaps one slender bit which could be about ⅝in. long. They can be of any size smaller and should differ in both size and shape. CG in Fig. 1 are the coloured glasses.

Next to ring R another disc of glass, GG, is inserted, and this should be of ground glass, i.e., matt surfaced on one side. To hold this in place I think it would be a great advantage to use a keeper ring, KR, which can be made by bending a length of stout brass wire; make it so that it will spring into position. By this means it will be possible to change the coloured glasses and try out fresh colour schemes.

Covering and Finishing

The outside of all the cardboard can either be covered with leather-grained paper or it can be given first a coat of shellac varnish and then black lacquered; or it can be painted with gloss enamel in any colour.

The reader who has never seen a kaleidoscope will want to know, before he makes one, what sort of effects he may expect to see. In Fig. 2 I have indicated the different tints by means of various shadings. From each of the two sketches it will be seen that the patterns resolve themselves into a series of overlapping hexagons of three different patterns, which, by repeated reflection in the mirrors, gradually fade away into darkness. Only three complete hexagons in each case have been drawn, all of which contain the primary image. These three hexagons are outlined in black and the primary image by a heavier line.

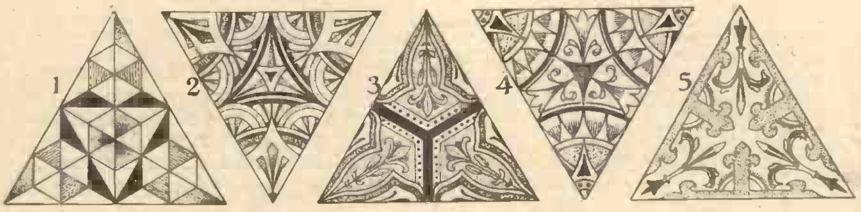


Fig. 4.—Drawn patterns for viewing.

Of course the reader will understand that changes in the pattern result from slowly rotating the instrument and watching the beautiful effects yielded. In my sketches that on the left shows patterns produced by thirteen bits of coloured glass, which vary little in size, while the right hand shows only seven pieces of glass of larger and more varied size.

New Type of Kaleidoscope

Now I come to the new types of kaleidoscope which I have been working out. The first of these is illustrated in Fig. 3 which shows a kaleidoscope with a barrel, not circular, as before, but of triangular cross-section, made of three strips of thin wood in which the mirrors make a close fit. Then, instead of one set of coloured glasses, and the observer having to rotate the whole instrument, there is a rotatable pair of glass discs, drilled at their centres for a pivot, the space between them being divided radially and equally into five or six compartments to contain coloured glass fragments. In the drawing I have shown six divisions. The object of providing separate compartments is to enable one to have differing colour schemes in each; for instance, suppose there are fourteen pieces of colour in one compartment, twelve of them could be all yellows, of depths varying from palest lemon to deep amber and the remaining two a deep and a pale green. The next compartment could be nearly all greens of different kinds with a deep blue and a violet; next, all blues relieved with, say, one blue-green and a tiny bit of either yellow or ruby. Purples and violets, mixed, might have one bit of green and a deep pink. The next compartment, all pinks, might have one green and a ruby or blue. Lastly, there are the ruby pieces which should be relieved only with blue or violet or perhaps a green. If yellow were introduced there should be no purple, violet or blue. The whole object in choosing each bit of glass should be to make the six colour schemes tasteful, and all different and distinctive.

The drawings in Fig. 3 will be found self-explanatory so I will just call attention to one or two points which may not be quite obvious. There are three small staples, cut from tinplate, which keep the mirrors from sliding forward and touching the glass discs; one of these staples is shown in the small sketch between the longitudinal and cross sections. The circular glass discs, each having a ⅜in. hole in its centre, are both fixed with a strong adhesive, on a turned, hardwood hub and this is fixed by driving on to a stout brass-wire shaft, or, alternatively, it can run loose on a fixed shaft. The outer disc is put on after the six partition strips have been stuck to the first glass.

As each compartment is fitted with the coloured fragments it is closed by a narrow piece of thin card or stout paper, glued to the edges of the discs, reaching from one partition strip to the next, and covered with a band of gum-strip or passe-partout paper. Let each compartment be closed separately, in case it becomes desirable to change any one colour scheme.

Such a kaleidoscope would be liable to become damaged if it were allowed to be knocked about in a lying down position and I suggest that it should be mounted on a stand, after the manner shown in the small elevation at the top left hand of Fig. 3. By placing it on a table near a window, with a hand mirror, of any suitable kind, for reflecting the light, the observer would be able to look down into the instrument with comfort, as one does in using a microscope.

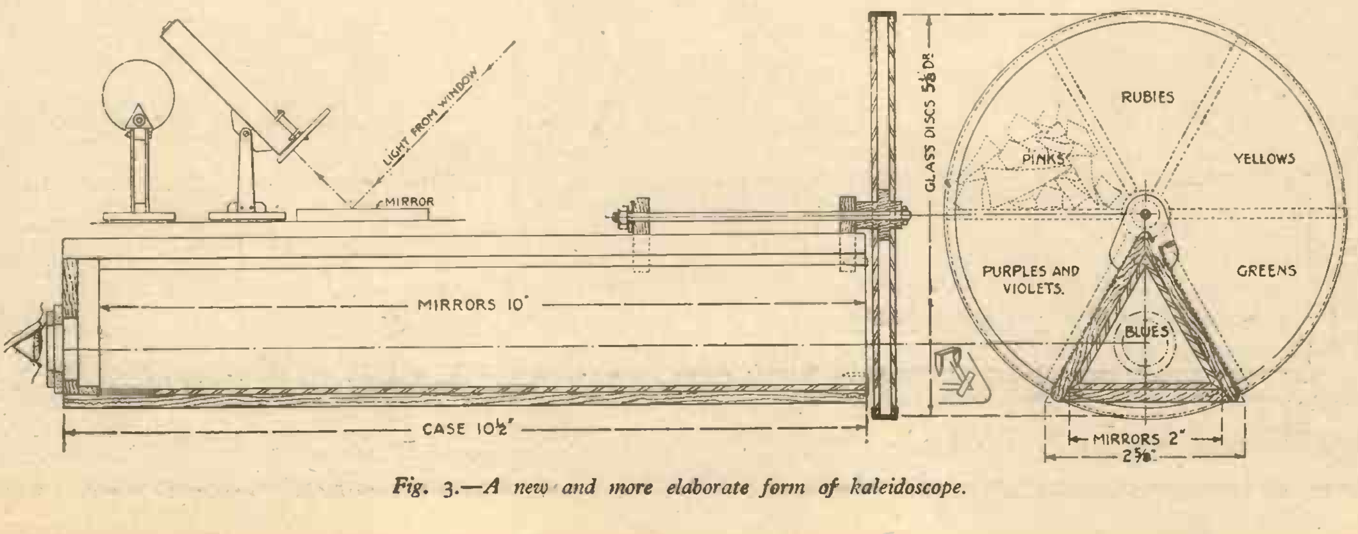


Fig. 3.—A new and more elaborate form of kaleidoscope.

Open-ended Instrument

The other suggestion is for a kaleidoscope with an end, opposite to that of the spyhole, which is left open, with no moveable coloured glasses; or, if not open, merely closed with a single piece of clear white glass. With such an instrument hand-drawn and hand-coloured patterns and their repetition by reflection are observed. In Fig. 4 I show five designs, of which none is really complete until subjected to triple reflection. Numbers 1 and 3 will produce hexagonal patterns: numbers 2 and 4 a repetition of circles, arranged diagonally, while No. 5 will give in triangular form the fleur-de-lis and the heraldic cross flory. The designer of repeating patterns for carpets, linoleum and all kinds of woven and printed fabrics, wall papers, ceiling papers, etc., would find such basic designs used with a kaleidoscope extremely useful for judging both patterns and colour schemes. The contemplated motif is first sketched, traced with draughtmen's Indian ink on either tracing paper, Cellophane tissue or ground glass, tinted with either water colours or transparent oil colours and held up to the open end of the instrument.

In fabrics, as well as in other things, patterns often repeat in squares and I suggest that for designing these a reflector should be made, in the manner shown in Fig. 3, that is to say, of wood, in the form of a long box but perfectly square in cross-section and with four mirrors instead of three.

If the reader is interested in the kaleidoscope only for amusement, and for entertaining his friends, he may very well make the instrument shown in Fig. 3, and draw the patterns in Fig. 4 on a single disc of ground glass, by tracing or copying from the reproduction of the drawing and adding another one of his own. For colouring, oil paints are best, the pigment being thinned and drying properties accelerated with Japan gold-size. But only artists' tubes of transparent colours should be used. For blues: Prussian Blue, Ultramarine. Greens: Alizarin Green, Viridian. Yellows: Aureolin, Indian Yellow, Raw Sienna. Reds: Alizarin Crimson, Scarlet Lake. Any mixtures of these are, of course, permissible.

In conclusion I would point out that the sides of the patterns, which are drawn for viewing, must be of exactly the same widths as the reflecting surfaces of the mirrors.

A Vegetable Slicing Machine

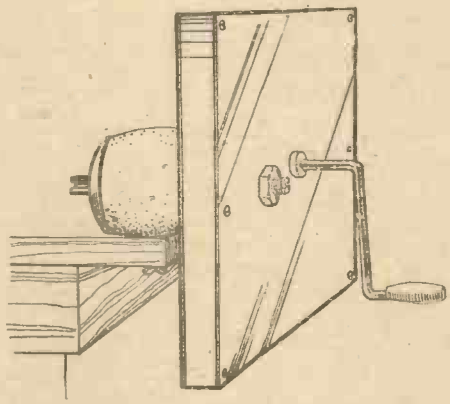
Constructional Details of a Useful Appliance for the Kitchen

By J. MORRISON

THE purpose of the machine to be described is to cut vegetables, such as apples or potatoes, into slices. The machine can be pre-set to cut slices of any thickness from ⅛in. to about ⅜in. thick, and once set all the slices will be exactly the same thickness.

Construction is fairly simple and most of the parts can be made from sheet and strip metal. The simplest form of construction is shown in the accompanying diagrams, but modifications can be made to suit individual requirements. For instance, the appearance of the machine can be improved by making the casing circular instead of square.

The size of the machine is unimportant, provided it is large enough to deal with the largest vegetables it will be called on to cut. A convenient size is to make the casing about 9in. square, with the vegetable aperture about 3in. in diameter.



Perspective view of the completed slicing machine.

Casing

The casing (A) can be made from aluminium or stainless steel, and should be put together with screws for ease in dismantling for cleaning purposes.

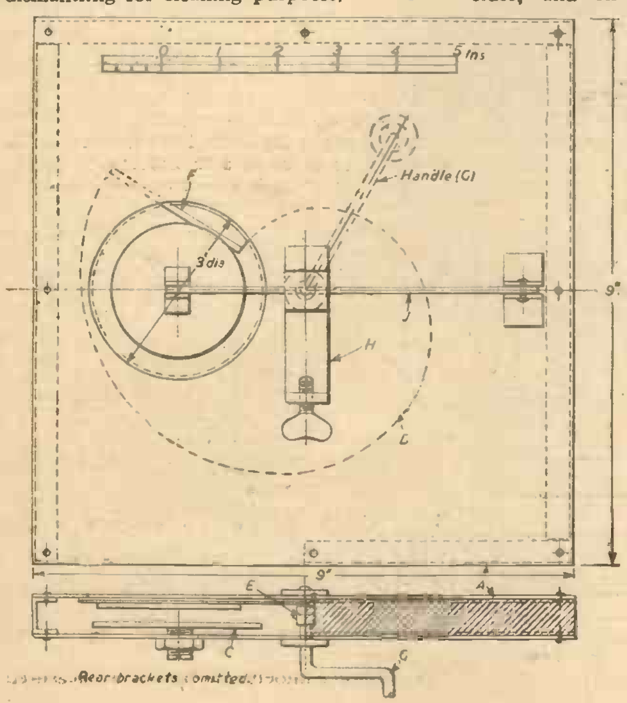
Two thicker pieces of metal are brazed or riveted to the centre of each side of the case to act as bearings for the cutter spindle. An opening (B) is cut out of one of the sides, and on the other side facing the opening a large nut is fastened to take the adjusting screw for the plate (C), which pre-sets the thickness of the vegetable slices. This plate is circular and has a bolt with the head sawn off fixed in the centre.

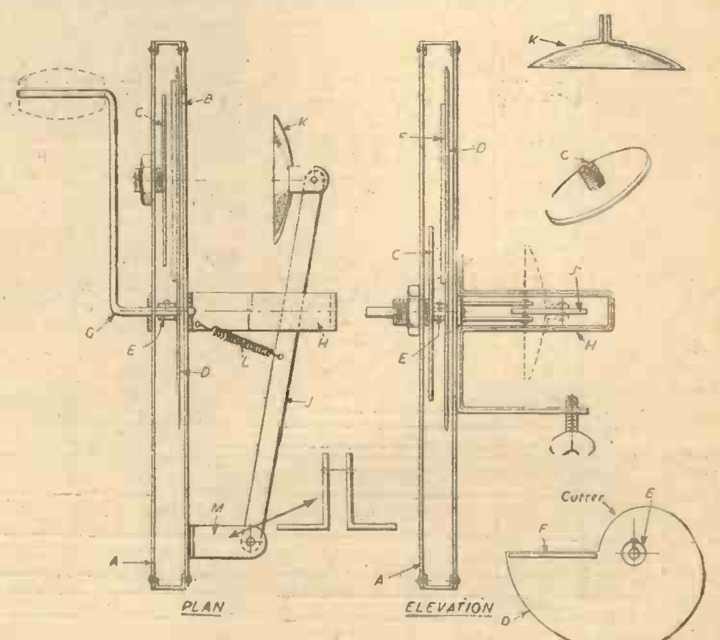
Cutting Blade

The blade (D) is cut to the shape shown from a piece of thin steel and is sharpened on the curved edge. It is brazed to a bush (E) which has a grub screw for holding it on to the spindle (G). A thin strip of metal (F) is also brazed to the flat edge of the blade for the purpose of pushing the vegetable slices downwards once they are cut, thus allowing them to fall into a basin placed below the machine.

Fixing Clamp

The bracket (H), made of strong strip metal, is bent to form a clamp for fixing the machine to a table, and also to act as a guide for the arm (J) which presses the vegetable on to the cutter by means of the cup-shaped disc (K) and spring (L). One end of arm (J) is pivoted in a bracket (M) formed with two angle pieces.





(Left) Rear elevation and underside view. (Right) Sectional plan and elevation, with details of cutter and cup-shaped disc.

Making Garden Ornaments

A Novel Method Utilising Celluloid Moulds

By "HANDYMAN"

"STONE" miniatures of gnomes, rabbits and the like are very popular at the moment as garden decorations.

To make these out of actual stone would take a long time and a considerable amount of the sculptor's art, but here is a method by which they can be turned out quickly by anyone. Cement and sand are used, but the final impression is that stone of some sort is the basic material.

Celluloid Moulds

Images can, of course, be built up and fashioned direct from a plastic consistency cement using suitable modelling tools, but the quick method referred to, and which calls for no artistic skill, makes use of celluloid moulds—these being the big celluloid toys obtainable at most stores. They can be obtained in a fairly wide variety of frogs, gnomes, rabbits and similar things, but if you have a youngster about it might be possible to get what you want from the "discarded" cupboard. Do not promise to return anything taken, however, for the mould has to be destroyed in the making of the image.

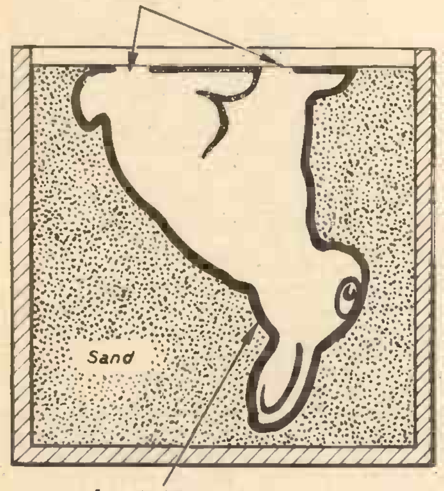


Fig. 1.—The method of fixing the mould ready for casting.

Suppose you have secured a rabbit and wish to make a "stone" replica, as the one shown in Fig. 2, proceed as follows: Turn the celluloid shape upside-down and cut two holes in the base as far apart as possible. Now take a box much bigger than the rabbit and put a layer of sand on the bottom. Place in the rabbit inverted and continue to fill up with sand till it is firmly held, but not losing any of its contours by side pressure. The set-up should now be as shown in Fig. 1.

Cement Mixture

The mould ready, the cement filling can be prepared. Make a good amount, and once you start getting it into the rabbit, work fairly rapidly. For this purpose Portland cement and sand mixed in equal proportions should be used. First work the dry ingredients well together and slowly add water till a thick cream-like consistency is obtained. The mixing must be done in some container like a bucket, and when just ready to start, stir in a dessertspoonful of ordinary household soda which helps to produce a fine-grain finish on the surface when the material hardens.

Introducing the cement into the mould is done through one of the holes in the base (now at the top). The other is for the escape of air, but through it is pushed a stick, and with this the cement mixture is worked up and pressed as it falls to the bottom. This is to prevent air bubbles forming and also ensures the mixture getting into all the corners and creases of the mould.

It is best to use a small tin for putting in the cement mixture, but do not be too long between successive tinfuls, and keep the stick going all the time. Continue thus till the rabbit is full, and then put everything on one side for 24 hours.

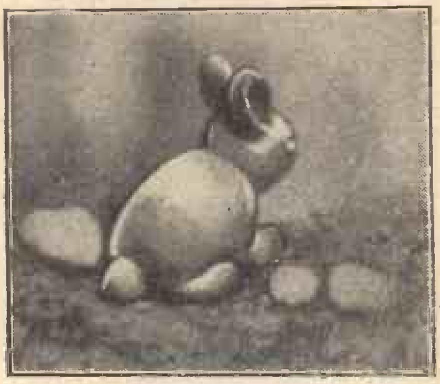


Fig. 2.—The completed garden ornament.

Removing Celluloid Casing

Now comes the removing of the celluloid casing. The simplest way to do this is to apply a match to one corner and burn it off. But it can be broken away piecemeal.

Should all have gone according to plan, a perfect reproduction of the toy will have been obtained. If air bubbles have formed there will be hollows in the surface, but these can be touched up with a little more of the mixture—this time quite stiff and more like a paste. Well moisten the hollow before applying the extra cement and when as much as possible has been pressed in, smooth off the top with the surrounding area.

The model is now completed, and it will be found to be quite effective. It is perhaps a pity that the celluloid toy has to be destroyed, but even so and at the full price of such articles, the stone image works out as an inexpensive job.

Back to First Principles

2.—Scrambling and Unscrambling

By W. J. WESTON

"EVERY body continues in its state of rest or of uniform motion in a straight line, except in so far as it is compelled by forces acting on it to change its state." There is Newton's first law of motion—or of inertia, if you like. Yes, and if more than one force acts upon the body each force produces its own effect; the *resultant* of the forces comes by a combination of the *component* forces. We may *combine* the forces and so find the resultant; we may *resolve* the resultant and so find its components.

The Problem

On a smooth surface inclined to the horizontal at an angle of 30 deg., a body weighing 10 lb. is kept at rest by the tension of a string. What force is acting parallel to the surface; what force is acting at right angles to the surface? (Fig. 1.)

The Comment

The intervention of the surface resolves the weight of the body into a pressure down the slope and a pressure against the surface. When the slope is steep most of the tension of the string is lost in pulling the body against the surface; the total tension increases quickly as the angle of the slope increases.

The Answer

The 10-lb. weight is resolved into two components; as in Fig. 2.

If $AB=10$, then $BC=5$.

For $\sin 30°=\frac{1}{2}$; and $BC=AB \times \sin 30°$.

Since $AB=10$ and $BC=5$, and ACB is a right-angle, then $AC=\sqrt{10^2-5^2}$

$$=\sqrt{75}=5\sqrt{3}.$$

The force acting parallel to the surface is $\therefore$ 5 lb.

The force acting at right-angles to the surface is $\therefore 5\sqrt{3}$ lb.

The Problem

The cyclist is riding due west; the wind blows from the south-east at a speed of $5\frac{1}{2}$ miles an hour; the bicycle carries a small flag. If the flag is blown due north, at what speed is the cyclist riding?

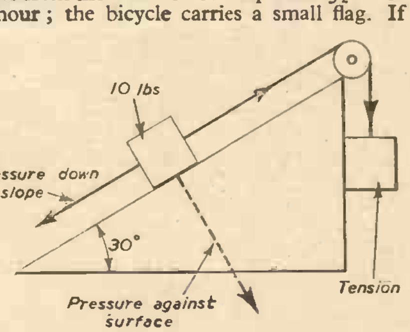


Fig 1.—A 10lb. body held by tension of string.

The Comment

The two forces impelling the flag to the north are:

1. A force impelling it eastwards, measured

by the reaction to the cyclist's motion westwards ;

2. A force impelling it north-westwards, measured by the action of the wind northwestwards as indicated in the diagram, Fig. 3.

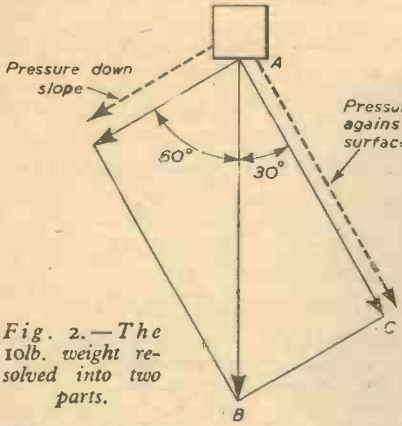


Fig. 2.—The 10lb. weight resolved into two parts.

The Answer

Let x = the number of miles per hour.

Then, since ∠ABC is half a right-angle and ∠BAC is a right-angle, the ∠ACB is also half a right-angle.

AB ∴ equals AC ; and $(BC)^2=(AC)^2+(AB)^2$.

That is $(BC)^2=2(AB)^2$

That is $(5\frac{1}{2})^2=2(AB)^2$ or $2x^2$

$$2x^2 \therefore =(5\tfrac{1}{2})^2=\frac{121}{4}$$

$$x \therefore =\frac{\sqrt{121}}{8}=\frac{11}{2\sqrt{2}}=\frac{5.5}{1.414}$$

= 3.889 miles an hour.

The Problem

A cage weighing 1,000 lb. is being lowered down a mine by a cable. What is the tension on the cable (1) when the speed is increasing at the rate of 5ft. per second per second, (2) when the speed is uniform, (3) when the speed is diminishing at the rate of 5ft. per second per second ? (Neglect the weight of the cable itself.)

The Comment

You are considering here two forces acting in the same straight line. The force of gravity pulls the cage down at an acceleration of 32.2 ft. per second per second ; the tension of the cable safely limits this acceleration. That tension is the greater as the cage accelerates upwards, the less as it accelerates downwards, constant when speed is uniform. For the second force—the inertia of the cage, its reluctance to change its state of rest or of motion, to obey either an upward pull or a downward thrust—acts in the first two events. The resultant, therefore, is a sum or a difference of the two forces.

The Answer

The force of gravity pulls the cage down with an acceleration of 32.2ft. per second per second.

The tension of the cable resists this pull, less 5, as speed increases at 5ft. per second per second, i.e., 27.2.

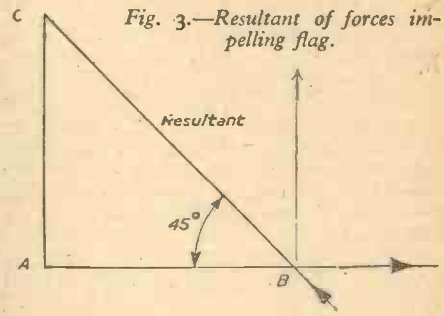


Fig. 3.—Resultant of forces impelling flag.

The tension of the cable resists this pull, plus 5, as speed diminishes at 5ft. per second per second, i.e., 37.2.

The tension of the cable resists this pull only when speed is uniform.

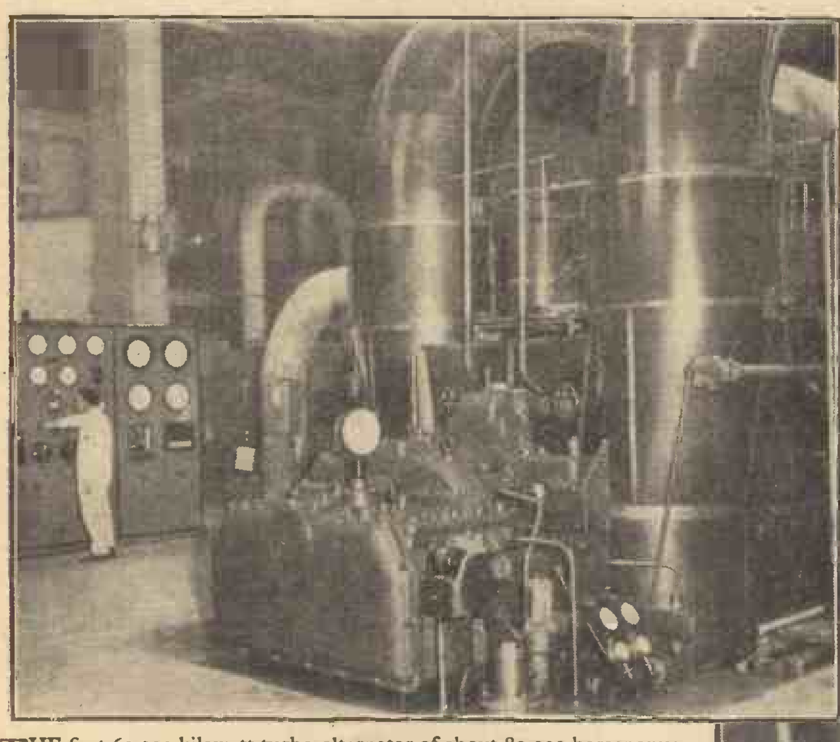
The tensions ∴ are :

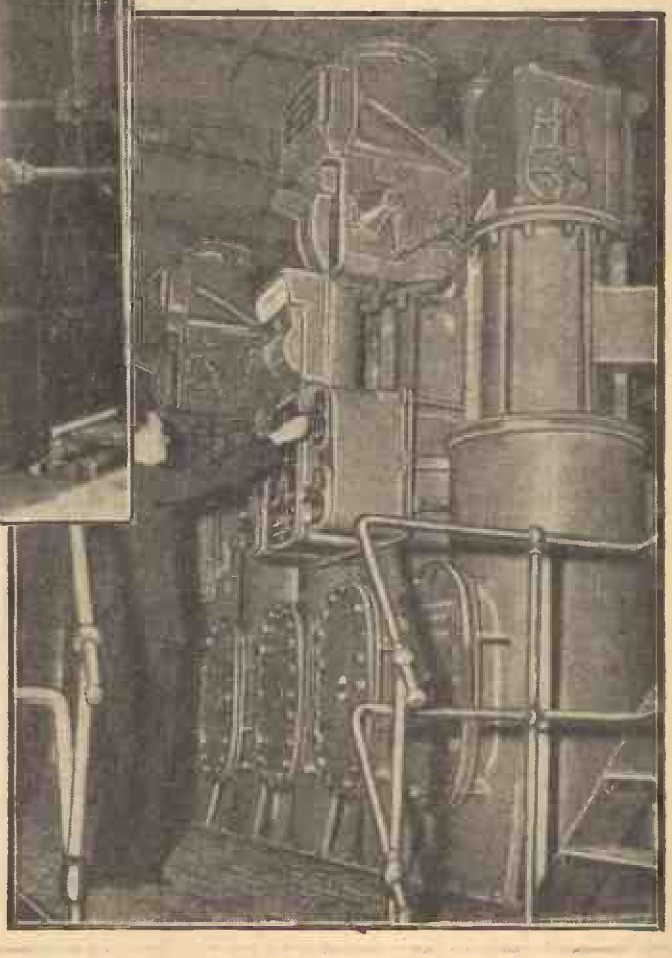
(1) $1{,}000 \text{ lb.}\times\frac{27.2}{32.2}=$ 844.7 lb.

(2) $1{,}000 \text{ lb.}\times\frac{37.2}{32.2}=$ 1,155.3 lb.

(3) = 1,000 lb.

Bankside Power Station





THE first 60,000 kilowatt turbo-alternator of about 80,000 horsepower, at the new Bankside Generating Station, London, S.E., has just begun to supply electricity. Few industrial projects have aroused such strong and widespread opposition as this station. There has been a generating station at Bankside, on the South Bank of the Thames opposite St. Paul's Cathedral, for some 55 years. This was due for rebuilding in 1939 when war came, and when, after the war, the project was revived vigorous protests came from the London County Council, the City Council and the Southwark Council, from the Dean and Chapter of St. Paul's and from other bodies. Despite these protests, however, the project was carried through. The new power station which, when completed, will comprise four 60,000 kilowatt generating sets, is a steel-framed structure faced with brick. The main building is 543ft. long by 240ft. wide and 90ft. high. The single chimney, designed as a tower, is 300ft. high. The new power station is oil fired and for this purpose a river jetty has been built to accommodate oil tankers and barges.

The photograph above shows the first turbine to go into action, with the control panel in the background and the photograph on the right shows one of the main 18-66,000 volt switches at the new power station.

The World of Models

A 9½in. Gauge Locomotive : Scale Model Cargo-passenger Vessel

By "MOTILUS"

AN amateur model engineer who sets out to build a 9½in. gauge model locomotive and tender by his own unaided efforts is indeed tackling a big venture: so I congratulate Mr. Robert H. Baxter, of Pietermaritzburg, Natal, who, some three and a half years ago, commenced just such a task and by the time this appears in print the model will probably be finished.

Starting from rough drawings of the frames and motion, done for him by a friend, Mr. Baxter built his model to free lance design. In a letter to me he wrote:

"I occasionally went back to the drawing-board and work-bench, to design and make up the various patterns for the 12in. driving wheels, 6in. bogie wheels, cylinders of 5in. stroke by 3½in. bore, the funnel, pumps, buffers, etc. I found that the wheel spokes took a lot of cleaning up and I wore out several files during the process as they were very rough, in spite of the fact that the patterns with which I worked were smooth and well relieved."

The locomotive frames were cut out by hand from ¼in. steel plate, angle iron being used for the horns, and great care was taken to ensure a good sliding fit for the axle boxes. An operation that took rather a long time was the machining of cylinders and fitting sleeves to the steam chests. Rings for the piston valves were machined from the solid and so were snifter valves, drain-cocks, automatic release valves, etc.

The coupling and connecting rods were cut out and filed from 3in. x 1in. steel bar. Combination levers, radius rods and anchor links were cut from ⅞in. by ⅞in. square bar. The eccentric rods were cut out, filed up and fitted with double row ball bearings at the "big ends." Expansion links were made to rock on ball bearings, all others being fitted with phosphor-bronze bushes and grease nipples. Crossheads were built up and fitted with brass slippers, which turned out to be quite satisfactory.

The smoke-box door was hammered out of plate, turned and fitted with the usual dart and cross bar. Hinges were cut from ¾in. by ¾in. bar, to obtain nice knuckles. All flanging, such as safety valve covers, steam dome and fire-box cleaning was beaten over formers.

Braking is controlled from the cab and the steam brake cylinder and shoes were machined from castings. The safety valves, whistle, boiler turret for injector, blower and steam brakes, were all made up from phosphor-bronze and stainless steel. An oscillating cylinder oil-pump is fitted, which has proved very satisfactory indeed. The only ready-made fittings were the gauge glass fittings, injector, steam and oil pressure gauges.

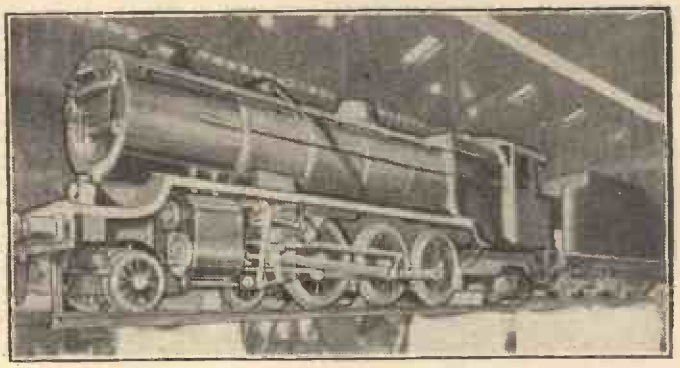


Fig. 1.—Mr. R. H. Baxter's 9½in. gauge, free lance design locomotive and tender, which he has built entirely himself at his home in Pietermaritzburg, Natal.

Bogies and Tender

The front and rear bogies are laterally spring controlled. The tender bogies are cut from ¼in. plate and fitted with cast-iron and phosphor-bronze axle boxes.

The tender is fitted with a 20-gallon water tank of copper. There is an emergency hand-pump of phosphor-bronze, with a stainless steel plunger.

With regard to the boiler, the front tube plate, throat plate and back head have been flanged from ⅜in. steel, a process which was found to require a very great heat for frequent annealing of the plates.

The model locomotive and tender measure approximately 15ft. overall. It has rather a large loading gauge, 32in. high, and a beam of 20½in., which are near to the dimensions of the South African railways. The latter are principally of 3ft. 6in. gauge track, with a loading gauge of 13ft.

Scale Model Cargo Ship

The design of modern cargo ships has shown refreshing changes in development during the post-war period. The accompanying photographs show a model of the latest addition to the John Holt fleet, the *Elizabeth Holt*, recently built by Messrs. Cammell Laird and Co., Ltd.

Without resort to pronounced streamlined effects, which often prove disappointing when applied to ship design, the *Elizabeth Holt* has been built with a pleasing, balanced appearance, with her sturdy masts, cargo handling apparatus and compact superstructure. The latter provides a certain amount of passenger accommodation and very adequate promenade space.

The model, illustrated in Figs. 2 and 3, was built by Messrs. Bassett-Lowke, Ltd., to a scale of 3/16in. to 1ft., and is complete in all exterior details.

Fig. 2.—An exhibition model of the cargo-passenger vessel, "Elizabeth Holt," latest addition to the John Holt fleet. The model is to scale of 3/16in. to 1ft. and was built to the order of the builders of the actual ship, Messrs. Cammell Laird and Co., Ltd.

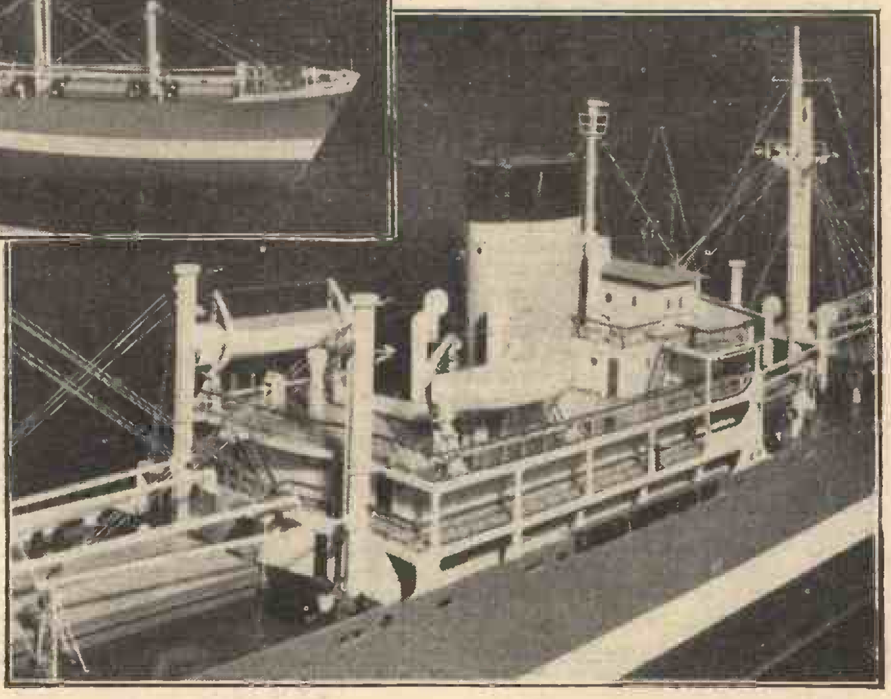


Fig. 3.—A close-up amidships view of the finely detailed exhibition model of the "Elizabeth Holt."

LETTERS TO THE EDITOR

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

Criticism of the "P.M." Microscope

SIR,—As a microscopist (amateur) of some considerable experience, I was somewhat surprised to read in the article in the current "P.M." on the construction of a microscope, that the thread on a microscope objective is 40 t.p.i. and ¾in. diameter.

This thread, which is standard all over the world (with the possible exception of Soviet Russia), was standardised many years ago by the Royal Microscopical Society, in 1857 to be exact. The necessity for standardisation was urged, and the Royal Microscopical Society thread, popularly known as the "Society Screw," was perfected in 1896.

I have not, at the moment, a copy of the exact standard, but I do know definitely that it is just over .8in. diameter and 36 t.p.i. Whitworth form.

Your contributor has also omitted to mention the correct diameter for the eyepiece fitting, which is .920in. (eyepiece is .917in.); incidentally, eyepieces should fit easily so they can be changed without altering the somewhat critical adjustments of the instrument. It is not necessary to have a velvet lined tube to accommodate them.

I have one other criticism of the design published and that is that the limb is too flimsy, especially at the point where the stage is attached. It will be all right for low powers (⅔in. or 16 mm.) but trouble will probably be encountered if any attempt is made to do serious work with higher power.

In any case, the 4 mm. and 2 mm. 0.1 objectives mentioned in the article really need a condenser to illuminate them adequately.

I also think that the fine adjustment would be better if the return action was by a fairly strong coil spring, instead of a collar on the adjustment screw. This would be a simple modification and would obviate backlash, a very important and desirable feature which you will understand is very necessary when I point out that the working clearance of 3 mm. and 2 mm. objective is only about .005in. to .01in.—G. A. BROADHURST (Dawley, Salop).

[*The author of our article on constructing a microscope agrees that the screwthreads for objectives should be as above and not as given in the article.*—ED.]

Interplanetary Space Travel

SIR,—In the January issue, Mr. W. Ellwood (Interplanetary Space Travel) states, "Astounding speeds may be attained in free space on a minimum amount of fuel." It is true that the minimum mass of fuel would be used to reach a given velocity, for one could not afford to take excess of fuel, but assuming 100 per cent. thermal efficiency of the engine, there is only one value for the mass of fuel required to reach a definite given velocity in free space.

He also states that for a rocket in the earth's atmosphere the "rate of expansion" must be increased before the rocket will move. In actual fact, at the beginning of firing we are concerned only with gravity for air resistance $\propto v^2$ and $v=0$.

The acceleration through space to a given velocity is a function of fuel consumed. Therefore the total "power" used, i.e., the total impulse in accelerating from v_1 to v_2 is always the same, there is nothing gained in changing velocity in space except that there might be external forces absent which are characteristic to our planet.

Because acceleration $\propto$ fuel consumption the maximum velocity attainable by any mass expulsion system in free space is

$$V_f = V_E \log_e \frac{M}{m}$$

where

V_f = Final vel.

V_E = Exhaust vel.

$\frac{M}{m}$ = Mass ratio, i.e.,

$$= \frac{\text{mass rocket fully fuelled}}{\text{mass empty shell}}$$

From this equation it can readily be seen that provided $\frac{M}{m}$ is great enough, not only could the rocket travel at its own exhaust velocity, but it could exceed this velocity.

From this statement then, clearly there is no *maximum* velocity for a theoretical rocket with an extremely large $\frac{M}{m}$. However, limitations imposed by engineering problems keep this ratio at round about

$$\frac{M}{m} = e$$

Assuming that we have such a rocket with

$$\frac{M}{m} = e$$

then the *maximum* velocity attained will be the "all-burnt" velocity when no fuel remains, therefore there is no need to cut the motor for no fuel remains anyway! At this "all-burnt" point of max. velocity, we have no choice but to continue cruising in free space at this velocity.

Referring to Mr. Ellwood's diagram, he states that of the energy dissipating from a point source, only half is utilised for propulsion, but considering the condition when the rocket moves so that $V_f = V_E$, it can be said that, relative to a stationary point in space, the kinetic energy of the fully expanded gas stream equals zero.

In actual fact the gas stream still contains heat energy, but in the ideal design, most of this heat energy would have been transformed into kinetic energy through the venture.—P. MANSFIELD (Camberwell, S.E.5).

Reversible Mirrors

SIR,—With reference to your reply to a reader's query on page 173 of the January issue regarding "reversible mirrors," these may be obtained from Messrs. John Newton (Kensington), Ltd., 266, Old Brompton Road, London, S.W.5.—J. HUDSON (Surrey).

Michelson-Morley Experiment

SIR,—Mr. C. W. Carr's assumption (Letters, December issue) that an aeroplane which is acted upon by a steady wind will take the same time to travel from the centre of a circle to any point on the circumference and return to the centre, is wrong.

In the vector triangle (Fig. 1), we have—

a = airspeed and course of aircraft.

b = wind velocity.

c = resultant ground speed and track of aircraft.

We require to calculate c

$$a^2 = b^2 + c^2 - 2bc \cos A.$$

$$c^2 - 2bc \cos A = a^2 - b^2$$

$$\therefore c^2 - 2bc \cos A + (b \cos A)^2 = a^2 - b^2 + b^2 \cos^2 A = a^2 - b^2 (1 - \cos^2 A)$$

$$(c - b \cos A)^2 = a^2 - b^2 \sin^2 A$$

$$c = b \cos A \pm \sqrt{a^2 - b^2 \sin^2 A} \quad \text{......(i)}$$

In Fig. 2 is shown the circle with A as its centre and radius R. Then AA_1 is the outward track and A_1A the return track. The

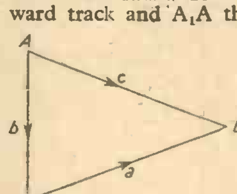


Fig. 1.—Triangle Vector showing resultant ground speed and track of aircraft.

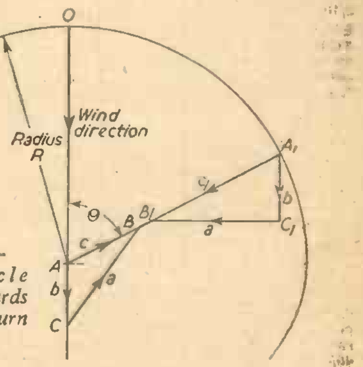


Fig. 2.—The circle and outwards and return tracks.

vector triangles ABC and $A_1B_1C_1$ give the ground-speeds C and C_1, respectively.

Angle $OAA_1 = \theta$.

Note that angle $A = 180° - \theta$

and angle $A_1 = \theta$.

Substituting in (1)

$$c = b \cos (180 - \theta) \pm \sqrt{a^2 - b^2 \sin^2 (180 - \theta)}$$

$$= -b \cos \theta \pm \sqrt{a^2 - b^2 \sin^2 \theta} \quad \text{............(ii)}$$

$$c_1 = b \cos \theta \pm \sqrt{a^2 - b^2 \sin^2 \theta} \quad \text{............(iii)}$$

The negative roots can be neglected.

(*Continued on page 257*)

READERS' SALES AND WANTS

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

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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, excepted from the provisions of the Notification of Vacancies Order 1952.

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COMPRESSORS for sale, 3 CFM, 180lbs. sq. in., on metal base, with driving wheel and receiver; price £3. ½ h.p. Heavy Duty Motors; price £3; carriage forward. Wheelhouse, 1, The Grove, Isleworth. (Phone: Hounslow 7558.)

TRANSFORMERS, for trains, welding, low voltage lighting, battery chargers, etc.; all transformers fitted with "earth protection" screen, "play safe." Write or phone your requirements to F. W. Whitworth, A.M.Brit.I.R.E., Model Dept., Express Winding Co., 333, London Road, Mitcham. (MIT. 2128.)

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COMPRESSORS, ex-W.D., twin cylinder, 8 cubic ft. capacity, 1½in. and 3in. bore by 3in. stroke; new condition; £6/10/-; s.a.e. details. D. M. Rogers, 2, Matlock Avenue, Southport.

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SLIPESE Approved Releasing Oil; saves time, temper and expensive tools; few drops release apparently immovable nuts, etc.; extensively used industrially; now available; ½-pint tin, oil-can spout, 2/6 plus 6d. postage; 3 tins post free. Slipworks, 95, Victoria Street, St. Albans, Herts.

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TOY CASTING MOULDS, soldiers, sailors, airmen, animals, etc.; catalogue, 9d.; Moulds for Plasterwork, plaques, ornaments and Coronation souvenirs. Moulds from 3/6 ea.; catalogue, 9d.; s.a.e. for list. F. W. Nuthall, 69, St. Marks Road, Hanwell, London, W.7.

WEAVING for pleasure or profit; 6d. for illustrated booklet, "The Hand Loom," Douglas, P.M., Andrew Canterbury.

"SPRAY-WEB" is the new technique for making Coronation decorations, lamp-shades, illuminated figures, simply by spraying with an ordinary household sprayer! 30/- per gallon; one quart 10/6. "Spray-Web," 48, Akerman Road, London, S.W.9.

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BUD MORGAN, The Model Specialist, 22, Castle Arcade, Cardiff. (Telephone: Cardiff 29065.) Model Aircraft, Trix, Tri-ang, Graham Farish, Model Railways and Galleons; first-class mail order service. Send for my 1953 price lists, price 3d.

CROYDON.—Woodside Model Aircraft Supplies, 72, Shirley Road, Croydon, Surrey. Mail-order specialists; lists free.

SHIPS IN BOTTLES, complete instructions, plans and unfinished parts; p/f 4/3. Gardner, 23, Wallbutton Road, Brockley, London, S.E.4.

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LONDON. — Robson's Hackney's Model Shop, 149-151, Morning Lane, E.9. (Tel.: AMHerst 2928.)

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PLYWOOD, 3/16in. Finnish Birch, very clean, sanded stock; 4 sheets, 30in. x 30in., 18/-; carriage paid. Stamps for lists of mouldings, plywood and complete woodworkers' supplies. Sawyers, Ltd., St. Sepulchre Gate, Doncaster.

MAHOGANY PLYWOOD; any parcel £1 delivered; c.w.o. Following new: 6 at 23 x 20 x ¼in.; 8 at 36 x 12 x ¼in.; 14 at 14 x 23 x ¼in.; 17 at 14 x 20 x ¼in.; 20 at 14 x 17 x ¼in.; 30 at 14 x 14 x ¼in.; 10 at 60 x 6¼ x ¼in.; 4 at 78 x 11½ x 3/16in.; 12 at 78 x 5¼ x 3/16in.; 24 at 78 x 3¾in. x 3/16in.; 40 at 78 x 2¼ x 3/16in.; 12 at 18 x 13 x 5/16in. Following, one side slightly glue stained: 5 at 33 x 23 x 3/16in.; 7 at 23 x 23 x 3/16in.; 16 at 47 x 9 x 3/16in. M. Leader (1920), Gosford Street, Middlesbrough.

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WATCHMAKERS' SCREWDRIVERS, high tensile blades, swivel top; set of 5, graduated sizes, in fitted box, 5/-, post paid. Sawyers, Ltd., St. Sepulchre Gate, Doncaster.

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AEROVOX 1 mfd. 600 v. working Condensers, 1/9; Sprague, 1 mfd. 1,000 v., wkg., 1/6; both types new with mounting clips; minimum order 6, pp 1/6. R.A.F. 24 v. Electric Muffs, 5/6, pp 1/-. Admiralty Self-Energising Chest Microphone and Headsets, No. 12500, operates without batteries, suitable for telephone conversations, approx. 1 mile, 15/-, pp 2/-. J. Hallett, 19, Upper Richmond Road, London, S.W.15.

METAL RECTIFIERS, 6v./12v., full 3-amp. size, new, latest Westinghouse patt., with circuit, 15/-, pp. 9d.; high-grade new Transformer for same, 26/10. Champion Products, 43, Uplands Way, London, N.21.

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MISCELLANEOUS

"MODERN WOOD TOYMAKING," a practical handbook, 190 illustrations, 2/6. "Home Woodwork," 50 useful things to make, 188 illustrations, 2/6. G. F. Rhead, Hartest, Suffolk.

1,100 FORMULAS for model-makers, engineers, handymen, etc., 3/9. P. M. Ashdown, 3, Raynham Terrace, Edmonton, N.18.

LETTERS TO THE EDITOR—

(*Continued from page* 254)

The total time required for the double journey

$$=\frac{R}{C}+\frac{R}{C_1}=\frac{R(C+C_1)}{CC_1}$$

Substituting in (ii) and (iii)

$$T=\frac{2R\sqrt{a^2-b^2\sin^2\theta}}{a^2-b^2\sin^2\theta-b^2\cos^2\theta}$$

$$=\frac{2R\sqrt{a^2-b^2\sin^2\theta}}{a^2-b^2(\sin^2\theta+\cos^2\theta)}=\frac{2R\sqrt{a^2-b^2\sin^2\theta}}{a^2-b^2}$$

$$\text{Total time taken}=\frac{2R\sqrt{a^2-b^2\sin^2\theta}}{a^2-b^2}$$

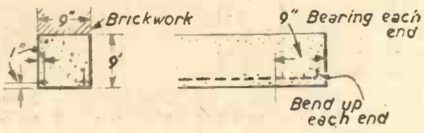
Hence, since θ is the only variable, the larger the angle the greater is $\sin\theta$ (up to $\theta=$ 90 deg.) and the smaller is the value of the above expression.

The conclusion is that the journey will be longest when travelling into and down wind and shortest when travelling at right angles to it over the ground.—R. T. LAWRENCE (Hornchurch).

Reinforced Concrete Slab

SIR,—Regarding your reply to Mr. Beckett (Farnworth) on reinforced concrete construction, in December's Queries and Enquiries, may we deal with it point by point.

(i) Mr. Beckett evidently requires a design for a reinforced-concrete lintel over garage doors, span of opening 7ft. 0in., and not an



Design for reinforced concrete lintel.

"R.C. Slab"—a term which suggests a floor or roof slab. Confirmation on this point is that he has tried to obtain an "H-girder" (known to structural engineers as an R.S.J., meaning rolled steel joist).

(ii) C.P.114 (1948), obtainable from the British Standards Institution, 28, Victoria Street, S.W.1, price 5s., recommends 1 : 2 : 4 nominal mix for this class of work with aggregate up to such a size as will pass through a ¾in. mesh sieve.

(iii) The aggregate should not include ashes nor fine brick dust.

(iv) On no account may horsehair or other organic matter be used in the construction of structural concrete.

(v) You give Mr. Beckett no clue as to the depth his lintel should be, and his enquiry is perhaps a little vague as to the load it would be carrying. For general purposes, we would suggest a depth of 9in. for a span of this sort with 2 ½in. diameter steel bars (*not* iron rods !) placed in the bottom of the lintel, with a concrete cover of 1in. as sketch.

The lintel should bear on 9in. of brickwork at each end and the ends of the bars should be bent up

(vi) There is no advantage in the inclusion of stray scraps of metal placed haphazardly in the mix, as a perusal of C.P.114 (1948), or any elementary text-book on R.C. design would show.—L. H. F. DEATH, (London, S.W.1.)

Golf Bag "Caddie Cart"

SIR,—In January issue of PRACTICAL MECHANICS, a reader requests for particulars of a "Golf Cart." I enclose particulars of one I have had in use for a few years which runs very well, and is well balanced.

The material used is not what the reader specified, but is easy to obtain and work. The small amount of welding can be done by any small garage.

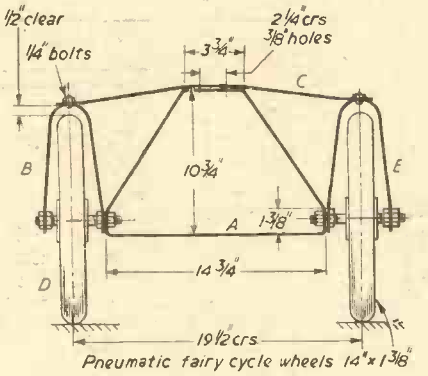


Fig. 2.—End elevation.

The pipes I procured from an electrician. The mainframe is bent to shape then welded up and the wheelframes should be bent to suit the wheels. The idea of handle being screwed is to make it easy to pack the cart into a car and make the cart useless so that others will not use it when the owner is away. A great deal of engineering experience is not necessary to make up this design. —ROBERT MACLEAN (Kilmarnock).

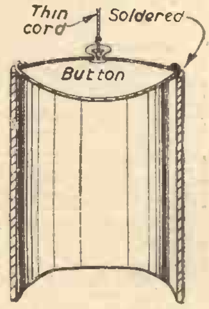
A 1 off Main Frame	¾in. × ⅛in. M.S.	
B 2 off Wheel Frames	¾in. × ⅛in. M.S.	
C 1 off Cross Brace	1in. × $\frac{3}{16}$in. M.S.	
D 2 off Wheels		
E 1 off Bag Frame		M.S.
F 1 off Handle		M.S.
G 2 off Straps		Leather
H 1 off Handle		Rubber

Westminster Door Chimes

SIR,—Re "Westminster Door Chimes," in my opinion this mechanically-operated unit, good as it is, cannot be compared with that of the electric chime-timing unit of March, 1950, by "Handyman."

I made this up within two weeks and it has worked perfectly ever since and is admired by all callers.

From the brass tubular chimes themselves, which are 1in. dia., better tone can be obtained if a shank type metal button is soldered (as per sketch). Mine are old A.R.P. buttons.



The bobbins used were from an old servant indicator as was, I believe, used in Victorian times.

Though belated—my congratulations to "Handyman," on such a fine job.—JAS. L. SEWELL (Catford, S.E.6).

American-type Windmill

SIR,—I wish to make a small windmill suitable for a garden ornament. I have already purchased a Raleigh Dynohub and wish to incorporate this in a small American-type of windmill. I do not propose to utilise the power produced for any set purpose. It is just an experiment I want to try out.

Could you supply me with a suitable design? I have a lathe and can do a fair amount of machining if necessary. Can you supply details concerning the size of sails and the best way of connecting these to the hub? A tail would be required to keep the mill automatically head to wind. I can get no books dealing with this subject and would be much obliged if you could suggest any other sources of information.—W. C. L. RICHARDS (Nottingham).

[*Readers' suggestions are invited.*—Ed.]

Tobacco-shredding Machine

SIR,—In your December, 1952, issue there appeared a letter from J. G. G. Davies (Tredegar), asking if any reader had designed a tobacco-shredding machine. I find myself in a similar difficulty to that of your correspondent and am hoping still that some reader will come forward with a solution to this problem.

[*Suggestions from readers will be welcomed.*—Ed.]

(*Continued on page* 258)

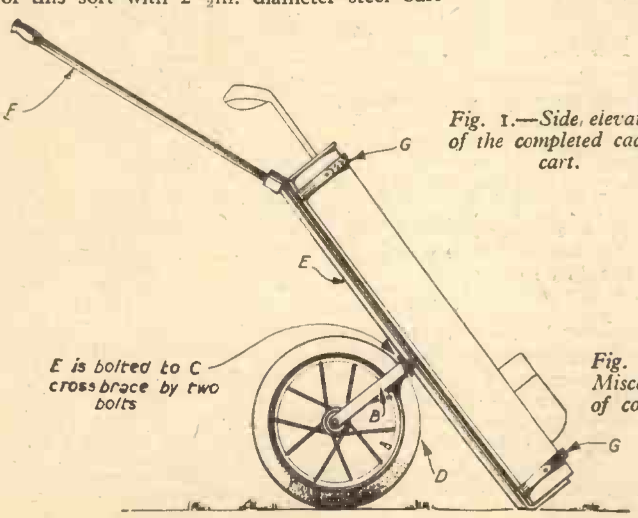


Fig. 1.—Side elevation of the completed caddie cart.

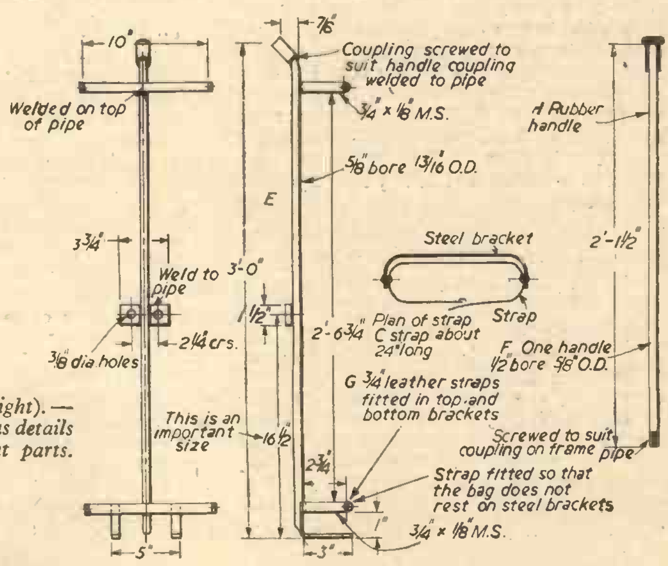


Fig. 3 (Right).—Miscellaneous details of component parts.

Trade Notes

Johnson Photographic Competition for 1953

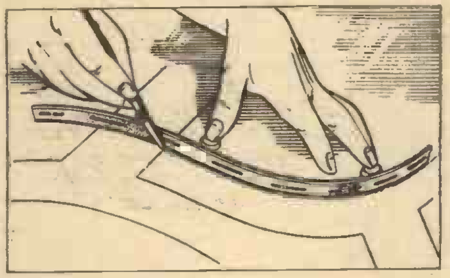
THERE are as usual two competitions, Spring and Autumn, and in each there are offered 30 cash prizes. There are three classes; class 1 is an open competition, class 2 is for novices and class 3 is for those under 18. In class 1 there are three sections, "Country Life," "Town Life," and "Portraits or Figure Studies," while the other two sections are for "My Best Photograph." The printing and developing must be the competitor's own work and full technical details must be sent with the print. Full details of the competitions may be obtained from your local photographic dealer.

This year, there is a new competition for members of Photographic Societies and Camera Clubs only. Class 1 is for advanced workers and is divided into two sections, A—"A Picture Indicating Power," and B—"A Picture Suggesting Peace." Class 2 is open to all Club Members and is also divided into two sections, A—"Pictures of People," and B—"Any Other Subject." The awards in each of the four sections are: 1 first prize of £10, 2 second prizes of £5, 2 third prizes of £2 and 2 fourth prizes of £1. This is the Spring Competition and there will be another in the Autumn for which a different set of subjects will be selected.

We have also received a list of the prize-winners in the Johnson's Autumn Competition.

Flexible Curve "Linear"

THIS instrument is for the drawing of curved lines, for curve shading, graph drawing, etc., and may be obtained in three lengths of 30, 40 or 60 cms. Without



finger grips, the prices are 17/6, 23/6 and 35/-, and with finger grips they are 19/6 and 37/-. This ingenious Italian instrument, constructed from 2 inner lead-alloy and 3 outer white celluloid sections, stays put without locking and is easily re-straightened. The Flexible Curve "Linear" is one of the many items included in the latest folder of W. G. Pinner and Co., 1, York Road, Birmingham, 16, who specialise in all types of materials for draughtsmen and artists.

"Putting It Back"

THE above is the title of a booklet written by E. L. Eastell, and published in the interests of battery longevity by Easco Electrical Limited, Brighton Terrace, London, S.W.9. This is not a detailed instruction booklet on re-charging, but it is couched in general terms and is intended to amplify rather than replace the battery maker's working instructions. The subject has been treated from a practical standpoint and is intended to aid the private motorist as well as the professional worker. The price of the booklet is 1/-, post free, and all enquiries should be addressed to Easco Electrical Limited.

The "Fusemaster" Screwdriver

THIS new pattern screwdriver has a transparent shockproof plastic handle and a silver steel blade finely ground to fit B.A. screws. The handle is hollow and contains a spool in which is wound approximately 100ft. of 5, 10 and 15 amp. fuse-wire,

The "Fusemaster" screwdriver.

sufficient to repair 600 fuses. The spool, which forms the screwdriver top, has a ring inserted so that the screwdriver can be hung near the fusebox. All metal parts are chrome-plated and polished and the "Fusemaster" is obtainable from tool merchants, ironmongers and stores, etc., at the retail price of 3s. 6d.

BOOKS REVIEWED

Development of the Guided Missile. By K. W. Gatland. Published by Iliffe and Sons, Ltd. 133 pages. Price 10s. 6d. net.

THE guided missile was rather forced on the attention of the people of this country during the V1 and V2 attacks, and since the war interest in this subject has again revived, but now from the point of view of interplanetary space travel. In this book all the main information now available on the development of guided weapons throughout the world is collected and followed up with some of the possibilities for the future. Three aspects of rocket propulsion are dealt with: its use as a weapon, as a means of research in the upper atmosphere and in space, and its eventual use in space exploration. The information in this book, besides being of use to technicians and military leaders, will be of great interest to all those who have thought seriously about the possibilities of combating a rocket attack or of travelling to the moon. Mr. K. W. Gatland was the author of a long series of articles on Rocket Propulsion which ran in this journal from July, 1944, to November, 1947.

The Automatic Watch. By R. W. Pipe, F.B.H.I. Published by Heywood and Co., Ltd. 166 pages. Price 17s. 6d. net.

THIS is a pioneer book in a new field, and the author deals in a practical manner with the care and maintenance, stripping and assembly of the various automatic watches now on the market. The salesman will find here all he needs to know to advise his customers on the different makes available. The repairer, too, who so far has had little experience with this type of watch, will welcome this book, which contains details of all the more important movements. There are nearly 100 illustrations, and a valuable glossary in which British, American and Continental terms are correlated.

LETTERS FROM READERS

(*Continued from page 257*)

Ladies "Hat Block"

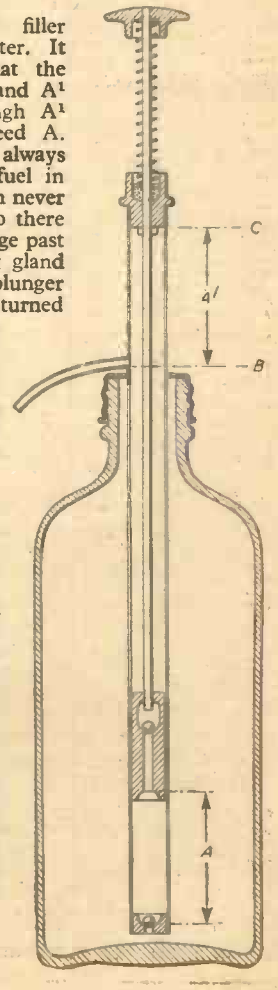
SIR,—My wife, who is a milliner, requires a ladies' "hat block" (steam jacketed) for remodelling hats. I have tried all the large millinery shops around this area, but to no avail. Could you please give me details how to construct one, and what would be the best type of metal to use, which will stand up to the requirements.—D. WALTERS (Wirral).

[*We invite suggestions from readers.*—ED.]

Petrol Pump for Lighters

SIR,—The sketch shows a simple pump which may be fitted to the screw cap of lighter fuel bottles for metering a given amount of petrol into the lighter. In most mechanical lighters the difficulty is that the user endeavours to get a quart into a pint pot by overfilling it. This saturates the flint and it is some time before it will spark. The cotton wool packing will only absorb a certain amount of petrol and anything in excess runs to waste. The cotton wool should be fairly tightly packed to fill every interstice so there are no open cavities for neat petrol.

As will be seen, the pump body is a piece of brass tubing carrying a plunger attached to a piston. The bottom end of the body is provided with a ball valve and so is the piston; thus on the first plunge the space is filled and on the next it is transferred through the ball valve in the piston to the space above the piston and so through the spout, which is inserted into the filler orifice of the lighter. It will be seen that the cubic spaces A and A^1 are equal, although A^1 can slightly exceed A. The line B will always be the level of fuel in *status quo* and can never rise quite to C so there is no fear of leakage past the small stuffing gland at the top. The plunger is, of course, returned by the spring shown. The complete device is soldered into a hole drilled into the centre of the screw cap to take the tube.



Remember when purchasing a lighter, that after the first filling the wool will sink a certain amount and it should be stuffed with new wool to take up the space. Use medical absorbent wool, not ordinary cotton wool. To ensure easy raising of the wick merely let this rest on the wool; it should not be entangled with it. — L. WINGROVE (Pinner).

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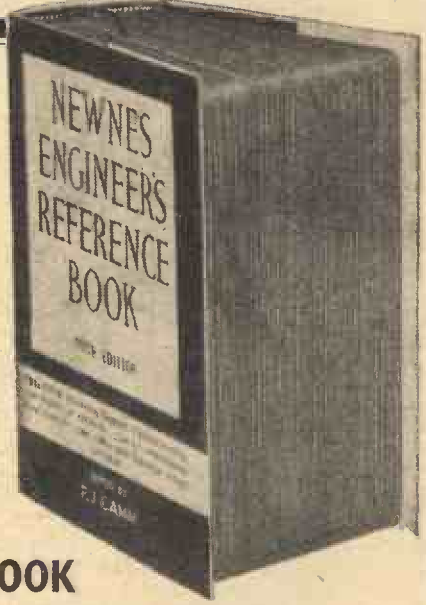
Edited by F. J. CAMM



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5-valve all mains superhet **RADIO**, 3 waveband coloured illuminated scale; fully guaranteed, £8/19/6, plus 7/6 carriage and insurance.
AUTOCHANGE UNIT by Collaro with pick-up for long playing and standard records, £11/10/0, plus 7/6 carriage and insurance.
Special Offer. Three Units for 29 gns. or £10/14/0 deposit and 12 monthly payments of £2/3/0, plus £1 carriage and insurance. Booklet of photos, circuit diagrams, etc., 2/6 (returnable).

THE ARGUS TELEVISION RECEIVER

A 21-valve Televisor for the amateur. Components, valves and cathode ray tube cost only £20/10/0, or £6/17/6 deposit and £1/9/9 monthly. Constructors envelope giving full details and blueprints 5/- returnable within 14 days if you think you can't make the set.

LAST FEW £3/19/6

Warms room as it dries clothes — stove-enamelled rails. AC or DC 650 watts. Size 3ft. x 3ft. x 5in. Made to sell at 12 gns. fully guaranteed only £3/19/6, carriage 7/6.

22/6 FLUORESCENT LIGHTING

Complete kit comprises Hi-craft 40 watts control unit, starter lamp, lamp holders, clips and wiring diagram. Price less tube 22/6, plus 1/6 post. Tubes 12/6 each carr. free, minimum quantity 6.

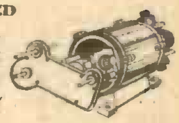
MAKE A RADIO

Using our parts in one evening you can make an all mains 4-valve radio with bakelite case, then you will make a £12 receiver which costs you only £6/1/6 or £2/3/0 deposit and 10 monthly payments of 10/6. (Carriage and insurance 5/-.)

R.1155 FOR £2 14s. 0d.

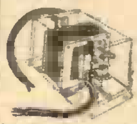
Considered one of the finest receivers ever made. Frequency range 75 kc/s-18 mc/s. Sets are complete with 10 valves in black metal case. Price £7/19/6 or £2/14/0 deposit, balance over 12 months. Carr. & Transit case, 12/6. **Mains Power Pack for R.1155** Plugs into socket on front, so no mods. to set necessary. Complete with speaker ready made to work, £5/15/0 or if bought with set £13/10/0 or £4/10/0 deposit.

MULTI-SPEED MOTOR



Works off AC/DC mains; fitted with gear box, any speed from 1 r.p.m. 12/6, post and packing 1/6.

TOY OR MODEL TRANSFORMERS



Output variable from 1 v. to 40 v. from AC mains. Totally enclosed and absolutely safe. 39/6, post 2/6.

ELECTRONIC PRECISION EQUIPMENT DEPT. 1
42-46 WINDMILL HILL, RUISLIP, MIDDLESEX. ● 152-3 FLEET ST. LONDON E.C.4

ELECTRIC MOTORS with Gearbox attached, can be driven off 230 v. A.C./D.C. or 24 v. D.C., or if driven by power (wind or water) will generate above voltages. Motor can be adapted for many uses. Price, with comprehensive instruction sheet, 24/-, post 1/11. Sheet separately, 2½d.
B.S.R. & DECCA Gramophone Motors with turntable, but less pick-up. 230 v. A.C., 2-speed 78 r.p.m. and 33⅓ r.p.m., £3/18/6, plus postage and packing 1/1. Suitable pick-ups from 35/10. Many other 'gram units in stock, including autochangers; all brand new, not surplus stock. Send 2½d. stamp for details.
ELECTRIC BLANKET for comfort on cold nights can be made in no time with our warming unit, 200-250 v. 40 watts. Heats up in ten minutes, and is safe to leave on all night if you wish. Price 35/-, post 1/6. 2½d. stamp will bring you details. New Zealand Stockists: H. F. Stevens, Ltd., 105, Worcester St., Christchurch, C.1, N.Z.
VIEWMASTER TELEVISION FOR THE CORONATION. The Viewmaster envelope contains seven full-size working plans for easy screw-together television, Guide book gives complete price list and shopping lists for the various stages, absolutely point-to-point wiring details, and trouble spotting guide. All parts always in stock and sent C.O.D. or cash with order. State your transmitter area when ordering. NO RADIO KNOWLEDGE NECESSARY. THE VIEWMASTER ENVELOPE, 7/6, plus 3d. postage.
SPRAY GUNS. Can be attached to any make of cylinder vacuum cleaner; three nipples included for paint, cellulose or distemper, and can also be used with soapy water for washing down walls, shampooing carpets, washing the car, etc. Only 16/6 each, inc. postage.
MAKE YOUR OWN RECORDS on plastic tape, using your gramophone for drive; records will play back thousands of times without loss of quality, or they can be erased and the tape used over and over again; tape will last for years. All parts in stock for immediate delivery. List 2½d., constructional data 1s.
SUPPRESSORS to quell noisy mains on radios, 10/- each, post 6d. Suppressors to quench interference created in vacuum cleaner, sewing machine and hairdryer motors, 11/-, post 3d.
MODEL BOATS, CARS and AEROPLANES. Send 5/- for full working plans of transmitters and receivers for controlling your models at a distance; no radio knowledge necessary. Range ½-mile for boats and cars, over 1-mile for aeroplanes. All parts in stock for immediate delivery. Send 2½d. for list, 5/6 for constructional data.
IVALEK CRYSTAL SETS, de-luxe type in white bakelite case, 21/-, need headphones at 8/9 and good aerial and earth, 5/-. Postage on set 1/-.
"ELECTRIC EARS" to stick (by sucker) on side of telephone to amplify, via amplifier, telephone conversations and record them if desired on a tape recorder. Also ideal for deaf people if connected to the hearing aid. £3/3/- each, plus 6d. postage.
VIBRATOR POWER PACKS, 6 v. D.C. input, 230 v. output; when driven off a car battery will give out 230 v. D.C. and will drive a 230 v. radio with .15 amp. current consumption valves, thus enabling a small home radio to be used as a car radio. 57/6, plus 2/6 postage.
ROTARY TRANSFORMERS for working model trains from D.C. mains. Output 12 v. at 2 amps., with 5 v. for track lights or signals, input 230 v. D.C., 37/6. Input 230 v. A.C., 47/6, postage and packing, 2/6 extra.
MINIATURE HEADPHONES, super lightweight; complete with length of flex to plug into radio's extension speaker sockets, good for grandma to listen-in. Quite safe, no risk, 17/6 per pair.
VALVES AND COMPONENTS of all types in stock and quoted for by return. Please let us have all details as shown on old part, together with make of set and year, if possible. No lists, as stock is too vast to catalogue, but all modern valves and components and many obsolete parts in stock, including parts for television. Send 2½d. stamp for reply.

PARK RADIO OF MANOR PARK, 783, Romford Road, Manor Park, E.12.

QUERIES and ENQUIRIES

A stamped, addressed envelope, three penny stamps, 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.

Restoring Mercury "Balance" of a Thermometer

I HAVE a very good "Maximum and Minimum" thermometer, made by Negretti & Zambra. It was in perfect working order until recently when my young daughter took it from its hook and held it upside-down. I have managed to get the mercury back down the "U" tube, but it now registers about 70 degrees above the correct temperature. Could you please advise me how to move the mercury so that it shows the correct temperature ?—F. A. Howes (Banbury).

IT would seem that your thermometer has not only been inverted but that it has been severely jerked upwards and downwards while in that position. The result is the internal "balance" of the mercury thread has been destroyed completely.

It is difficult to remedy this condition, although, of course, not impossible. Since the mercury in one limb of the thermometer is higher than it should be, the remedy is to endeavour to "push" the mercury thread downwards until the correct meniscus level is attained. This "pushing" is effected by very carefully laying pieces or strips of cloth saturated with hot water over the alcohol bulb above the mercury level. The alcohol will, of course, expand upwards, but it will also expand downwards against the mercury, and it is this downwards expansion that you have to rely on. You may, of course, be fortunate enough in getting the same result by jerking the thermometer in the vertical direction, but the "expansion method" is more controllable. Perhaps success will come by a judicious combination of these methods.

"Keeping" Swimming-pool Water

I AM proposing to construct a swimming pool in my garden, capacity, say, 9,000 to 10,000 gallons. I understand there are certain methods of aerating the water and keeping it fresh, thus saving constant changing. What systems are there ? Alternatively, what publications give full details ?—J. Valmos (Tottenham, N.17).

THERE are various methods of "keeping" swimming-bath water, but the most satisfactory, from your point of view, would also be the most expensive. The admission of ozone to water necessitates an ozone generator, and one must keep a chemical watch on the condition of the water.

A straightforward chemical method is the addition of calcium or sodium hypochlorite, which produces a small amount of chlorine, having an anti-bacterial action. Another method is known as chloramination, which involves ammonia and chlorine. It is, however, difficult to advise you specifically, for one requires to know the extent to which the bath is used, the nature of the surrounding terrain, etc.

There are defined standards for healthy swimming-bath water, such as freedom from albuminoid ammonia. The most dangerous source of contamination is by the "bug" B coli which, as you may know, comes from the anal region of humans. It is considered that water should contain not less than 0.2 parts per million of free chlorine to keep it reasonably healthy.

I would suggest that you get in touch with the Institute of Water Engineers, London. They have published a fine, but rather ambitious—from your point of view—manual, with a section on swimming-bath water.

Electric Razor Query

I AM experiencing a rather peculiar trouble with my electric shaver, employing a balanced armature which (although I have serviced commutator and brushes) does not rotate in two positions. Can you explain this, as when current is switched on at any other position the razor functions perfectly, being self-starting ?—S. Parratt (Bristol, 2).

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.

WE assume that the razor is not stiff and that the position of non-starting does not correspond with a stiff spot in the razor movement. If the motor has a wound stator and a wound armature with commutator and brushes, i.e., if it is a series motor, it is possible that an open circuit has developed in the armature windings. In this case, you may notice severe sparking when the motor is running, and that the commutator segments which are connected to the faulty coil are marked by burning. If the cause is not due to solder having been melted from the commutator connections the armature may have to be rewound.

To test for an open circuit you could remove the brushes and connect a torch battery in series with a bulb and two test leads which are placed on adjacent segments of the commutator in turn. The lamp should light equally on all pairs of segments; if it lights only feebly or not at all on two segments this indicates that there is an open circuit in the coil which is connected between these segments.

Casting in Soft Metal

I AM a schoolmaster and wish to cast suitable presentation plaques and medallions for sports, etc. The only equipment available is a Bunsen burner but I have access to almost unlimited quantities of milk bottle tops, and also a small quantity of old printing type. Can you tell me how to melt down the aluminium caps and what sort of retort is necessary; or make any suggestions ? I propose making plaster casts for the initial moulds. Any metal suggested would have to have a fairly low melting point.—H. G. Williams (Twickenham).

THE practicability of melting down milk bottle tops for the purpose for which you want to use the metal is doubtful. Everything depends upon the alloy of which they are made. Usually they are so thin that they oxidise and burn on being fused. Type metal is a much better proposition, but moulds of plaster of Paris will not stand up to the high temperature of this in its molten state. A mixture of one part of fine, well-washed sand to two parts of Portland cement will do so. The moulds must be allowed to set naturally, and when thoroughly hard must be dried in a current of hot, dry air until every trace of moisture has evaporated.

It would be well to make the thickness of the moulds equal at least one half the diameter of the medallions to be cast and from the edge of the medallion impression a number of very fine grooves should be cut to the outside of the face of the mould to serve as air vents.

If one of the low melting point metal alloys were used, either plaster or even Plasticine may be used for moulds. These metals melt at:

Rose's	212 deg. F.
Newton's	205 „ „
Darcet's	200 „ „
Wood's	155 „ „

They may be fused in an ordinary tin can over a Bunsen flame. Type metal can be melted in an iron saucepan and ladled out and poured from an iron ladle. A gas ring will be found best to take the saucepan.

A non-ferrous metal merchant will probably be able to supply the alloy which you decide to use.

Moulding Composition

I HAVE made an oval frame for a mirror, and I intend to decorate this with a design using "Barbola" paste to give a carved effect. I wish to paint the frame a light colour—ivory or cream, with shaded portions of a light brown in some of the recessed or raised parts, to give an "antique" appearance such as that on very expensive mirrors now on sale.

Could you please tell me the procedure

to get this effect and what kind of paint to use, etc.?—C. Teale (nr. Leeds).

IF you want to make up your own moulding composition you can do so with the following:

Glue (melted) ...	1lb.
Resin	1lb.
Linseed oil ...	½ pint.
Gilder's whiting	Enough to make stiff paste.

Add the resin to the oil, then put in the melted glue, following this by kneading in the whiting, until you get a dough-like mass. Mould and allow to set. To get the "antique effect," paint with a light brown paint. Then, when quite dry, paint over the proud parts with a cream paint, using a broad brush with stiff bristles, so that they do not penetrate into the low spots or recesses.

Heating a Workshop

I SHOULD appreciate any information you can give me on heating a proposed workshop, the building to be of brick with asbestos roof, external measurements 20ft. x 12ft., height 9ft. 6in. to 7ft. at rear, windows occupying about 48 sq. ft. The temperature must be sufficient to safeguard machinery from rust.

Do you advise panel or tubular heaters, thermostatically controlled, and can you give details of loading required ?

Can you make any comparison between initial outlay and running costs of either of these systems and solid fuel ?—D. Buswell (Coventry).

IF the air is dry and the temperature can be kept fairly constant, quite a low temperature, say, about 40 deg. F., should be adequate to safeguard the machines. However, we presume that you will need a temperature of about 60 deg. F. for comfortable working, and the heating elements should be large enough to maintain this temperature, and preferably to raise the temperature by about 20 deg. F. fairly quickly when required. We suggest that you use heaters rated at 4 to 5 kilowatts, preferably tubular heaters, with thermostatic control. The tubes are best distributed around the room and mounted a few inches from the floor, but banks of tubular elements may be mounted a few inches above each other where space is limited. Alternatively, you could use convector heaters consisting of a casing containing an element operating at black heat, the casing having a cold-air inlet at the bottom and a warm-air outlet at the top and/or front.

A slow-combustion stove burning anthracite and coke would be suitable as an alternative and would, no doubt, involve a lower initial outlay than the electrical installation, but would not be as convenient. It is difficult to give any useful comparison of running costs—much will depend on the local cost of electricity and the labour involved in attending to a stove.

Astro-photographic Half-plate Camera

PLEASE give me some advice on the following :

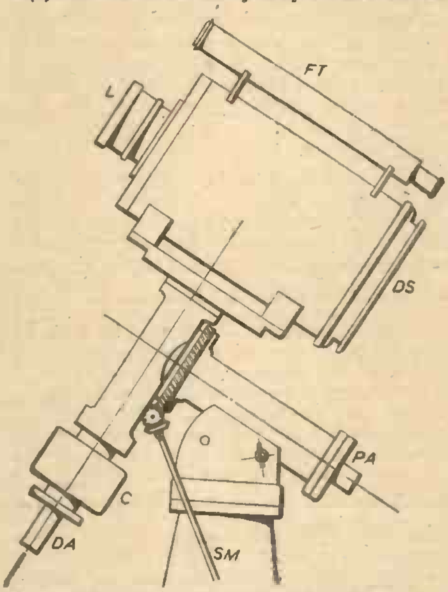
(1) The main construction of an astro-photographic half-plate camera.

(2) The best method of mounting the camera, with slow-motion attachment.

(3) Some books on astro-photography. —A. Foulget (Birmingham, 9).

(1) THE main construction of an astro-photographic camera depends upon the focal length of the lens and this upon the heavenly bodies or objects to be photographed, and the mechanical design of the body of the instrument upon not only the length but the diameter or aperture and weight of the lens. It must be understood that for photographing large areas of the starry heavens a quite different form of camera and lens would be required from that used upon the sun and moon, planets, etc. For the former an ordinary photographic lens, half-or whole-plate size, can be used and the lens and dark slide carried in a rectangular box (like a box camera); but for the latter—the sun, moon, etc.—a long-focus, photo-visual telescope object glass would be required, and the instrument would become then a photographic telescope giving a very much larger image than does an ordinary half-plate lens. In both cases the camera can be made of wood.

(2) The best and only way to mount the



The Key : L—Lens, DS—Dark slide (plate holder), PA—Polar Axis, DA—Declination Axis, C—Counterpoise Weight, SM—Slow Motion Drive from Clock or Motor, FT—Following Telescope.

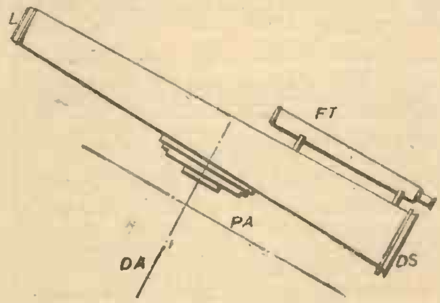


Fig. 1.—The complete arrangement necessary for mounting a camera for photographing large areas of starry heavens.

Fig. 2.—The arrangement used for photographing the planets, the moon, etc., using a long focus photo-visual telescope object glass.

camera is equatorially—that is to say, on a declination axis which is carried upon a polar axis so arranged that it is parallel with the axis of the earth. Exposures of the plates will, in many cases, except those on the sun and moon, be of long duration, and, therefore, the polar axis will require to be power-driven and to keep accurate siderial time. Hand-operated slow motion will not be sufficiently uniform and exact.

(3) Some books which may be of use to you are: "The Telescope," by Louis Bell, Ph.D., published by the McGraw-Hill Book Co., New York; "Amateur Telescope Making" and "Amateur Telescope Making—Advanced," both published by "Scientific American," 24, West 40th Street, New York, 18, N.Y.

Principle of a Stereoscope

I WISH to make a stereoscope for viewing stereoscopic pictures. Could you please let me know the principle of a stereoscope and how I could make a simple one ?—R. Engers (Welling).

THE principle of the stereoscope lies in the fact that two photographs are taken of the same subject from viewpoints separated by a distance of from 2½in. to 3½in. When the prints from the negatives are mounted side by side and placed in the stereoscope they are looked at with both eyes simultaneously; the left eye sees one picture and the right eye the other, and the effect is that of looking at the same relief and distance as was seen by the photographer's eyes when he took the pictures of the actual subject.

To make a stereoscope, the first thing to do is to obtain a pair of lenses, double convex, of approximately 6in. focus with a diameter of 1½in. These are mounted in holes cut in a plywood panel 2½in. apart, centre to centre. Below these holes and midway between them a gap is cut to accommodate the nose of the observer. From this panel another piece of plywood, at right-angles to it, extends backwards for about 8in. and on this a suitable stage is made to slide. This stage is merely a support for the stereoscopic pictures and must be capable of holding the pictures in an upright position and parallel with the lenses in the first panel. The sliding of the stage is necessary in order to meet differences in the focus of the eyes of various observers. Underneath the horizontal strip of plywood a handle may be fitted for holding.

Electrodeposition

I WAS greatly interested in the article—"Metal Forming by Electrodeposition," page 107 December, 1952, issue and would like to know more about it.

(1) The paraffin wax former of the film projector: was this suspended in the bath, or resting on the bottom ?

(2) Was the current supplied to this projector housing by a battery charger or by a car battery ?

(3) Can this battery charger be run off A.C. mains ?

(4) Can you suggest any books on this subject ?—J. T. Pulham (Dagenham).

(1) A brass rod was obtained and a 4in. strip of brass was soldered on to this so as to form an inverted "T." This was then heated and pushed in to the bottom of the wax mould. This rod also served to conduct the current to the former and for this reason the graphite coating was continued in the form of a strip up to this brass rod. This was then suspended upside-down in the plating bath.

(2) The current was supplied by a car battery which had a battery charger capable of supplying 5 amps. floating across it.

(3) Unless one happens to be on D.C., a battery charger is normally run off A.C. mains. In my case, I obtained a rectifier and transformer from one of the ex-Government supply companies, such as those which often advertise in PRACTICAL MECHANICS.

(4) We regret that we cannot suggest any books which deal exclusively with the subject of electroforming. However, most text books on electroplating contain a chapter on this subject.

Anti-freeze Mixture

PLEASE provide me with a formula and method of making an anti-freeze solution for normal use in a motor-car.—G. W. Davies (Nazeing).

IT is customary to-day to use ethylene glycol as an anti-freeze, to which is added a little triethanolamine phosphate as a corrosion inhibitor. The amount of anti-freeze required would depend on the lowest temperature to which you desire protection. One gallon in three gallons of cooling water will provide protection down to about twenty deg. F. below freezing. An eggcupful of inhibitor should do.

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TERMS : CASH WITH ORDER. NO C.O.D.

All goods sent on 7 days' approval against cash.

EARLY CLOSING DAY THURSDAY

MAINS TRANSFORMERS (NEW), input 200/250 volts in steps of 10 volts, output 350/0/350 volts 180 m/amps, 4 volts 4 amps, 5 volts 3 amps, 6.3 volts 4 amps, **45/-** each, post **1/6** ; another 350/0/350 volts 180 m/amps, 6.3 volts 8 amps, 0/4/5 volts 4 amps, **45/-** each, post **1/6** ; another 500/0/500 volts 150 amps, 4 volts 4 amps C.T., 6.3 volts 4 amps, C.T., 5 volts 3 amps, **47/6** each, post **1/6** ; another 425/0/425 volts 160 m/amps, 6.3 volts 4 amps, C.T. twice 5 volts 3 amps, **47/6** each, post 1/6.

ELECTRIC LIGHT QUARTERLY TYPE CHECK METERS, all for 200/250 volts A.C. 50 cycles 1 phase, 5 amps load, **17/6** each, post 1/6 ; 10 amp, **21/-** each, post 1/6 ; 20 amps load, **25/-** each, post 1/6.

RESISTANCE BOXES. Sub/Standard 200 ohms, **37/6** each.

¼ H.P. A.C. MOTORS, 1,425 r.p.m. 110 volts only, **£2/15/-** each.

MAINS TRANSFORMERS (NEW), input 200/250 volts in steps of 10 volts, output 350/0/350 volts 300 m/amps, 6.3 volts 8 amps twice, 4 volts 4 amps, 5 volts 4 amps, **70/-** each, carriage **3/6** ; ditto, 450/0/450 volts 250 m/amps, 6.3 volts 8 amps twice, 4 volts 4 amps, 5 volts 4 amps, **70/-** each, carriage 3/6 ; another, input as above, output 500/0/500 volts 250 m/amps, 6.3 volts 8 amps twice, 6.3 volts 4 amps, 4 volts 4 amps, 5 volts 4 amps, **75/-**, carriage 3/6. Another, wound to (electronic) specifications, 350/0/350 volts 250 m/amps, 4 volts 8 amps, 4 volts 4 amps, 6.3 volts 8 amps, 0/2/6.3 volts 2 amps, **70/-** each, carriage paid ; another, input as above, output 500/350/0/350/500 volts 250 m/amps, 6.3 volts 6 amps, 0/2/6.3 volts 2 amps, 0/4/5 volts 4 amps twice, **75/-** each, carr. 3/6.

EX-RADAR MAINS TRANSFORMERS, 230 volts input 50 cycles 1 phase, output 4,500/5,000 volts approx. 80 m/amps, 6.3 volts 2 amps, 4 volts 1¾ amps, 2 volts 2 amps, these transformers are new, immersed in oil, can be taken out of the oil and used as television transformers giving output of 10 m/amps, overall size of transformers separately 5½in. x 4½in. x 4in. and 3in. x 3in. x 2½in., price **75/-** each, carriage paid.

MAINS TRANSFORMERS (NEW), suitable for spot welding, input 200/250 volts, in steps of 10 volts, output suitably tapped for a combination of either 2/4/6/8/10 or 12 volts 50/70 amps, **95/-** each, carriage 7/6.

MAINS TRANSFORMERS (NEW), 200/250 volts input, in steps of 10 volts, output, 0, 6, 12, 24 volts 6 amps, **42/6** each, post 1/6. Another as above but 10-12 amps, **55/-** each, post 1/6 ; another, as above, but 25/30 amps, **75/-** each, carriage 3/6 ; another, input as above, output 0/18/30/36 volts 6 amps, **47/6** each, post 1/6.

EX-U.S.A. W.D. ROTARY TRANSFORMERS, 12 volts D.C., input 500 volts, 50 m/amps, 275 volts 100 m/amps D.C. output. Complete with smoothing switches, fuses, etc., as new, **17/6** each, carriage 2/6, can be run on 6 volts, giving half the stated output.

EX-NAVAL ROTARY CONVERTERS, 110 volts D.C. input, output 230 volts A.C. 50 cycles, 1 phase, 250 watts capable of 50% overload, weight 100 lb., price **£10/10/-** each, carriage forward.

MAINS TRANSFORMERS, 230 volts input, 150/0/150 volts 200 m/amps 6.3 volts 8 amps, 5 volts 2 amps output, **23/-** each.

AUTO WOUND VOLTAGE CHANGER TRANSFORMERS, tapped 0/110/200/230 volts 350 watts, **55/-** each, post 1/6 ; as above, but 500 watts **70/-** each, carriage 3/6 ; as above, 200 watts, **40/-** each, post 1/6.

MAINS TRANSFORMERS (By well-known makers). Input 100 and 230 volts, output 6 volts 1½ amps twice, price **7/6** each, post 1/- ; another 200/250 input, output 25 volt 4 amps C.T. **25/-** each, carriage 1/6.

MAINS TRANSFORMERS, 200/250 v. input, 400/0/400 v. 300 m/a 6.3 v. 8 a., 5 v. 3 a., 2 v, 3 a., 4 v. 2 amp twice at H.P., **82/6** each.

ROTARY CONVERTORS, ex-R.A.F., 12 volts D.C. input, 230 volts 50 cycles 1 phase at 100/120 watts, **£5/15/-** each ; ditto, 24 volts D.C. input, **75/-** each ; ditto, 230 volts D.C. input, output as above, **£5/15/-** each.

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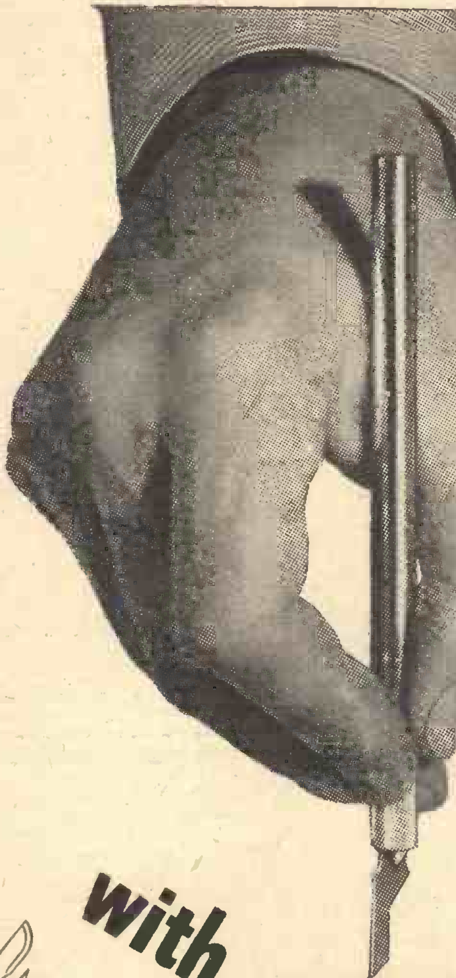

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The following are just a few items in our stocks. Send 6d. in stamps for comprehensive list giving full details of Potentiometers, Condensers, Resistors, Telephone Key Switches, Rectifiers, etc.

PHOTOGRAPHIC ENLARGER TIMERS.—An ex-Govt. unit suitable for giving ¼ to 8-second exposures 10/- ; or up to 16 secs. 15/6. Post 1/6.

PROJECTION LAMPS.—115 v. 750 w. Prefocus, Brand New, 25/-.

BROMIDE PAPER. 5½in. x 5½in., glossy, soft, 7/6 per gross packet.

RESISTANCE MATS.—Make ideal heating mats for Aquariums, Photographic solutions. Print dryers, etc. Mains voltage, 150 or 620 watts. Black heat, size 10in. x 6in., 2/6. Post free.

BALL BEARINGS.—No. EE2. ¾in. x ¼in. 3/-, post free.

THRUST RACES.—13/16in. x ⅜in., **1/6**, post free.

GOVERNORS.—Suitable for small models, 2/6 post free.

SWITCH FUSES.—Ironclad Revo. D.P. 30 amp., 250 volts. Brand new, **12/6**, post **1/6**.

LOW VOLTAGE CIRCUIT TESTER.—A self-contained unit for making a complete and rapid check of the generator-battery circuit of a vehicle. Battery voltage, regulator and cut-out settings and generator performance can all be easily determined. American made. Complete with instruction book, £5.10.0. Post 2/-.

BATTERY TESTER.—Complete in case with heavy current test prods 200 amperes. Plate selector switch with 7 positions, enabling the test to be made in accordance with the number of plates per cell. Meter with coloured scale indication, 70/-. Post 2/-.

MICROAMMETERS. — F.S.D.50. Flush type 2½in. dial scaled 0/100, contained in test set No. 28. 70/- Complete. Post 2/-.

VOLTMETERS.—0-300 A.C. Moving Iron 3½in. Flush or Surface Type, 25/- ; 0-20, 2in. Flush Moving Coil, 7/6 ; 0-40, 2in. Flush M.C., 10/6 ; post 1/-.

MOVING COIL METER with 1 M/A movement, 2½in. flush, rectifier type, scaled 0/100 volts A.C. Resistance 100 k. ohms. A very useful basic meter, 30/-, post free.

PORTABLE TEST METER.—Just the job for the home constructor, in neat case, 6in. x 5in. x 4in., reading 1.5, 3, 150 volts, 6 and 60 m/a. D.C., 5 k. and 25 k. ohms, 37/6. Post 1/6.

THERMOSTAT.—For frost protection, on at 34 deg. F., off at 49 deg. F., 1½ amps. at 250 volts, adjustable, 4/6. Post 6d.

THERMOSTAT.—Bimetal type in sealed glass tube, 2½in. x ½in. 30 deg. Cent. Ideal for Aquariums Wax and Oil Baths, Gluepots, etc. Will control 1 amp. at 240v., 5/-. Post 6d.

THERMOSTAT.—Satchwell 12in. stem, 0/250 v. A.C./D.C., 15 amps. A.C., .1 amp. D.C., 10 to 90 deg. Cent., 35/-. Post 1/6.

PRESSURE UNIT MK.23/AP.—6in. x 4in. x 3in., contains a small compressor operated by a 27 volt D.C. motor with switches, fuse, indicator lamp, 10ft. of air line and 21ft. of twin flex in a flexible tubing, etc. American made. Brand new. Only 45/-. Post 2/6.

POWER MICROPHONE INSERTS.—Truvox. Diam. 2¼ in. x 1in., 5/-. Post 6d.

THROAT MICROPHONES. — American twin-button type with strap lead and plug, 5/-. Post 6d.

HEAD SET ADAPTOR.—High to low impedance, 2/6. Post 6d.

HEADLAMP complete with Battery Case. Fits on forehead. Leaves both hands free, 10/-. Post 1/-.

VEEDER COUNTER 0-9999, 1in. x ¾in. x ¾in. Very useful, 10/-. Post 6d.

AERIAL RODS.—12in. long, ¼in. diameter. Any number of sections can be fitted together, 2/6 dozen, 6/- for 3 dozen, 11/- half gross, 20/- gross, £6 per 1,000.

SLOW MOTION DIALS.—6in. Scaled 0-100, reduction 200 to 1 or direct, ideal for wavemeters, signal generators, etc. Our price, while they last, 5/6. Post 1/-.

FLASHING SWITCH UNIT with 6 contacts. Full rotation 60 seconds, operated by a Sangamo Synchronous Motor. 230 volts A.C. 2 watts. In metal case, 3in. x 2½in. x 2½in., 15/-. Post 1/-.

INTERESTED IN FISHING ?—Then send for one of our tapered whip aerials and make yourself a fine rod worth pounds. Consists of three tubular steel, seamless copper plated sections, 4ft. long, which screw into each other and are well finished, 7/6. Carriage 2/-. (Eire, 6/6.)

CUTTER HEADS.—"Recording" high impedance. A bargain at 55/-. Post 1/-.

CUTTER STYLII, 6/- per doz., large quantity available at special rates.

ACCUMULATOR CHARGERS. 230 v. A.C., in black crackle case with fuses and meter, 6 and 12 volts at 4 amps. Bargain Price, £4 19/6. Pkg. and carr., 5/-.

ACCUMULATOR CHARGERS. Hand generator, delivering 6 v. D.C. at 4 amps., complete with automatic cut-out, in case, 16in. x 10in. x 7½in., 45/-. Carriage 5/-.

" ELF " CIRCUIT BREAKER. 220 volts, 2 amps., size 3in. round, 10/6. Post 1/-.

STUART PUMPS.—230 volt A.C. motor, will lift 400 gals. per hour 15 ft., £11/15/- ; larger size, ¼ h.p., £22/10/0. Carriage 7/6.

24-VOLT D.C. MOTORS with double ended shaft 2in. x 3in., 8/6. Post 1/-.

TWIN FLEX, in black braided covering, approx. 25-yd. coils, 7/6. Post 1/-.

INTERCOM. CABINETS.—Solid back, polished all round, 15½in. x 9½in. x 6½in., with two 4in. circular frets for speakers and cut-out for control panel, 25/-. Post 3/6.

TELEPHONE HAND SETS.—Brand new with cord, 15/- each. Post 1/6.

MASTS, TELESCOPIC.—Extending to 12ft. in 7 sections, 15/6. Post 1/6.

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