MAKING A MICROSCOPE

NEWNES

PRACTICAL MECHANICS

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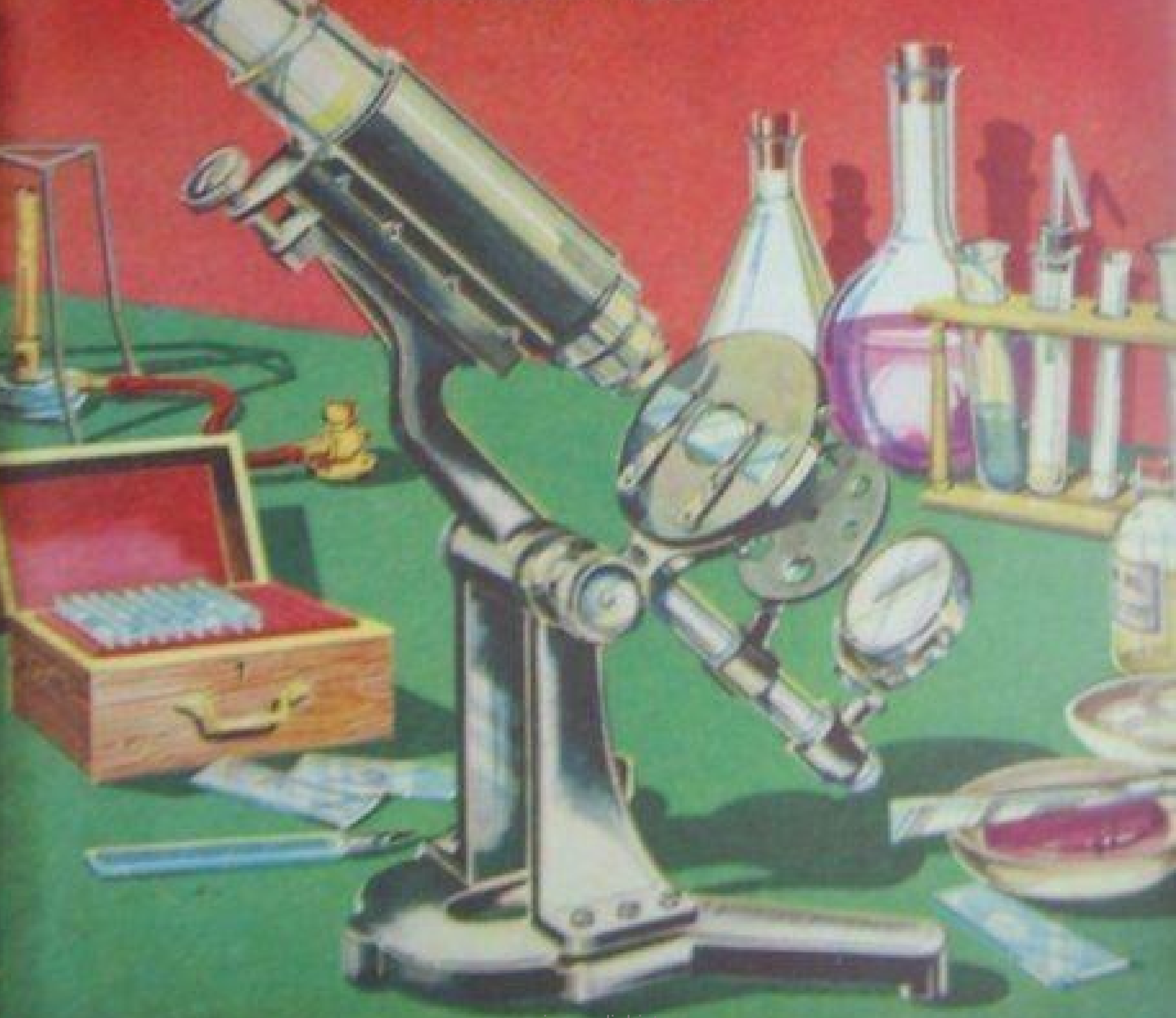
EDITOR: F.J. CAMM

JANUARY 1953



JANUARY, 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

Important Scientific Developments

FOUR important scientific developments have taken place since the previous issue of this journal went to press and they are bound, in time, to bring about important changes in the fields of electronics, power supply and locomotion.

SOLAR ENERGY

The first relates to the use of solar energy, concerning which a report was recently published by the National Physical Laboratory, based on the findings of the Committee on the Utilisation of Solar Energy. It may come as a surprise to many to learn that there is in existence even to-day some practical applications of the use of solar energy. They show that we can learn something from what hitherto were considered the unenlightened races. "Alas ! the poor negro with untutored mind," wrote the poet. Yet for a long time past they have been utilising, though on a small scale, solar energy for cooking. In South Africa, biltong, which is the meat of the antelope cut very thin rather like a rasher of bacon, has been cooked and dried by the heat of the sun. They also, by a simple system of lenses or collectors, make use of the heat of the sun for lighting fires.

The committee was appointed some time ago to investigate the possibilities of using solar energy and to indicate whether research work on the subject could be undertaken by the Department of Scientific and Industrial Research. Attention was chiefly confined to direct applications of solar energy, and indirect sources of such energy, including windmills, were ignored. There have been one or two projects for using solar energy, but nothing on any considerable scale for power and heating. The great problem, especially in non-tropical countries, is the intermittence of sunlight and the fact that least solar energy is available when it is required. At present the cost of designing and building collectors is high and that probably has deterred many from experiments.

The committee reached the conclusion that whilst present trends are not encouraging, and that we cannot expect to have solar energy in the immediate future, some applications may be possible in specially favourable circumstances. It is already successfully applied to the heating of water and house heating by means of collectors, the cooling of air for air conditioning by means of an ammonia absorption machine, cooking on a stove by means of a mirror, the production of power by means of a hot-air engine, developing power by thermo-electricity, producing fuel by photo-synthesis, and one or two other minor applications. These uses are chiefly in tropical countries. The amount of heat from the sun reaching the earth's surface varies only to a small extent and averages 1.35 kW per square metre. If someone could discover a practicable method of applying solar energy we could be independent of coal.

POWER FROM THE AIR

The second important development relates to power from the air. A company has been formed in France under the title of The National Association for the Utilisation of Aeolian Power, which really means the power of the wind. Progress has been such that experimental apparatus gives over 80 per cent. efficiency against 15 per cent. of the ancient windmill. One great advantage of this new system is that generating stations can be set up in series, whereas water turbines must be specially adapted for each particular place.

AIR TYRES FOR LOCOMOTIVES

The third development relates to the successful demonstration in France of the use of pneumatic tyres for underground trains. A 12,000-mile test has just been completed on the Paris Metro Railway, and after the test the tyres were found to be as good as new. The carriages run on specially prepared wooden flooring and it is stated that each tyre will last for 180,000 miles. The cost of upkeep, of course, is very much smaller than with iron tyres running on the iron road ; and the passengers travel in greater comfort and with very much less noise. The London Underground is investigating the system. The noise of rolling stock as the wheels pass over the expansion gap in each section of the track is considerable, and apart from noise the succession of jolts at fairly high periodicity causes excessive wear and crystallisation of some parts of the rolling stock.

TRANSISTORS

The fourth and probably most important development relates to transistors. The Radio Corporation of America has announced that they have successfully harnessed transistors, which are really tiny germanium crystals, and that they now perform many of the functions of electron tubes in a wide range of electronic applications such as radio, television and computors. A demonstration was given showing them operating an experimental television receiver, radio sets, loudspeaker systems and miniature transmitters. The television receiver was no larger than a portable typewriter case and it made use of a 5-in. cathode-ray tube. But for this there were no other tubes in the set. In other words it was valveless. It gave excellent results and, of course, can be operated by use of a battery. A car radio receiver employing transistors operated direct from a car battery without the usual rectifying unit and transformer. This receiver had push-button tuning and used 11 transistors. No valves whatever were employed, and it uses only one-tenth of the current of the standard radio receiver. R.C.A. also demonstrated a tiny radio transmitter employing one transistor and a few simple components.

These are important developments quite outside the sphere of conjecture, and a great deal more will be heard of them in the near future.—F. J. C.

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Making a MICROSCOPE

Constructional Details of a Practical Instrument for the Student and the Laboratory

By E. W. TWINING

THE design and drawings are for the making of an instrument of simple form, but of such size, construction and completeness as will enable the user to do serious and useful work in microscopy. It is possible to change the power of object glasses and eyepieces ; there is a revolving or rotary stage and an arrangement for taking a substage and mirrors ; there is no coarse rack and pinion focal adjustment, but there is a screw fine adjustment. The mechanical coarse adjustment is not really essential since the approximate focal position of the instrument in relation to the object under observation can be obtained by sliding the body of the barrel by hand and then getting critical sharpness by means of the milled head of a fine screw.

The Optical System

Before describing the practical construction of the microscope, the optical principles of the instrument must be dealt with, for every user of this magnifying system should understand the basic laws on which it works. Readers are referred to an excellent article which appeared in PRACTICAL MECHANICS for May, 1949, under the title "Lens Calculations Made Easy," written by Mr. J. A. Storer, B.Sc. There are one or two points relating to lenses which are not referred to and it is with these that it is proposed to deal.

Fig. 1 shows in cross-section six lenses, of which the first three, A, B and C, have the property of bringing light rays to a focus at a point and forming a real image ; these are known as converging lenses. In all such lenses the point at which parallel rays meet, after passing through the lens, is called its principal focus and the distance of this point from the lens is its focal length. If the rays proceed from a point, pass through the lens and meet again at another point, the radiant point and its image, after refraction, are known as the conjugate foci. The axis of a lens is a right line drawn perpendicular to its two surfaces, as the line through the centre of Fig. 1.

There is a very real relationship between the curvatures of lens surfaces and the resulting foci and the drawing Fig. 2 illustrates this. Parallel rays falling upon a double-convex lens are brought to a focus in the centre of its diameter ; conversely, rays emanating from that point are rendered parallel. The focus of a plano-convex lens having, on one side, the same curvature as the double convex, will have a focus equal to twice that of the latter. Actually the exact distance of the focus from the lens will depend to some extent upon the refractive index of the glass of which it is made as well as upon curvature. A lens of crown glass will have a longer focus than a similar one of flint glass, since the flint has a greater refracting power than crown. For all practical purposes, however, we may consider that the principal focus, for parallel rays, of a double-convex lens is at the centre of its radius of curvature and of a plano-convex at the opposite side of the circle. For a given radius of curvature the

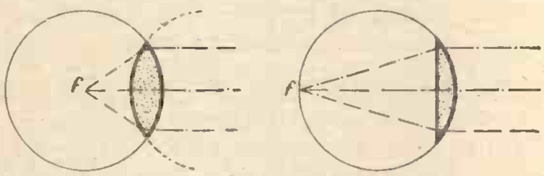


Fig. 2.—Foci of double- and plano-convex lenses of equal radius.

foci of a plano-convex and a double-convex are as 2 to 1.

The principal focus of a meniscus lens, as C in Fig. 1, having surfaces of differing curvatures may be found by multiplying the radius of curvature on one side by that of the other and dividing the product by half the sum of the two radii.

The refracting influence of diverging lenses D, E and F, in Fig. 1, will be the opposite of convex; parallel rays which fall upon them will diverge, as if from a principal focus which, in this case, is known as the negative focus. This will be, for a plano-concave lens, F, at the diameter of the sphere of curvature, and for a double-concave, E, in the centre of the sphere. Almost the only use which is made of diverging lenses is in conjunction with those which converge the rays, as will be explained in the following paragraph. Other applications of it alone are: as an eyepiece in opera glasses, for spectacles for the correction of short sight, and by artists as a reducing glass.

Abberations in Lenses

In the construction of a microscope, either simple or compound, the curvatures of all

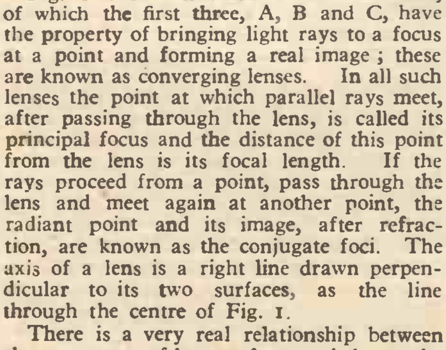


Fig. 1 (Left).—Six different forms of lenses ; A, B and C, converging, and D, E, F, diverging.

Note: All measurements can be taken off the scale at the right-hand side, but most of the dimensions are given in the detail drawings.

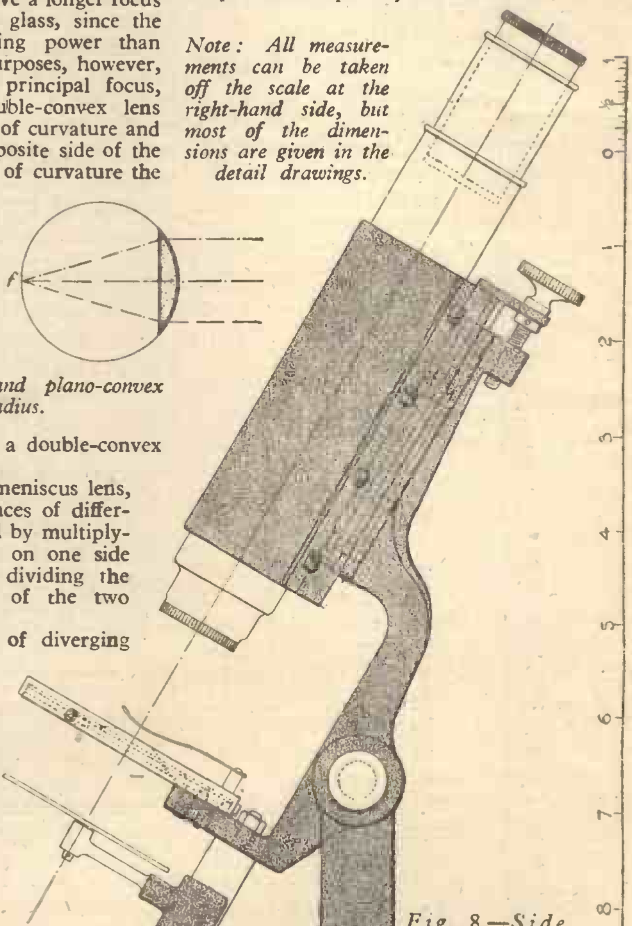


Fig. 8.—Side elevation of the completed microscope, reproduced half full size.

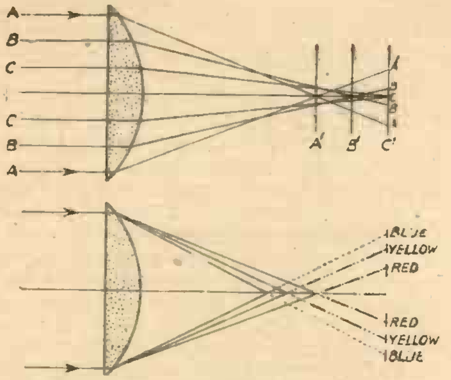
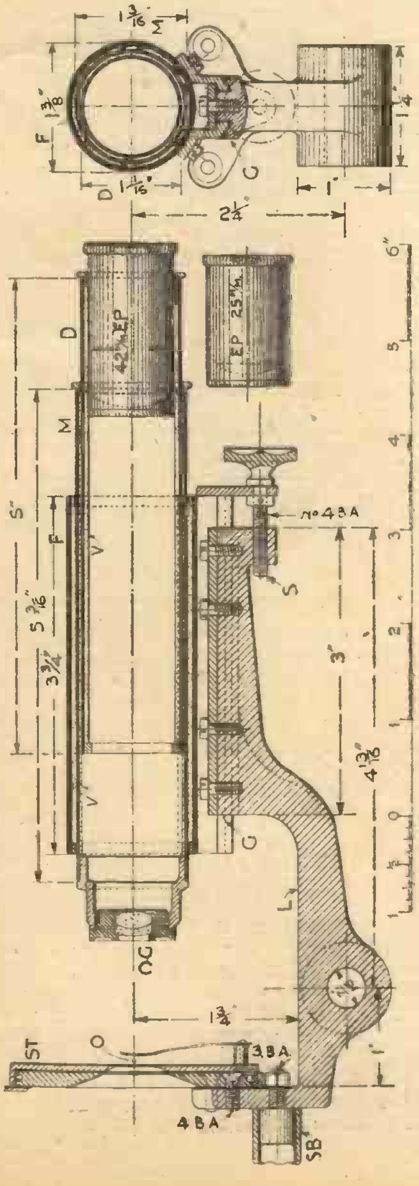


Fig. 3.—Diagrams indicating aberration, spherical and chromatic.

the lenses are spherical; converging lenses, however, with such curvatures have the defect of not bringing all light rays passing through them to one and the same focus, each circle of rays from the axis to the circumference being converged to a different point. This is shown by the upper diagram in Fig. 3, where it will be seen that the marginal rays, A,A, are more refracted and come to a focus at A1, nearer to the lens than B,B, and B falls nearer than C, the central ray being the longest of all. This defect is that known as spherical aberration, and it results in the image of the object viewed being rendered indistinct by all other rays than those, either central or marginal, according to the distance from the object at which the lens is held. In the microscope and the telescope there are two ways in which spherical aberration can be eliminated; the first, only partially, by cutting away or stopping off the marginal rays and so utilising only the central and those immediately around the centre, and second, by making the lens of two glasses, each of different refractive index, one of crown glass and the other of dense flint. The resulting combination would then be as if A, in Fig. 1, were placed in juxtaposition with D or F; convex side of A to concave side of the negative lens, the latter being the flint.

As I have said, microscope lenses are all of spherical curvature; this is because, by reason of their small size, it is not possible to grind, polish and figure them to any other form; large lenses, however, can be made which overcome the aberration and these are given curvatures which may be spherical on one side and either elliptical or hyperbolic on the other.

There is another, quite serious, fault in all single lenses; that is chromatic aberration, and by no alteration of form or figure can this be corrected. Any single ray of light passing through any part of a lens, except the optical axis, is split up into all the colours of the spectrum, in the manner and in the order shown in the lower drawing, Fig. 3, from which it will be seen that the blue rays are the most refrangible, that is to say, the most bent. Fortunately, by careful computation and design it is possible to combine crown and flint glasses of such refractive indices that both spherical and chromatic aberrations are greatly reduced and may, at a monetary price, be entirely eliminated. Examples of this complete freedom from aberration may be found in the highest grade photographic lenses, the photo-visual object glasses of telescopes and in the best microscope objectives.



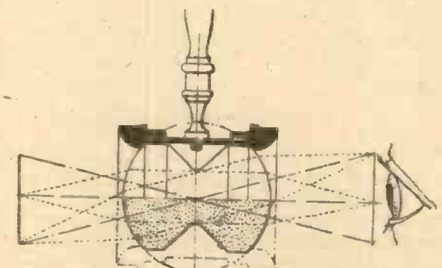


Fig. 4 (Above).—Sir David Brewster's hand magnifier. Fig. 7 (Left).—Longitudinal and cross-sections through the microscope, limb, and stage.

The Simple Microscope

The microscope in its most simple form consists of a single lens only, which, carried in a circular frame with a handle, is commonly known as a magnifying glass. Perhaps the most powerful form of such single lens is that designed by Sir David Brewster and illustrated in section in Fig. 4. It is known as a Coddington lense, simply because a Mr. Coddington, of Cambridge, had one of them made by an optician who gave it his client's name, supposing that it had been invented by him, though Coddington never laid claim to it, knowing, as he did, that Sir David had, nine years before, published his design. The form of the lens is that of a perfect sphere, with an equatorial belt ground away to form a cylinder, and with a deep circumferential groove around the centre of it. This groove has a depth of less than half the radius of the sphere and, when blacked, acts as a stop or diaphragm. As a magnifier it performs well and has a large field of view. It has sometimes been used as a telescope eyepiece. The focus, for ordinary crown glass, is 3/2 the radius of the sphere. It will be found a most useful accessory by the microscopist when walking abroad collecting specimens for examination later under higher powers.

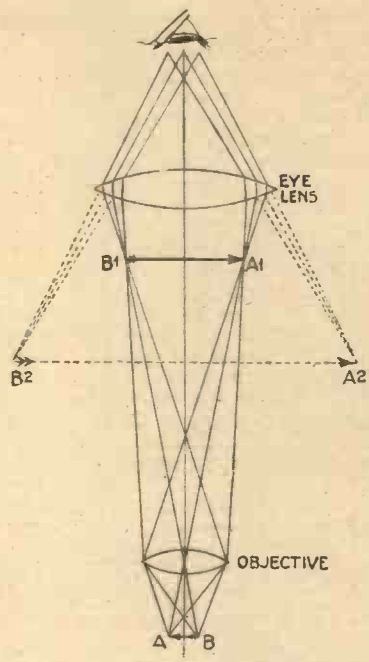


Fig. 5 (Above).—The optical principles of an elementary compound microscope. Fig. 6 (Right).—The optical system of the microscope.

The Compound Microscope

The limit in power with a single lens is reached and the next step is the combining of two lenses to obtain increased magnification; this is the compound microscope which, in its elementary form, is shown in the diagram Fig. 5, where two lenses are arranged in line above an object, lettered A, B. The lens nearer the object is the objective, and this is of short focus; the shorter it is the greater is its magnification.

A real inverted image of the object is formed at A1, B1. This image is then viewed through the eye lens, which forms an enlarged virtual image, A2, B2, resulting from the rays refracted by the eye lens and reaching the eye as if they came from points below the lens, where they would meet. Thus the final image, as seen by the eye, is the proportion between A, B and A2, B2.

Such a system possesses all the faults of aberration to which I have referred, and to give good definition both the objective and the eyepiece are composed of more than one lens. An objective of low power is an achromatic combination of one crown and one flint glass, but in higher powers there are often two, or perhaps three of such combinations, mounted in a cell, one above the other. The eyepiece is nearly always of the Huygenian form—invented by the famous astronomer, Professor Huygens—with two plano-convex lenses, placed a distance apart equal to half the sum of their two foci, with their convexed sides towards the objective. Optically, these eyepieces are exactly similar to those of astronomical telescopes.

Fig. 6 represents the low-power system of the microscope, the construction of which I am about to describe. The achromatic objective has a focus of 32 millimetres and the eyepiece an equivalent focus of 42 mm. In the diagram, which is drawn to scale, O is the object glass, or objective, F the field lens of the eyepiece and E the eye lens with, between E and F, a stop or diaphragm S. The course of the light is shown by three rays drawn from the centre and three from each end of the object; these rays, if not prevented by the lens F, or the stop S, would form an image at A, A, but as they meet with the lens F they are converged by it and, meeting at the stop, which is placed there to cut off all extraneous light, a further magnification of the image is effected by the eye lens E, precisely as if it were an original but larger object.

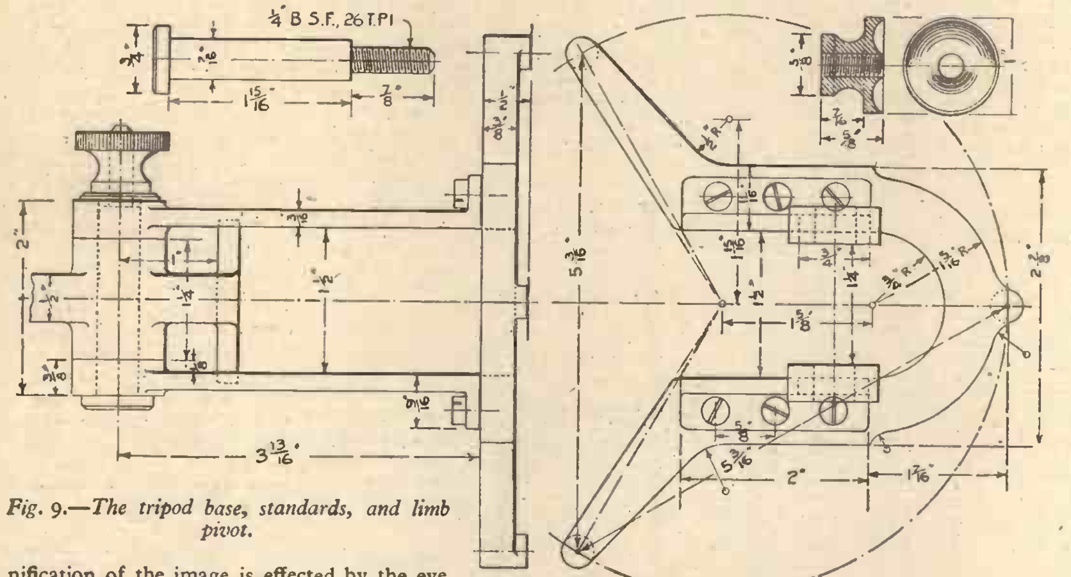


Fig. 9.—The tripod base, standards, and limb pivot.

Design and Construction

It will be seen from Fig. 7, which shows a vertical section through the optical centre line, through the limb and the stage, that the barrel of the instrument is made up of three tubes, one within the other. On the right-hand side they are also drawn in cross-section. The innermost is the draw-tube D, by means of which the distance between the objective and the eyepiece may be varied. This slides in the second, or middle, tube M, which carries the objective at its lower end. The objective tube is carried and slides in the outermost and, to all intents and purposes, fixed tube F. This outer tube is not actually a fixture, because it has a small up-and-down movement in guides G, carried by the limb L.

The amount of this movement, a total of half-an-inch, is controlled by the screw S, and is required for fine adjustment of the focus on the object O under examination on the stage ST. SB is the sub-stage bar, the purpose of which will be apparent from the next drawing, Fig. 8.

Velvet and Suede Linings

Three others items bearing reference letters in Fig. 7 are the 32 mm (1¼in.) objective OG, a 42 mm eyepiece EP, already shown in Fig. 6 (these, together, for low-power magnification) and a 25 mm eyepiece, also marked EP. The linings of all the tubes, lettered V, V, are indicated by stipple. These linings are of black velvet, each with the pile turned inward towards the polished surface of the tube, which has to slide in it. In the innermost tube, D, the velvet is really only required to form a cushion surface at the top for the eyepiece, but as velvet is a better non-reflector of light than even dead-black lacquer it may as well be carried right down to the bottom of the tube. For the lining of the outer tube, in which M will slide, use suede leather, with the suede surface inwards: in Fig. 7 this lining is shown somewhat thicker. If leather is used it should be put in not in one piece, but in strips each about half an inch wide; six strips, equally spaced, around the inner circumference. An alternative would be strips of cork. If, when the leather or cork is fixed, it is found that tube M is held too tightly, the surface can be reduced by No. 1 glasspaper, glued around a wooden mandrel.

With regard to the adhesive for sticking the velvet and the leather or the cork to the tubes. Glue is of no use; it would become brittle and leave the metal. The best plan is to clean the tubes with a piece of not too fine emery cloth, leaving a scratched and roughened surface. Give a single coat of thin shellac lacquer and then two coats of good oil varnish, either "oak" or "copal." When the second coat is tacky, i.e., partially dry, pass in the velvet or leather strips and press down on to the varnish; then leave the tubes open, at both ends, for three or four days for the adhesive to harden.

The design and arrangement of the guides G will be obvious from Fig. 7, but the attachment of the plate, through which the shaft of the screw S passes, may not be so clear. It is silver-soldered on the ends of the two dove-tailed guides which carry tube F, and the best way to do this silver-soldering will be to take another piece of the same tube and drill and tap and screw on the guides and use this tube as a jig to hold the guides in an upright position, resting upon the plates, the latter being supported horizontally on a piece of firebrick or asbestos card. Then, with a blowpipe, do the silver-soldering, taking care that both guides get an equal flow of solder.

Soft solder can be used in other places on the microscope; for instance, the rings inside the ends of all the tubes F, M, and D can be soft-soldered, and so can the ring into which the objective screws. This ring will be a small casting, turned all over and screw-cut, in the lathe, for the objective. The thread is ⅘in. diameter, with a pitch of forty threads per inch, but obviously the objective, all the objectives, in fact, complete in their cells, had better be obtained before the screw-cutting is done, so that the fit can be tested as the screwing proceeds.

Objectives, Eyepieces and Magnification

Both objectives and eyepieces can be purchased from Messrs. Broadhurst, Clarkson and Co., Ltd., 63, Farringdon Road, London, E.C.1. Eyepieces cost 22s. 6d. each, and the 32 mm objective is priced at 45s. Additional objectives vary between this figure and £4 10s., acording to the focal length required. High-power objectives are often made up of three achromatic combinations, the smallest nearest to the stage, and all dead central and true on the optical axis of the instrument. The smallest of these may be less than ⅛in. diameter. The reader cannot buy the bare lenses and mount them himself, as few workers outside the optical instrument trade have either the tools, the skill, the knowledge or the experience that such mounting of lenses calls for.

As it will be of considerable interest and importance to the microscope user to know what magnification he is getting with his objectives and eyepieces we are enabled through the courtesy of Messrs. Broadhurst, Clarkson and Co to give the table shown below.

The full list of objectives covers no less than ten of different foci, giving magnifications ranging from 7 to 1,275, all with the three eyepieces listed above, but certain of those whose focal lengths are in intermediate numbers of millimetres are omitted. It should be noted that an intermediate of 3 mm (not listed) and the 2mm objective are for oil immersion. The user of the microscope is recommended to purchase the first two eyepieces, the 42 and the 25 mm, and the first four objectives in the above list, leaving oil immersion to be acquired later.

Objectives focal length	Approximate magnifying power with eyepieces		
	42 mm	25 mm	17 mm
32 mm	25	45	65
16 mm	62	110	155
8 mm	115	200	285
4 mm	285	490	690
2 mm	530	900	1,275

To resume the making of the instrument. It may be noticed that reference has been made to screwcutting, in the lathe, the thread to take the objective. A much quicker way is to bore first and then, as the work revolves, to chase the thread with a chasing tool having teeth of 40 per inch pitch; but unless the reader is highly skilled in the use of this tool it is far safer to screwcut.

Referring again to Fig. 7, the limb L is a brass or gunmetal casting, as are also the dovetailed sliding guidepieces each secured by four screws, to the barrel F. The foot of L is a projecting bracket which carries the stage ST and the sub-stage bar SB. The top face of this bracket must be machined or filed to present a perfectly flat and true surface, square in all directions with the guides.

Fig. 9 shows full details of the three-footed base, the two supporting brackets and the 7/16in. diameter pivot and clamping pin.

(To be continued)

OIL-BURNING UNIT FOR STOVES

Converting a Slow-combustion Stove or Small Boiler to Oil Fuel Burning

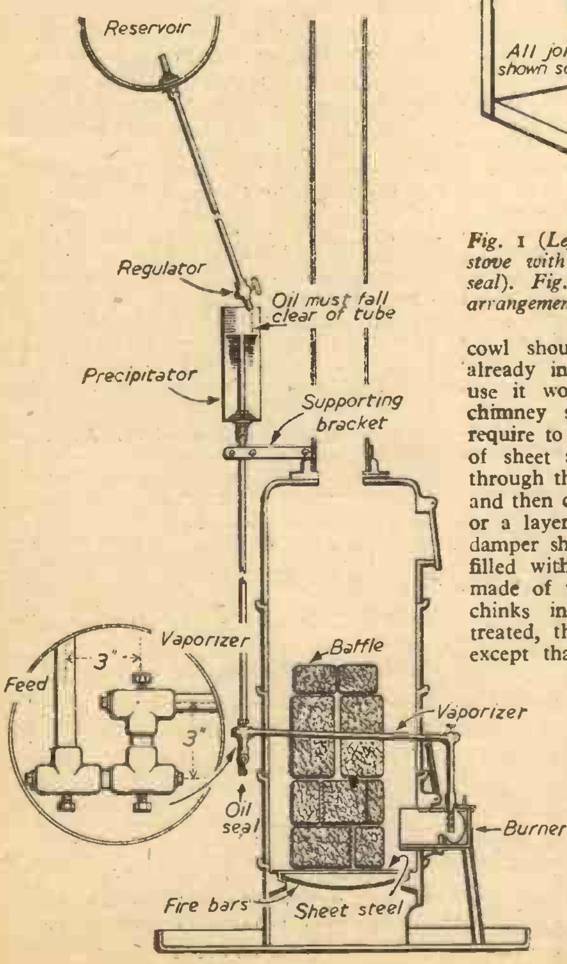
By W. A.

THE simple and practical oil-burning unit about to be described is intended for use in conjunction with slow-combustion stoves, small boilers, etc., and when fitted will enable waste sump oil of the motor trade to be substituted for the coal or coke normally used, which to-day is not only expensive but frequently difficult to obtain during the winter months. The burner described will enable fuel costs to be cut almost to nil without any falling-off in heating efficiency. No difficulty whatever should be encountered in obtaining plentiful supplies of waste oil as it is accumulated by every garage carrying out servicing, and as it is a most difficult substance to dispose of—it cannot be buried and should not be poured into the sewers—in the majority of cases the proprietor will be only too pleased to dispose of it cheaply to anyone who will take it off his hands.

Burners constructed to this pattern are particularly suited to use in workshops, greenhouses and garages, such being the usual locations of the type of stove mentioned, and although in point of fact the burner would function equally well fitted to a bungalow range or other enclosed type of domestic heater, the main difficulty here would be in arranging a suitable position for the feed tank, added to which the purring sound made by the burner when working would probably prove objectionable. The apparatus built by the writer was fitted to a cylindrical cast-iron stove standing 4ft. high and is in regular use for heating a building of some 13,000 cu. ft., where it raises the temperature much more quickly than was possible using coke and, moreover, when once the desired degree of heat has been reached it may be maintained for a reduced consumption of oil with no more trouble than just a slight adjustment of the tap, immediate control such as this being quite impossible with solid fuel.

Preparing the Stove

The first essential to success is a good natural draught, and where combustion is known to be sluggish or smoke puffs back into the building steps should be taken to remedy this state of affairs by lengthening the chimney pipe in order to carry it clear of the roof and any adjoining buildings. A cowl should also be fitted if one is not already in position. If coal has been in use it would also be as well to have the chimney swept. Next the fire bars will require to be covered up, either with a disc of sheet steel which may easily be fitted through the ash door if first divided in two, and then covered with an inch or so of sand, or a layer of fire-clay could be used. The damper should be removed and the opening filled with either fire-clay putty or a putty made of wet asbestos fibre, and any other chinks in the stove should be similarly treated, the object being to exclude all air except that taken in through the ash-door via the burner, leakages elsewhere reducing the effciency of combustion.



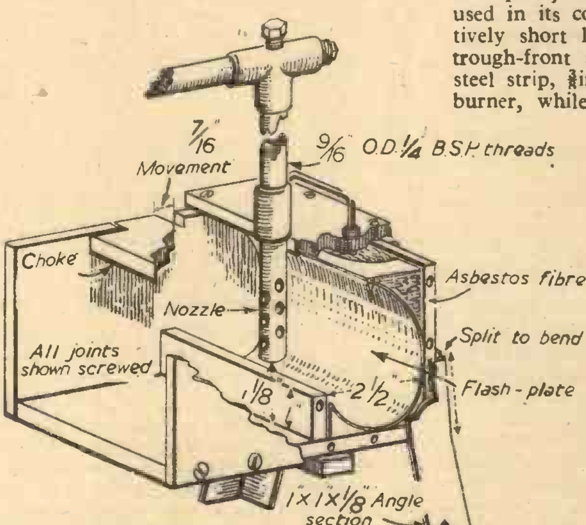


Fig. 1 (Left).—Section of stove with burner fitted (inset detail of oil seal). Fig. 2 (Above).—Part section showing arrangement of trough, nozzle and flash-plate.

Constructing the Burner

Reference to Fig. 1 will show how the burner fits into the bottom or ash-door of the stove, the door itself being lifted up out of the way, and it is the measurements of this opening that restrict the dimensions of the burner and also, to some extent, the heat generated. This latter, however, will not be a disadvantage, assuming a suitable size of stove to have been installed in the first instance, as in any event more heat will be generated from the oil than resulted from the use of solid fuel.

While no exact measurements can therefore be given for width or height—these varying with different sizes and makes of stove—in the case previously referred to these dimensions were 7in. and 4in. respectively—experiment has shown that the remaining measurements are more critical, those given showing the best results and should be carefully adhered to. A clearance of 1/8in. all round the burner is necessary to permit expansion. Examination of Fig. 2 will reveal that there is only one moving part, the choke, the purpose of which will be evident later, along with a removable cover for cleaning purposes, and a replacable flash-plate, necessary due to the light metal used in its construction having a comparatively short life. The bottom, sides, back, trough-front and cover are cut from mild steel strip, 3/8in. thick is suitable for a large burner, while 1/4in. would be ample in one not wider than 5in. The sections should be cut and assembled with due regard to the proposed method of joining, which may be by drilling and tapping to take 1/4in. or 3/16in. metal-thread screws, in which case the sides will be butted against the bottom and the joints caulked in the region of the trough. But where there is access to welding plant advantage should be taken of this as a more rigid and oil-tight job will result, and bottom and sides should now be arranged corner to corner (see Fig. 3) enabling the angle so formed to be filled with weld. After the back and trough-front have been fastened in, suitable strips of metal must be secured to the sides and bottom forming a stop to prevent the burner entering too far into the stove and also to help exclude air. The cover plate should now be assembled and light legs of suitable length attached to the end of the burner remote from the stove. The flash-plate is the next consideration and this should be bent up to the shape shown from about 18 s.w.g. sheet steel, and a replacement could be made at the same time. When fitting the flash-plate to the burner a piece of asbestos mill-board or a small quantity of asbestos string or fibre should be inserted between it and the back, thus conserving the initial heat. The plate is merely dropped into position without any permanent fixing, being held in place by the cover. A small hole should be drilled in the edge of the choke to enable it to be adjusted with a stout wire hook.

The Vaporizer and Nozzle

Sufficient 9/16in. steel tubing, depending on the size of the stove and the position of the feed-tank, should now be obtained along with four collars and four "T" joints. A small brass tap that will fit into one of the collars will also be required. The "T" joints are used at the angles to facilitate cleaning and should be drilled and tapped ¼in. B.S.F. opposite the leg of the "T" and fitted with an extra stud, so as to enable a piece of wire to be passed through each of the tubes in the system. The tubes are now fitted together as shown in Fig. 1 and for this purpose a ¼ B.S.P. die will be necessary. Two ⅜in. holes must be drilled in the casing of the stove, one centrally above the open ash-door (about 6in. above the top of the burner) and the other opposite 1in. higher up. These are to accommodate the vaporiser tube. The three "T" joints connected to the vaporiser at the back of the stove form an oil seal and enable a low pressure to be generated. Screwed into a collar at the bottom end of the front tube is the nozzle, this being made from a short length of tube reaching from the level of the trough edge to the underside of the cover-plate, and is drilled right through with a series of ¼in. holes, three in each direction.

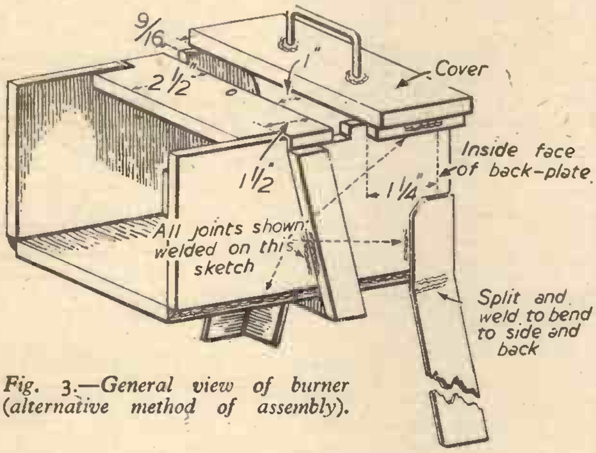


Fig. 3.—General view of burner (alternative method of assembly).

As only unfiltered oil is used in the burner the sediment must be removed by precipitation and this is achieved by fitting the device shown to a collar at the top of the back pipe, about a foot above the top of the stove, and removing and emptying as required. This is simply a canister attached to a short piece of tube which passes through its base reaching to within 3in. of the top and secured by nuts and washers at each side. Between the upper washer and the metal a second one of soft leather should be placed just to make the job oil-tight, or alternately the whole could be welded together.

Arranging the Baffle

In order to prevent the burning gases from being drawn straight up the chimney, so wasting their heat, a baffle must be constructed of loosely placed fire-bricks—or part bricks if a small stove—in such a way that the flames are forced upon the vaporising tube and against the sides of the stove before making their escape. In the writer's stove the bricks are stacked as indicated in Fig. 4 and the efficiency of the arrangement is shown by the fact that within an hour of lighting the cast-iron casing can be made to glow at a bright-red heat for more than half its height, and, of course, heat continues to be radiated by the bricks for a considerable period after the oil has been shut off.

The Oil Feed

A 10-gallon drum is quite suitable as a reservoir, although any sort of tank of similar capacity would answer equally well, and this should be located at a convenient point above the height of the stove and fitted with a suitable length of tube to reach just above the precipitator where it is terminated with a small brass tap or valve with which to control the oil consumption and the heat generated. If a convenient beam is available the drum can be suspended by sheet metal straps in a horizonal position. The tube should project into the drum some 3in. or so as an added precaution against sludge or water reaching the vaporiser. A hole of suitable size must be made at the opposite side of the drum to the outlet to permit of filling, and probably the simplest method of carrying out this operation is by means of a stirrup-pump from a 5-gallon drum on the floor.

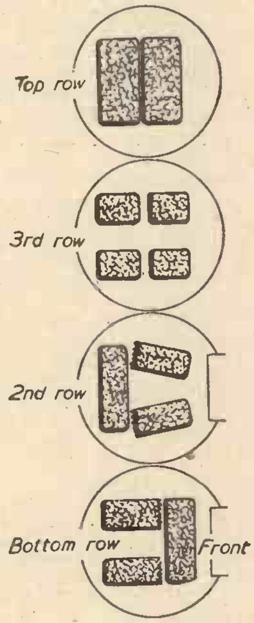


Fig. 4 (Right).—Plan of baffle courses.

Cycle of Operation

To start the stove, first of all open the tap and allow the oil to come level with the top of the tube in the precipitator. A scrap of cotton waste is then placed in the trough just beneath the nozzle and a gill of paraffin is poured into the top of the tube within the precipitator (here a warning against the use of petrol should be noted, as the vapour would inevitably be drawn into the body of the stove with disastrous results as soon as a light was applied) and with the cover removed from the burner to reduce the draught, the waste is lit. Replace the cover and close the choke right up to the nozzle, when the paraffin will burn fiercely. Now is the time to open the oil valve again, regulating it at first to give a tail of oil about 1/16in. thick. Until the vaporiser heats up, wet oil will run from the nozzle and burn in the trough, and care should be exercised to ensure that the trough does not run over. After about five to ten minutes it will be seen that the oil in the trough is drying up and that a fierce flame is generated round the nozzle, now burning completely vaporised oil. The flame spreads to the full width of the burner, following the flash-plate from the trough up to the choke opening, whence it is sucked down and into the stove by the force of the incoming air, hence the need for an efficient chimney and the sealing of all chinks. At this stage the choke is fully opened (1in. gap) and the feed regulated to provide the required heat, when the stove will burn all day without further attention other than the occasional removal of carbon from the trough with a small scraper, and even this may not be necessary unless the oil is very dirty.

Accelerating Combustion

It should be explained that the purpose of the flash-plate is to accelerate combustion in the early stages; once the burner has become properly heated (550-600 deg. F.) it would function equally well if this were omitted. Although the cotton waste would burn away in time, a cleaner flame will result if it is pushed into the body of the stove with a piece of wire as soon as the surface of the oil in the trough is well alight. Maximum oil consumption in a large burner should fall short of a gallon an hour, and for average needs two to three hours to the gallon can be expected. Before starting up on subsequent occasions the plugs in the ends of the vaporiser and burner tubes should be screwed out to enable these tubes to be cleaned with a stout wire or rod, and the holes in the nozzle should be cleaned at the same time.

Central Heating Boilers

In conclusion, it should be mentioned that in some types of boilers, such as the "Robin Hood," it will be found impracticable to pass the vaporiser through the body of the appliance, and when adapting them to use oil, the burner, which should not exceed 4in. in height, must be fitted in the lower part of a plate made to cover the ash-door opening. A double vaporiser tube is then arranged to pass through the upper part of the same plate, the oil seal being fitted at the side of the burner. Where the height of the ash opening is insufficient to accommodate both burner and tubes, the latter would have to be arranged in a separate plate fitted to the upper opening and directed downwards towards the flames inside the boiler.

An Electric Floor Polisher

Constructional Details of an Inexpensive Appliance for Home Use

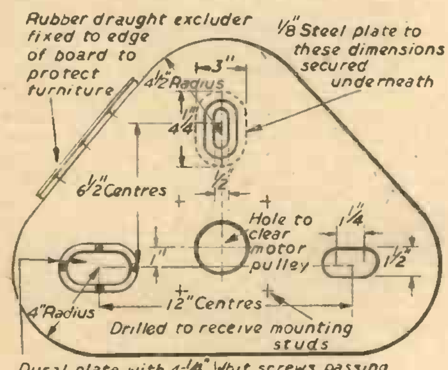
By E. G. H.

The completed floor polisher ready for use.

THE machine described below was originally made for polishing the sawdust composition floors which are being extensively used in these times of timber shortage. It will, however, give a high polish to linoleum, parquet, etc.

Although the machine is similar outwardly to some commercially made polishers, the details are modified to enable it to be easily produced in the amateur's workshop. A 3½in. lathe will cope with all the turning, which is quite straightforward.

The machine is purely for polishing, the application of polish being by hand.



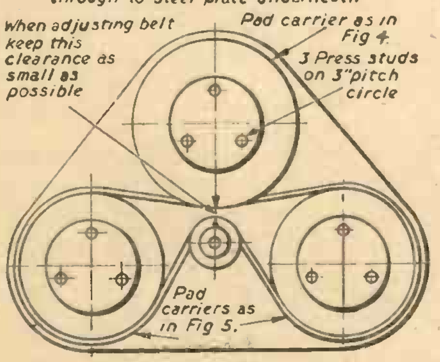


Fig. 3 (*Above*).—*Plan of base layout.*
Fig. 8 (*Below*).—*Underside of base showing the path of the vee belt.*

General Arrangement

The appliance consists of a motor mounted vertically over a triangular plywood board, and driving on the underside three ball-bearing pad carriers by vee belt. The drive is so arranged as to rotate the front pad carrier in the reverse direction to the other two. Detachable felt polishing pads take the place of the conventional (and expensive) rotary brushes. A tubular handle is hinged to the two lower motor feet, and carries an "on-off" switch in a convenient position. The tee handle is large enough to give complete control over the machine when in use.

The following details need not be strictly adhered to as the reader may have similar components or materials to hand which he wishes to utilise.

The machine described, however, has been found to be the most satisfactory of several types constructed, and has given the writer trouble-free service over the past three years.

The Motor

This is a ¼ h.p. induction motor running at 1,425 r.p.m. It should be noted that as this unit is mounted vertically there will be an appreciable end thrust on its lower bearing due to the weight of the rotor. A ball-bearing motor will support this weight without trouble, but should the reader have a motor with bronze bush bearings, trouble might develop due to the shoulder of the rotor spindle sinking into the end of the bush. However, a motor of this type can be used quite satisfactorily by modifying the lower bearing in either of the ways shown in Figs. 1 and 2.

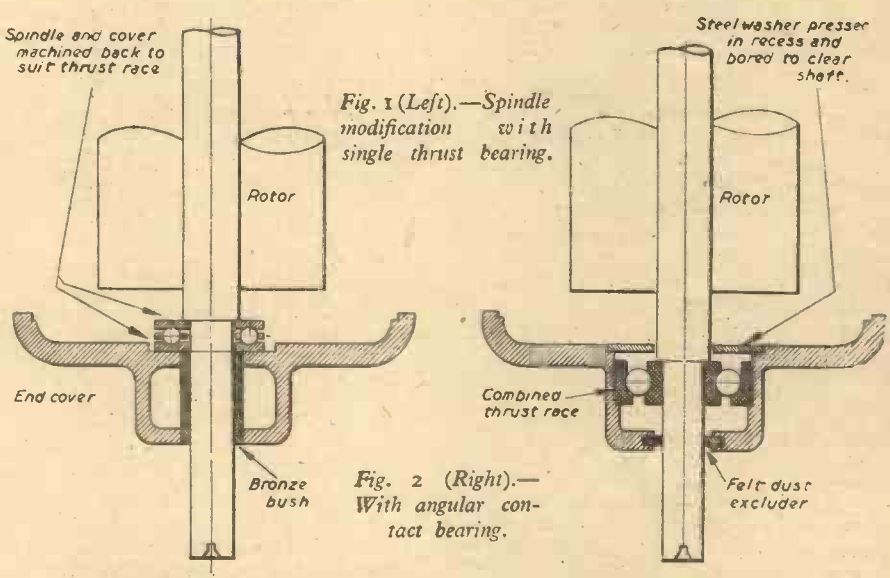


Fig. 1 (*Left*).—*Spindle modification with single thrust bearing.*

Fig. 2 (*Right*).—*With angular contact bearing.*

Modified Bearings

Which method to use will depend on the design of the end cover. Some types have a compartment surrounding the actual bearing and containing an oil-soaked worsted packing. Reference to the table of race diameters given below in conjunction with the spindle sizes

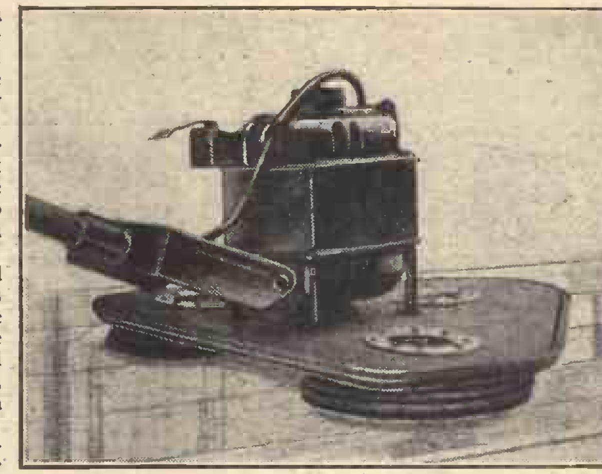
MATERIALS REQUIRED

Amount or No. Required		Use
1	¼ h.p. motor suited to mains supply	
1	5 amp. "micro break" switch	
1	3-pin plug to suit supply point	
1ft. 6in.	¾in. conduit	Handle.
1	¾in. 3-way junction box	"
2	¾in. brass bushes	"
2ft. 6in.	1in. O.D. cycle tubing	"
1	¾in. gas socket	"
1ft. 6in.	1¼in. × ⅛in. flat mild steel	"
2	⅝in. bore rubber grommets	"
6in.	⅜in. × 1/16in. spring steel	" clip.
1ft. 6in.	¼in. round mild steel (bright)	" pivot.
1ft.	¾in. × ⅛in. flat mild steel	" bracket.
3	⅜in. × 1in. hexgonal bolts	Bracket bolts.
1ft. 8in. × 1ft. 3in.	½in. plywood	Base.
18	¼in. × 1in. B.S.F. round-head steel screws	"
10in. × 5in.	18 g. dural or aluminium	" (slots).
2yd.	Rubber draught excluder	" protector.
10in. × 5in.	⅛in. mild steel plate	" (adjustment).
2ft. × 8in.	⅜in. hard fibre or seasoned plywood	Pad carriers.
3	½in. × 1in. Whitworth set screws	" "
3	½in. Whitworth hexagonal nuts	" "
9	½in. flat washers	" "
3	1¼in. " "	" "
3	⅝in. bore ball races (Hoffmann No. LS7)	" "
18	Carpet press studs	Pads.
1yd. sq.	3/16in. art felt	"
1	2½in. × ⅜in. vee pulley (bore to suit motor)	Drive
1	⅜in. vee belt (54in. approximately)	"
	Sufficient rubber 3-core flex.	
	Sundry washers, screws, etc.	

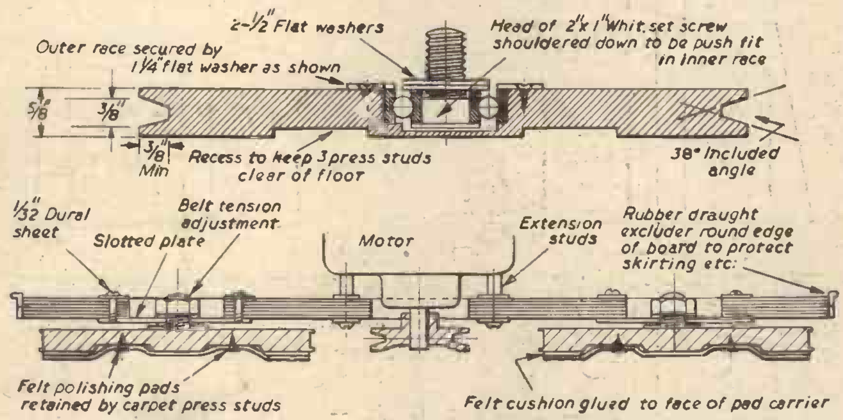
will enable the reader to determine if the housing can stand boring out to carry an "angular contact" single-row bearing.

If the foregoing method is decided upon, set up the end cover in the 4-jaw chuck true to the register, and bore out a tight push fit for the race as shown in Fig. 2. The rotor spindle should also be machined to be a tap fit in the bore of the race, care being taken to form the shoulder to bring the rotor into its original position. Before assembly the race may be lightly packed with soft grease. A flat washer, bored to clear the spindle and pressed into a counterbore above the bearing, will protect the race from grit and dust and help retain the grease.

The alternative method is to still use the bronze bush, but to take the rotor weight on a single thrust bearing. Again the end cover should be set up in the lathe true to the register, but in this case only faced back to accommodate the race. To avoid reducing the length of the bush too drastically, the shoulder on the spindle may also be machined back. Here again care should be taken to ensure that the rotor is brought into its original position.



Close-up view of the polisher.



Figs. 4 and 5.—Sectional views giving details of pad carrier bearing and arrangement of motor and rear pad carriers.

The Motor Board

This is a piece of ½in. plywood shaped as shown in Fig. 3. The three slotted plates, of ⅛in. mild steel, which provide belt adjustment, are drilled and tapped ¼in. B.S.F. and secured to the underside of the board by round-head steel screws. The aluminium pieces surrounding the adjustment slots add to the appearance of the machine and also prevent the screw heads from sinking into the wood.

A length of moulded rubber draught excluder is secured to the edge of the motor board by suitable large headed nails and prevents woodwork, etc., from being damaged if in contact with the machine.

The motor itself is mounted on the board by four special studs (Fig. 7), which take the place of the end cover securing crews (or nuts). The size of these studs will, of course, vary with the make of motor.

Dimensions of Hoffmann Angular Contact Bearings			
No.	Bore	Outside Diam.	Width
LS 5 AC	½in.	1 5/16in.	⅜in.
LS 7 AC	⅝in.	1 9/16in.	7/16in.
LS 8 AC	¾in.	1⅞in.	9/16in.

Dimensions of Hoffmann Single Thrust Bearings			
No.	Bore	Outside Diam.	Width
W ½in.	½in.	1 9/32in.	⅝in.
W 9/16in.	9/16in.	1 13/32in.	⅝in.
W ⅝in.	⅝in.	1 13/32in.	⅝in.
W ¾in.	¾in.	1 17/32in.	⅝in.

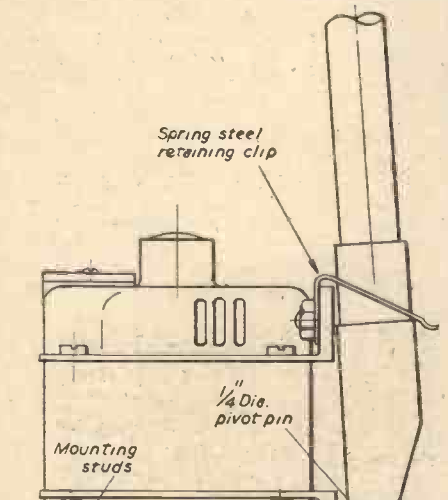


Fig. 7.—Detail of motor and lower end of handle.

The Polishing Pad Carriers

These are made from ⅝in. hard fibre or seasoned plywood to the dimensions given in Fig. 4. It will be seen that the front carrier is vee grooved, but the two rear ones are machined to take the back of a standard ⅜in. vee belt. The belt is fitted round the motor pulley and pad carriers as shown in Fig. 8. On the original machine the length of vee belt required was 54in., but slight variations in diameter of pulleys, depths of grooves, etc., may necessitate a belt of different length.

The ball races used are the plain single row type of a suitable size. Those used by the writer were Hoffmann LS 7, which have the same dimensions as the LS 7 A.C. race shown in the table. The races should project 1/64in. above the pad carrier to enable the securing washer to pinch the outer track.

The carriers are part covered on the underside with felt to provide some degree of resiliency when polishing uneven surfaces. A proprietary adhesive may be used, but carpenters' glue has given no trouble on the writer's machine. The pads are of art felt (about 3/16in. thick) and should be ⅛in. larger in diameter than their carriers. They are secured by three carpet press studs such as are used in car upholstery. It is suggested that at least three sets of pads be made for normal usage.

The Handle

This is quite straightforward, and here again the details need not be strictly adhered to. On no account, however, should the tee handle be replaced by the "vacuum cleaner" type or difficulty may be experienced in controlling the machine.

The stem of the handle is 1in. O.D. steel cycle tubing, brazed at the upper end to a three-way junction box, which has been shouldered down to receive it, and at the lower end into a bored out ¾in. gas socket brazed to the yoke (Fig. 6). Two 7in. lengths of ¾in. conduit screwed at both ends and two bushes complete the handle. A 5 amp. "micro-break" switch (contacts of which are heavier than the ordinary type) is fitted to the junction box. The three-core flex is now threaded through a grommet fixed in the back of the box and the live side cut and taken into the switch. The earth wire should be bared for a length of 1in. and looped under the head of a 2 B.A. brass screw and washer tapped into the inside of the box. The flex may now be

(*Continued on page 169*)

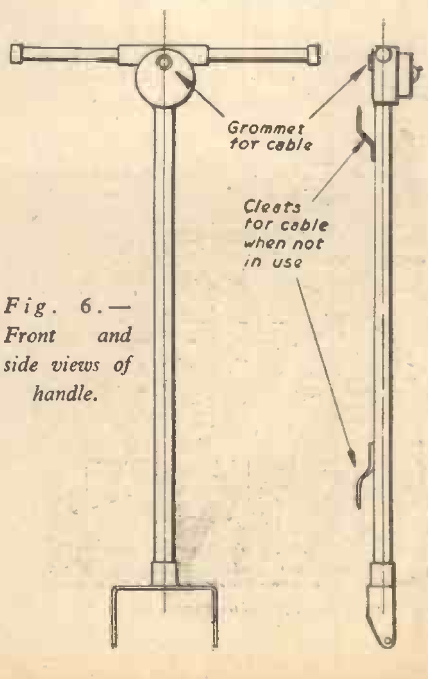
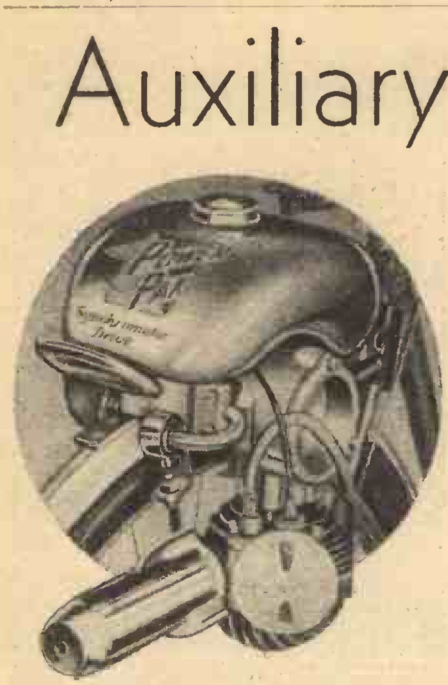


Fig. 6.—Front and side views of handle.

Auxiliary Engine Units for Pedal Cycles

A Review of Some of the Latest Models Shown at the Recent Cycle Show at Earls Court

By R. L. JEFFERSON



The Power Pak unit with synchromatic drive.

THE display of auxiliary motor units, or "clip-ons" as they have come to be called, was more comprehensive than ever at the Earls Court cycle show this year.

The "Cyclaid"

On Stand No. 148 the British Salmson company were displaying the "Cyclaid," a belt-driven unit fitting directly over the rear wheel. The "V" belt of rubber texture operates from a pulley on the engine to a rim securely bolted to the rear wheel spokes.

The unit, a 2-stroke of 31c.c., has a compression ratio of 1 : 5.6. The cylinder is an aluminium casting with a steel liner with detachable head. Extension hub bolts and nuts are supplied with the unit, and these are hollowed to take a 3-speed cable if necessary. Throttle control is of the twist grip type and should be fitted on the right side of the handlebars, and the decompressor on the left. The motor support is adjustable to take various sizes of wheels. The unit is made by British Salmson Aero Engines Ltd., 76, Victoria Street, S.W.1. The retail price is £24 complete.

"Cyclemaster"

The very popular "Cyclemaster" on Stand No. 140 has been improved by increasing the capacity to 32 c.c., and incorporating a coil in the dynamo for lighting purposes.

The Cyclaid belt-driven unit.

This unit is supplied as a built-up wheel complete with tyre and tube, the rim being of extra heavy gauge. The braking is of the back-pedalling hub type with positive action. Although the capacity of 32 c.c. may seem small the makers claim a performance equal to many larger engines due to the advanced design of the inlet valve. Drive is through chains and an oil-bath clutch, this latter enabling the engine to be kept running when the cycle is at rest. Lighting and ignition are built in and consist of the Wipac unit. The complete unit retails for £27 10s. and is guaranteed for six months.

Showing the compact arrangement of the Cyclemaster.

On Stand No. 50 Britax (London) displayed a new and novel unit, The "Lohman Motor." This is of the compression ignition type and, of course, dispenses with sparking plug, magneto and carburettor. The unit is fitted unobtrusively below the bottom bracket, and transmission is by a roller of easily adjustable type; it is claimed to be non-slipping.

The capacity is 18 c.c. with bore and stroke of 28 mm. and 30 mm. The engine achieves .75 b.h.p. at 6,000 r.p.m. The fuel consumption is given as 350 m.p.g., and the weight is 11 lb., which latter is an amazing figure for such a performance. The price is 24 guineas.

The "Cucciolo"

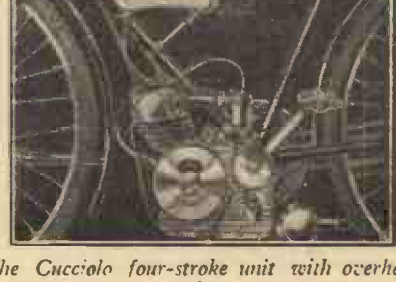
Britax also displayed the Ducati "Cucciolo" ("Little Pup"). This little unit has several very distinctive features. It is a 48 c.c. four-stroke with overhead valves, and has a two-speed pre-selector gearbox. The drive to the rear wheel is direct by chain, lighting current is supplied by separate L/T coil. The positioning of the unit at the bottom brackets makes for stability. The engine develops 1.25 b.h.p. at 5,250 r.p.m. Lubrication is, of course, indepedent and fully automatic. The machine is a first-class example of Italian workmanship. The price complete is £40, and H.P. terms are available. The address is Britax (London), Ltd., 115-129, Carlton Vale, N.W.6.

The "Mosquito"

Mosquito Motors Ltd., Moorfields, Liverpool, 2, were showing their well known units and also a complete cycle. This latter has been specially built to take the unit. Seat tube length is 21in. and all tubes are of heavy gauge, as are the chain stays. On this model the standard fork is a heavy duty type with large diameter ball bearings. A spring fork can be supplied for an extra £4. Braking is by Perry coaster hub to the rear wheel; the front brake is a heavy duty stirrup type. When spring forks are fitted the control is by cable. The equipment on this cycle includes pump, toolbag and tools, taxholder and bulb horn. The panniers in the illustration are an extra at 59s. 6d.

The "Mini-Motor"

Trojans were occupying Stand No. 149 and were showing the new Mini-Motor Mark III, which has been reduced in price to £18 18s. 0d. There are several detail improvements; an entirely new lever enables the engine unit to be raised clear of the tyre or lowered into contact with it. The



The Cucciolo four-stroke unit with overhead valves.

An exploded view of the Power Pak unit.

engine is a 49 c.c. 2-stroke. The tank, which has a capacity of $\frac{5}{8}$ of a gallon, is rigidly attached to a chassis of new design; the decompressor is in conjunction with the throttle level to facilitate starting.

The "Mobylette" unit has several distinctive features.

Trojans have special easy terms of only £2 down, the balance can be spread over nine months. There is a fitting charge of 15s., tax, insurance, etc., bring the amount up to approximately £5 10s. od. The address is Mini-Motor (Great Britain) Ltd., Trojan Way, Croydon, Surrey.

On Stand 111 Motor Imports Co. were showing the front wheel drive "Berini." This company have taken over the distribution of this unit which remains unchanged from last year's model. The price has been reduced to £19 19s. od.

The Mini-Motor, which is a friction-drive on the back wheel.

The "Mobylette"

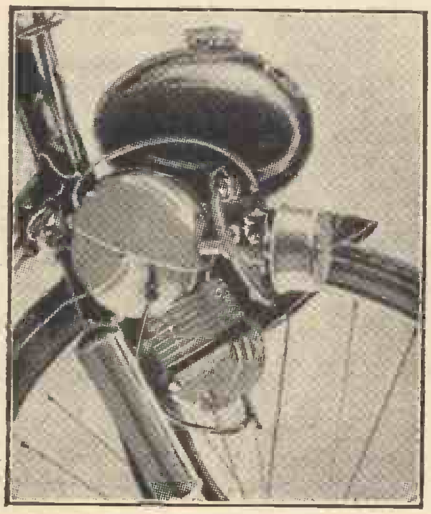
This firm also distribute the Mobylette autocycle of 49 c.c., the price of this has been reduced to £39, plus £10 16s. 8d. purchase tax.

The machine which really took my eye on this stand was the super de-luxe model at £69 12s. 10d. This machine has a clutch and internal expanding rear hub brake, the frame has twin top tubes which are braced at the junction of the seat tube, and continue through to the rear fork-ends. The down tube of substantial diameter is slightly curved to accommodate the engine. The transmission by chain is $\frac{1}{2}$in. by .305. Ignition and lighting are from the flywheel magneto. The tyres are oversize balloons in white rubber, and brake levers are of the inverted type. The capacity of this model is the same as the standard model. Teledraulic forks of neat design completed a very attractive machine.

The "Power Pak"

The popular Power Pak was on Stand No. 74 at the reduced price of £25 4s. od. The distributors, Sinclair Goddard and Co., 162, Queensway, W.2, were also showing an improved model at £27 6s. od.

This model incorporates synchromatic drive of self-engaging type with single plate clutch starting, stopping and clutch operation are automatically controlled from a single lever.



The front-wheel drive Berini unit.

The VeloSolex with the engine mounted over the front wheel.

Both the standard and improved models are of 49 c.c. They are supplied with magdyno, anti-splash guards and a Power Pak pennant.

It should not be forgotten that the Dunlop "Motorette" tyre was evolved in collaboration with the Power Pak experimental staff.

"VeloSolex"

A frame of advanced design was that of the VeloSolex, which is of the open swan neck type built up in four units to facilitate replacement should the need arise.

The engine, which is a two-stroke 3-port of 45 c.c., with bore and stroke of 38 mm. and 40 mm. develops .4 h.p. at 2,000 r.p.m.; the carburettor is of the floatless type fed by a Solex fuel pump. The engine is coil sprung and rubber suspended. Drive is by roller from the ballraced crankshaft. This machine, a complete autocycle, has a dry weight of 60lb.; the price is £37 10s. od., plus £10 8s. 4d. purchase tax.

The 1949 Cycle Show was conspicuous for the absence of these little units, but at the 1951 show there were ten firms displaying them. This year there were even more. All have been improved, some very greatly, and many have been reduced in price.

The answer to the dismal prophets who called them a flash in the pan is the number one sees on the roads of nearly every country of the world.

Showing the panniers fitted to Mosquito motor-driven cycles.

The Armament of Ship Models

With Particular Reference to Models of Old-time Vessels

By R. K. BATTSON

MANY builders of "period" ship models, unless they are working to a really authentic plan (of which there are lamentably few) tend to over-arm their vessels, both as to the number of guns and their size. A small galleon under sail, displaying what appear to be about fifty beer-bottle necks on each side, may, or may not, be decorative; but it is certainly not accurate.

The average period model of about 3ft.

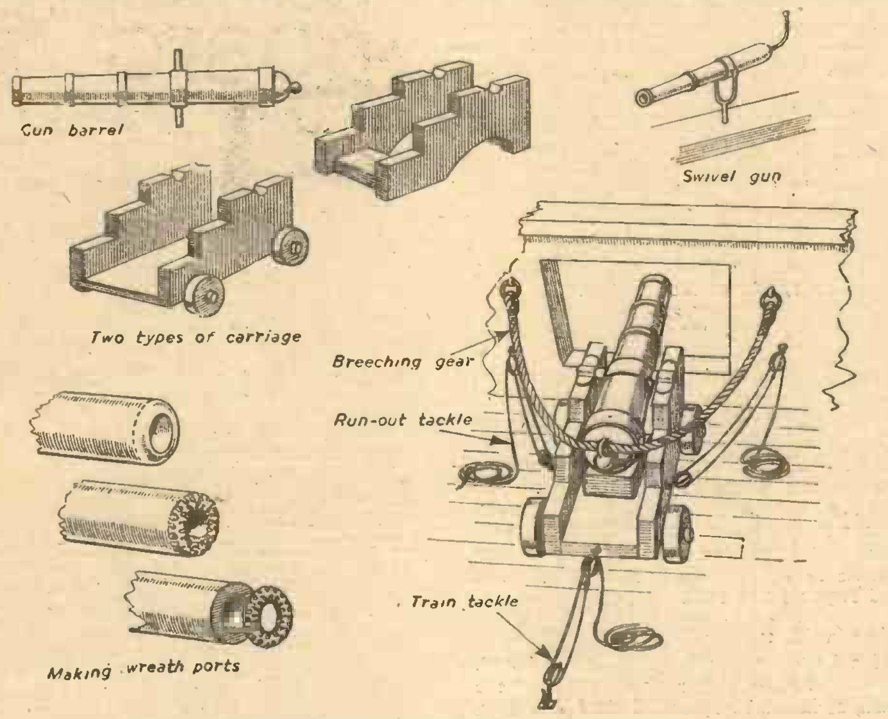


Fig. 1.—Component parts and tackles for old-time cannon.

in length, is approximately ⅛in. scale; and an upper-deck gun in this scale is only ¾in. long overall, including the carriage, so it will be seen that some restraint is called for. Commercial firms mostly offer guns which are quite the wrong shape, and grossly oversize for all but a really huge model. So it is better (and less expensive) to make one's own.

It should be noted that, except when actually about to fight, a ship's guns were run in, and, under sail, most of the portlids closed, so that it is neither necessary nor desirable to display serried ranks of grinning muzzles. Not too much notice should be taken of old ship pictures in this respect; the artists were rarely seamen (as their peculiar ideas on sails and rigging disclose) and they loved the mass display of impossibly large cannon.

Making Cannon

Owners of lathes will, of course, need no advice from me to turn their guns in brass, but less fortunate folk can get by very nicely with fine dowel rod. This should be slightly tapered towards the muzzle, and the reinforcing rings represented by narrow strips of glued paper wound neatly in place. A piece of stout wire passed through a previously-drilled hole will represent the trunnions, and a pin, driven up to its head in the breech end, the cascabel. Bore out the barrel for a short distance, and paint with finely-ground brass paint, or black to which a little brown has been added; the latter for bronze or iron guns.

Carriages can be built up from thin wood (two side pieces and a floor), the sides being notched for the trunnions, and cap hinges added in thin card. Four slices of dowel rod will provide the trucks (wheels), and can be glued in place, and a small elevating wedge inserted under the breech end of the barrel.

Later developments of the carriage were built up of separate timbers instead of having a solid floor.

Where the scale permits, some attempt should be made to show the breeching gear, run-out and train tackles, but in the normal ⅛in. scale, the blocks for these purchases would be about the size of a carroway seed and, rather than fit over-scale gear, it is much better omitted.

In a solid hull, lower and between-deck guns, where only the muzzle portion is visible, can be mounted on plain block carriages, inserted in a morticed hole, somewhat larger than the gunport, cut in the hull before the side and bulwark pieces are pinned in place.

In some of the elaborately-decorated ships of the 17th and 18th centuries, carved wreath-ports were fitted. These can be worked up either in plastic wood, or, better by first shaping a round stick of wood to the outside diameter of the wreath, and then boring out the middle to the interior diameter, to the depth of an inch or so. The edge is then rounded and lightly carved, either with a small file or carving chisels, and thin slices cut off (being careful not to break the piece across the short grain), glued to the hull over the gun-port proper, and gilded; when two or three slices have been cut from the stick, it can be bored deeper.

Small swivel-cannon can have their barrels made as described, the handle being formed from a pin bent at right-angles, and the whole mounted in a soldered-up wire crotch fitted in the bulwarks.

Eighteenth-century carronades were altogether shorter and fatter than the gun; in some forms, they were mounted on slides instead of carriages, with screw elevating gear. The slide carriage pivoted at one end, the other running on the deck on rollers to provide a training arc.

Modern Armament

Modern turret guns are quite straightfor-

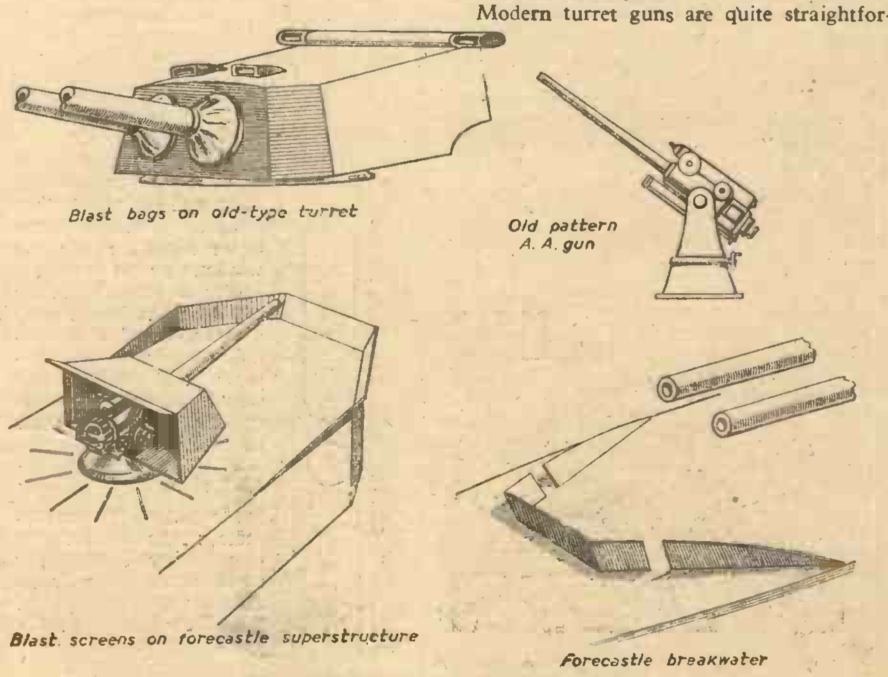


Fig. 2.—Modern types of Naval armament.

ward, and can be arranged to elevate if desired by drilling right through guns and turret at the breech end and mounting on stout wire which is a tight fit for the holes, and the ends of which are nipped off and filed flush with the turret sides. The older pattern guns had white canvas covers (called blast bags) fitted at the point of entry into the turret, and these can be worked up in plastic wood or putty, to hang in realistic folds, and are then painted white.

Old pattern A.A. guns and destroyer guns, the former with all their works exposed, and the latter fitted only with splinter shields, are rather more difficult, especially in small scales. It is usually sufficient, however, to shape the barrels with a file, solder on the recoil cylinders and run-out boxes, and add small trimmings, such as breech-mechanism levers and training handles, in fine wire, which can be quite safely glued in place. Dial sights can be made from thin card stamped out on an office punch and painted brass. Splinter shields can also be shaped from thin card, creased at the angles and glued on.

Pedestals can be worked up in wood from solid, and, if the scale allows, can permit both training and elevation. But, as a general principle it seems best, in small-scale work, to fix everything down once and for all; delicate working fittings are all-too-ready victims to the ham-fisted admirer.

The chief thing, when trying to make wood look like metal, is to get a superfine finish before painting; and to be extremely particular about metallic paints. Some "brass" paint appears to consist of brass filings mixed with treacle and will ruin a small model gun. If you cannot get really finely-ground brass paint, use artist's gold, and subsequently varnish it, which will slightly yellow the finish and look much more convincing.

A Cricket Score Board

This Design was Submitted in Response to a Request Published in Our "Letters from Readers" Page in the September, 1952, Issue

By J. B. CHANNON

THE drawings give a good idea of the system used and, as will be seen, both numbers hung on hooks and numbers on an endless belt showing through apertures in the board are used. The tens and unit figures of the batsmen's scores and the tens and unit figures of the total are registered by means of the belts and the others are indicated by means of plates hung on hooks. These plates may either hang on the front of the board or at the rear and show through apertures cut for the purpose.

The Band

This is an endless belt of stout black linen, or canvas, on which the numbers are painted. As the operator pulls in the direction of the arrow (Fig. 2) the successive numbers appear in the appropriate window. In order to register the numbers accurately a white line is painted horizontally across the back of the board and corresponding numbers on a white line on the inside of the band: thus at the position shown in Fig. 3 the number 3 should be visible at the window.

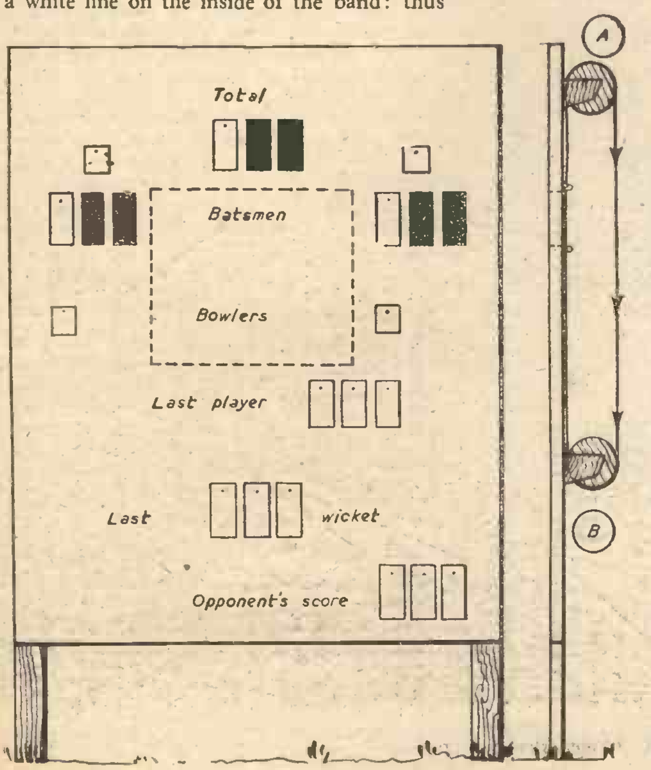
The Roller Supports

These differ slightly. The slots in supports (A) slope slightly downwards towards the board so that, when the spindle of the roller is placed in them, it falls to bring the roller close to the board. Supports (B) have vertical slots long enough to allow the rollers to hang freely and so keep the band taut (see Fig. 3). The band is kept close to the window by metal rods above and below the opening, free to turn in holes drilled in L-shaped brackets. Each band requires two rods.

Using a Box

If a box is required rather than a board, a rectangular opening may be made in the board, as indicated by dotted lines in Fig. 1, and the various screws on which plates are hung arranged so as to be accessible from this opening. Alternatively, windows could be cut for them and the plates hung inside the box, possibly on doors hinged to fit the windows or on screws.

For a box the bands could be run horizontally across the roof, with suitable modification of supports and rods; this would allow a neater spacing of the other number plates.



Figs. 1 and 2 (left).—Front and side views of the proposed score board.

Materials

No dimensions are suggested: the builder can please himself according to the materials available. A board can be made of "hardboard," well weatherproofed, attached to a rectangular frame of stout timber, and its legs well sunk into the ground. This should not require staying unless the situation is a very windy one.

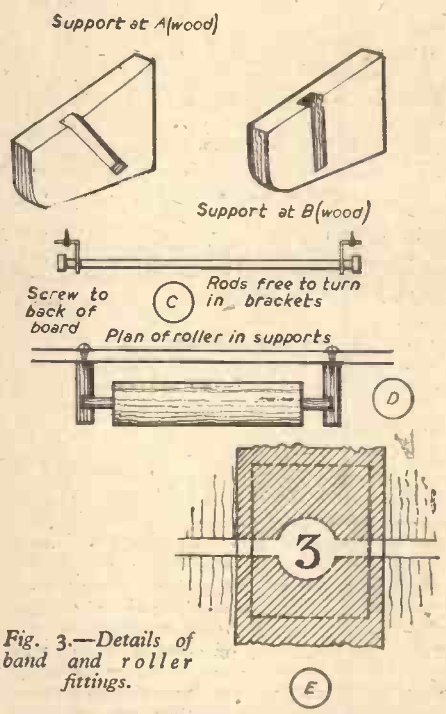


Fig. 3.—Details of band and roller fittings.

Operators

Two operators are almost essential: each scores for his own man and does his appropriate share of the "totals" band. They will have to settle "extras" between them.

Remember—the more the information displayed, the less likely is the spectator to be able to understand it.

A Clothes-airing and Drying Cabinet

Constructional Details of a Useful Folding Appliance for Domestic Use

By "HANDYMAN"

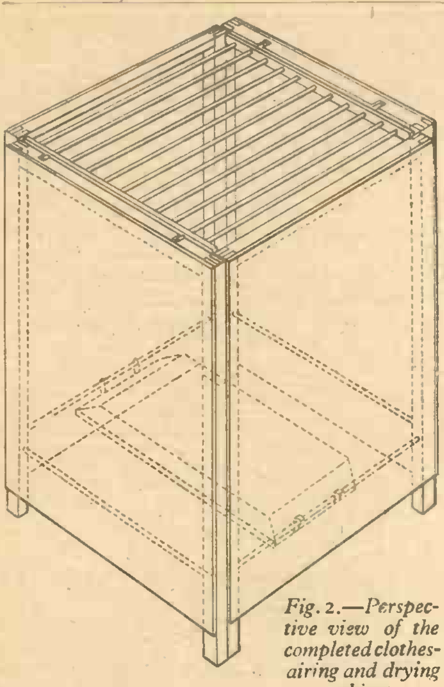


Fig. 2.—Perspective view of the completed clothes-airing and drying cabinet.

THE drying and airing of the washing associated with a new addition to the family can be an embarrassment to those living in restricted accommodation, particularly in wet weather, and this drying cabinet was designed and built with this problem in mind. It was designed so that it could be folded into as little storage space as possible, while, when opened for use, providing some 10 cubic feet or so of drying capacity. The drier was built in two main sections (Fig. 1), each of which would fold flat, but which could be opened out to form a rectangular cabinet approximately 2ft. by 2ft. by 3ft. high.

Frameworks

Four wooden frameworks are first constructed from 1¼in. by 1¼in. timber and ½in. dowel as shown in Figs. 3 and 4. The simple joint shown in Fig. 5 was used and has proved quite satisfactory, but those with greater woodworking ability may prefer to use a joint of their own preference. The frames are covered on the outside with plywood, hardboard or thick cardboard as whim or purse dictates, a space of 2in. or so being left at the bottom of the frames to allow air circulation. Slots are cut in the frame members in positions shown in Figs. 3 and 4, those in the top members (Figs. 4 and 6) being to support the top grid on which the clothes are hung, and those in the vertical members (Figs. 3 and 7) being to carry the same grid when the drier is packed away. The frames are hinged in two pairs, which, when erecting the drier for use, are opened at 90 deg. and stood together to form the rectangular cabinet. Hooks and eyes on the abutting members serve the dual purpose of holding the two parts together when erected and holding the folded sections in the folded position when packed away.

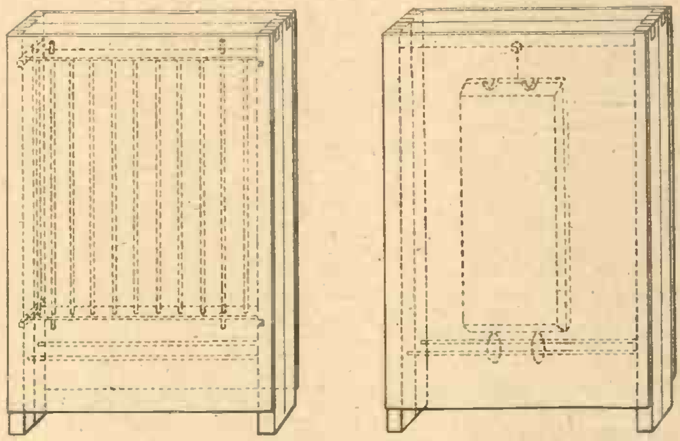
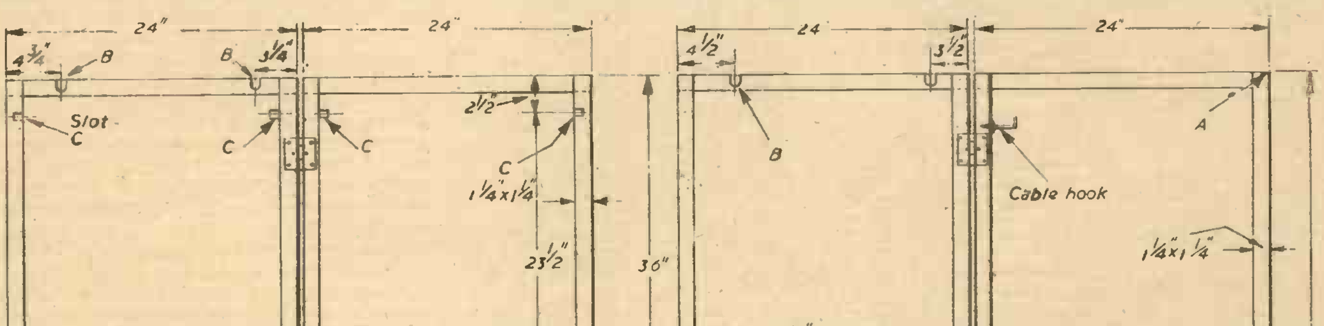


Fig. 1.—The two main sections of the drying cabinet.

Grid Construction

The grid on which the clothes are hung (Fig. 8) drops into the slots provided in the top members and also serves to keep the structure square and rigid. It is made by cutting accurately to length nine pieces of ½in. dowel 23⅜in. long and two pieces 25¼in. long. Two strips of wood 22½in. long by 1½in. wide by ⅜in. thick (ply is suitable) are cut and dressed and the dowel centres marked off. A ½in. auger bit is used to bore half-way through the strip, the point of the bit making a small hole right through which is used for insertion of a small screw. The short bored section and the screw provide sufficient end support for the dowels, but a *small* spot of glue can be placed on the dowel end before screwing up. It is, however, important to bear in mind that this part of the apparatus will get warm and that contact between warm glue and baby's clothes is not likely to meet with general approval. The two longer dowels pass right through the side strips and project about ¾in. each side. These projections slip into slots B, Figs. 3 and 4. Fig. 8 shows the dimensions of the grid, and Fig. 9 the enlarged detail of the dowel end support.

The heating element calls for the greatest care in construction. Two principal requirements must be met: (a) the apparatus must be electrically safe, and (b) there must be no risk of fire or damage of any degree by over-heating of the clothes being dried. Fig. 10 shows the construction adopted, which has proved effective and safe over several years' usage. Although an electric fire element was used, the heat is dissipated to such an extent that clothing can fall from the grid on to the element and remain there for a long period without any over-heating. An ordinary coiled wire electric fire element of 250 volts 600 watts rating was used, but the working temperature was reduced from the normal bright red heat to a barely visible glow by pulling out the element to several



Figs. 3 and 4.—Details of the framework showing slots and dowels.

times its normal length. The heat was further dissipated by placing immediately above the element a sheet of perforated zinc sheet such as is used for meat safes, etc. Above this again, with about 1in. spacing between, was placed a layer of small-mesh wire netting. With the current switched on, the hand can be placed in contact with the wire netting without injury. In spite of this low prevailing temperature, the total heat released within the cabinet is sufficient for its purpose. The element wire is supported by asbestos board and all connections are fully protected against accidental contact.

Heater Construction

The baseboard is made from ¼in. thick asbestos board and the large piece which carries the element wire should be cut to shape and dimensions shown in Fig. 10. The central slots (to assist air circulation over the element wire) and bolt holes for 6 B.A. size bolts should then be cut. The short end sections are then cut as shown. These are intended to fasten to the main board with

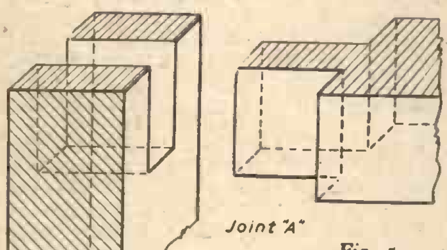


Fig. 5.

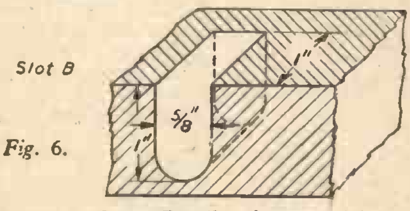


Fig. 6.

Figs. 5 and 6.—Details of corner joint and slot B.

insulated 6 B.A. bolts in order to protect the cable connections and to cover the nuts and bolt-ends of any part in connection with the heater wire and therefore electrically alive. These sections are fixed later.

The main element terminal screws are fastened to the main board, and intermediate element supports prepared by cutting pieces of brass shimstock or similar thin sheet approximately 2in. by 1in., folding in half to make a double 1in. by 1in. layer and making a small hole in the double thickness to take a 6 B.A. bolt. This is shown in Fig. 10.

Fixing the Element Wire

The element wire, which will be very closely coiled when purchased, is fixed by its free ends to the two terminals on the baseboard, still in the very close-coiled condition. The centre of the element length is found (by counting the coil turns) and about three turns at the centre are straightened out. One element support as described above is slipped over this straight section and bolted to the baseboard at the same end as the terminals (see Fig. 10). Each half of the element is again sub-divided equally into two and the centre three turns straightened out. An element support is slipped over each of the two straight sections in turn and a gentle pull is exerted on the supports in order to extend the coiled wire *just sufficiently* to allow the supports to be bolted down at the other end of the baseboard. It is important to see that the coiled wire is not over-extended (i.e., that some tension remains when the support is fastened down), otherwise the wire will be slack and unsafe on the baseboard.

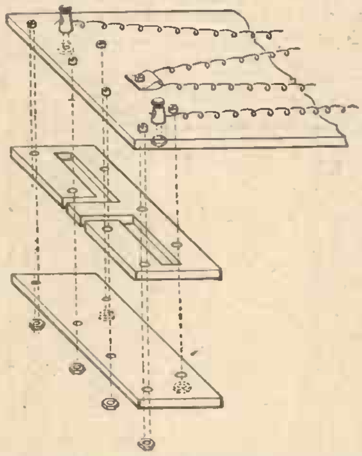


Fig. 11.—Exploded view of the end section of the asbestos board.

The baseboard is next surrounded by a frame, made by bending a length of I-section brass curtain runner to fit snugly to the board, the flange of the I-section supporting the board. Dimensions are given in Fig. 10. The ends of the runner strip may be bolted together with a web-strip or may be butt-jointed and soldered. Stout wire cross-bracing underneath the baseboard may be added if desired. On the element side of the baseboard a number of small L-shaped pieces of brass strip are soldered to the inner side of the runner strip to hold the baseboard firm.

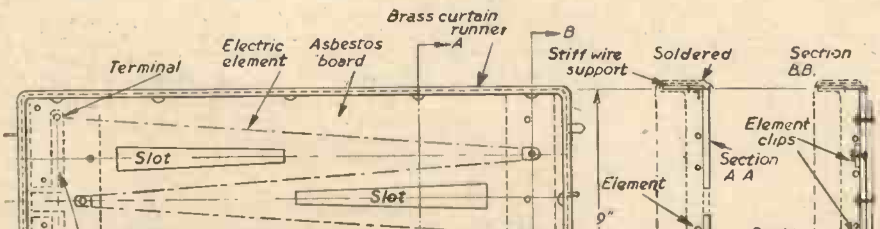
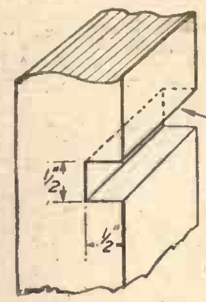
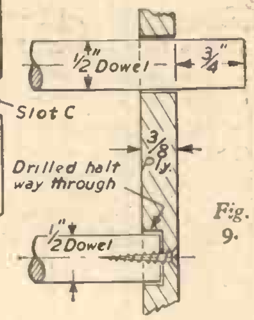


Fig. 10.—Details of the heater construction.





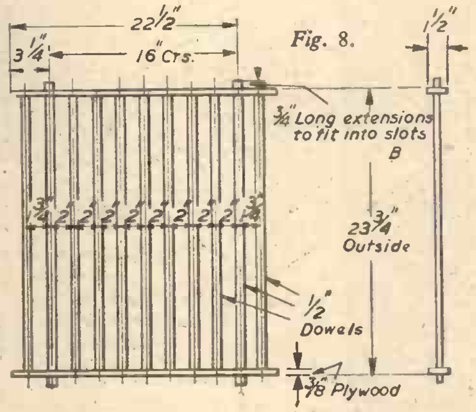


Fig. 7.—Details of slot C. Figs. 8 and 9.—The clothes grid and details of dowel end support.

A length of three-core cable is next connected to the underside of the terminals, sufficient length being separated to lay inside the cable slots cut in the end board section (Figs. 10 and 11). The earth lead is soldered to the frame. All electrically live points on the underside of the baseboard are now covered by bolting up the end sections of asbestos board (Figs. 10 and 11).

A stout wire frame (⅛in. diameter approximately) is made as indicated in Fig. 10 and is soldered to the frame. The perforated sheet is fitted over this frame as in Fig. 10 (note particularly sections AA and BB), completely covering in the element wire and baseboard. The wire netting is next fitted in accordance with the sketch, again covering in the whole framework of the heater, and a sound job made of soldering netting and sheet to the frame.

The heater is suspended permanently from the ½in. dowel member of the main framework by two wire loops soldered to the heater frame end. Two stiff strip metal hooks are soldered to the heater frame at the end remote from the wire loops, and with the complete drier erected and the heater lowered into position the hooks are bent so that they support the heater by hooking on to the ½in. dowel member of the main frame (see Fig. 2). Finally a short length of cord with a ½in. diameter wire ring is tied to the wire netting near the hooks and the cord length adjusted so that the heater is comfortably suspended from a small hook in the top member of the main frame when in the folded storage position (Fig. 1). Two hooks are screwed into the frame (Fig. 4—heater half) to carry the cable when folded.

When setting up, the two parts are opened out at 90 deg., the grid removed from one half and the cable unwound from the other. The two parts are stood together as shown in Fig. 2 and hooked together. The heater is lowered into position and plugged into an electric supply. The grid is dropped into position and clothes hung over the rods, hanging down inside the cabinet. For airing, it is preferable to lay a large duster or similar material over the whole of the cabinet top. This restricts air circulation and a gentle airing heat is obtained.

MODEL LOCOMOTIVE BOILER MOUNTINGS

The Correct Shapes and Curves of Chimneys, Domes, and Safety-valve Casings

By "ENGINEER"

UNDER the term "mountings" all items which are attached externally to a boiler should, of course, be included, but in this article, because I intend to deal with the subject from an aesthetic aspect and not so much from a technical one, I shall cover only those most prominent features: the chimneys, the domes and the safety-valve casings. It is not the purpose served by nor the construction of these things with which we are concerned, for they are already well known to model locomotive builders, but the accurate reproduction of their true external shapes and proportions when reduced to miniature size, by scale.

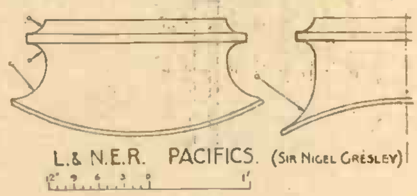


Fig. 1

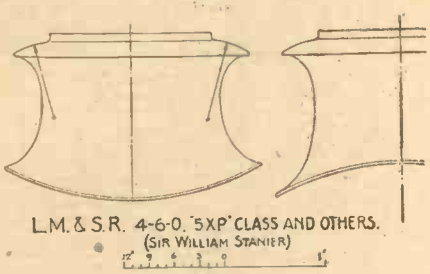


Fig. 2

In the majority of full-size prototypes the shapes and curves are very elusive, and some excuse may be found for model makers who fail to get them true, when it is considered that general arrangement drawings—published in books and engineering periodicals—and even small scale diagrams issued by railway works, are scarcely ever correct. Since these are the sources on which the model maker has to depend for his information how can he be expected to make his engines look exactly like the prototype? For it is an unquestionable fact that if either, or all, of these prominent and important mountings are not faithfully copied the whole character of the model is altered and its identity may be almost, if not quite, lost.

In order to assist the model maker to attain accuracy in the form and proportions of his three miniature mountings I have prepared drawings of the chimneys, domes, and, in some cases, of safety-valve covers, for each of the four railway groups before nationalisation and, so far as was necessary, of each of the biggest of the old companies prior to the grouping of 1923. These drawings cover a period back to about the last decade of the nineteenth century. In a few cases examples are given prior to this.

Nearly all the drawings have involved a considerable amount of trouble in their preparation; many have been scaled down from larger drawings and still more have been scaled up from photographs, for which photographs a scale had to be constructed from known measurements, such as the wheel base or wheel diameters. I have given a scale against each item and where I have shown shading lines the parts so shaded are of polished brass or copper. All unshaded portions of chimneys, or the whole of them, are black and domes shown plain are painted the same colour as the boiler.

The first batch of drawings, Figs. 1 to 6, show chimneys of forms introduced either shortly before, or after the date of grouping of the railways; all of them are in use at the present day.

The London and North Eastern Railway

Fig. 1 shows a very much shortened form of chimney with characteristics originated by Patrick Stirling of the Great Northern and carried on by Mr. Ivatt. On some of the engines of British Railways it will be found to be taller owing to lower boiler level, but the same curves or radii are preserved.

The London, Midland and Scottish Railway

Fig. 2. Several classes, beside the 5XP, have this chimney. Note that true curves make up the general form of the shaft; there are no radii. The chimneys of the Pacifics (4-6-2) are shorter and the curves smaller. The lip at the top is noticeably smaller than the diameter of the shaft. Some of the latest British Railway locomotives, of course, have double chimneys; these are not shown.

Fig. 3. Here is a chimney which Mr. Stanier (afterwards Sir William Stanier) placed on the smokeboxes of six coupled goods and many tank engines built or re-boilered by his predecessors. On the tender engines many of them are shorter than the drawing shows them, whilst on some tank engines they are a little taller. Stanier, of course, went to the L.M.S. from the Great Western and this chimney is a very close copy of Dean's but with a black top instead of copper.

The Great Western Railway

Fig. 4 shows what is, in the opinion of many people, the most handsome and boldest chimney in use to-day. It is somewhat shorter than the chimney on the "Castle" class engines and where copper-topped chimneys are used on other classes they are both taller and of a little smaller diameter.

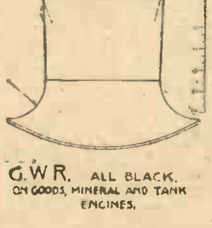


Fig. 5 (*Left*)
Fig. 6 (*Right*)
Fig. 7 (*Below*)

Many Great Western engines have the far less attractive, wholly of iron, smoke vent shown in Fig. 5. This is cast in one piece although it is made to look like a built-up chimney. At one time some of the two-cylinder 4-6-0 engines of the "Saint" class had this but now all have the cylindrical pattern with copper tops. I venture to think that if Mr. Collett's "King" class chimney is the most handsome, and all that a locomotive chimney should be, then this all-black pattern is the most ugly and most out of keeping with Great Western traditions.

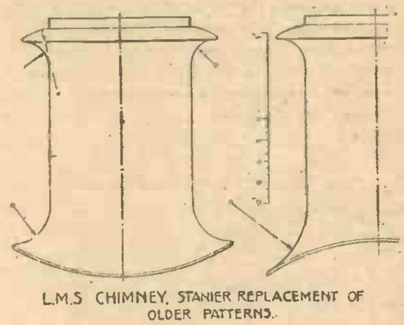


Fig. 3

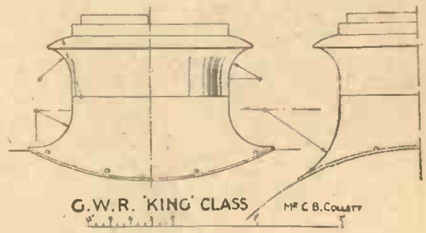
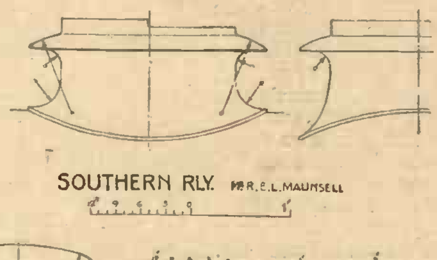


Fig. 4

The Southern Railway

Fig. 6 represents the chimney of the re-boilered "Lord Nelson" class and others. If the parallel portion of the shaft were lengthened it would represent the smokebox mounting on engines having lower pitched boilers.

The domes and valve casings for the modern engines (the L. & N.E.R., the L.M.S. and the S.R.) I have shown in one drawing, Fig. 7. All three of these shown vary in height on different classes of engines, although it may be taken that the radius of



all curves is maintained. On the Great Western boilers there are, with a very few exceptions, no domes, but on the tapered boiler barrels there are the safety valves, the casings of which are of polished brass. Attached to each of these are two covers over the top water-feed check valves. These covers and the lagging plates over the water pipes are painted. The assembly of one of these is drawn in Fig. 8.

The Pre-grouping Companies

The old independent companies were in 1923 grouped together to form four great transport combines covering the whole of Great Britain. I cannot deal with them all and have to omit quite a number of the smaller systems. To commence I shall take the Midland Railway. Fig. 9 shows the correct forms of all the chimneys in use from the time that Mr. Johnson assumed office as locomotive superintendent up to the time of grouping, but the Johnson drawing first calls for comment. Up to some time in the late eighties Mr. Johnson built up his chimneys in three parts: the base, the shaft and the cap, but from about 1889 he cast them in one piece. The dotted lines in Fig. 9 show the positions of the lapped joints of the base and cap over the slightly tapered shaft of the earlier chimney.

The lines of the one-piece casting were pure curves and resulting in one of the most pleasing chimneys ever designed. To go with this chimney Johnson put on his engines the equally attractive dome and safety-valve casing, which is drawn in Fig. 10. On the dome there were two levers, valves and spring balances, side by side, and in the brass valve case there was one direct spring-loaded valve. When boilers became larger and higher pitched, notably in Johnson's first compound engines, the chimney, whilst retaining almost the same curves, became shorter, and the Salter lever-loaded valves disappeared. The dome then became more like that adopted by Deeley and drawn in Fig. 11.

Deeley's chimney is shown in Fig. 9; from this it will be seen that the top was like Johnson's, but the shaft conical and inverted. When Sir Henry Fowler took office in 1909 he also retained the same top, but his shaft was cylindrical. This chimney was made to replace Johnson's even when no other alteration was made to the engines, notably on Johnson's well-known single wheelers. Even though the smokebox did require renewal there was no reason why the original chimney could not have been put back again. Sir Henry Fowler's dome, Fig. 11, became a common form with other designers and will be referred to again later.

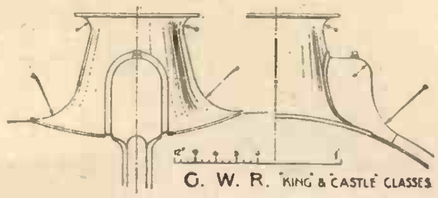


Fig. 8

The London and North Western Railway

The mountings for the engines of this company, shown in Figs. 12 and 13, remained unchanged in detail from 1871, when F. W. Webb took office, all through his régime and those of Whale and Bowen Cooke to 1923, the only modification being that of height. When Bowen Cooke brought out his "Claughton" class of four-cylinder, 4-6-0 type engines, the domes, though low, still retained the hemispherical top.

Note particularly the proportions of the chimney top, the square base, and the amount of taper on the dome and upper part of the safety-valve casing.

The Great Western Railway

William Dean was not the originator of copper tops to chimneys, even on the Great Western, yet he evolved the extremely neat form which has persisted down to the present day and was copied by at least two other companies' designers. The standard chimney of Dean's own engines is drawn on the left-hand side of Fig. 14, and in Fig. 15 the dome and safety-valve casing which Dean put on his fine bogie singles and also on the four 7ft. 4-coupled bogies, Nos. 7, 8, 14 and 16. These were about the largest ever put on British engines. All Dean's earlier engines had similar but smaller domes. When Churchward took office, officially it was in 1902, but unofficially before that, he dropped the use of a dome with his Belpaire boilers and put Dean's safety-valve casing on the boiler barrel. At the same time he completely changed the chimney to an all-black, tapered, cast-iron one, as in Fig. 14. This was retained for some years until the copper top was revived about 1908. Churchward's chimney had a pleasant appearance, but it never looked right on Great Western engines.

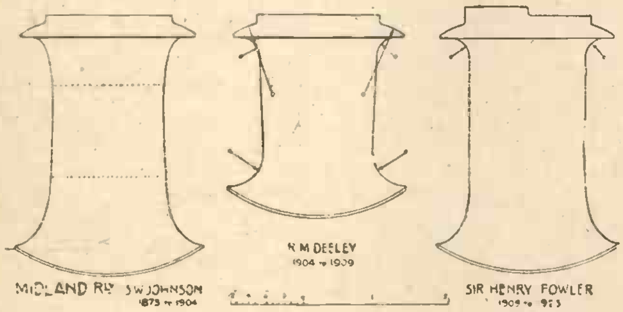
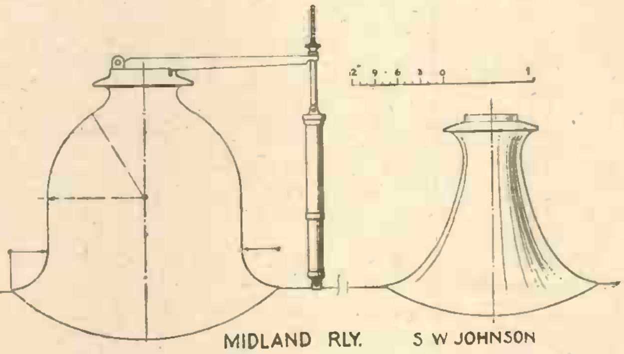


Fig. 9 (*Left*)
Fig. 10 (*Right*)



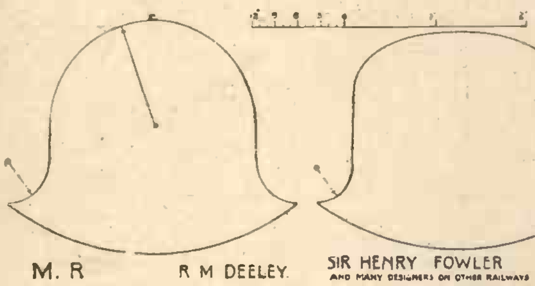
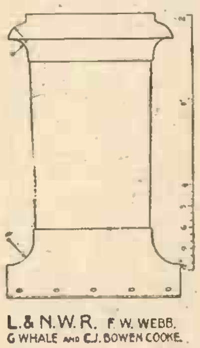


Fig. 11

Fig. 12 (*Right*)



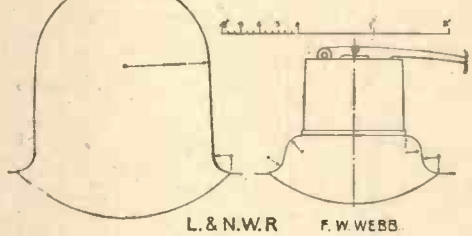


Fig. 13

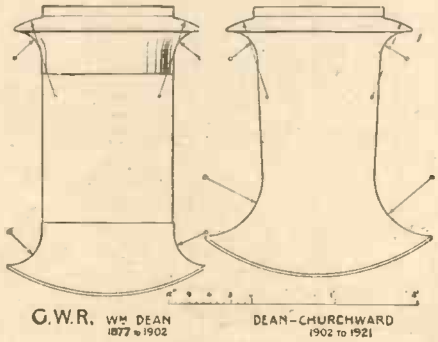


Fig. 14

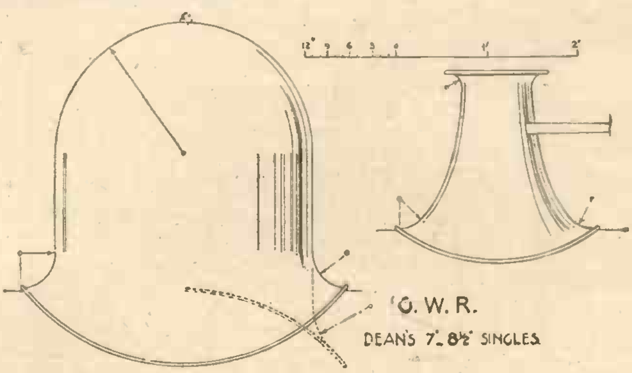


Fig. 15

The Great Northern Railway

We have in the Great Northern an instance of loyalty to an efficient and artistic designer, inasmuch as the general character of Patrick Stirling's chimneys has been maintained by Mr. Ivatt and Sir Nigel Gresley, and exists to the present day. Strangely enough, Mr. Stirling's earlier chimneys were built up, as in the centre drawing in Fig. 16; then the shape was a little modified and, with the shaft, cap and base in an unbroken outline, was cast in one piece, as in the chimney on the left; finally he reverted, in his last batch of 8ft., outside cylindered singles, to the much older form, though I feel sure that these also were cast.

The long, unbroken line of his boilers was distinctive. His beautifully-shaped brass safety-valve casing, the lines of which were true curves, occupied the usual position over the firebox. This valve casing is drawn in Fig. 17. Ivatt's chimney, on the right of Fig. 16, was used on his famous Atlantic type, and the dome was similar to Fowler's, in Fig. 11.

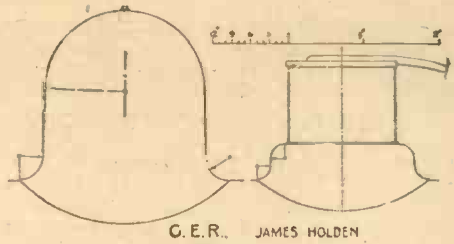


Fig. 19

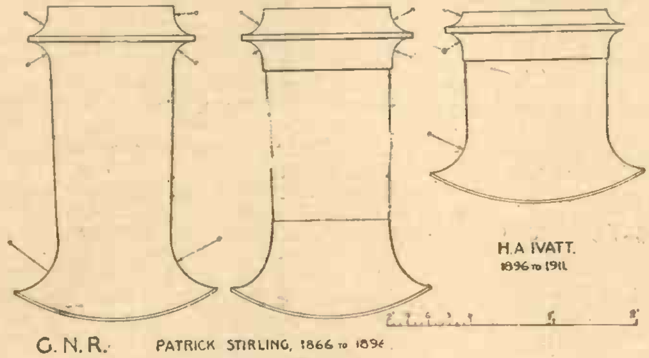


Fig. 16

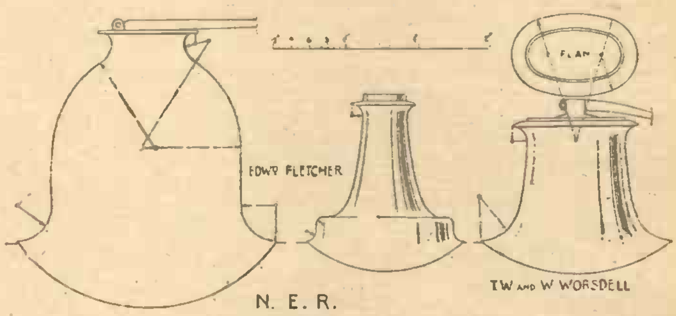


Fig. 21

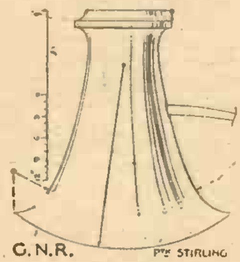


Fig. 17

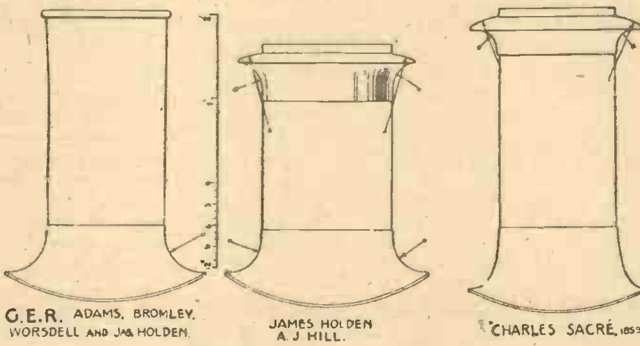


Fig. 18

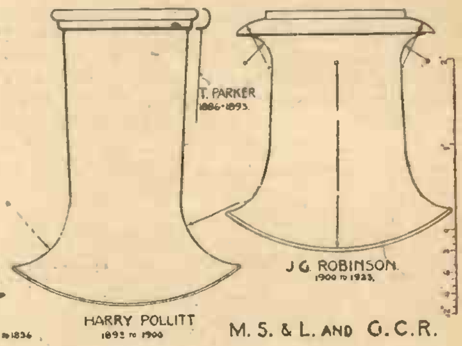


Fig. 22

The Great Eastern Railway

On this line the plain chimney, with a simple, beaded iron ring at the top (see Fig. 18) was adopted by at least four successive locomotive superintendents, and then James Holden, after having adhered to it for about thirteen years, changed to a straight cylindrical chimney with a polished top, almost like Dean's, on the Great Western, except for the fact that bright brass was used instead of copper. This chimney first appeared in 1898 on the handsome 7ft. bogie singles. After that, though shortened on higher boilers, this chimney became standard by Mr. Holden's successors.

Mr. Holden's dome and safety valve are shown in Fig. 19. Both were painted, with the exception of the bead around the top of the valve casing, which was of brass. Note the slight taper on the dome.

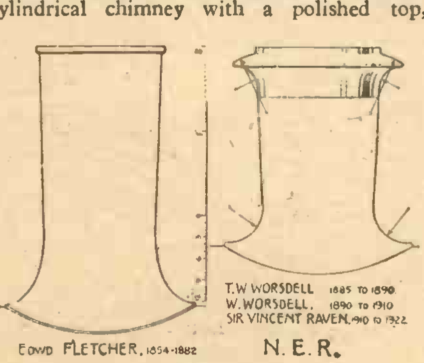


Fig. 20

The North Eastern Railway

Edward Fletcher adopted a plain-tapered shaft with a small bead at the top and terminated at the base in pleasing curves which I have reproduced in Fig. 20. Sometimes there was, in the earlier chimneys, a second bead around the waist, at the point where the curves merged into the straight lines.

Fletcher's dome and valve casing are shown in Fig. 21. There were two valves and levers on the dome, as in the case of Johnson's, on the Midland engines. Most domes of other designers had hemispherical tops, but Fletcher's were a little elongated and it should be noted that the radius is struck from points off the centre line.

The chimneys of T. W. Worsdell and of his brother, Wilson Worsdell, were shaped as shown on the right of Fig. 20, although they, of course, varied in height. The first of Mr. Worsdell's chimneys were wholly of cast iron, and it was Wilson Worsdell who introduced the polished top, which was of brass, not copper. Chimneys of this pattern, together with the safety-valve casing shown on the right of Fig. 21, remained in use to the end of 1922. Although the valve case was elliptical at the top the part which saddled on to the boiler lagging was circular in plan. The Worsdell dome was almost the same as that of the Great Eastern, Fig. 19, with the possible exception that the splayed base was of little larger radius.

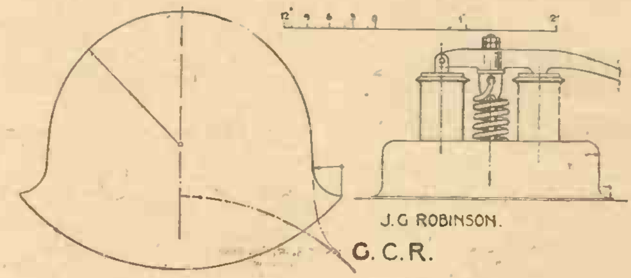


Fig. 23

The Great Central Railway

The name of this company, prior to 1897 was: The Manchester, Sheffield and Lincolnshire railway.

The locomotive superintendent at that time was Mr. Harry Pollitt. His chimney is shown in the centre of Fig. 22 and beside the top of it is drawn the deep iron bead of his predecessor: Mr. Parker; in other respects both chimneys were alike.

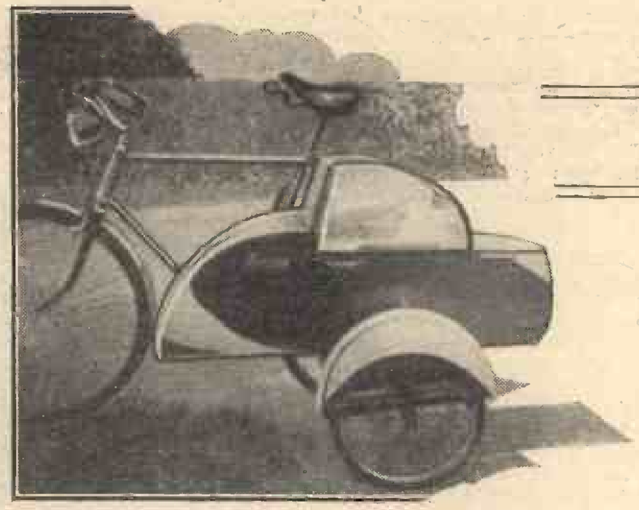
Before Mr. Parker, Mr. Charles Sacré was in office; he was the designer of the very pretty 7ft. 6in., 2-2-2 engines, which carried the chimney shown on the left. The domes, up to the year 1900, were normal, though Mr. Sacré's were somewhat taller.

The chimney of Mr. J. G. Robinson is shown on the right of Fig. 22 and his dome and safety valves in Fig. 23. The chimney was finished at the base with curves and not radii.

(*To be concluded.*)

A Cy

An Efficient Outfit wit



The completed side-car ready for use on the road.

THE drawings and sketches clearly show the main features of the side-car chassis, or bogie, for anyone desiring to construct the arrangement in its entirety, but the special features consist of the coupling devices on cycle and bogie respectively, the brake mechanism and its connections between the cycle and the side-car, and the retractable rests which enable the user to disconnect the main machine and leave the bogie stationary with or without the car attached. These features have been thoroughly tested in actual practice under purposely severe conditions. In place of a child, a sandbag weighing 42lb. was carried as passenger to test the general behaviour of the whole arrangement, e.g., reaction to frame of cycle, coupling tube and clamps; effect of braking on steep hills with and without the car fitted, loaded and empty; reaction on cycle frame and couplings when running bogie over a specially laid bumpy track with the cycle running on a smooth track; behaviour of side-car assembly, when stationary and independent of cycle, on an incline, in a fairly strong wind, and with a child passenger rocking the car on its springs.

In service this combination has covered 200 miles on all kinds of road surfaces including rocky coastal byeways, country lanes and cart tracks. In all instances the impressions obtained were satisfactory to both the rider and the child passenger. Furthermore, on reaching one's destination, should the passenger be sleeping, as often happens, the side-car can be detached from the bogie and carried indoors as a cot.

Should either parent find it necessary to use the cycle independently the bogie can be uncoupled in a few seconds, the rests lowered, and the cycle is free and uncumbered while the bogie remains conveniently intact and ready for reconnecting when required. Speed of assembly and dismantling is achieved by the use of wing-nuts and by the design of the coupling fitments concerned.

Is there any need for the fitting of a brake to a side-car or cycle trailer, and has it any definite advantages? With regard to its use with a trailer many readers will, I feel sure, agree that a suitable brake is a necessity, by reason of the running position of the trailer in use, but with regard to side-car braking there will be many and varied opinions. In order to put the matter to trial thoroughly, the mechanism sketched and described in this article was devised and, in practice, it *is* definitely a great advantage, not only on steep hills where the danger of "running away" is paramount, but also on busy roads where traffic is plentiful in both directions.

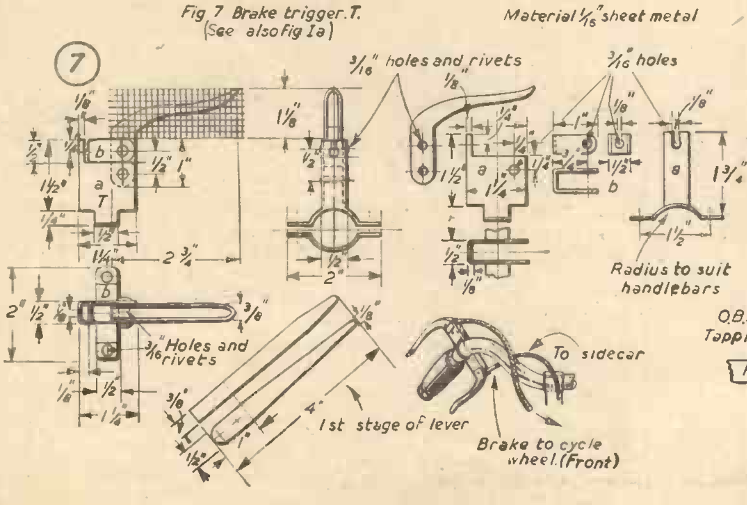
Brake Application

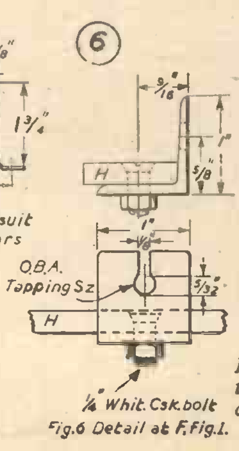
The rear brake of the cycle is applied with one hand while the side-car brake is applied with the other. A little practice soon enables the user to exert initial pressure to the cycle brake before bringing the side-car brake into action so that all the retarding strain is not thrown suddenly on to the

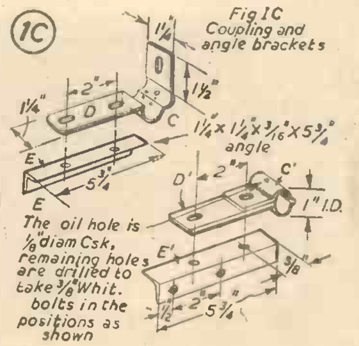
The side-car chassis fitted to a cycle.

couplings and frame of the cycle by the drag of the moving but decellerating side-car. The action must be spontaneous but smooth, and is comparable to the foot movements on clutch and accelerator when changing gear in an automobile; first pressure on cycle brake and immediately apply pressure to side-car brake. The result is an effective two-wheel retard with no ill effects or undue strain on the parts acted upon. The absence of front-wheel braking is apparent since both the rider's hands are engaged, but the combined action of the dual brakes is found to bring the combination to even a skidding halt which the action of a front-wheel brake application could do little to improve. During experiments the side-car and cycle rear-wheel brakes were synchronised so that they would both act from pressure on one lever, thus leaving the other hand free to apply the forward brake. Results proved that the forward brake was useful but not necessary, since the rear brakes had to be applied first, and that action alone sufficed before ever the forward brake could be effective. To apply the front brake first was undesirable, as it tended to jerk the side-car forward quite an appreciable amount, causing severe stress on couplings and frame. After extensive trials the original arrangement was reverted to, and the forward brake left idle. When the side-car brake is operated, a tendency for the handle-bars to veer left is experienced, but only a slight tendency, which is readily arrested by the rider himself.

The trigger shown in the accompanying drawings is designed so as to be placed within finger-tip reach and the lever gives just sufficient pressure for the operating of the brake mechanism. Anyone wishing to dispense with the specially made trigger can do so by using the brake lever fitted to the front wheel of the cycle. The Bowden cable from the forward brake is disconnected from the lever and the nipple of the side-car







Figs. 6 and 7.—Details of brake trigger components. (Note: A description of Figs. 6 and 7 will be given next month.)

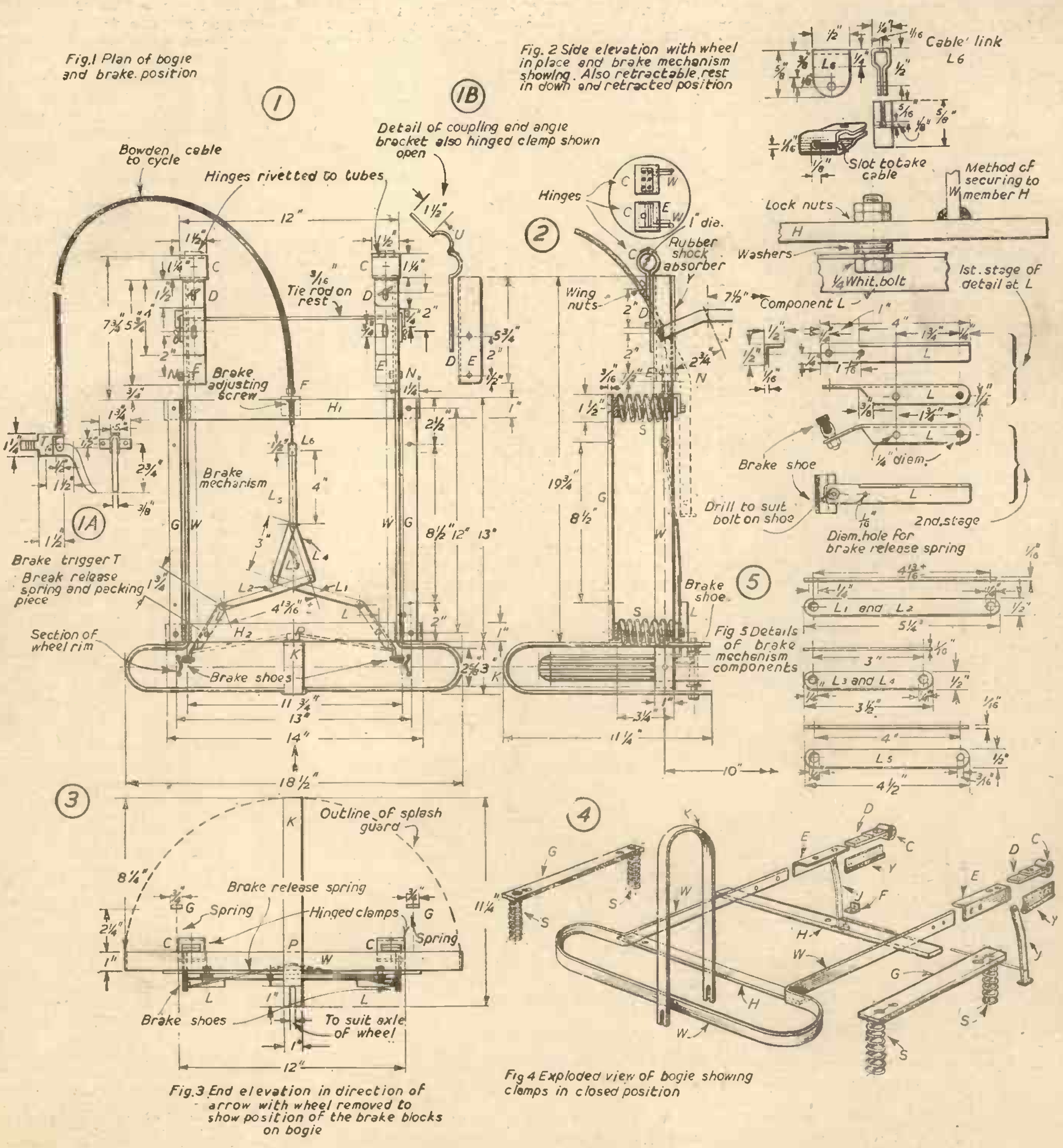
cle SIDE-CAR

Brake and Retractable Rests for Use When Detached

By D. V. PRIEST, A.M.Inst.Mechs.

brake inserted in its place. No great gain is derived, however, because when using the cycle for solo purposes the front brake has to be connected up again. By utilising the trigger fitting, none of the standard fittings of the cycle are disturbed. It is left on the cycle and when the side-car is not in use is still there ready and is no great extra weight for the soloist to carry. Furthermore the leverage obtainable from the standard brake lever is too severe for the brake mechanism here described—the object of our brake being to halt the side-car, *not* the whole combination. The halting of the whole combination, or the gradual slowing down of same, is achieved by the combining of the cycle and the side-car brakes. Neither will do it suitably alone.

The method of arranging the braking system can be adapted to suit most existing ready-made chassis, but for those intending to build the whole side-car from "scratch," attention should be paid to the constructional design so that it will be of such a nature as to co-operate with the braking system. In



Figs. 1 to 5.—Details of bogie frame, brake mechanism, and retractable rest.

any cycle side-car combination there is a certain amount of drag which, of course, leads to stress and strain between the cycle and the attachment. This is to be expected, due to the cantilever like form that coupling arrangements often take and because of the difficulties of designing a coupling suitable for attachment to the meagre holds afforded by the rear forks of the cycle. It either has to be a heavy arrangement to give the necessary strength where required or it has to be a light but large arrangement which when fitted to the machine covers quarter of the rear wheel, picks up mud and generally gets in the way during repairs.

Coupling Rigidity

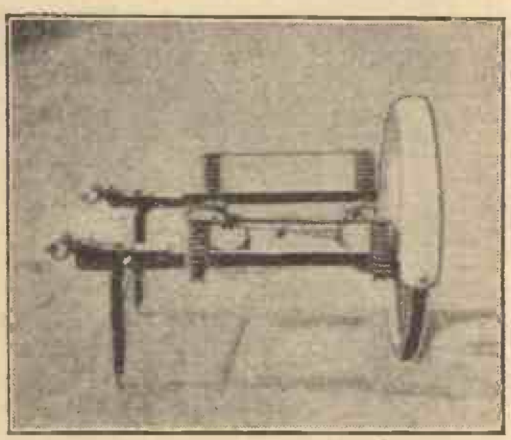
The bogie is often found to be of rigid construction, and, although allowance is provided for "lean" when cornering and so on, the rest of the steelwork is decidedly robust and holds itself rigid from the coupling to the hub of the side-car wheel. Thus any jolt received by the wheel is transmitted directly to the coupling and into the cycle frame.

To avoid these harmful reactions the side-car bogie, the couplings and the brake must afford just enough rigidity for safety in use but with enough "give" to cut out as much as possible the shudders arising from bumpy roads and other contributors to the detriment of the machine's welfare.

Referring now to the drawings, Figs. 1, 2 and 3 show the general constructional features in three views. Fig. 1 is a plan view of the bogie without the wheel but showing the position of the brake and its parts including (in Fig. 1a) the cable connection to the brake trigger on the cycle handlebars. At 1b are shown details of the coupling clamp in the open position, while Fig. 1c is an exploded view of the clamps and angle-iron brackets, one being for the forward and the other for the rear positions respectively. For convenience in reference each part on the principal views is lettered and the lettering applies in all views given. Fig. 2 is a side elevation of the bogie with the wheel in place and it must be noted that this particular wheel is 13in. diameter across the rims. It is important and is the governing factor in the correct positioning of the brake arms (detail "L") and, of course, the height above ground level of the coupling tube and fork clamps to be described later. In Fig. 2 the rests (item "J") are shown in the down position while the retracted station is indicated by the dotted lines. The springs used to support the actual carriage are marked "S" with cross-member "G" in place. The inset is an end view in two directions of the hinged clamps "C." One view showing the hinges and the other the placing of the angle-iron bracket, the clamp arms and the main frame "W." Fig. 3 is an end elevation looking through the wheel but without the wheel in place. The brake shoes and brake release spring are also visible with the splash guard and axle support "K."

Construction

Starting with the main frame "W," a length of 3/16in. x 1in. mild steel flat strip was chosen as the most suitable material. It proves stiff enough for safety, but due to its thickness it allows for a certain amount of flexibility when made up. A piece 3ft. 7in. long was taken and forged to the shape illustrated, the bends for the wheel guard being of 1½in. radius. A piece of the same material is cut to 28in. long and bent to the inverted U shape needed for the splash guard support "K." From the bends in the frame "W" to the extremities of the arms measures 19¾in. (see Fig. 2) and on completion of the forging operation these are cut. The distance across the arms is 11½in. to the inside and 11¾in. to the outside (see Fig. 1). Next two 14in. lengths of 1in. x ¼in. flat strip are cut to form parts "H_1" and "H_2." This thicker material was chosen in order to prevent any fore and aft rocking movement in the bogie, i.e., to ensure its being perfectly horizontal and parallel to the road under all running conditions. These strips were welded to the frame in the positions shown, 13in. from the outer edge to the outer edge in one direction and having 1¼in. overhang in the other. When welding it is advisable to deal first with the cross-member "H_1" as once it is in place the legs will not close in as would be the case if the other member was welded first. The heat applied so close to the bends causes the material to straighten and so alters the set of the arms. With member "H_1" secured first, this is avoided and the parallelism retained. With these cross-members secured the part "W" is complete apart from drilling the holes and attaching item "K." This latter is drilled to suit the wheel axle diameter and then



View of the side-car chassis, showing the springs and retractable rest.

slotted as shown to allow for any vertical adjustment and also for removal of the wheel. A distance of 2in. is marked from the ends of each leg and this gives the position for welding to the frame "W" on the one side and cross-member "H_2" on the other. "K" is placed at right angles to "W" and is, of course, centrally placed on the wheel guard, i.e., on the 9¾in. mark. Three ¼in. holes are drilled to accommodate the splash guard bolts, a ¼in. hole is drilled at each end of the cross-members "H_1" and "H_2" to retain the springs "S" (see Fig. 2), a ¼in. hole is placed in the centre-line mark of member "H_1" and on "H_2" at 1in. from the main frame "W" on either hand a ¼in. hole is placed to accommodate the brake arms "L." The positioning of these holes will, of course, be governed by the diameter of the wheel from rim to rim, but in this particular case they are as stated.

Clamps and Brackets

Referring now to Fig. 1c, the couplings and angle-iron brackets are dealt with. The clamps "C" consist of two pieces of tubing of inside diameter 1in. with a wall thickness of preferably ⅛in. making for 1¼in. outside diameter. These are carefully sawn to form a top and bottom as in a split bearing. The arms "D" of the clamps are of ⅛in. x 1¼in. mild steel flat strip the bottom arm being 4in. long and the top arm 1½in. long. These are drilled to take ⅜in. dia. bolts at 2in. centres. The holes are elongated to afford adjustment when setting the wheel track and the pieces are then welded to the top and bottom halves respectively of the split tube. It is advisable to do the welding with the two pieces firmly bolted together so that a good seating of the two arms is ensured. With the welding completed, the hinges can next be fitted. These are ordinary steel butt-hinges, size ½in. They are bent to conform to the outer wall of the tube and are then riveted. Countersunk rivets are used with the heads inside the tube the holes being countersunk for this purpose. This is done by marking the holes on the outside, drilling them, parting the two halves and countersinking the holes on the inside. The two halves are again bolted together, the rivets inserted, a round bar or bolt of 1in. diam. pushed through the bore to hold them in place, the hinges placed on the rivets and the heads formed by using a small ball-pane tack hammer instead of dollies. The rivets may be of aluminium, as the hinges do not take any strain in service—the weld and clamp arms do that. By passing a bearing scraper over the inside of the now completed tubes any flats or burrs can be removed from the rivets so that a good smooth bearing surface remains. The addition of a small oil hole as shown is useful as a final touch.

Track Adjustment

The brackets marked "E" are made from two pieces of 1¼in. x 1¼in. 3/16in. angle-iron, 5¾in. long. It will be seen that they are drilled as front and rear pieces. The flanges taking the clamps ("C" and "D") are drilled ⅜in. at 2in. centres to suit the holes in the clamps. These are not elongated, however, because only slight track adjustment is required. The centre of the hole nearest the cycle is ⅝in. from that edge (see Fig. 1c). In the remaining flange, marking ½in. from the wheel end, ⅜in. holes at 2in. centre are drilled. These are then transferred to the frame "W" by placing part "D" on "W" with the end of the angle-iron flush with the end of the legs of the main frame. The holes are scribed through and drilled. The brackets "E" are secured to "W" by only one tight ⅜in. bolt and the clamp arms "D" are likewise secured by one bolt. The remaining holes accommodate the free bolts and their wing-nuts shown by the arrows in Fig. 2. Before tightening the securing bolts a length of rubber of 5¾in. is inserted between the flange of "E" and the leg of "W." This consists of ordinary draught-stop such as is placed around the edges of doors and serves as an ideal shock absorber at this vital constructional point. An examination of the views at Figs. 1 and 2 will show that between the cross-member "H_1" and the securing bolts "N" there is a ¾in. length of the 1in. x 3/16in. main frame "W." This narrow section may be termed the weakest part of the chassis frame but it is thus the part which takes the unwanted stiffness out of the arrangement. The ¾in. section of the side-car bogie, though it is not long enough to allow bending, is long enough to allow springiness. The stiffness at the weld on "H_1" plus the stiffness at the bolt "N" is an additive to the functioning at this important point. The rubber insertion is not essential but is a precautionary device and useful in so much that it fills up the gap caused by the joining of the flat face at "W" to the tapered flange of the angle-iron bracket "E." It also cushions the faces and acts as a mild form of spring-washer for the retaining of the wing-nut which holds the rests in the retracted position, as should these fall down, through vibration while travelling, the results would be annoying.

Carriage Springs

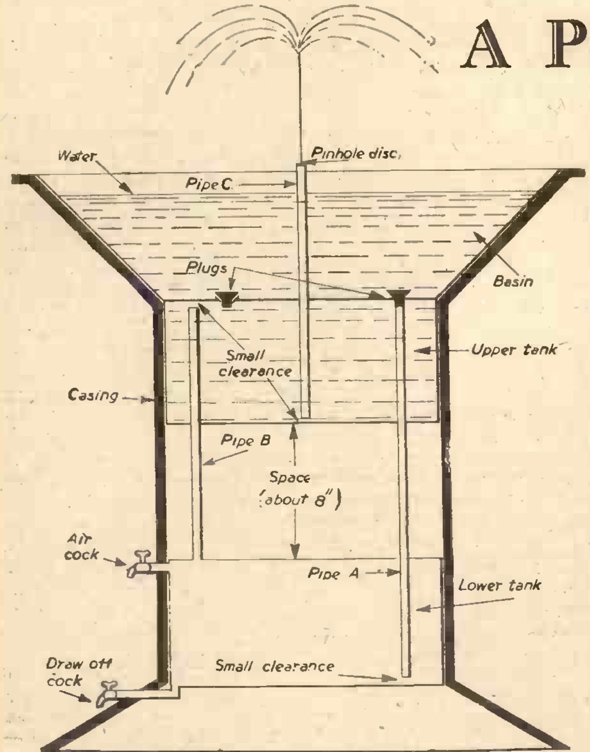
The frame with brackets and clamps is now complete except for the carriage springs and members "G." Fig. 2 shows the springs in place on the extremities of the cross-members "H_1" and "H_2." They are 3¼in. long in their relaxed state and 1½in. dia., having six coils. If it is at all possible four identical springs should be obtained, although, provided they are strong and reliable, odd ones would do in these days of scrap shortages. They are retained by ¼in. dia. bolts in the holes provided on "H_1" and "H_2." The members "G" are also of 3/16in. thick flat strip ¾in. wide and 13in. long. These strips are identical and it is as well to drill them both together. The holes for the springs have their centres ½in. from each end and are of ¼in. dia. The holes for retaining the carriage are also ¼in. dia. but those nearest the splash guard are drilled 2in. from that end while those nearest the cycle are 2½in. from the end (see Fig. 1). This is to afford as much clearance as possible for the rider's leg between the pedal and the fore part of the carriage. The distance between the hole centres is 8½in., as shown. The holes for the springs on members "G" are countersunk for obvious reasons and the nut manipulated on to the bolt inside the spring coils. Once they are secured they are permanent. A tight jawed spanner simplifies the job by holding the nut while the bolt is screwed into it from above. At this stage of the work the wheel may be fitted into place ready to receive the brake fittings. Fig. 3 is merely an end elevation. The dotted line from part "L" to "L" represents the brake release spring of which more will be said later. Fig. 4 is an exploded view of the main components from detail "C" to detail "Y." No dimensions are given for the sake of clarity in this view.

The Brake Components

In Fig. 5 the components of the brake mechanism are shown. These are marked L for the arms and L1, L2, L3, L4, L5 and L6 for the other pieces. The full-size illustration on the extreme left is self explanatory, the lock-nuts being fitted to ensure security but freedom for the arm to pivot on the bolt. The washers are used to centralise the brake shoes so that contact with the rim is made as near diametrical as possible. More or less washers may be needed than are shown, these being merely to denote their presence. In the centre view is shown the arms. They are of ½in. angle-iron, 4in. long and of 1/16in. flange thickness. They are identical except for being right- and left-hand. The view is of the left-hand arm and illustrates the method of cutting and bending the horizontal and vertical flanges. In order to retain as much strength as possible a mitre-cut is made in the horizontal flange. This extends for 1in. from the brake shoe to 1⅜in. on the mitre, leaving a 1/16in. x ½in. strip which is bent back to meet the angle of the wheel rim. Here again the amount of bend must be ascertained whilst doing the job, since the brake shoe must carry the block into contact with the rim in the best and firmest way during its operation. The hole for the brake shoe is ¼in. from the edge and of a size to take the bolt provided with the shoe. These fittings are standard cycle brake shoes and blocks. The only other hole in the vertical flange is a 3/32in. dia. one placed 1 1/16in. from the end of the arm and ⅛in. from the edge of the flange. This is to accommodate the small hook in the brake release spring. On the horizontal flange two ¼in. dia. holes are made at 1¾in. centres starting ¼in. from the other end of the arm which is radiused off as shown. The connecting strips (Fig. 5 right centre) are of mild steel 1/16in. thick x ½in. wide. Little need be said of these except to note that on the piece marked L5 one hole is ¼in. dia. and the other 3/16in. dia. Great care should be taken to ensure the exact positioning of all holes, however, as any slight error will upset the whole arrangement. Component L6 is made to hold the nipple of the Bowden cable and is also 1/16in. x ½in. strip bent to the shape shown, with a slot for the cable to pass through freely. It will be seen that a 1/16in. gap is left for joining the link to component L5 which is held in place by a 3/16in. bolt and wing-nut. This is provided for purposes of disconnecting when taking the wheel out, etc., the other strips being joined by rivets. The view of the cable link is full size.

(To be continued.)

A Perpetual Table Fountain



A sectional view of the completed fountain.

THIS little fountain is quite self-contained and does not need a constant supply of running water. It is portable, and can be used either indoors or in the garden. At first glance it looks as though the secret of perpetual motion has been discovered. The water in the basin is forcing itself in a jet to a height of 10in. or more above its own surface! Actually, however, the jet will cease when all the water in the upper tank has been forced out.

The fountain is made quite simply. If you have a couple of old petrol cans of equal size they will do splendidly for the tanks and will give about forty-five minutes' working without attention. They should be fixed on their sides, one above the other, with a space of about 8in. between them. A simple frame of wood or metal can be easily rigged up to keep them in position. The lower tank must have an air cock at the top and a draw-off cock underneath; old gas fittings will come in useful here. The top basin can be made from any handy metal; it rests on the upper tank and has a filling plug, as shown.

Pipes A, B and C are tubes of ¼in. or smaller diameter, preferably of brass. It is best to solder all joints between pipes and tanks, as they must be quite watertight. To finish the job, solder on the top of pipe C a thin brass disc in which a pinhole has been drilled. On the size of this hole depends the volume of the jet and the length of time the fountain will play.

How the Fountain Works

To start the fountain, first put a plug in the top of pipe A. Remove the plug from the bottom of the basin, fill the upper tank and basin with water and put back the plug. Now unstop pipe A and the fountain will start to work.

Magic? Not at all. When you unplugged pipe A, the water ran down and compressed the air in the lower tank. Pipe B transmitted the pressure to the water in the upper tank, which was forced up pipe C and so out through the pinhole, forming the fountain jet. The flow will go on because the head of water in A is acting against a smaller head in C. No water flows through B.

Of course, as the water rises in the lower tank, the "working head" of water is reduced and the jet weakened. The jet does not, however, become a mere dribble but stops quite suddenly when the lower tank is full of water and the upper tank full of air. The water level in the basin remains the same.

Restarting

To restart the fountain, plug pipe A, open the air cock and empty the bottom tank through the draw-off cock. That tank will now be refilled with air and the air cock should be closed again. Now refill the basin as originally described, and the fountain is ready for another "run."

A painted casing, of either wood or metal, will give the job a finished appearance. The fountain is silent except for the sound of falling spray.

Miniature Plugs and Coils

Constructional Details of a Small Ignition Coil and Plug Suitable for Model Aircraft and Model Boat Engines

Coil Core

THIS is made from soft iron wires, 2in. long. It is important, for good results, that the right type of wire is used. It can be obtained from an old car ignition coil to ensure that it is of the right quality. Sufficient wires to make a core of 3/16in. dia. are required, and the finished core should be wrapped with empire cloth insulation (one layer).

Primary Winding

The primary winding consists of approximately four layers of .024in. (23 S.W.G.) enamelled copper wire, hand wound on to the insulated core, reversing the winding ½in. from each end (D.C. resistance, .4 ohms).

Secondary Winding

This consists of 8,000 turns of .0024in. (46 S.W.G.) enamelled copper wire (D.C. resistance 5,000 ohms). A winding fixture or bobbin is required to produce the secondary winding successfully, and a suitable fixture for this purpose is shown in Fig. 1.

A former made from adhesive paper tape, 1½in. wide, should first be wound on to the spindle of the winding fixture. Four layers are required, and care must be taken to see that the former is not too tight on the spindle, or there may be difficulty in withdrawing the finished secondary winding from the winding fixture. Start winding the secondary, interleaving each layer with paper .001in. thick and reversing each layer ¼in. from each end of fixture. Make off the start and finish off the winding with a flex pigtail for connection purposes.

Withdraw the secondary winding from the winding fixture when complete.

Assembly

Insert the core and primary winding inside the secondary winding former, and place the assembled coil in a suitable container, joining the finish of the primary winding to the start of the secondary winding, and leading this through a suitable aperture, winding through the casing at suitable points in a similar manner.

Now immerse the complete coil and casing in hot paraffin wax, leaving it for a few moments until all air inside the container has been expelled. Withdraw from wax and drain off.

A Miniature Sparking Plug

Materials required:

1. Hexagon mild steel bar, ⅜in. across flats.
2. Old radio resistor body, with hole through the centre, made of Steatite, a material similar to porcelain.
3. A piece of nickel chrome wire obtained from an old electric fire element of a diameter to suit the hole in the resistor.
4. A small quantity of gasket cement as used on motor-car joints, and a little french chalk, added to gasket cement to give body.

Making the Body

The hexagon bar should be checked in a centre or capstan lathe, faced and drilled 5/32in. dia. to a depth of 9/16in.

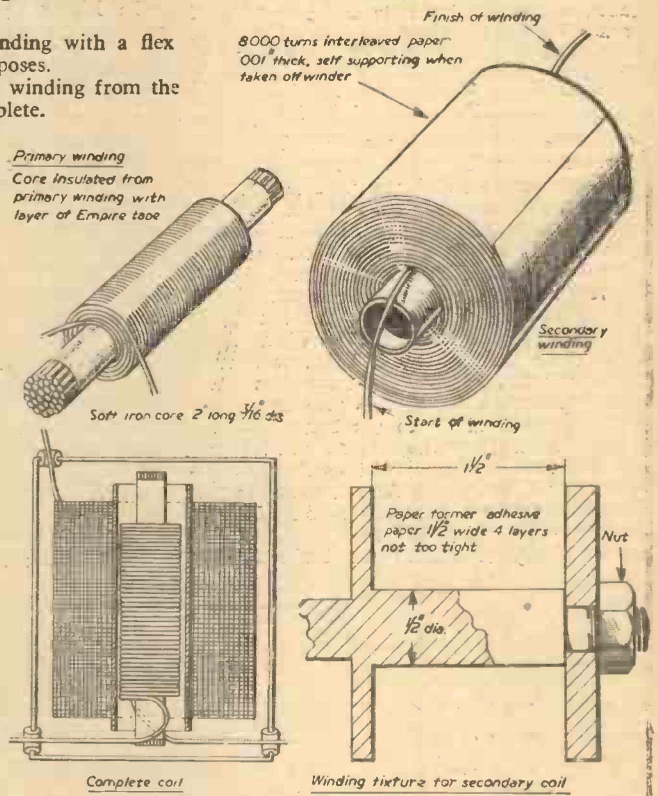


Fig. 1.—Details of coil windings.

This hole should next be counterbored ¼in. in diameter to a depth of ¼in. Turn the outside of the bar to ⅜in. dia. for a distance of 3/32in. and chamfer down to the ¼in. hole to form a feather edge. Part off to give body a length of ½in.

Reverse the body in the chuck and turn down to ¼in. dia. for a distance of 3/16in. and then screw cut or die the ¼in. dia. 32 threads per inch.

Making the Insulator

Grind one end down to ⅛in. dia. for a length of 3/16in. and chamfer out to ¼in. dia. at the same angle as drill used to counterbore the body.

Next, grind to ¼in. dia. for a distance of 3/16in. from shoulder of chamfer, and then grind down to 3/16in. dia. with radiused shoulder. Grind off and face end approximately ⅜in. from start of shoulder.

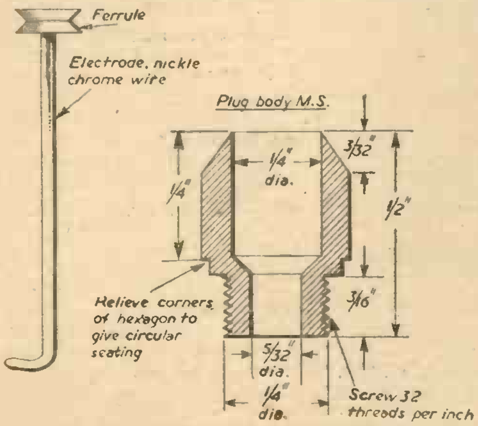
The Electrode

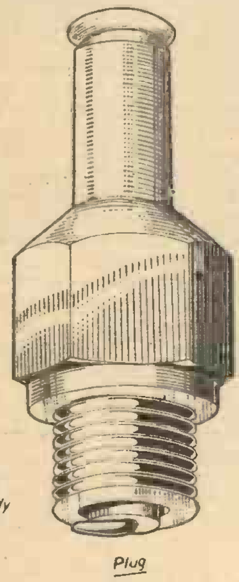
Grind one end of the wire to a fine point, and bend it over at right angles. Make a small ferrule to fit the top of the electrode.

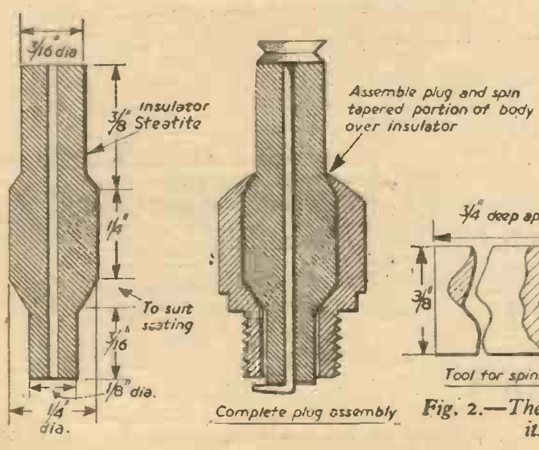
Assembly

Smear the inside of the plug body with jointing compound and insert the insulator. Spin over the feather edge of the plug body on to the radiused shoulder of the insulator, using the special tool shown in Fig. 2.

Paint the electrode with jointing compound, insert the insulator, and then fit the ferrule on the end of the electrode and carefully spin over, using tool in drilling machine.







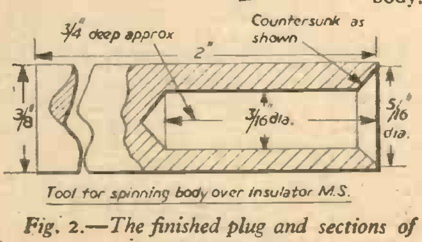


Fig. 2.—The finished plug and sections of its component parts.

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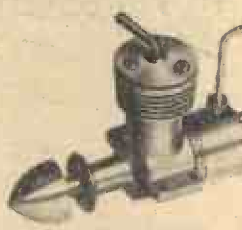

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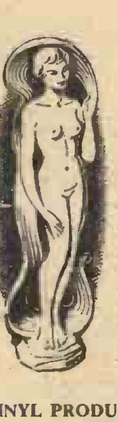

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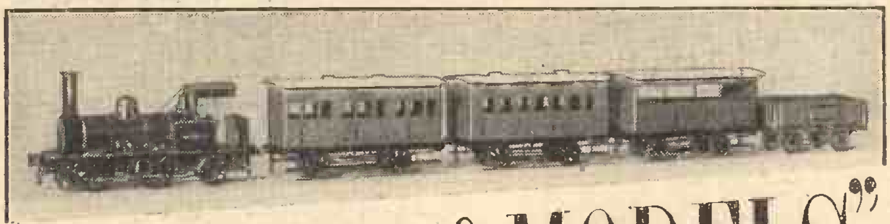


The "World of MODELS"

By "MOTILUS"

"The Model Engineer" Exhibition

HAVING been a regular visitor to the annual "Model Engineer" Exhibition in London for more years than I care to remember, I view some of the recent innovations at this popular show with mixed feelings. I am, however, entirely in favour of one development that has emerged during the past two or three years: this is the introduction of demonstration stands, where model-makers can be seen at work on their hobby.

When I visited "The Model Engineer" Exhibition held last October I thought the models entered for competition showed better standards than ever in this fascinating hobby. Coming, as they do, from all parts of Britain and from amateur craftsmen of all ages, these competition models give a good impression of what model-makers are doing. Added to this there are the loan models, all of them first-class specimens of model-making, so that there is a great deal to interest both experts and greenhorns.

Railway models, of course, are as big an attraction as ever and some beautiful work is being done on locomotive models. An especially fine example was Mr. J. I. Austen-Walton's 5in. gauge "Twin Sister" locomotive, scale 1in. to 1ft. (Fig. 1). This 0-6-0T L.M.S.R. class 2F model had the back of the cab removed during exhibition, so that the exquisite detail work inside the cab could be seen. The model was made almost entirely in stainless steel and all the details were functional.

Winner of the Championship Cup in the Steam Locomotive Section was Mr. L. R. Raper, of Wakefield, for his 3½in. gauge free-lance locomotive, to a scale of ¾in. to 1ft. (Fig. 2). This was based on a heavy-duty 0-6-0ST contractor's type locomotive. Another heavy-duty locomotive model, by Messrs. G. and P. Wheeler, was awarded a silver medal: this was a 5in. gauge 4-6-4T Halton type locomotive, to a scale of 1in. to 1ft. I must mention also Mr. F. Granger's 5in. gauge locomotive, an 0-6-0 S.R. "Vulcan," which has already hauled 3,500 passengers for the Hitchin Model Engineer Club without major overhaul. Bronze medal winner, Mr. C. J. Hainge, is to be congratulated on his 3½in. gauge 0-6-0T L.M.S.R. class "3F" locomotive, built from scrap materials during service in H.M. Forces.

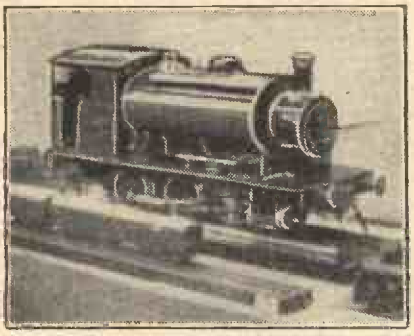


Fig. 2.—Mr. L. R. Raper's 3½in. gauge contractor's type locomotive model, for which he was awarded the Championship Cup for steam locomotive models.

Ship Models

An extraordinarily large number of exhibits were to be seen in the various ship classes, from tall, graceful sailing ships of all periods (Fig. 3) to the tiny miniatures, and the inevitable expression of popular art, ships in bottles.

A championship winner that drew much admiration was a 5/16in. scale model of a scene with an Admiral's barge, which took Mr. C. A. Chapman four years to build. The barge, a non-working model, was plank-built throughout, despite its small size, and was made from plans supplied by the Admiralty. This excellent, detailed model was set on a sapphire blue sea as the focal point of a gay, tropical scene, such as might be found in the West Indies. The barge was drawn up at the quayside, awaiting the return of the Admiral from a shore visit, and the figures of natives on the quay were beautifully modelled. Baskets of tropical fruit stood around, oranges, limes, pineapples and bananas, each individual fruit separately made. A palm tree curved gently at one side made from 3,000 fitted pieces! A small native boy perched on the quay wall was eating an orange, the peel scattered about him. All these points aided the realistic atmosphere that pervaded this model scene.

Among the non-working sailing ships I was interested to find a model ship, *Sea Witch*, built by Mr. D. D. Bilimoria, of Bombay, the model showing a good degree of accuracy in its construction. I have since learned that Mr. Bilimoria is hon. treasurer of The Bombay Society of Model Engineers, which has been thriving since 1939 under the energetic guidance of the chairman, Mr. M. P. Polson, A.S.E., F.R.S.A., F.R.G.S. The Bombay Society was the first in India and aims at the development of model engineering and allied craftsmanship.

General engineering models were well represented and I noticed a good proportion of well-made traction engines. A slightly modified 1½in. scale Fowler showman's engine won a silver medal for Mr. G. C. Taylor, who had put some very good detail and colour work into his model. Mr. A. L. G. Newman, bronze medal winner, had entered a 1½in. scale Burrel traction engine, built to a design by Mr. D. Bretherton, who used to be a traction engine designer for Messrs. Burrells. (Continued on page 170)

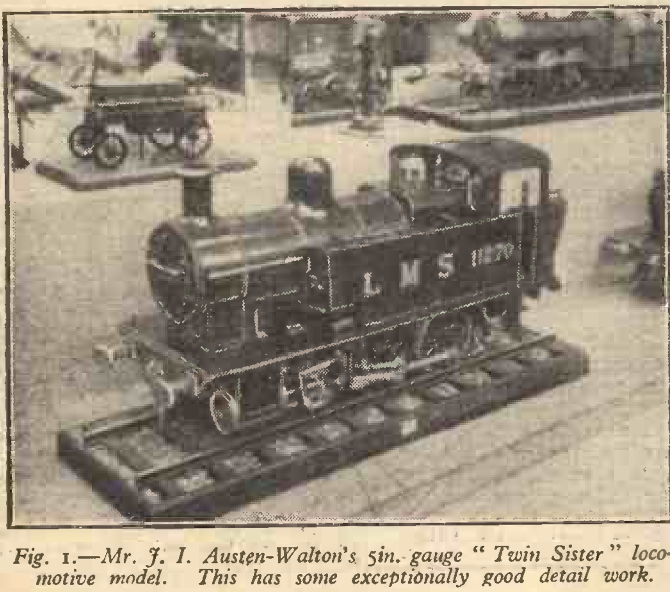


Fig. 1.—Mr. J. I. Austen-Walton's 5in. gauge "Twin Sister" locomotive model. This has some exceptionally good detail work.

Fig. 3.—Ancient and modern were both well represented in the sailing ship competition entries at "The Model Engineer" Exhibition.

LETTERS TO THE EDITOR

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

Push-button Starter Circuit

SIR,—I read with interest the reply to K. Copping (Watford) in the September issue, regarding a push-button starter circuit.

May I point out that this circuit could not operate, as it would be necessary to push both stop and start button at the same time to energise operating coil. Stop-button contacts should normally be closed and opened for de-energising operating coil.

I also think the explanation of operation is not clearly described, and is misleading inasmuch as L_2 and L_3 operate the coil, not L_1 and L_2.

In the remote circuit, both stop-buttons should normally be closed. I enclose a circuit, and I think the following information will answer the enquiry a little more clearly.

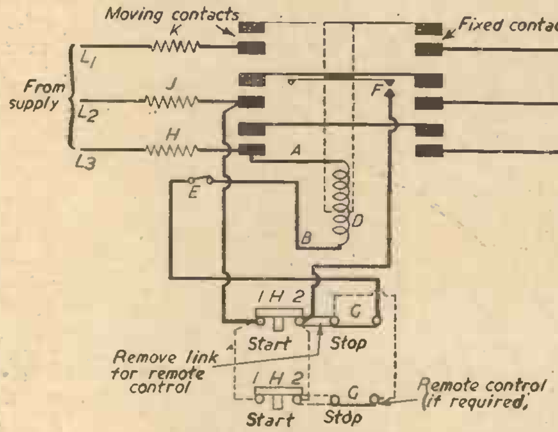
With the operating coil D, A is connected to L_3. B through overload trip to stop button G, which is normally closed. Through the link to start button 2, from 2 to F on moving contacts. Start button 1 is connected to L_2.

When H is pressed, D is energised, shorting out F points, and taking over from H. H can now be open circuited. When G is depressed the coil circuit is open and operating coil de-energised.—W. J. DOLAN (Walthamstow).

[*It was intended that the lines L_1, L_2, and L_3 should be numbered from the bottom instead of the top of the diagram. However, as shown, we agree that the coil is supplied from the lines L_2 and L_3 and not L_1 and L_2.*

We agree that both "stop" push-button switches should normally be closed. As you will, no doubt, observe, the four push-button switches have been correctly shown, apart from the fact that the contacts of the "stop" push-button switches have been shown in the pressed position. You will note that the position of the buttons attached to the moving contacts of the push-button switches indicates that pressure on these buttons opens the "stop" push-buttons and closes the "start" push-buttons correctly. Actually the contacts of the "stop" bush-buttons were shown closed on the original diagram, but were accidentally altered slightly when the drawing was prepared for reproduction.

The diagram which you have forwarded appears to indicate that pressure on the "start" push-buttons will open them; in fact, they have been shown as normally closed push-buttons.—ED.]



Push-button starter circuit corrected diagram.

Interplanetary Space Travel

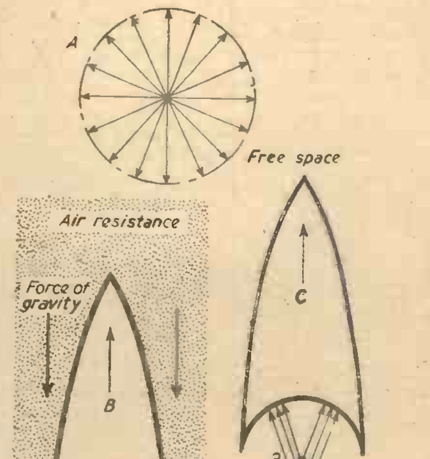
SIR,—In the November issue V. A. Milburn ("Interplanetary Space Travel") contends that propulsion of a body across free space does not seem possible. On the contrary—astonishing speeds may be attained in free space on a minimum amount of fuel. Perhaps the accompanying diagrams may help a little. If a point source of energy is tapped, the force released will radiate in all directions away from the point source as seen at "A." If the point source is placed at the position shown in "B" it will represent the fuel in the combustion chamber situated in the tail of a rocket. Half the force radiated is wasted, as it escapes immediately, but the other half is trapped by the hollow hemisphere; it is this half which does the work. If "B" is a rocket in the earth's atmosphere, the rate of expansion must be increased until the air resistance and the force of gravity is overcome. The rocket will then ascend.

When the rocket is in free space as indicated in "C," it will be in a weightless condition; there will be negligible gravity and no air resistance. "C" gives three consecutive positions of the point source radiating energy as the rocket is projected.

It will be seen that, apart from the minute power required for projection across free space, there would be an enormous build-up of speed even if the same small rate of expansion was used. Indeed, it would seem that the now weightless rocket could be projected at a speed equivalent to the expanding energy! A staggering thought, to say the least. Having attained maximum velocity, the motor could be cut, and if one so desired the rocket would cruise at that speed for ever.

V. A. Milburn's suggestion of a body disintegrating in free space, ignores the gravitational law that matter is attracted unto matter. Each speck has its own centre and force of gravity, but is influenced by any larger mass in its *vicinity*, thus the atoms of a space-ship would still remain together. It is imperative that this *must* be so, otherwise every single body in existence would have disintegrated long ago.

The same writer's suggestion of "no vision in space" warrants closer examination. Light, paradoxically enough, is invisible, and we are only aware of its presence when it strikes a body, such as the moon's barren surface or the molecules of our atmosphere and, in turn, the retina of the eye. Whether the eye would still register light if it were placed in a vacuum is a matter of speculation. We do know it can register light which has passed through a vacuum and enters the atmosphere. The contention that we should be unable to take our bearings in a space-ship falls down immediately we give our ship an internal atmosphere, which it must have for us to exist. This atmosphere automatically gives the eye its familiar conditions of functioning, and we should be able to take our bearings with the utmost clarity and steadiness of vision.—W. ELLWOOD (Hatfield).



Mr. Ellwood's rocket propulsion diagrams.

SIR,—I found the letter about interplanetary space travel from your correspondent, V. A. Milburn, very interesting; his ideas show thought, even if they are a bit unorthodox or revolutionary to the ordinary man. I have no quarrel with the main trend of his thoughts, as I understand them (that is not to say I accept them!), but there is one part which I feel is absolutely "off the rails," and, no doubt, you will receive more than one letter on this particular point.

The point at issue is the statement in the fifth paragraph that a traveller in space could not see to take bearings because of the absence of a medium through which to see. Surely light does not need a medium through which to travel? And if it does, then that medium (whatever it is) must exist because we do, in actual fact, see through it. The point in the next paragraph that we see other planets through atmospheres does *not* prove the following statement: "Thus we see through or across the intervening space." If there is a complete void between atmospheres through which light cannot travel, then can V. A. Milburn explain just how light gets from one atmosphere to another? And further, can he explain how we see other heavenly bodies which have no atmosphere at all, or which is frozen solid?

And how is it that we can see objects in an evacuated jar on our own earth—true we cannot reach a perfect void, but if some sort of medium is required to transmit light, then might not its "thinning down" to almost vanishing point in the evacuated space result in at least a dimming or "ghosting" of our perception of objects within it?

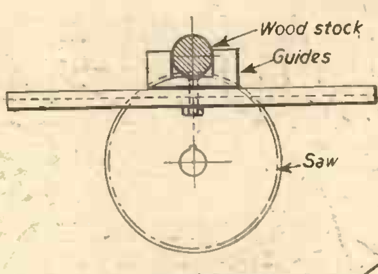
Let us suppose that we could "see across the intervening space" if we look through atmospheres." Then surely the space traveller will still see, because he will have at least some sort of atmosphere inside his space-ship, or his space-suit—after all, he's got to breathe! And I can't imagine him undertaking that journey with an oxygen mask only over his face, and his eyes uncovered!

Finally, I would like to ask your correspondent for more details about his theory of a hollow sphere shrinking at a terrific rate. Does he mean that the entire Universe is the sphere? If so, why is it shrinking? What makes it do so? Do things within it shrink, too? Or will they be overtaken by the shrinking sphere, and what happens to them then? I would like to assure your correspondent, quite sincerely, that I'm not trying to be facetious at his expense, or to pull him to pieces—it's merely that I'm voicing my first natural reactions to his theory—after all, he may be right!—C. S. WEDLOCK (Horley).

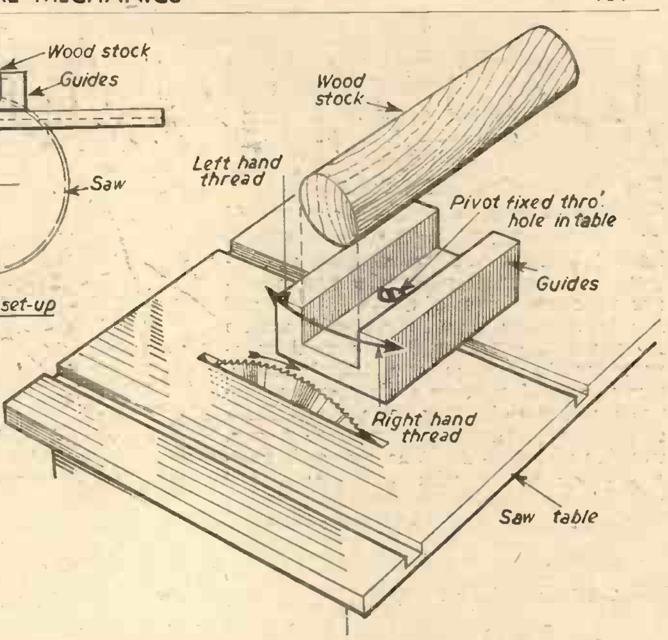
Novel Method of Screw Cutting

SIR,—Using the top of a circular saw and placing two small parallel strips of wood on a pivot, to act as guides, at right angles to the direction of the saw, I find that it is possible to cut screw threads of any pitch, left hand or right hand, by simply varying the angle of the guides in relation to the saw.

The rod to be threaded is placed in the guides as shown in the sketch, and fed to the saw in a rotary forward motion. The saw blade keys itself in its own cut and proceeds in the direction given it by the angle of the guides. The accompanying photograph shows the first test piece tried out.—H. A. D. JOSEPH (Epsom).

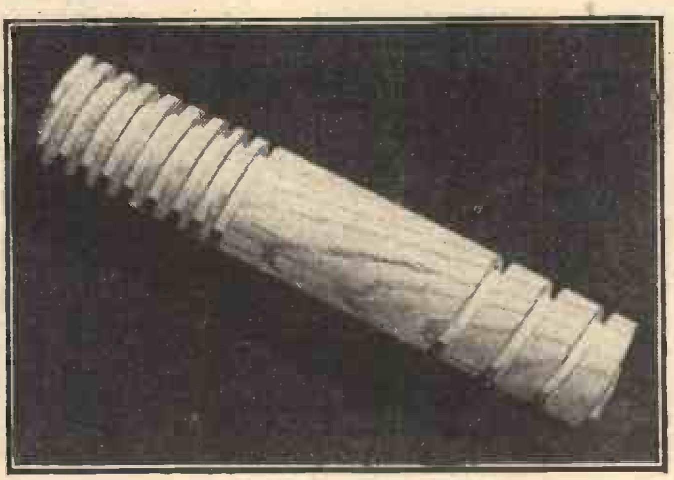


End view of set-up



Right: Mr. H. A. D. Joseph's method of cutting screw-threads on wood by means of a circular saw.

Below: A view of his first test piece, the finish of which could probably be improved with practice.



Making a Plaster Cornice

SIR,—In the November issue N. J. Wilson gets some advice about his plaster cornice which, in my opinion, is not strictly correct.

The drawings given by J. Heelas are very good, except that the nib rail is not required on the ceiling. The nib of the horse (or mould) will bear on the ceiling and must be held tight to it while "running" the cornice.

The amount of plaster of paris advised by Mr. Heelas is not enough. The proper mix for a good job would be approximately three of lime putty and one of the plaster. Installing a cornice by this method is really a job for a skilled man, and if Mr. Wilson is not one, he would be advised to buy a cornice made up in lengths from one of the firms engaged in its manufacture. He would only have to nail it in position and make up the joints and mitres by hand.—A. BOYLAND (Celbridge, Co. Kildare).

Boiler for Model Steam Launch

SIR,—I am about to build the Model Steam Launch described in the August and September issues, but find that no dimensions are given for the boiler. Can you supply these please?—J. M. DOUBLEDAY (Silloth).

[*Dimensions for the boiler are as follow: Length 4in.; dia.* $1\frac{3}{8}$ *in. It has end plates sunk in and soldered. The material is 24g. sheet copper rolled to form a cylinder and lap jointed. The end plates are of 22g. copper. Sheet iron of 22g. is used for the boiler casing.*—ED.]

Golf-bag "Caddie Cart"

SIR,—As a new reader of your journal PRACTICAL MECHANICS, which I think is one of the most interesting journals of its kind published, I would like to make use of your query service.

Will you kindly inform me if you have ever published the constructional details for a golf-bag "caddie cart" made up from aluminium tubing, and if so, could you tell where I can obtain details of same?—J. G. S. COATES (Middlesbrough).

[*We invite readers' suggestions on this subject.*—ED.]

AN ELECTRIC FLOOR POLISHER

(*Continued from page* 148)

drawn down through the stem of the handle and out through another rubber grommet at the lower end and taken to the motor. Here again the earth wire should be connected to a convenient screw on the body of the motor. The handle itself is pivoted to the motor by a ¼in. mild steel spindle passing through a double eared bracket bolted to the two lower motor feet. A light spring clip keeps the handle in a vertical position when the machine is not in use.

The rubber flex should be of ample length and is wound, when not in use, on a pair of ¼in. round mild steel cleats brazed to the stem of the handle.

Operation

When using the finished machine the polish should be sparingly applied to the floor and allowed to partially dry. The polisher is then switched on and worked with a "to and fro" motion over the waxed surface. The pads, when dirty, may be removed and washed in warm soapy water. It is, as stated before, a great advantage to have at least one spare set of pads.

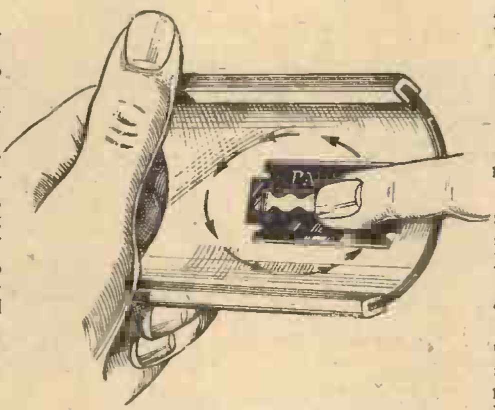
Trade Notes

The Modelcraft Handbook

THE handbook lists all the products of Modelcraft, Ltd., 77(s), Grosvenor Road, London, S.W.1, and these include plans, complete kits, separate accessories and woodpacks for many types of model. Plans and kits are supplied for making lineside models for use with gauge 00 layouts, road transport models, modern and period houses, many types of old-time sailing craft, sailing boats, yachts and power boats, Royal Navy and Merchant vessels, and for aircraft, cars, weapons of war, etc. The booklet is illustrated throughout with photographs and detailed sketches and every item is priced. The Modelcraft Handbook may be obtained from the above address, price 1s. 6d.

Atomic Blade Keener

THE purpose of this new and extremely simple device is to re-sharpen the blunt edges of used razor blades, and we are given to understand that some of its users have had months of use from one ordinary double-edged razor blade. The Keener is non-abrasive, does not wear out and does not wear away the blade. It is used dry and requires no oil, paste or water; it is finished in white plastic. The price, including tax, is 3s. 6d., plus 6d. postage, and it may be obtained from the makers, Korving, Ltd., 54, Frederick Street, London, W.C.1.



The Korving Keener in use.

Multicore Silver Solder

WITH the co-operation of Johnson Matthey, of Hatton Garden, London, E.C.1, Ersin Multicore Solder is now available in Comsol alloy. This tin/lead/silver solder has a melting point of nearly 300 deg. C., which is 113 deg. C. above the melting point of the usual tin/lead alloys.

Ersin Multicore Comsol solder is normally supplied in 16 S.W.G. and is intended for soldering processes where components are likely to be subjected to excessive working temperatures. Projector lamps, some types of electric motors, etc., are examples. It is believed that Comsol may also be suitable for use on radio and electrical equipment being subjected to sub-zero temperatures, although research into this is at present still proceeding.

Generally, this new product will be supplied direct to manufacturers, the price being slightly less than that charged for Ersin Multicore 60/40 alloy.

BOOKS REVIEWED

Our Neighbour Worlds. By V. A. Firsoff, M.A. Published by Hutchinson's Scientific and Technical Publications. 336 pages. Price 25s. net.

THE author is a fully qualified and practical astronomer but he writes in a strain that the layman can understand. He uses the most up-to-date knowledge of the solar system to make a survey which is used as a basis for his researches into the problem of interplanetary travel, a fairly imminent exploration in which he firmly believes. He delves both into the fields of knowledge and of speculation, but it is always made clear whether or not it is fact that is being presented. This is not an astronomical treatise, nor is it a fantasy of the pseudo-scientific kind: it is an attempt to add the rapidly expanding science of space flight to known astronomical information and present a few ideas of the prospects. Mathematical formulae have been deleted from the body of the book and put all together in an appendix. The illustrations comprise both astro-photographs and drawings and photographs of astronomical apparatus; art paper is used throughout.

The Cyclemotor Manual. By the Staff of "Motor Cycling." Published by Temple Press, Ltd. 107 pages. Price 6s. net.

THE purpose of this book is to answer the questions likely to be asked by the new owner or prospective purchaser of an auxiliary motor. It deals with running costs, legal formalities and routine maintenance, and gives all the technical knowledge needed by the driver. Units are dealt with individually and each engine is illustrated by a special "exploded" drawing showing assembly. A full description of the unit and instructions for its maintenance are included in the text, and there is a special chapter devoted to the location and cure of mechanical troubles. There are also chapters on basic principles and on riding a motor-assisted bicycle. The book is compiled by the staff of "Motor Cycling," who have ridden most cyclemotors available in this country and write from experience.

Motor-cycle Maintenance and Repair Series: Velocette Motor-cycles, by R. W. Burgess: The J.A.P. Engine, by A. C. Fenner and W. Phillips. Published by C. Arthur Pearson, Ltd. Price 6s. net each volume.

INCLUDED in the well-known Motor-cycle Maintenance and Repair Series, these volumes provide owners and repairers with a guide to the Velocette motor-cycle and the J.A.P. engine respectively. All the Velocette models from 1933 are dealt with, and chapters are included on routine running adjustments, K and M four-stroke and GTP two-stroke engines, clutch and gearbox, carburettors, wheels, chains and brakes, forks, electrical equipment, and a separate chapter dealing with the LE model. In addition to photographs, many sectional and "exploded" diagrams are included.

The J.A.P. handbook deals with the motor-cycle-type engines, racing units and industrial types, and a specialist contribution is included by W. H. Phillips, Harringay Speedway team manager and mechanical adviser, on tuning and overhauling racing engines. The book is well illustrated throughout and contains chapters on overhaul, lubricating systems, carburettors, magnetos and a full index.

Motor Cycling Road Tests. Published by Temple Press, Ltd. Price 5s. net.

THIS first edition of road tests is comprised of reports published in "Motor Cycling" during the past four years. These reports answer the motor-cyclist's questions about speed, handling, performance and economy, and give much-needed information to the prospective purchaser of a new machine. This booklet is illustrated throughout with photographs and drawings, and at the end are 12 specially drawn cutaway diagrams to supplement the test report in the text.

Club Reports

The Ramsgate and District Model Club

MEMBERS of the above club recently exhibited at the neighbouring town of Broadstairs, and at the Ramsgate Trades Exhibition, their model of Ramsgate Harbour.

This 32ft. to the inch scale model was described by the local press as the "pièce de résistance." It was certainly admired by thousands of people, and the club must have obtained a great deal of publicity through this project.

Various delicately executed models were also exhibited by individual members.

A cordial invitation is extended to all interested persons and fellow modellers at the club's premises—Princes Street, Ramsgate.

MR. E. CHURCH, Hon. Secretary, 14, St. Mildred's Avenue, Ramsgate, Kent.

New Ideas Exhibition

THE Modern Inventions and New Ideas Exhibitions will be held at the Central Hall, Westminster, S.W.1, from February 18th to 28th, 1953. Promoters, Moorland Exhibition Enterprises.

H.R.H. The Duke of Edinburgh has extended his patronage to this exhibition, an encouragement which inventors will greatly appreciate.

It is planned to display inventors' prototypes in a setting of up-to-date equipment from the major industries of this country, so stressing the importance of new developments. Medals will be awarded for meritorious inventions shown. Inventors all over the country are invited to participate in this, the first large-scale display of inventions in this country since 1939. Correspondence should be addressed to:

GENERAL SECRETARY, Institute of Patentees, 207-208, Abbey House, 2-8, Victoria Street, London, S.W.1.

THE WORLD OF MODELS

(*Continued from page* 165)

Quite a large number of entries appeared in the aircraft sections. "General Craftsmanship" was well represented and there were many interesting scenic and architectural models.

Radio-controlled Models

Probably the most attractive of the special features was the marine tank and radio-control section. The interest in radio-controlled models naturally increases every year as more and more operations become possible under the direction of radio-control. Several different types of ship models were demonstrated here, as well as Mr. Tamplin's model Churchill tank, first seen at the 1951 Exhibition, and modified and improved for the 1952 demonstrations.

There is something for every modeller in

THE NEW

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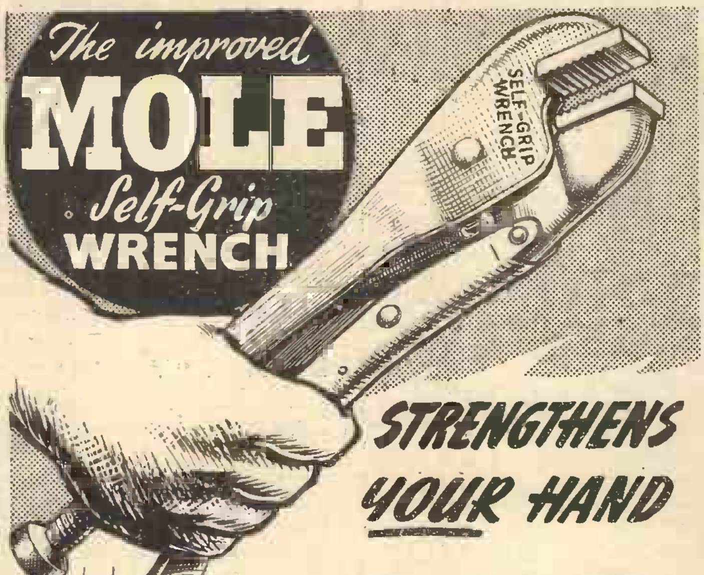

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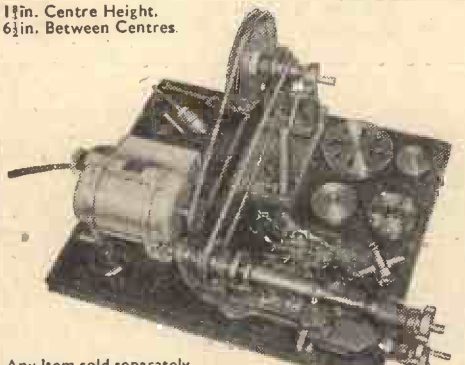

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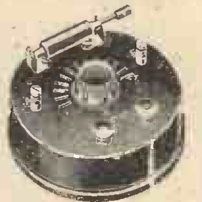

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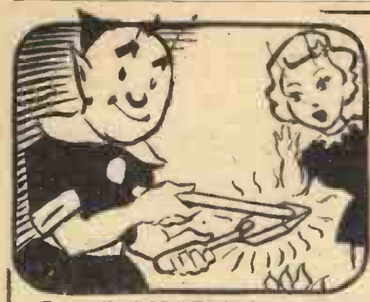

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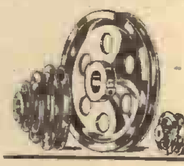

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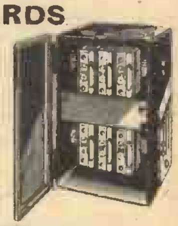

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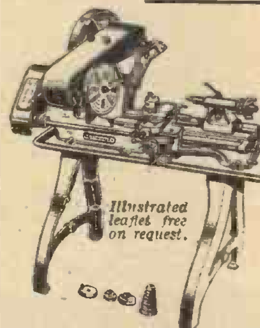

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QUERIES and ENQUIRIES

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.

Stop Sizes and f Numbers: Checking Shutter Speeds

(1) I have a lens with which I hope to build a camera the rating is as follows, B & H Ansix Type V 1⅜ in. (35mm.) f/3.5. Please inform me of a scale in fractions of an inch and their equal in f numbers, the smallest aperture being 1/16 in. opening up to ⅜ in.

(2) Could you inform me of a method of checking the speed of a shutter ?—A. D. Smith (Corsham).

(1) GIVEN below are the diameters and stop numbers for the 1⅜in. (35mm.) lens.

There is no simple way of checking shutter speeds, except by comparing results of exposures made, simultaneously, with another and reliable camera. The speeds of shutters vary considerably on different cameras for similar speed workings. I had two cameras, both with compound shutters and Zeiss lenses; the shutters had a range from 1 second to 1/250th, yet the times on one shutter were noticeably longer then the other.

The only reliable way to check would be to fit up a revolving drum, making *one revolution per second*. Fix round the drum a band of sensitised film or bromide paper. Make a box to fit on the back of the camera, light tight, containing an electric lamp. Point the lens, close up, at the film, start the drum revolving, fire the shutter, develop the film and the proportion that the length of the fogged or blackened part of the film bears to the whole length of it, or to the circumference of the drum, will be the fraction of a second of the exposure. Thus, suppose the diameter of the drum is 12in., and the circumference and film length 37in., if the fogged portion is 1¼in. in length the exposure will be, as nearly as possible, 1/25th second. Obviously the job would have to be done in the dark room and with a ruby lamp for general lighting. A number of exposures could be made on the same film and it would not matter if the fogged portions overlapped, providing the lamp at the back of the camera was not very brilliant. The circumference and especially the revolution speed of the drum are very critical points.

Lens B & H, Type V, 1⅜in., 35mm., f/3.5.

English Stop Number	Stop diameter inches	diameter in millimetres
f22	1/16	1.6
f16	5/64	2.2
f11	1/8	3.2
f8	11/64	4.38
f6.5	7/32	5.38
f4.5	5/16	7.7
f3.5	25/64	10.0

Restoring Pitted Red Tiles

I HAVE moved into a new house, the kitchen floor of which is formed of red tiles. These were covered with linoleum, and the action of the moisture trapped underneath has pitted the surface of the tiles rather badly.

Can you tell me any method of bringing them back to a new condition ?—M. Oates (Halifax).

YOU are faced with a difficult problem but might find a treatment with coloured cement helpful. The tiles should be thoroughly cleaned and moistened, especially in the pits.

A mixture of one part of cement with four parts of sand is coloured, when dry, with red iron oxide. The amount of oxide will depend on the exact shade of the tiles, and a little trial and error with a sample mix will give you the proportion of colour to use for a good match with the tiles. The coloured concrete is then pressed firmly into the damped pits on the tiles, and allowed to set for at least 48 hours before use. When the concrete is in a mastic condition after a few hours it can be smoothed carefully with the finger, to give a fairly good surface.

An alternative suggestion is to use a floor paint, or lino paint, using this to fill in the pits, if the latter are not deep.

Patching Camera Bellows

CAN you give me the formula for a flexible paint to apply to camera belows to fill pin-holes ?. Is there any such paint on the market, and if so where can I buy it and what is its approximate cost ?—M. A. Davidson (Liverpool, 14).

THERE is no such thing as a really flexible paint, and there is certainly no paint which, of itself, would withstand the strain on it involved by the opening and closing of camera bellows.

Fortunately, however, the trouble with your camera bellows is not very difficult to cure. The bellows merely require careful patching over the pinholes with small scraps of thin leather or rexine cloth. Take the camera into a dark room. Open out the bellows extension fully. Place a low-wattage electric lamp inside the camera and switch on the light. The disposition of the pinholes will be seen at once. Cut out suitable fragments of leather or rexine and stick them in position on the bellows with duroflex adhesive or seccotine. Very likely the pinholes will have formed on the sharp corners of the bellows. In this case, fresh corners will have to be made from thin rexine or thin leather. These are then fastened in position over the faulty corners, lightly clipped for an hour or two whilst the adhesive sets, and then, maybe, touched up with a little paint or colour to match up with the rest of the bellows. If the bellows, as a whole, are getting dry and are inclined to pinhole frequently, rub them over every other week or so with a soft cloth saturated with castor oil. This will help to keep the leather soft and to prevent it from cracking.

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.

Reversible Mirrors

IN the film "The House on 92nd Street" the F.B.I. agents were shown making use of what was described as a "reversible mirror" which, if viewed from one direction, appeared as an ordinary mirror but, from the other side, was like a sheet of plate glass. This device enabled the F.B.I. to take photographs of enemy agents without themselves being observed. Will you kindly advise me how this effect is achieved and the scientific explanation; and whether it is possible to purchase this type of glass commercially in this country and, if so, the approximate price and the name of the manufacturers.—D. F. Ecclestone (Suffolk).

THE principle of the reversible mirrors to which you refer is achieved by depositing a very thin film of metal, silver for example, on a glass surface. Viewed from one side the glass looks opaque, but you can see through it fairly clearly, from the opposite side. The explanation is tied up with the optical properties of very thin films, which are so thin as to be transparent, even though they may be of metal.

We are not sure that such glass is made commercially in Britain, but you might enquire of an optical firm like Pullin Optical Co., Ltd., Phoenix Works, Great West Road, Brentford, Middlesex.

Cleaning Tobacco Pipes

I FIND difficulty in cleaning my smoking pipes by the common method of the pull-through pipe cleaner. Some of the tar, gum, etc., is removed but the job is never thorough and the pipe clean and fresh.

Could you suggest a harmless liquid for getting rid of all the nicotine, etc. ?

It did occur to me that steam, forced through under light pressure, might be satisfactory, but this is inconvenient and difficult to do.—S. Kremer (Manchester 20).

THE main deposits in a smoking pipe are carbon, resinous products and tobacco juice bonded with tobacco "tar," all of which tend to char with time.

To clean, first of all remove as much deposit as possible with a pipe cleaner and scrape out the bowl. Then plug the mouthpiece temporarily, and fill the pipe with alcohol or methylated spirits. Leave it to stand for a day or two, then rinse out with alcohol, and allow to dry thoroughly.

If you are a connoissuer of tobacco this treatment may leave your pipe with not quite the flavour you would like, in which event you could swill it through with something like brandy and let it soak. Rum is also a pleasant flavouring. Keep the alcohol away from the outside, for it will dull any high polish on the wood.

Fitting a Direct Viewfinder

I HAVE an old folding camera which has the number indicating hole on the 16 exposure side, but is a 2¼ x 3¼ size camera. In order to use without cutting case I have masked off for 16 exposures.

The viewfinders were never very effective and, now size is changed, I wonder if you can give me any simple information as to how to make up a simple wire viewfinder to fit on side of case, i.e. a direct viewfinder.—S. C. B. Mee (S. W.15).

A DIRECT-VISION finder could easily be fitted. The aperture in the front of this should have its sides in the proportion of 2¼ to 1 5/8th. An actual size of 18mm. by 13mm. is suggested. (This being the size of *aperture*, not *outside* dimensions of the frame.) If the lens is of 4¼in. focal length, the angle subtended along the longest side of the negative will be 30 degrees (approx.). 30 mm. should therefore exist between the frame above mentioned and a small rear frame or plate, the latter having a hole 3mm. in diameter, to which the eye is placed.

The two frames (e.g., front one with 13 x 18mm. aperture, and rear one with 3mm. hole) may be hinged for folding down; when erected, they should be 30mm. apart, as mentioned.

A check that the view seen through finder is correct may be made by removing back of camera and substituting ground-glass or *thin* tissue paper for the film, and fixing the camera so that a distant scene is projected on the paper (shutter open). In the event of the lens being of different focal length from that you suggest, it will be necessary to increase or reduce the size of the front aperture in the viewfinder which is being made, or to move the two components of the finder nearer together or farther apart, so that the exact angle of view is obtained.

Building a Canoe

I AM considering building a canoe by covering a light wooden framework with a skin of laminated paper but I have been unable to find details of the type of paper used or the glue used for bonding the lamination.

Would a kraft or imitation kraft paper be suitable and could casein or resin glue be used for bonding ?—Robert W. Hersee (Glam.).

WE suggest the use of strong cartridge paper. For an adhesive either casein or ordinary glue, treated with potassium bichromate, might be used, in either case there must be no doubt about its waterproof qualities. Whatever glue is used the paper would obviously have to be put on in small pieces since large sheets could not be made to lie down on surfaces which are curved in all directions. It would be preferable to make the skin of several thicknesses of thin, closely-woven canvas. By laying this "on the cross," that is to say diagonally as regards warp and weft in relation to the lines of the hull, a whole side of the canoe, can be covered in one sheet. This can then be treated with either cellulose dope, varnish or a mixture of paint and varnish and a second sheet laid on and similarly doped; then a third sheet and so on until a sufficient thickness of skin is attained. Finally, the last sheet, when thoroughly dry, is rubbed down with glasspaper and given finishing coats of enamel paint.

Spontaneous Glass Fracture

AT the hospital where I am employed, we are rather mystified by the peculiar shattering of the clear, plain glass plate forming the detachable top of an instrument trolley, otherwise constructed wholly of metal tubing and mounted on rubber-tyred wheels—normally equipped with

a "safety-chain" to drag along the ward flooring (but not actually in place when the breakage occurred).

The trolley was stationary, unattended and without any equipment of any sort on the glass plate, when a slight report was heard and the glass disintegrated and fell in fragments, apparently without any interference or change in normal atmospheric conditions.—(Miss) Anona N. Middleton (Grays, Essex).

THE spontaneous fracture and complete disintegration of the glass sheet to which you refer is quite a well-known, although not nowadays a very common phenomenon.

We ourselves have experienced similar effects in war-time in connection with laboratory flasks, beakers and other chemical glassware which, standing undisturbed on storage shelves were sometimes found in a disintegrated state and, once or twice, actually shattered themselves to fragments with a sound like a rifle shot during the day and for no apparent reason. Yours is a precisely similar case.

The reason is that when molten glass is allowed to solidify it tends to set up great strains within itself. The more quickly the solidification of the glass takes place the more intense the internal strains. Such glass if struck with a light hammer or even nicked with a pair of pliers will often shatter to pieces. In such instances, there is a sort of chain action throughout the mass of glass, the release of a local strain, releasing strains in other areas, and so on, the strain-release effect travelling through the mass of glass with great rapidity.

In order to stop this sort of thing happening, good quality glassware is annealed by heating up to a given temperature in an oven and then by being allowed to cool down gradually. This slow cooling, although it does not entirely remove internal strains, very much lessens them so that there is very little risk of any spontaneous strain-release with consequent disintegration of the glass.

Occasionally, however, it happens that a glass sheet or other article escapes the annealing process or else is not properly annealed. When this happens, and the unannealed article passes out into use, there is always the risk of the spontaneous disintegration happening, and in such glasses, no precaution can be taken against this event.

This is the sort of thing which has happened in the instance which you quote. Either in consequence of some slight surface scratch, some small tremor or vibration, or even as a result of the glass's internal molecular activity, a local strain has managed to release itself. A chain action has been formed, and the entire mass of glass has released its own inner strains and has disintegrated itself in consequence.

Plate glass is rolled, and during this process, some consolidation and strain relief is given to the glass surface. Notice, therefore, in the instance of your plate glass that the surface of the glass has not disintegrated. It has remained more or less as a continuous skin covering a disintegrated interior and tending to hold the latter together. If the glass had been reasonably free from internal strains this event would not have occurred.

Cycle Fork Offset

I INTEND to design and build my own cycle frame but find difficulty in calculating the offset of the forks. I have been told that for any combination of head angle and wheel diameter there is only one correct offset and this must be worked out by formula. Is this correct and, if so, what is the formula ?—C. J. H. Marks (Cornwall).

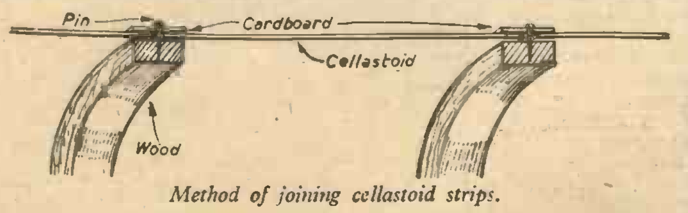
THE easiest way to deal with this question is to draw the centre line of the steering column at the desired angle to the horizontal and to set the point of contact of wheel and ground about an inch behind the point where the centre line of the column meets the ground. At the point of contact erect a perpendicular to the ground with length equal to the radius of the wheel. The upper end of the perpendicular is the centre of the wheel, and its distance from the centre-line of the steering column is the "offset."

By adopting a dimension greater than 1in. the steering becomes more stable. By adopting a dimension less than 1in. the steering becomes less stable. If the wheel touches the ground at a point ahead of the centre-line of the steering column the steering is unstable.

It is not true to say that for any particular steering column angle there is only one offset that is satisfactory.

Gauge "00" Station Roof

I HAVE just completed a terminus station for a "00" gauge model railway. The arch roof, built up on trusses at 6in. intervals, is covered with cellastoid, applied in one piece 49in. long by 23½in. wide. The cellastoid is glued down all round. We found that as soon as the roof was moved from my home where it was built, to the railway in a friend's cellar, the cellastoid went lumpy. Could you tell me if there is any way of treating cellastoid to prevent this ?—T. Nelson (Southport).



Method of joining cellastoid strips.

YOUR sheet of cellastoid is obviously much too large. Expansion and contraction alone are bound to be unequal and when the presence of even slight moisture is added the buckling is aggravated. You would be well advised to cut the sheet up into strips running crosswise and arched over the station roof, inserting light wooden girders, bent by steaming, all to exactly the same curve equal to the required camber of the roof and letting each of these support the two edges of adjacent cellastoid strips. Then over every joint pin down a narrow strip of cardboard. As shown in the diagram. The cellastoid will not be cemented in any way and, therefore, expansion and contraction will take place across the roof; the ends of the cellastoid being left free to move.

Electric Motor Queries

I HAVE a 230/1/50 15.5 amp, 2,950 r.p.m. capacity motor. It has six terminals arranged thus :

A3	Z1
A2	A1
A4	Z2

A1 and Z1 are coupled together.

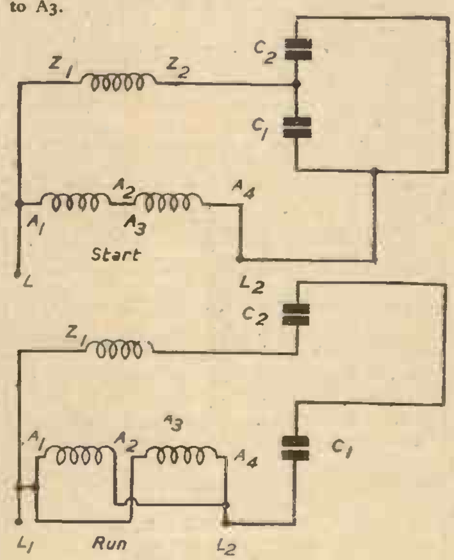
I take it that I shall need condensers to operate with this motor. Can you tell me what type and capacity these should be and also what the connections will be, also the starting current off load. A formula for future reference would be very useful.—W. F. Williams (Wilsham Bishops).

IT would appear that the motor is one of the capacitor-start-and-run types and we suggest that you use the following connections :

Z1 and A1 to be linked as at present. A1 and A2 appear to be the ends of one of the main windings and A3 and A4 the ends of the other main winding, whilst Z1 and Z2 are the ends of the auxiliary winding.

For starting connect line terminal L1 to A1 and line terminal L2 to A4. Connect A2 to A3. Connect Z2 to the common connection of two condensers C1 and C2, the other sides of these condensers being connected in parallel to line L2.

For running connect L1 to A1 and L2 to A4 (same as for starting), Connect A2 to A4 and to one terminal of C1. Connect the other terminal of C1 to one terminal of C2 and the other terminal of C2 to Z2. Connect A1 to A3.



Circuit diagrams for a capacitator motor.

It will be seen that, for starting, the two main windings are connected in series and fed from the supply, the auxiliary winding being fed from the supply through the two condensers in parallel. For running the two main windings are connected in parallel and fed from the supply, whilst the auxiliary winding is fed from the supply through the two condensers in series. The type HLAT starter, as supplied by Brook Motors, Ltd., of Empress Works, Huddersfield, would, no doubt, be suitable for this motor. The condensers should be continuously rated and could have a capacity of about 40 mFd. each. The starting current may be about 25 amps. Alternatively, if the motor starts on light load you could start up with the two main windings in series, or possibly in parallel, and the starting winding fed through a condenser of about 80 mFd. capacity. The motor may be reversed by reversing the connections to Z1 and Z2.

Cleaning Radiator Tubes : Watch Cleaning Fluid : Mercury Gilding

(1) MY house is fitted with a "Neo" No. 2 fireplace for heating water and radiators and I find great difficulty in cleaning the tubes of coal tar deposit. Could you give me a formula for a solution to use ?

(2) Could you give a formula for a watch-cleaning fluid that is non-rusting ?

(3) Please give me the formula and method of application for mercury gilding on metal such as brass, clock cases, etc.—P. Ryan (Northants).

(1) A MODERATELY strong solution of caustic soda (1 in 6) would clean your radiator tubes, but there would be a danger in using this solution in that it is a caustic one and is liable to set up corrosion. We advise you to effect the necessary cleaning as much as possible by scraping and other manual methods. When once the tubes are reasonably clean, you can prevent the further deposition of scale by dissolving in the water a small quantity of sodium metaphosphate. A slowly soluble form of this chemical can be obtained under the name of "Micromet" from Messrs. Albright and Wilson, Ltd., 49, Park Lane, London, W.1, which firm, we think, will send you full particulars concerning this material and its domestic use. The "Micromet" will, of course, not prevent the deposition of tar, which apparently comes from the fuel which you burn. The tar deposit can best be removed by dissolving out with benzole.

(2) The following is a good formula for making the watch-cleaning fluid in which you are interested :—

Solution 1.—Boil 1oz. of oleic acid in 1 quart of water.

Solution 2.—Add 6oz. of ammonia to 1 quart of water, then add 2oz. of acetone.

Bring this liquid to the boil for a moment and then add it slowly to the hot Solution 1. Stir the mixed solution until it is homogeneous.

A still simpler solution for watch cleaning can be made by dissolving ½ lb. of ammonium carbonate and ½ lb. of soft soap in ½ gallon of water.

Both these solutions have good cleaning properties, but they do not prevent rusting of steel. Hence, the parts so cleaned should be immersed in methylated spirit or iso-propyl alcohol in order to remove the surplus water.

(3) Mercury gilding, or "fire gilding," as it is called, is an extremely expensive process, and for your work it might be more economically preferable to employ some form of electro-gilding, particulars of which you will find in any textbook on electro-plating.

Mercury gilding utilises an amalgam of gold and mercury of somewhat indefinite composition. This amalgam can be made by dissolving gold filings or powder in hot mercury. It is essential to use "fine" or pure gold for this purpose, and not the ordinary carat gold. Fine gold, in powder form, can be obtained from Messrs. Johnson, Matthey and Co., Hatton Garden, London, E.C., price about £1 per gram.

The article to be fire gilded is degreased and scrupulously cleaned. It is then brushed over with a solution of mercuric nitrate (strength immaterial). This will deposit a very thin film of mercury on the surface of the brass or copper. A fine wire brush is then rubbed over the mercury-gold amalgam (which should be in pasty, semi-solid form). The wire brush is then rubbed over the article to be gilded. An even layer of amalgam is thus applied to it. To increase the thickness of the gold deposit this operation may be repeated a number of times, but finally the article must be heated in a charcoal fire in order to expel the mercury. This "firing" is a dangerous operation, for the mercury vapour which is expelled from the article is easily inhaled and is very poisonous. After the mercury film has been driven off by the heat the applied gold appears as a pale yellow deposit which is rendered more uniform by scratch-brushing. The colour of the gold film can be deepened considerably by passing the work through a paste made of alum, common salt and saltpetre. After this, the work is heated until the residue of the salt mixture on its surface just fuses. The work is then immersed in hot water, which dissolves out the fused salt mixture. It is then rinsed. Such an operation can be repeated several times, and each time the colour of the gold deposit will be enhanced.

In experienced hands fire gilding gives extremely good results, but there are very few people able to perform such operations.

Telescope Queries

PLEASE inform me what magnification is necessary to view the moon and planets (rings round Saturn, etc.). I understand that the magnification is found by dividing the focal length of the object glass by that of the eyepiece ; is this correct ? Where can I obtain the necessary lenses, ex-Government if possible ?—R. G. Clarke (Suffolk).

A GOOD magnification for viewing the objects named is X40.

Such magnification can be obtained with a 3in. dia. object glass focus 40in., and an eyepiece having an equivalent focus of 1in., or a 2½in. O.G. of 30in. focus and eyepiece of ¾in.

Yes, the power is $\frac{O.G.}{EP}$; therefore on a 40in. O.G. a ½in. f. eyepiece would yield a magnification of 80.

Try Messrs. Broadhurst Clarkson and Co., Farringdon Road, London, E.C.1, for the lenses.

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