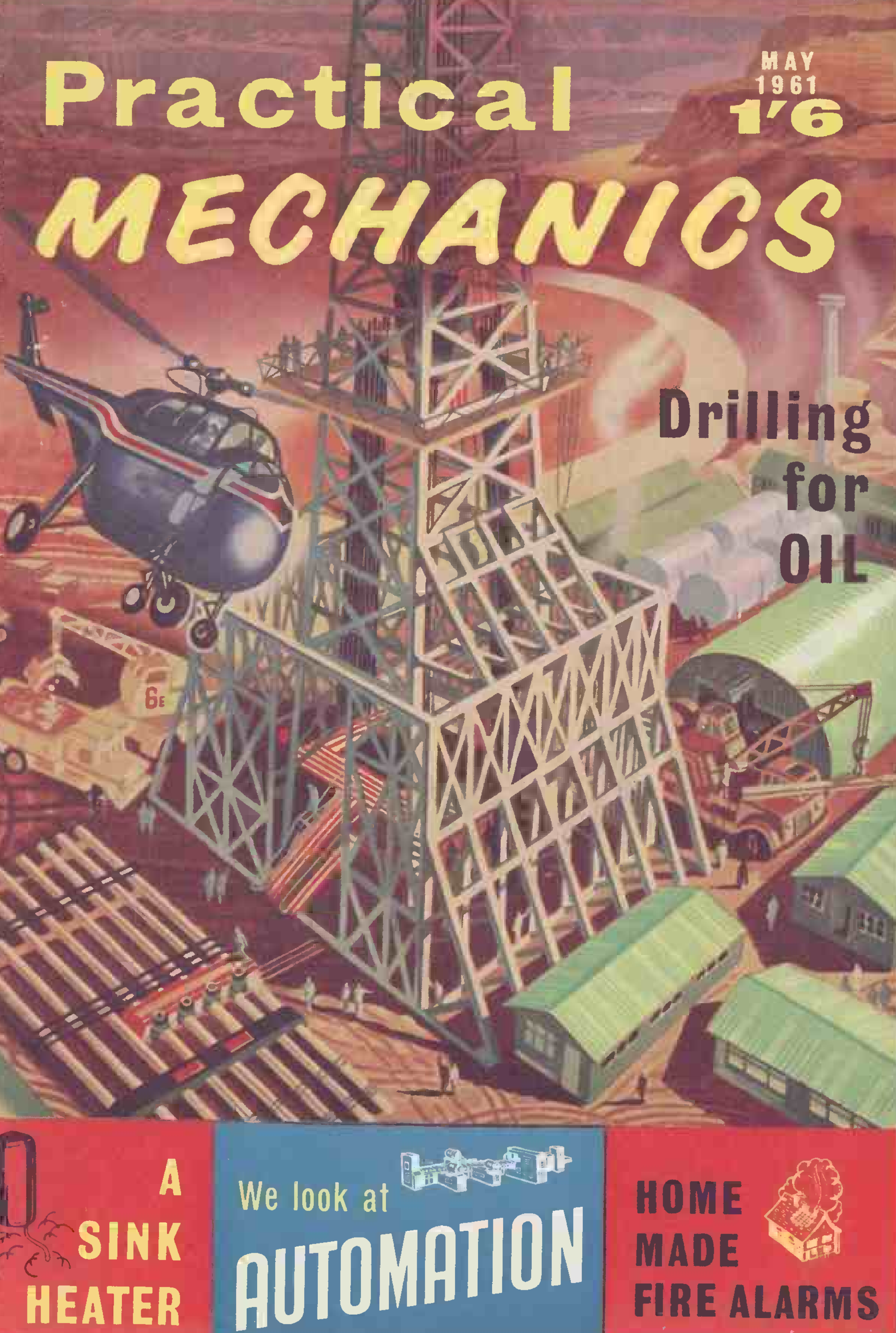
Practical
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Drilling
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We look at
AUTOMATION
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MADE
FIRE ALARMS

Practical MECHANICS

Vol. XXVIII May, 1961 No. 325

Editorial and Advertisement Offices
"PRACTICAL MECHANICS"
George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2.

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

SUBSCRIPTION RATES
including postage for one year

Inland - - 22s per annum
Abroad - 20s. 6d. per annum
Canada - 19s. per annum

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CONTRIBUTIONS

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

FAIR COMMENT

BRITAIN'S OIL INDUSTRY

THE centre pages, as well as the cover of this month's issue, are devoted to explaining in simple terms the process of drilling for oil. Because of the gamble involved in drilling speculative "wildcat" wells and because of the many adventure books and films written around this theme, the whole subject has been endowed with a false aura of romance. There is of course a great deal of nervous tension during the final stages of drilling and immense excitement if a well is brought in, but none of this should be allowed to obscure the basic and real importance of the work to the oil industry or, indeed, the importance of the oil industry to the world as a whole. We depend upon petroleum derived from oil to power most of our land transport and all of our aircraft. Fuel oils are necessary to feed the engines of the world's shipping fleets and to keep the wheels of industry turning; oil fuel is also becoming more and more popular for domestic heating. In addition to these vastly important uses, there is an almost inestimable number of others included under the heading of the petrochemical industry.

The twin industries of oil refining and petrochemicals have only been carried on on a large scale in recent years; in fact they are a post war development. Britain has no significant indigenous oil resources, although there are a few producing wells. For this reason it has always been necessary for us to import oil. Prior to the last war our oil requirements were some nine million tons and we were able to refine only two million tons of this annually. Three quarters of our oil was imported as finished products. By 1960, however, things were completely different. Our petroleum requirements had risen to 40 million tons but we now had a refining industry able to cope with almost all our needs. At the end of 1960 a new refining station came into operation at Milford Haven. With its resources added to those of existing refineries, the refining capacity of the U.K. is now somewhere in the region of 50 million tons annually.

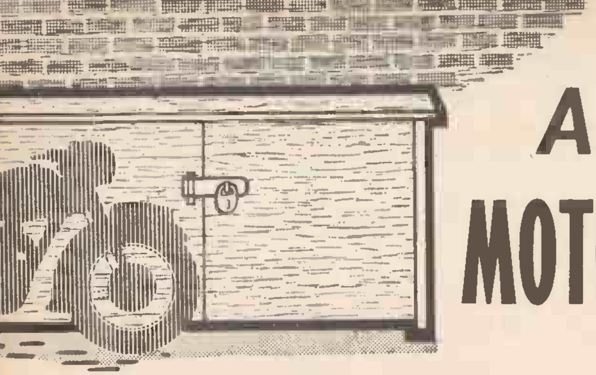
This is a fine achievement and the confidence shown in the future of the industry by those responsible for this expansion certainly refutes those who dismally prophesy that the world's oil supplies will soon be used up.

It is a fact, according to the latest figures, that current proven reserves are 40,698,000,000 tons. Judging by figures published in the past, this is probably well below the actual amount. In 1938 for instance oil reserves were quoted to be 5,274,000,000 tons and consumption in 1938 was 280,000,000 tons. Without any increase in the consumption rate, we should have run out of oil in 1957; instead in 1961 we have an oil reserve seven to eight times larger than in 1938.

The answer is twofold; we have discovered new sources of oil and that the old were far richer than was at first supposed. The Far Eastern oilfields in 1938 were assessed at only a fraction of the potential they were later found to possess. Ten years later the Canadian oilfields were discovered and even more recently there has been the opening up of the North African oilfields. Thus, even the latest estimate of our oil reserves is unlikely to be accurate and some great new discovery in North Africa may add very significantly to present estimates.

From talking about oil on a world scale to the working of a single drilling rig is not really a very great step because all the new discoveries of oil have been made in the same way—by drilling. Now read our article and find out how it is done.

The June 1961, Issue will be published on May 31st, 1961. Order it now!



A Foldaway MOTORCYCLE GARAGE

BY D. WOOD

NEAT, WEATHERPROOF AND A THIEF DETERRENT

THE garage is fitted to the side of the building and the main requirement is that there should be a firm, level space (with access) at least as wide as the machine is high, and a little over the overall machine length. The measurements given in this article will suffice for the majority of machines, though for scooters and small two-strokes they could be slightly reduced.

Construct the parts in the order given.

Back Support

Timber approximately 5in. × 1in. is used for the verticals. Two pieces each 3ft. 6in. high are plugged firmly to the wall, with a further piece, of 2in. 1in. section and 7ft. 6in. long, placed across the top " goal-post " fashion (see Fig. 1) and also plugged. A " Rawltool " No. 12 can be used together with the appropriate fibre plugs and three 2½in. screws in each piece. Give a good coat of paint.

Pivot Blocks

Two of these, each a quarter circle of 5in. radius cut from ¼in. thick mild steel plate, are required. Four ¼in. holes are drilled in each block in the positions shown in Fig. 2a. From the same material two further pieces, each 5in. × 1in., are prepared and after drilling as indicated, each of them is welded to the pivot blocks along one edge. As the pivot blocks are " handed " it is necessary to ensure that the two strips are welded to opposite sides of each block. This is made clear in the illustration at Fig. 2b.

Frames

There are four, three of which are identical. Each of the latter is made from a 12ft. 11½in. length of ⅝in. × 3/16in. steel strip. After drilling a ¼in. hole ½in. from each end, each strip is bent at right-angles 3ft. 2in. from each end, forming a broad inverted " U ". The fourth frame is bent in the same way but should be of 2in. × 3/16in. strip. After ¼in. holes have been drilled at the ends in the same manner as for the other frames, further holes, this time of ⅛in. dia. should be drilled ½in. in from one edge all round the frame at 6in. centres (refer to Fig. 3). Radius the ends of the four frames as shown.

Locking Struts

A pair of struts have next to be made, each comprising two pieces (Fig. 4a). They are identical in shape and size, except that the lip (shown inset in Fig. 4a) is bent the opposite way for each side. A ¼in. hole is drilled through both parts of one of the struts so that in use, a padlock can be slipped through. Shown in Fig. 4b is one of a pair of bearings. These bearings support the top of the struts at each side of the garage. The bottom of each strut is located in the hole shown in Fig. 3.

Canvas Cover

The canvas used should be of a close weave and thoroughly waterproof. As it is unlikely to be obtained in a size large enough to be made up without joining, it should be sewn together where necessary to achieve the shape required. The two sides should be cut to the dimensions given in Fig. 5. Note that a segment is cut out at the corner to just clear the pivot blocks. An allowance of ½in. should be made over the measurements shown and the straight edges and corner hemmed by this amount. The other piece of canvas should be 6ft. 10in. × 5ft. 6in. with the top and bottom turned in 2in. and 1in. respectively (Fig. 5). The canvas is then sewn together to fit nicely over the width of the frames. It is of course sewn inside out, then turned so the seams are on the inside. Note that the extra length of piece " A " is left at the top.

A domestic sewing machine is not suitable for sewing the cover together but a boot repairer's patching machine, if available, could be used. Failing this, strong cobbler's thread is used in two needles. These needles are at each side of the canvas and are pushed through the same hole when sewing (Fig. 6).

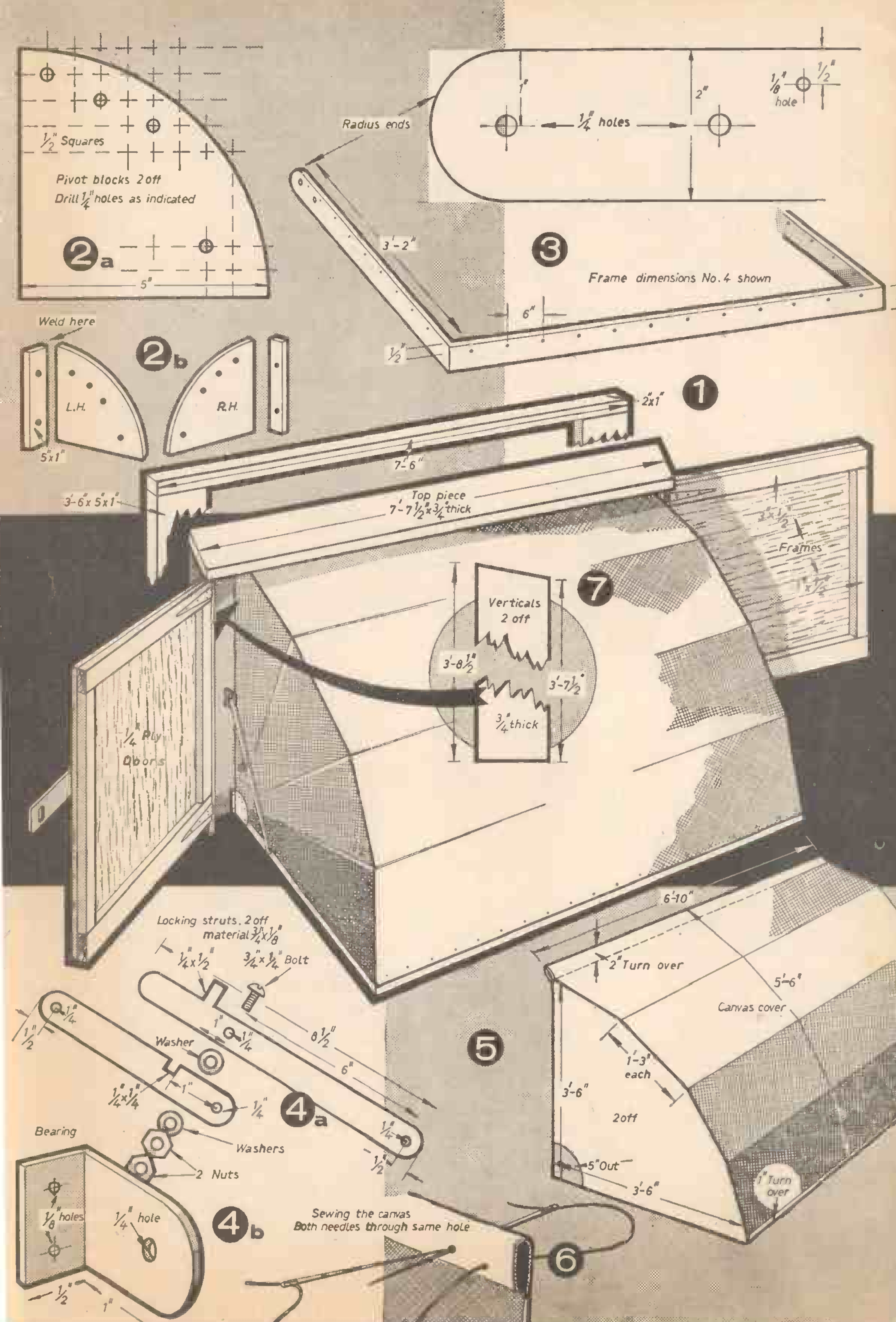
Outer-frame and Doors

Dealing with the outer-frame first, two identical pieces are prepared, ¾in. thick and 6½in. broad. They are each 3ft. 8½in. high, sloping to 3ft. 7½in. at the front. The top piece is ¾in. × 7½in. × 7ft. 7½in. 1in. in from what will be the front edge of this, a 1in. square batten is screwed, finishing ¾in. from each end.

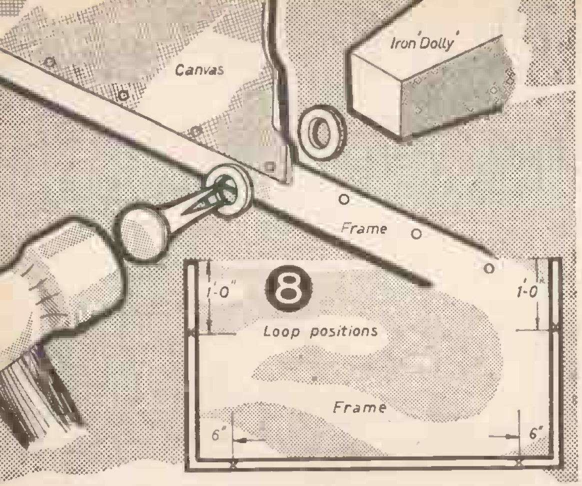
The doors should be constructed of light material; ¼in. plywood or similar. Each is 3ft. 9¾in. broad and 3ft. 6½in. high. These doors are framed, using 1in. × ½in. at the sides and 3in. × ½in. wood across top and bottom and for securing the T-hinges (Fig. 7).

Assembly

Commence by fastening the bottom of the cover to the lower frame. Bifurcated rivets (⅜in. × ⅛in.) are used for this; hence the ⅛in. holes previously drilled in the frame. Start at one end. After placing the cover in position 1in. above the bottom edge of the frame, a large bradawl or similar tool is used to penetrate the canvas. A 3/16in. washer is slipped up to the head of the rivet, which is pushed through the canvas and the frame. Another washer is placed on



1/2" Squares
Pivot blocks 2 off
Drill 1/4" holes as indicated
2a
5"
Radius ends
1"
2"
1/4" holes
1/8" hole
1/2"
3'-2"
3
Frame dimensions No. 4 shown
6"
1/2"
Weld here
2b
L.H.
R.H.
5"x1"
1
2"x1"
7'-6"
3'-6"x 5"x 1"
Top piece
7'-7 1/2"x 3/4" thick
2"x 1/2"
Frames
1"x 1/2"
7
Verticals
2 off
3'-8 1/2"
3'-7 1/2"
3/4" thick
1/4" Ply
Doors
6'-10"
2" Turn over
5'-6"
Canvas cover
Locking struts. 2 off
material 3/4"x 1/8"
1/4"x 1/2"
3/4"x 1/4" Bolt
1/4"
1/2"
1"
8 1/2"
Washer
6"
1/4"x 1/4"
4a
5
1'-3"
each
3'-6"
2 off
Bearing
Washers
2 Nuts
5" Out
3'-6"
1" Turn over
1/8" holes
1/4" hole
4b
Sewing the canvas
Both needles through same hole
6
1/2"
1"



the rivet, the prongs are flattened back with a light hammer, a "dolly" at the rivet head taking the force of the blows. This operation is repeated all the way round the frame (Fig. 8).

The next step is to locate the other frames on the cover. Using a discarded leather belt, several pieces are cut, each 7in. long. After looping round the frames, each is, using further bifurcated rivets, fastened to the inside of the cover as indicated at points marked in Fig. 8. The frames are located 15in. from each other. As the frames are light, no other support will be necessary.

Fig. 9 shows how the frames are next fastened to the pivot blocks. Use 1½in. × ¼in. bolts, together with two nuts to each bolt to enable them to be locked. The number of washers used between frames and block can be varied to take up any slight difference there might be in the widths of each frame.

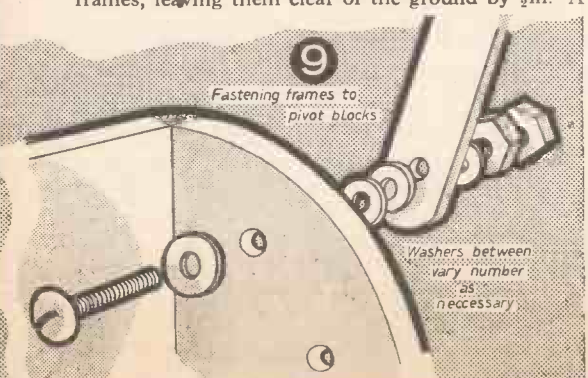
The pivot blocks are now screwed to the bottom of the back support, level with the inner edge of each upright. After this, the cover is fastened, using wood-screws with washers behind their heads, to the cross-piece of the back support.

The locking struts are fastened to the lower frame at each side with a 2in. × ¼in. bolt and locknuts. A dozen or so washers placed between the strut and the frame will keep it well clear of the canvas cover.

The top bearing should be bolted to the top end of the strut, so as to move freely without slackness. The strut is then put in the fully-open position and the bearing screwed to the back support.

The outer-frame is now screwed in place, a triangle of 1½in.-2in. thick wood being used at the bottom to stiffen and unite each upright and back vertical. This will strengthen the outer-frames sufficiently to carry the weight of the doors.

A pair of T-hinges is next fastened to each of the doors, after which the latter are screwed to the outer-frames, leaving them clear of the ground by ½in. A bolt or simple "hook and eye" will serve to keep the doors in the closed position.



The entire structure should be well painted, preferably before commencing assembly. All bearings should be greased.

The cost should amount to no more than £5 or so, and may be considerably less.

Books for the SCOOTERIST and MOTORCYCLIST

A NUMBER of new books in the Motorcycle and Scooter Maintenance and Repair Series have recently become available. The two well-known series are published by C. Arthur Pearson Ltd., Tower House, Southampton Street, Strand, W.C.2.

VESPA by H. G. Cornish. 176 pages. Price 10s. 6d. net.

COVERED in this book are the rod-type, G, GL2, 42L2 and GS V.S.1 models. The author, who is Spares Manager of Douglas (Kingswood) Ltd., has aimed at giving the reader a full understanding and appreciation of his machine with a view to obtaining efficient service and maximum life. Also, of course, there are full instructions for maintenance and repairs which come within the scope of the average owner. The usual practice of allocating a separate chapter to each aspect of the vehicle has been followed and the information supplied is comprehensive. The volume is well-illustrated and many excellent perspective illustrations are included.

ARIEL Motor Cycles by C. W. Waller. 237 pages. Price 10s. 6d. net.

THE complete range of Ariel motorcycles is covered in this handbook, from 1948 to 1960, including also single-cylinder models prior to this date. The first five chapters are devoted individually to the various types of engine and the succeeding chapters deal with components. Individually covered are Gearbox and Clutch Assemblies; Carburetters; Front Forks and Steering Assembly; Wheels, Hubs and Brakes; Rigid and Spring Frames and Electrical Equipment. Many photographs and drawings are included and at the end of the volume is a comprehensive index.

VINCENT Motor Cycles by Paul Richardson. 222 pages. Price 10s. 6d. net.

VINCENT owners who carry out much of their own maintenance will enjoy owning this book. Some of the repair jobs it describes go somewhat further than is usual in the owner-rider's maintenance handbook, but even those without the facilities for carrying out the work described will gain knowledge of their machine from reading about it. Some sample chapter headings are as follow: The Front End; The Rear End; Cylinder Head, Barrel and Piston; The Lower Engine Half; Primary Drive and Clutch; Gearbox and Secondary Drive; Lubrication System; Ignition and Electrical Equipment; Racing; Sidecars, Accessories and Extra Equipment. An appendix contains a great deal of tabulated information.

A DAYLIGHT DEVELOPING TANK LOADER

By J. A. Logue

Fig. 1.—The completed loader.

THE film loader described enables the film to be wound on to the spiral of a developing tank, in comfort, in normal lighting. Fig. 1 shows the completed loader and Fig. 2 gives details of the assembly. The loader is a lightproof box with hinged lid and a shaped cloth front which allows both hands to work freely inside the box; elastic bands in the cloth prevents the ingress of light around the wrists.

Materials and Construction

The front, back and sides are cut from 9in. × ¾in. cleaned timber, the front and back 14in. long and the sides 8½in. This allows the corners to be rebated as shown in Fig. 2, they are glued and nailed together. The base and top are cut from 3mm. plywood and glued and nailed in position. When the glue has hardened, the lid, 1in. deep, is parted from the main body of the box and an opening cut in the front to take the cloth. The lid is fitted to the body of the box with two 1½in. hinges; 1in. × 3mm. plywood strips are glued and nailed in place projecting up ¼in. above the top edge.

Black lightproof cloth is folded and cut to the shape shown in Fig. 2 and sewn along the lines shown dotted. The cloth around the hand-holes is neatly hemmed. Elastic ½in. wide is threaded through the hems and adjusted to grip the wrists comfortably before knotting and cutting. Coat the edges of the timber and the cloth with impact adhesive and press into position. Nail a ⅝in. wide cardboard strip around the inside as shown in Fig. 2. Fix an attaché-case type lock to the front, a 3mm. thick piece of plywood may be required under the top hasp of the lock to register it properly with the lower part.

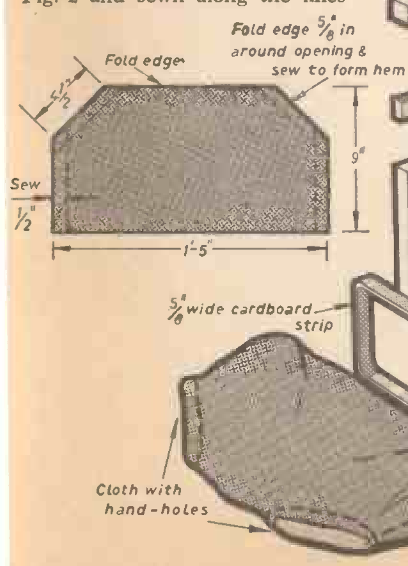
The inside of the box should be painted with black paint, this paint is made by putting a few ounces of orange flake shellac into a container and pouring in methylated spirits to just cover the shellac. After a few hours when the shellac has dissolved add two teaspoonfuls of ebony spirit dye and stir.

Method of Use

In use the developing tank and the spool of film are placed in the loader and the lid fastened. The hands are put through the hand-holes and the film wound on to the film spiral. The spiral is then replaced in the tank and the lid fitted back on. The tank can now be removed from the loader for developing, fixing and washing.

MATERIALS REQUIRED

Front and back; 2 pieces 14in. × 9in. × ¾in. planed whitewood.
Sides: 2 pieces 8½in. × 9in. × ¾in. planed whitewood.
Top and bottom, 2 pieces 14in. × 9in. × 3mm. plywood.
1 piece 18in. × 17in. black lightproof cloth.
1 piece 32in. × ⅝in. card strip.
2 pieces 1½in. butt hinges.
½ yd. ½ in. wide elastic.
1 Case lock.
Nails, glue, shellac, methylated spirits and ebony spirit dye.



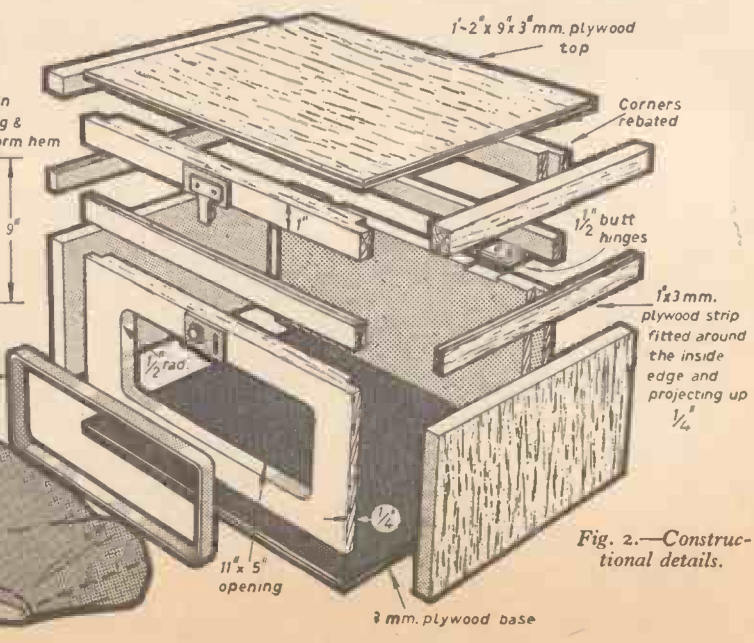
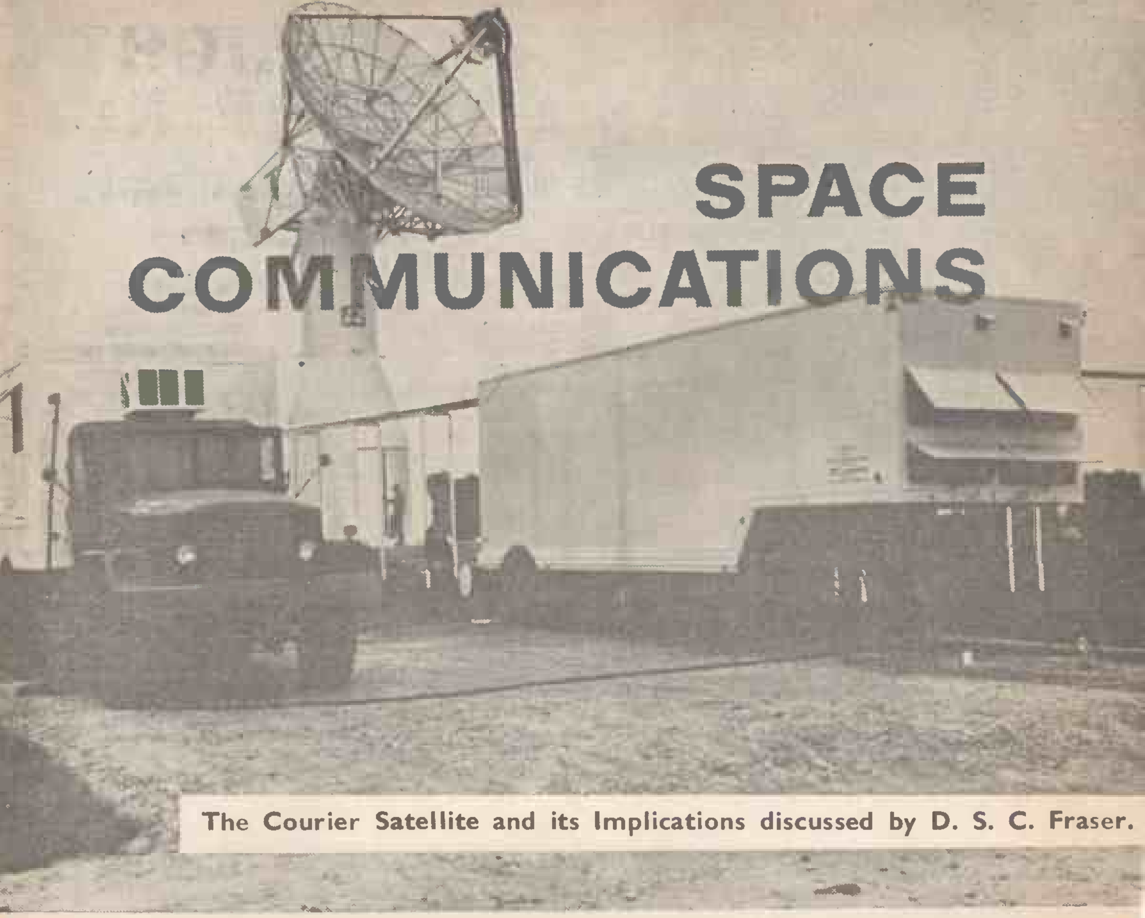


Fig. 2.—Constructional details.

SPACE COMMUNICATIONS

The Courier Satellite and its Implications discussed by D. S. C. Fraser.



The ground station for the Courier communication satellite at Fort Monmouth, New Jersey.

THE United States celebrated the third anniversary of the Space Age with the successful launching, on October 4, of the delayed-repeater Courier communication satellite, following which a team of British communications experts left for the U.S. for a series of technical discussions on matters associated with the possible use of communications systems via earth satellites.

The British team was headed by Major General L. de M. Thuillier (Retd.) and included officials from the Post Office; the Office of the Minister of Science; the Ministry of Aviation; the Admiralty, and the Ministry of Defence. Discussions were held with a number of agencies of the U.S. Government and with private firms, and visits were made to technical installations of the National Aeronautics and Space Administration, and the Department of Defence.

The Courier, which is designed to operate for a year, is the most complex communications satellite launched so far. Its success represents a forward step towards a space communications system capable of globe transmission of voice, teletape, and TV messages.

The Courier satellite, now orbiting the earth every 115 minutes at an altitude of 500 to 700 miles, has 300lb. of electronic instruments packed inside. It is 51in. in diameter and weighs 500lb. With these instruments, it can store more than 70,000 words a minute and re-transmit them to earth at the same speed. It can, therefore, exchange about 350,000 words in five minutes with its ground stations each time it circles the earth. The development of this type of active communications satellite, it has been predicted, may revolutionise world news distribution within the next few years.

Courier uses frequencies in the ultra-high range for the first time in satellite communications, and these give relative freedom from man-made and natural interference.

Its transmission power is provided by nearly 20,000 solar cells, which convert sunlight into electricity to run radio and other equipment during daylight, and charge miniature nickel cadmium batteries for operations when the satellite is in the earth's shadow. The solar cell system provides 62V. of power.

The internal electronic equipment includes five teletype circuits—one for incoming messages, one for outgoing, two spares, and a fifth circuit for voice information. It was this last circuit which received and returned a message from President Eisenhower to the United Nations on Courier's first day of orbit.

Thirty Commands

The Courier can carry out about 30 commands as it travels on its course at a speed of 15,500 m.p.h., but it will pick up only one code specially designed for it. Commands are sent from two ground tracking stations, one in New Jersey, the other in Puerto Rico. Ground crews at these points have to work fast, for they have only six to ten minutes to comunicate with Courier each time it passes overhead.

The words are stored on magnetic tape in a highly condensed code, and are re-transmitted to earth at such a speed that 720 high-speed teletype machines would be needed to keep up with them. Since these are, obviously, not available, its signals are recorded directly on tape which is then slowed down and decoded later by normal-speed machines.

The satellite payload has a remarkable capacity for "thinking." For example, when Courier picks up its correct coded signal from a ground station, it automatically turns on its transmitter and receiver and switches off its own tracking signal, by which it is identified by the ground stations, to conserve power. If the coded command is incorrect, it is rejected by the payload. In the event of mechanical failure of part of its equipment, spares are immediately switched into action.

Ground stations receive signals from Courier by means of a reflector 28ft. in diameter, designed for both VHF and microwave frequencies. Courier's telemetry system employs a FM transmitter with a maximum deviation of 6 Kc/s. Courier transmits a 50 mW. continuous signal.

During its first 24 orbits, Courier handled more than 2,000,000 words in communication with the earth. In four passes during one day it received and sent back on command approximately 1,000,000 words.

Conceived by the U.S. Army's Signal Research and Development Laboratory at Fort Monmouth, New Jersey, and designed and developed by the Philco Corporation's Western Development Laboratories, Courier is regarded as the forerunner of a far more ambitious communications system known as Project Advent and planned for 1966.

Under Project Advent, it is hoped to put into orbit about 22,000 miles above the earth a number of satellites, which, during a 24-hour orbit could blanket the earth with high frequency radio signals. These satellites would move at the same speed as the earth's rotation, and remain over the same spot on earth all the time. Under such a project it is believed that instant global radio, television, teletype and telephone communications might be possible.

The first Advent satellite is expected to be launched in 1963. Meanwhile, Courier, the forerunner of the system, is purely experimental. Its operating life is estimated at one year, though it may remain in orbit for several years after that.

The launching vehicle used for putting Courier IB into orbit was the two-stage Thor-Able-Star rocket. The occasion marked the hundredth firing of the Thor-IRBM, which provided the first stage for the launching rocket.

In the three years since October 4, 1957, which saw the first Russian Sputnik put into orbit, the United States launched 26 earth satellites and two deep-space probes. Seventeen of these are still in orbit.

The Courier satellite is given its final checkout prior to launching from Cape Canaveral, Florida. At left is the Thor-Able-Star nose cone inside which the satellite rides until orbit altitude is attained.

EVENING STAR

3. This instalment deals with the wheels, crankpins and axles.

NOW we can make a start on the wheels. Grip each wheel casting by the tread in the three-jaw, setting it to run truly. Centre it with a big centre-drill in the tailstock chuck. First put a $\frac{1}{4}$in. drill through to make a pilot hole, then follow with a $\frac{27}{64}$in. drill, and finally a $\frac{7}{16}$in. reamer. Face off the back (that sounds like Pat speaking!) with a round-nose tool set crosswise in the rest, and take a slight cut off the flange, to true it up. Don't forget that a slow speed is necessary to turn cast-iron. If you go too fast, the tool's edge will be finished in a few seconds. The boss is turned flush with the rim.

Reverse in chuck and grip by the flange. Face off the rim to $\frac{7}{16}$in. thickness, then face the boss until it stands $\frac{1}{16}$in. proud of the rim. Change the round-nose tool for a parting tool, and cut a little rebate (small shoulder) at the point where the spokes join the rim. This represents the joint between wheel centre and tyre in a full-size wheel, and is shown by a double line in Fig. 12.

Treads and flanges are finished with the wheel mounted on an improvised faceplate (Fig. 13). For this I use an old wheel casting a little smaller than the wheel to be turned; any piece of similar size will do. Chuck in three-jaw, face-off, and recess the centre about $\frac{1}{32}$in. depth for about 1in. dia. Centre, drill a $\frac{1}{4}$in. pilot hole, open out to $\frac{13}{32}$in. and tap any fine thread, $\frac{1}{2}$in. dia. Put $\frac{1}{2}$in. of similar thread on the end of a piece of $\frac{1}{2}$in. round mild steel about $1\frac{1}{2}$in. long. Screw this tightly into the hole, and turn the projecting part until the wheels will just slide on without shake. Screw about $\frac{1}{2}$in. of the end with a $\frac{7}{16}$in. die in the tailstock holder, and fit a nut to suit.

Mount each wheel on the stub, face outward, and secure it with the nut, but don't tighten the nut enough to distort the wheel. Then with a roundnose tool, turn tread and flange to within a few thousandths of an inch of finished size. When the last one is done, regrind the tool and take the final cut to bring it to size; then mount each wheel on the stub and take the final cut *without shifting the cross-slide*. Each wheel will then be exactly the same diameter without further need of measurement. Before removing, hold a file to each flange, to round it off while still revolving; then hold the file to the edge of the tread, to chamfer it slightly, as shown. Don't forget that the driving wheels—those with the big balance-weights—have plain flat treads with no flanges.

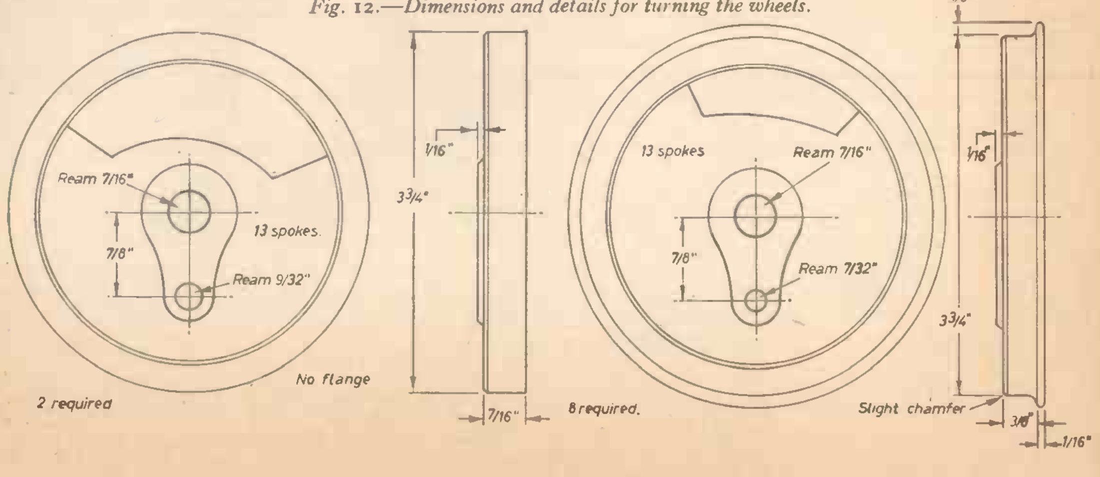
Drilling Jig

It is absolutely essential that the holes for the crankpins are exactly the same distance from the axle holes, so a drilling jig for the crankpin holes in the wheel bosses is made from a $1\frac{1}{2}$in. length of 1in. × $\frac{1}{4}$in. steel bar (Fig. 14). Scribe a line down the middle, and make two deep centrepops on it $\frac{7}{8}$in. apart. Drill through with $\frac{15}{64}$in. drill, using either drilling-machine or lathe; the holes *must* go through dead square, or the jig will be useless. Open out one hole with a $\frac{27}{64}$in. drill. Chuck a piece of $\frac{1}{2}$in. round mild steel in the three-jaw, face the end, and turn 1in. length to a sliding fit, without shake (very important, that) in the axle hole in the wheel.

Further reduce $\frac{3}{8}$in. length to a press fit in the larger hole in the jig. For beginners' benefit, here is a simple way of turning press fits. First turn the metal to a shade larger diameter than the hole, then turn $\frac{1}{8}$in. of the end so that it will just enter the hole tightly. Note the position of the graduated collar behind the cross-slide handle. Myford and similar lathes all have them, but if there isn't one, note position of the handle itself. Move the handle back half-a-turn, then bring it forward again until within half a division of its previous position. This neutralises any slackness between the cross-slide screw and nut. Take the finishing cut over the rest of the $\frac{3}{8}$in. length with that setting, and it will be a press fit in the hole in the jig. If the cross-slide handle has no graduated collar, bring the handle back a little short of its original position, using your own judgment.

Part off the turned piece of rod at $\frac{1}{2}$in. from the shoulder, and squeeze it into the hole in the jig, using the bench vice as a screw-press, as shown in Fig. 15. To use the jig, insert the peg in the axle hole in the wheel boss, and adjust the jig until the small hole is

Fig. 12.—Dimensions and details for turning the wheels.



central. Clamp the jig to the wheel boss, and drill the boss $\frac{13}{64}$in. using the hole in the jig to guide the drill. After drilling all ten, put a $\frac{7}{32}$in. parallel reamer through all the holes in the flanged wheels. Those in the driving wheels (flat treads) are opened out with a $\frac{17}{64}$in. drill and reamed $\frac{9}{32}$in. Bigger crankpins are needed to take the driving stresses.

Crankpins

The crankpins (Fig. 16) are made from silver-steel, the natural polished surface of which is resistant to wear. If the lathe has collets, or if the three-jaw chuck is reasonably true, the steel rod can be gripped direct and turned to the sizes shown on the drawing. If the chuck doesn't hold truly, use a split bush. To make it, chuck a piece of $\frac{1}{2}$in. brass rod about $\frac{3}{4}$in. long. Face the end, centre, drill through $\frac{17}{64}$in. and ream $\frac{9}{32}$in. Make a centrepop on it, opposite No. 1 chuck jaw. Remove from chuck, slit lengthwise with a hacksaw, and replace with the pop mark opposite same jaw. Insert steel to be turned in the bush, tighten the chuck, and go ahead with the turning. The rod will run quite truly. Turn each shank to a press fit in the wheel boss, by the method just described, and part off to the overall length of the pin. Use plenty of cutting oil applied with a brush.

To adapt the split bush for holding the $\frac{3}{8}$in. steel, grip it in the chuck (not tightly enough to close the sawcut) with the pop mark still opposite No. 1 jaw, and bore it out with a little boring tool made from the tang end of a worn-out file (Fig. 17), until the $\frac{3}{8}$in. steel will just slide in. Then tighten chuck, and turn the pins to sizes shown.

Grip each short pin in the chuck, holding by the shank. Centre, drill No. 40 to $\frac{3}{8}$in. depth, and tap $\frac{1}{8}$in. or 5 BA. To tap truly, put the tapwrench tightly on the tap close to the thread, and hold the shank in the tailstock chuck just loosely enough to allow it to slide without shake, see Fig. 19. Pull the lathe belt by hand, working it up and down, and feed the tap into the hole very carefully by aid of the tapwrench, using plenty of cutting oil. Take the job easy, as silver-steel is mighty hard and tough, and patience is required to get a clean thread.

Turn the outer ends of the longer $\frac{9}{32}$in. pins to $\frac{9}{64}$in. dia. for $\frac{3}{16}$in. length, and screw 4 BA with a die in the tailstock holder. The ends of the $\frac{3}{8}$in. pins are turned to $\frac{1}{4}$in. dia. for $\frac{3}{16}$in. length, and left plain. Finally, press all the shanks into the holes in the wheel bosses, using the bench vice as press, as previously mentioned. To prevent damaging the screwed ends, put a brass nut on while pressing.

Axles

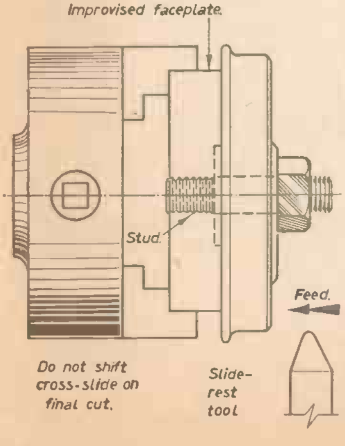
The axles (Fig. 20) are turned from $\frac{1}{2}$in. round mild or silver-steel. Saw or part off five $4\frac{3}{8}$in. lengths, chuck in the three-jaw and face off each end until the overall length is exactly $4\frac{9}{32}$in. If the chuck is reasonably true, the axles can be held in it for turning the wheel seats. If it isn't, either make a split bush as described for holding the crankpins truly, or else put a piece of thin metal, such as brass foil or shim steel between the offending jaw and the axle. Turn all the ends for $\frac{1}{2}$in. length, to approximately $\frac{7}{16}$in. dia., a press fit in the holes in the wheel bosses, by the method previously described.

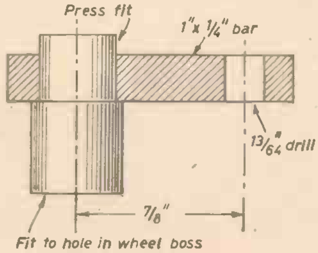
Next job is drilling the oil ducts. At $\frac{1}{4}$in. from the shoulder of the wheel seat, turn a groove about $\frac{1}{16}$in. wide and $\frac{1}{32}$in. deep, with a pointed tool rounded off slightly at the end. From the bottom of this groove, drill a $\frac{1}{16}$in. hole right through the axle, so that it emerges in the groove at the opposite side. Chuck the axle in three-jaw, and with a size E centre-drill in the tailstock chuck, make a centre-hole just deep enough to leave a slight countersink at the edge. From the bottom of this, run a $\frac{1}{16}$in. drill into the cross-hole, taking care as the drill breaks through, to avoid breaking off the point. They cost muckle bawbees the noo, ye ken!

When the engine is working all you have to do, to oil the journals and horn slides, is to apply a small syringe filled with fairly thick oil, or ball-bearing grease, to the centre-hole in the end of the axle, and press the plunger. The oil or grease is then forced through the ducts, and not only provides the necessary lubrication, but forces out any grit that may have found its way in. This system does away with any need for oil cups or boxes with pipes leading to the axleboxes, and is far more effective. I'll tell you in due course, how to make the syringe or oil gun. Incidentally, in the heyday of steam, many full-size American and Continental locomotives had pressure-applied grease lubrication for many of the moving parts. This saved the driver's oil feeder a lot of work!

Eccentrics

Two eccentrics are needed, one for driving the boiler feed pump and one for driving the ratchet gear of the lubricator. Both are shown in Fig. 18. I make mine from offcuts of mild steel shafting, which is lovely stuff to turn. For the larger one, chuck a piece of $1\frac{1}{2}$in. dia. round steel in three-jaw, and face the end. With a parting tool a little over $\frac{1}{8}$in. wide, and the end ground off square, form a groove $\frac{3}{32}$in. deep and $\frac{1}{4}$in.





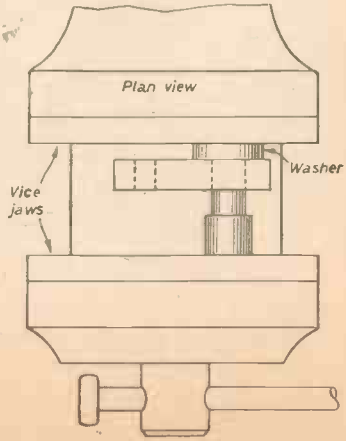


Fig. 13.—(*Left*) *Finishing treads and flanges.*
Fig. 14.—(*Above*) *Drilling jig for crankpins.*
Fig. 15.—(*Right*) *Using bench vice as screw press.*

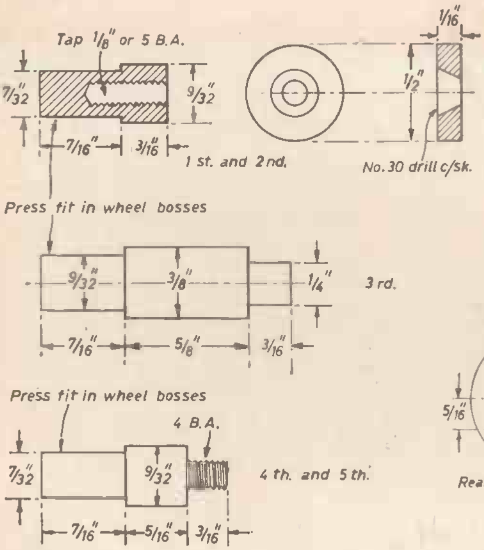


Fig. 16.—*Making the crankpins.*

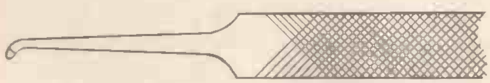
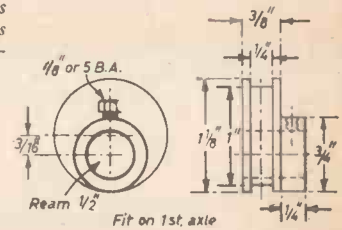
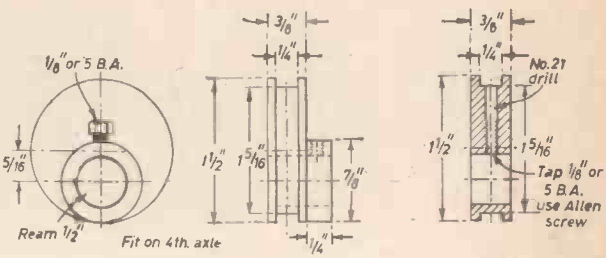


Fig. 17.—*Boring tool made from tang end of old file.*

Fig. 18.—*Details and dimensions for the two eccentrics.*





wide, at $\frac{1}{16}$in. from the edge. Beginner's note: chattering of the tool can be avoided by running the lathe at slow speed, and using plenty of cutting oil. The cutting should come off the steel like a close-coiled watch spring, with a sound like frying bacon, though it doesn't smell so good! Take two cuts to get the required width of groove, and work the tool from side to side at the bottom of the groove, to get a smooth finish. Part off at $\frac{5}{8}$in. from the end.

The facing tool-marks will indicate the true centre. At $\frac{5}{16}$in. from this, make a heavy centrepop, and chuck the piece in the four-jaw independent chuck with the pop mark running truly. Another beginner's tip: bring up the lathe tailstock with its centre-point in the barrel, and you'll see in half-a-tick which chuck jaws need adjusting, and how much, to bring the pop mark " spot-on " to the centre-point. Replace the centre with the tailstock chuck, open the pop mark with a centre-drill run a $\frac{31}{64}$in. drill right through, and follow with a $\frac{1}{2}$in. parallel reamer. Feed this in slowly, using plenty of cutting oil.

Chuck a short piece of round steel about $\frac{5}{8}$in. dia. and turn $\frac{3}{8}$in. length to a press fit in the $\frac{1}{2}$in. hole. Press it in from the grooved end of the eccentric, put the rod in the chuck, and turn down the other end of eccentric, to $\frac{7}{8}$in. dia. for $\frac{1}{4}$in. length. Be careful when starting the cut, as the steel will be running what the kiddies call "all wobbly." Finally knock out the stub mandrel, drill a No. 40 hole in the boss as shown, and tap it for a setscrew. The eccentric for the lubricator drive is turned in exactly the same way, but from $1\frac{1}{8}$in. round steel, to the dimensions given in Fig. 18 (top).

An alternative arrangement is to leave out the boss, making the eccentrics $\frac{3}{8}$in. wide only, and drilling a No. 40 hole from the bottom of the groove, through the widest part of the eccentric, into the $\frac{1}{2}$in. hole. Open this out with No. 21 drill to half its depth, tap the remainder $\frac{1}{8}$in. or 5 BA, and fit an Allen grub screw. Also, iron castings may be used instead of mild steel. These are machined in the same way, being held in the chuck for turning grooves and flanges, by a chucking-piece cast on the side opposite to the boss. This is parted off after the turning is finished.

Next month I shall deal with the coupling rods.

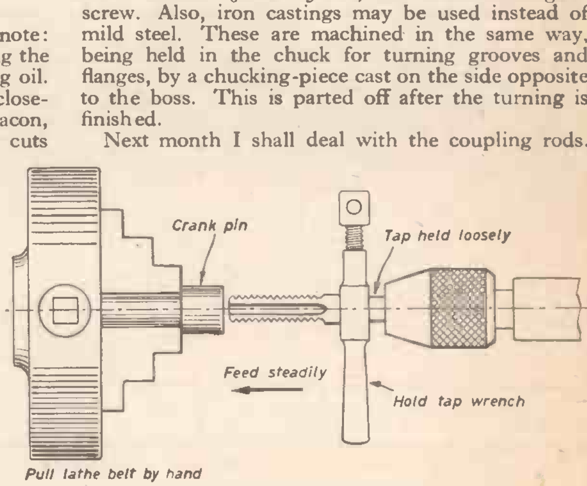
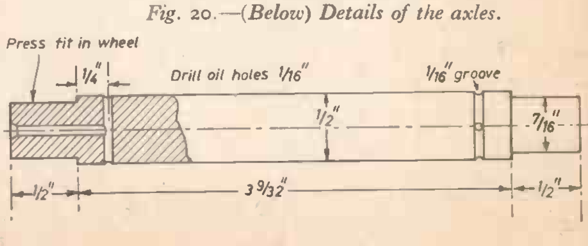


Fig. 19.—*Tapping the pins.*

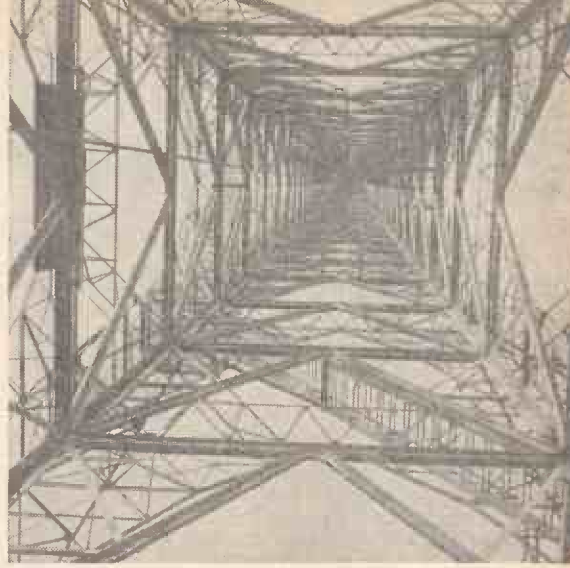
Fig. 20.—(*Below*) *Details of the axles.*



SCIENCE NOTES

High Power

SIX power lines, each weighing 31 tons, are being strung between two towers 630ft. high (see photo, right). The towers have been erected on either bank of the Thames at Greenhithe and form part of a new 275,000V. supergrid system. This operation of spanning the Thames is being tackled by engineers of the British Insulated Cables Company.

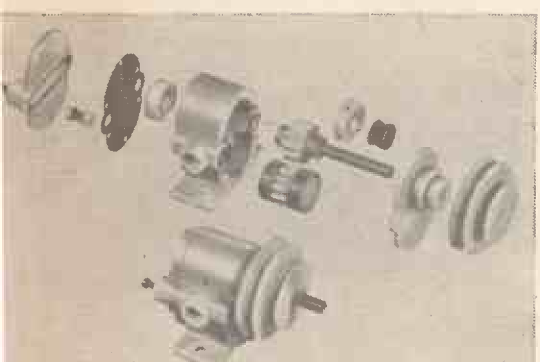


Looking skywards through the centre of one of the 630ft. towers.

Plastic Pumps

THE latest thermoplastic material, "Delrin" acetal resin, developed by the Du Pont organisation has been used for making a general purpose gear pump (below) which offers higher standards of performance at lower production and operating costs. The manufacturers are Planet Products of Chicago, Illinois. The pumps have a capacity range of up to 18·5 gal. per min. and can be operated at pressures from 0 to 100 lb. p.s.i.

"Delrin" acetal resin is a tough, rigid, high-strength engineering material with mechanical properties approaching those of non-ferrous metals.



The "Delrin" general purpose gear pumps in assembled and "exploded" forms.

Trouble-shooting Engines—New Technique

IF the operating temperatures of engine parts like valves, pistons, rings, bearings, gears, etc., become too high, the engine can fail. A new method of measuring the operating temperatures has been developed by scientists of Shell Research Ltd. It is known as the hardness relaxation method and depends on the fact that when certain alloys are heated and then cooled, their original hardness is changed. The extent of the change depends on the maximum temperature reached. Usually it is only necessary to compare the original hardness of an engine component with its hardness after running to determine the maximum temperature reached (see photo below left), but when the metal of the component is not suitable, small inserts of a suitable alloy can be employed.

(Below) A technician measuring hardness changes in a sectioned alloy piston.

New Resuscitating Apparatus

DEVISED by W. K. Dyer, Superintendent of the Scottish Division, N.C.B.'s Coatbridge Mines Rescue Station, this new assembly, shown in the photo below, enables unconscious miners to be carried from areas of foul air with far greater ease.

It is less bulky and can be carried by one person or laid on a stretcher, avoiding the double duty of carrying the stretcher and the existing type of apparatus at the same time. None of the components is new, but the complete assembly is original.

(Below) The new resuscitating apparatus assembly.

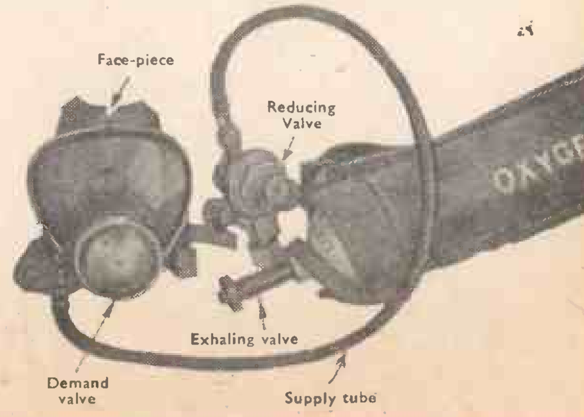


Fig. 1.—The camera/binocular combination.

CONNECTING CAMERA and BINOCULARS

LACKING a telephoto lens, I decided to couple my 35mm. camera to a pair of 7 x 50 binoculars (Fig. 1). To mount the binoculars on the tripod the mounting shown in Figs. 2 and 5 was evolved. The hinge of the binoculars comes to a very positive stop with the eyepieces at their widest distance apart, leaving a deep, wide channel between the lens barrels. The bracket keeps the instrument steady, at the same time allowing focusing and immediate removal at all times. The focusing eyepiece is available for use by the right eye.

No dimensions for the bracket are given, since they will differ from one instrument to another. Materials were a handle from an old soldering iron, a short length of copper busbar, two lengths of curtain rail bent round a piece of piping to conform to the curves of the binocular and riveted to the busbar. A piece of hard rubber, held down by the handle, prevents the load from tilting over sideways. Two ¼in. holes were tapped, to hold the rod through the handle, and the unit to the tripod, respectively. The edges of the rail, fitting precisely over the hinges of the binocular, make all movement fore and aft impossible. The short handle also enables one to hold the entire unit in the hands if required.

Fig. 3 (Above) and Fig. 4 (Below)—Two photographs taken with the camera/binocular combination.

Camera/binocular Coupling

The metal ring of one screw-type camera filter was removed, and press-fitted over the thread on the retaining-ring. Three very small holes were drilled at equal intervals from the outside. Stubs from ordinary pins hold them together very rigidly. When the camera is screwed to the eyepiece, a small space between camera and binocular lenses make the insertion of small glass filters possible.

Experiment showed that the extension restricted light reaching the camera so that maximum aperture was f/8. Stopping down from f/2.8 to f/8 made no difference, but the use of the smaller stops was as usual.

A magnifying glass was used over the ground glass to ensure perfect focus on the camera side. The other eyepiece was then turned until the object was perfectly focused for the right eye, and the setting marked. The camera is used at f/11 or f/16, and since the right eye focuses at f/8, the danger of out-of-focus pictures is quite small. The object is kept very slightly off-centre (towards the camera) to compensate for the widely-spaced objectives. Results can be seen in Figs. 3 and 4.

N.B.—The lenshood was made from a small tin-can. The outside is covered with leather—the inside given a dull finish with blackboard-paint.

Fig. 2 (Left) and Fig. 5 (Right) show how the binoculars are mounted on their bracket and on the tripod.

Rescue that old oil drum and make a WORKSHOP FORGE

By A. S. Hussey

THE forge described uses for its air supply a domestic vacuum cleaner and will be found very useful for those who wish to make their own small castings of brass, aluminium, etc. It can also be used for the forging of lathe tools.

Construction

The first requirement is a five gallon oil drum, preferably with a conical top, as with the screw cap removed a chimney may be fitted. Fig. 3 shows the oil drum with the section measuring 12in. long (round the circumference) and 7½in. high, cut and bent down to form a hob on which to rest long tools. This is best done by first cutting across the top with a hacksaw and then cutting down the sides with snips. Before it can be bent down it will also be necessary to cut a little across the bottom from each side owing to the curvature of the drum. The section can then be levered out and bent down.

Next cut a 1in. hole in the side 1½in. up from the bottom, leaving two strips that are bent outwards to form brackets through which the air pipe will be bolted.

Air Pipe Valve

This is a piece of 1in. O.D. pipe the end of which is cut at an angle of 45 deg. so as to deflect the air upwards. Approximately 3in. from the end, two saw cuts are made as in Fig. 1, these must be exactly opposite each other to allow free movement of the throttle plate. The plate is a piece of tin-plate with one end bent round to form a handle; a ⅝in. hole is cut with a chisel at the other end. The rough edge of the hole must be hammered flat to allow easy insertion through the saw cuts. The strip is inserted through the saw cuts and when the hole is central with the pipe the end is bent at 90 deg. to form a stop. Place the pipe in position projecting 4½in. into the drum and then drill through the pipe and the strips that support it to take a 3/16in. bolt as in Fig. 2.

Operation

Connection of the vacuum cleaner hose to the 1in. pipe may require a sleeve depending on the size, this can be made from a piece of tin-plate bent round and bolted, an exact fit is not necessary as the air supply is more than ample. However, if more air pressure is required, removal of the bag from the cleaner will help.

The fire is lit in the normal way with a little paper and wood and the hose is connected to the blowing end of the cleaner and switched on. Add a little coke (small pieces being the best for forge work) and open the air valve a little. The fire will burn very quickly and give an intense heat. For example, a 2oz. tobacco tin full of aluminium will melt in about ten minutes.

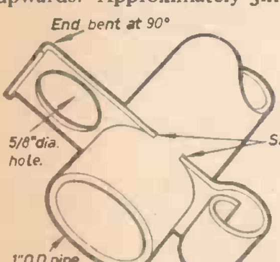


Fig. 1.—(Left.) The air valve.

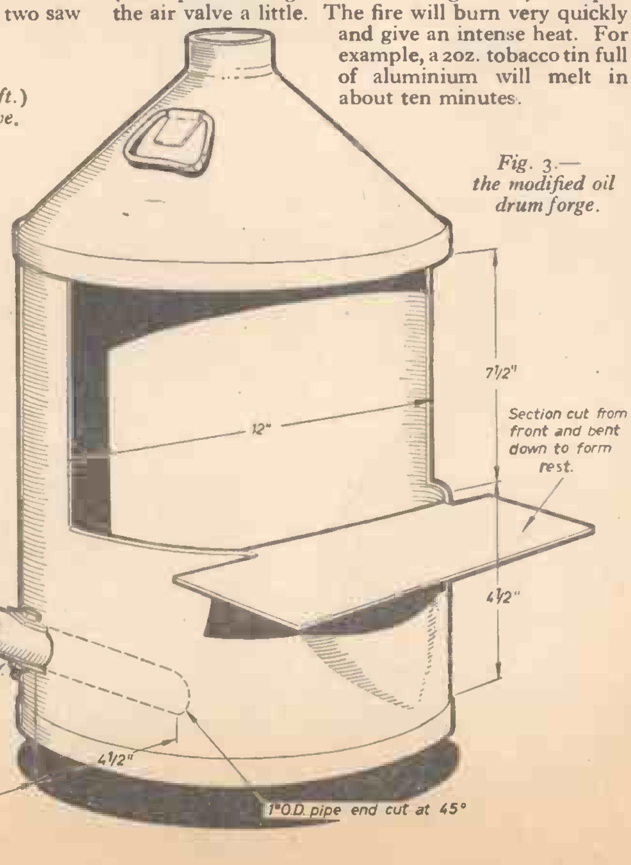


Fig. 3.—the modified oil drum forge.

N.B.—For frequent use, line the bottom with fire cement.

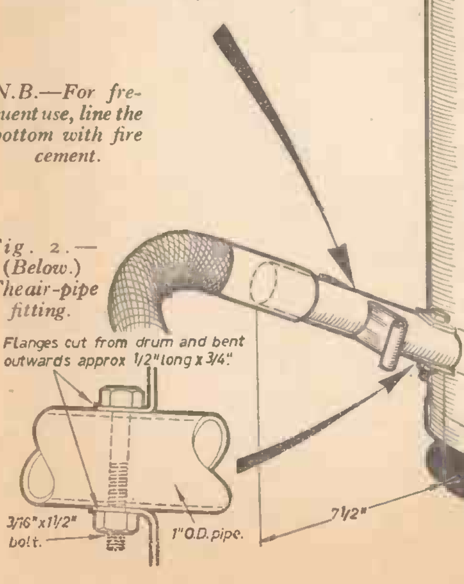


Fig. 2.—(Below.) The air-pipe fitting.

READERS'

This one belongs to James E. Brearley

Some of the equipment on the left hand workbench.

THE workshop is housed in a wooden shed measuring 14ft. 6in. long by 7ft. wide, with a span roof 6ft. at the eaves. The space between the eaves and the apex is used for the storage of long stock. The building has double doors, 5ft. wide, at one end, to give easy access as well as to provide more light.

The ground-plan shows the general lay-out. Proceeding from the door along the right-hand side of the workshop, the first item of equipment is a 12in. saw-bench. This originally had a flat-belt drive, but I modified it for 3 V-belt drive, bringing the motor close to the rear of the bench, making a compact job.

Next to the saw-bench there is a 7ft. × 2ft. joiner-type bench. This is ½in. less in height than the saw-bench, the reason being that the handling of long timbers at the saw-bench can be greatly eased by the use of a ½in. dowel as a roller on this bench.

At one end of the bench top a joiner-type vice is fixed permanently, and I also have a portable 3in. swivelling vice which can be fitted as required. Beneath the bench there are drawers, and also a rectifying unit giving 6V., 12V. and 24V. D.C. The output panel for this is fixed to the wall above one end of the bench in a good position for testing and checking purposes. Besides this there is a test meter, constructed from a 250V. D.C. meter.

Below the output panel and meter there is a compartment covered by a lid which contains flying leads and battery for the meter.

Behind the bench there is a 4ft. × 2ft. window, with a hand-tool rack running the full length of the sill. To the right of the window, there is a nest of drawers and shelves, also a cupboard with sliding doors which is used to store fragile material. To the left of the window are the output panel and test meter already referred to, and another nest of drawers and shelves. At the upper left-hand corner of this nest is a small cupboard which contains an illuminated magnifier. Illumination is by a 12V. car lamp supplied via a transformer. The cable is spring-loaded, and the cupboard door controls a microswitch, so that when it is opened the magnifier is automatically illuminated ready for use.

Fixed to the rafters above the window, about 10in. from the wall, and running paralled with the bench, is a set of alloy slide rails, enclosed in bone-dry timber and painted to ensure good insulation. These rails are live, with a 24V. current, and carry a 24V. motor and flexible drive, which permits the use of dental burrs and small drills on any part of the bench. The motor used is a ex-W.D. Booster Pump type, and it gives a very good performance.

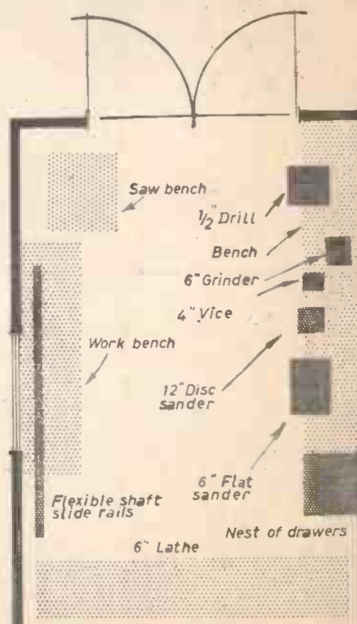
Across the end of the workshop opposite the door is a 6in. lathe. This is a very old lathe, and was originally driven by flat belt from a wall countershaft. This had to be modified to belt drive to suit the location. The wall behind the lathe accommodates shelves and a rack for lathe tools.

On the left-hand side of the shed two-thirds of the length is taken up by a bench 1ft. wide with drawers and shelves beneath. This carries various pieces of equipment; nearest to the door there is a four-speed drill then a 6in. double-ended grinder a 4in. vice, a 12in. disc sander and a 6in. flat sander. Finally, at the end of the bench there is another nest of drawers and shelves.

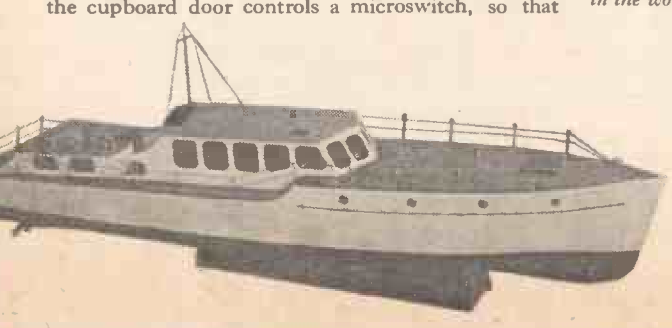
Overall illumination is provided by two 5ft. 80W. fluorescent tubes, and each item has its own point lighting.

Home-made items include the actual shed which houses the workshop, the disc sander and an electric hand-drill.

Regarding drawers and shelves, I prefer shallow drawers and shelves, in various sizes tailored to suit the materials and tools, and as many as possible. I use tin-plate to make the smaller drawers, thereby ensuring the maximum of capacity in the minimum of room.



(Right) Workshop ground plan showing layout of equipment.



(Below left) This fine model boat was made in the workshop

(Right) Two further views of Mr. Brearley's workshop.

WORKSHOPS

and this one to N. E. Jenkinson

Exterior view of the outhouse workshop.

MY workshop is installed in a brick-built outhouse, presumably originally intended for the storing of gardening tools. It has the advantage of being detached from the house and has a concrete floor and corrugated asbestos roof.

To eliminate severe condensation, apparently due to the asbestos roof, it was decided to install proper heating and the Electricity Board duly wired a power point from the house. A 6ft. tubular metal heater was attached to the wall and provided a gentle heat. A false roof was put in consisting of sheets of hardboard nailed to the wooden beams supporting the asbestos roof. Condensation ceased at once and the outhouse was noticeably warmer.

As I do not tackle heavy woodwork, a white kitchen table with a screw-on top serves as a bench. The top

Wood-turning lathe on its shelf.

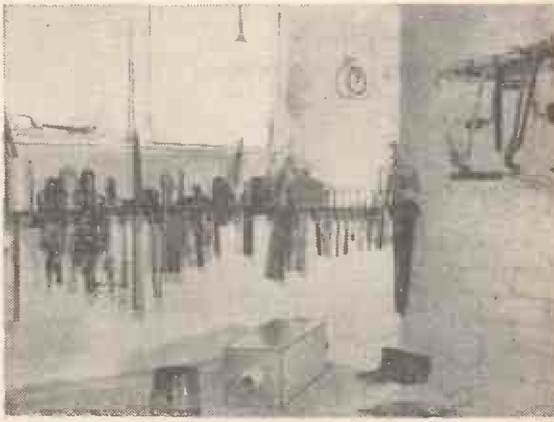
was unscrewed and moved forward 2in. to allow ample room for securing clamps, vices, etc., and a piece of thick shelving was added at the back to compensate and give a bigger working surface.

To house more than sixty tools, the expense of metal clips would have been considerable, a 6ft. piece of deal, 4in. × ½in., was obtained instead and holes were cut to accommodate every tool. The ones used frequently were placed nearest to the bench. The shelf was then supported in six places to take the considerable weight, and painted with gloss paint.

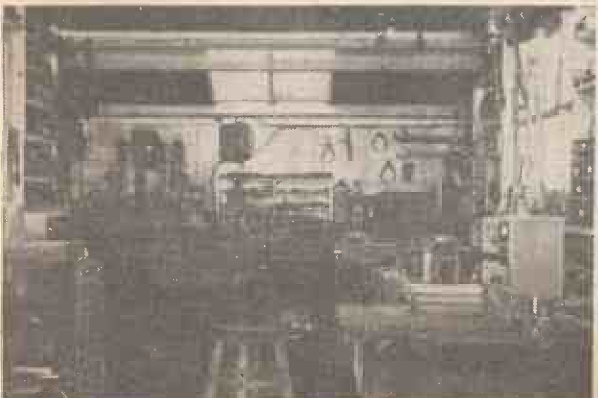
Wider shelves were fixed to the side walls to take numerous tools, boxes, etc., which could not be hung up.

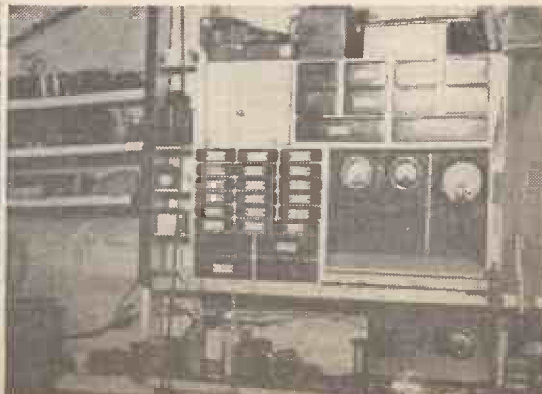
I had the good fortune to win a small wood-turning lathe (minus power and stand) in a competition. This was installed on a thick, heavy wooden shelf. The metal brackets supporting the shelf had to be very strong, otherwise the machine vibrated in use. It is driven by electric motor and serves to do small turning jobs for models, polishing round objects and sharpening tools on the grinding wheel.

The workshop is used chiefly for light woodwork and model making, and also for the making of photographic gadgets.



The tool rack.





Automation...

Simply explained by

D. A. Watt

WHAT is the true significance of automation? A truly automatic mechanism is a mechanism which has the capacity of self-regulation: that is it can control or regulate some variable in the machine or process, of which it is an essential part, without constant human attention.

Probably one of the earlest automatic devices was the centrifugal governor invented by James Watt in 1788 to control the steam supply, and hence the speed, of his steam engines. A typical governor of this type is shown in Fig. 4.

Another simple example, even more familiar, is the thermostatic control used in a domestic heating system (Fig. 5).

Basic Principles of Automatic Control

Our two previous examples have two characteristics in common. Firstly, in each case there is a continuous sequence of events between the input and output end of the system, this continuous connection is referred to as a " closed loop " and is represented diagrammatically in Fig. 6. It means that the input and output of the system depend on each other, and any change in either directly influences the other.

The second characteristic is that in both cases there is a means of detecting and measuring the output and transmitting this information back to the input. This is known as " feedback " and the information fed back is used as a basis for controlling or adjusting any deviations from the required output. The concept of the control loop as applied in our two examples has been known and used for many years. However, by its very nature, it is necessary for a measurable deviation to occur in the output before correction can be applied. As a result the output varies between a maximum and minimum and this range is a function of the particular installation. In the case of our second example the extent of this range is not very critical but in the case of engine speed control it is highly desirable in many cases to have extremely accurate control.

Single Loop System

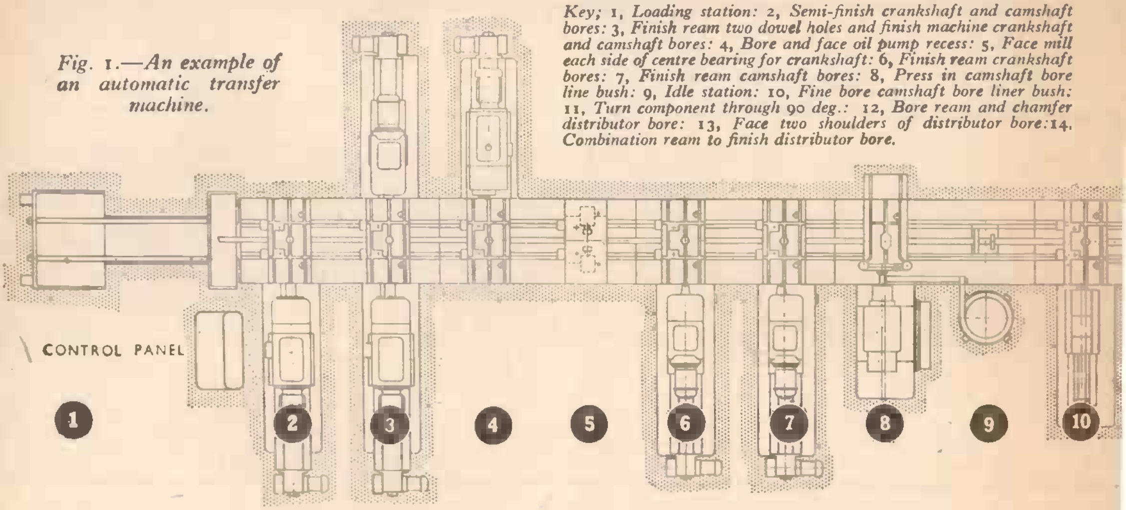
It was almost a century after the invention of the speed governor when Clark Maxwell applied differential calculus techniques in the analysis of a combined engine/speed governor system and established a basis for predicting the behaviour of a simple single loop system.

Through the development and application of pneumatic, hydraulic and electronic devices, coupled with a fuller understanding of the principles of control systems, it became possible to control accurately the variables in production processes automatically. This enabled production control processes to be designed and adapted on the basis of the self-regulating closed loop to an extent not possible before—and this was eagerly exploited.

MACHINE FOR OPERATING ON AUSTIN SEVEN CYLINDER BLOCKS

Fig. 1.—An example of an automatic transfer machine.

Key; 1, Loading station: 2, Semi-finish crankshaft and camshaft bores: 3, Finish ream two dowel holes and finish machine crankshaft and camshaft bores: 4, Bore and face oil pump recess: 5, Face mill each side of centre bearing for crankshaft: 6, Finish ream crankshaft bores: 7, Finish ream camshaft bores: 8, Press in camshaft bore line bush: 9, Idle station: 10, Fine bore camshaft bore liner bush: 11, Turn component through 90 deg.: 12, Bore ream and chamfer distributor bore: 13, Face two shoulders of distributor bore: 14, Combination ream to finish distributor bore.



Continuous Process Industries

Obviously the industries to which automatic control can be most easily and advantageously applied are the continuous process industries. Such industries are paper-making, printing, flour-milling, chemical manufacture and oil-refining. In fact, automatic control has been in use in these industries for many years. In some cases it has developed to such an extent that some of the latest processes could not be carried out without it.

In the petroleum and chemical industries much of the process control is achieved using compressed air as the control medium. The processes encountered in these industries involve either heating, cooling, compressing, condensing or pumping liquids or gases. Hence the variables to be controlled are either pressures or temperatures which are corrected by opening a valve to add or remove a liquid or gas.

Fig. 2.—An Asquith 18-Station Transfer Line for machining automobile cylinder heads at the Vauxhall Motor Co. Ltd.

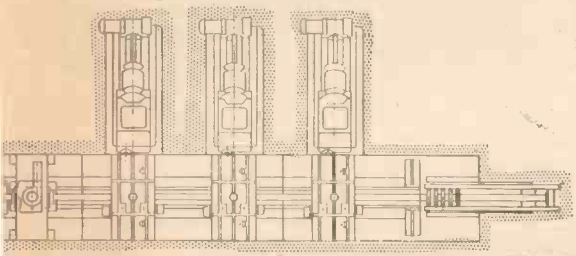
Simple Pneumatic Controller

Fig. 7 shows the principle behind one simple type of pneumatic controller. A constant pressure air supply is fed to a small orifice which in turn is connected to a nozzle of slightly larger diameter from which air discharges and impinges on a flapper or reed. When the flapper moves closer to the nozzle under the influence of the input thrust the pressure in the line between the orifice and the nozzle rises. If the flapper is moved away from the nozzle the pressure in the line falls since the restriction at the nozzle is less than that of the orifice. These changes in pressure act on the piston in the output cylinder to give an output thrust sufficient to open or close a valve.

Fig. 8 shows that a very small movement of the flapper causes quite considerable changes in the output cylinder pressure, and the output is of sufficient magnitude to be used directly in a control valve.

It is obvious that the input to the flapper could be supplied from any detecting device such as a thermostat, pressure gauge or, as is shown in Fig. 9, a level indicator. In this example a drop in liquid level causes the control valve to open, closing again when the control point liquid level is regained. In practice the controller would not be so simple as this as the control would be either fully open or fully closed. This can be overcome by various methods such as a lever system on the float linkage.

Practically all pneumatic controllers used in the process industries are based on this principle but of more advanced designs incorporating devices to give exactly the degree of control required.



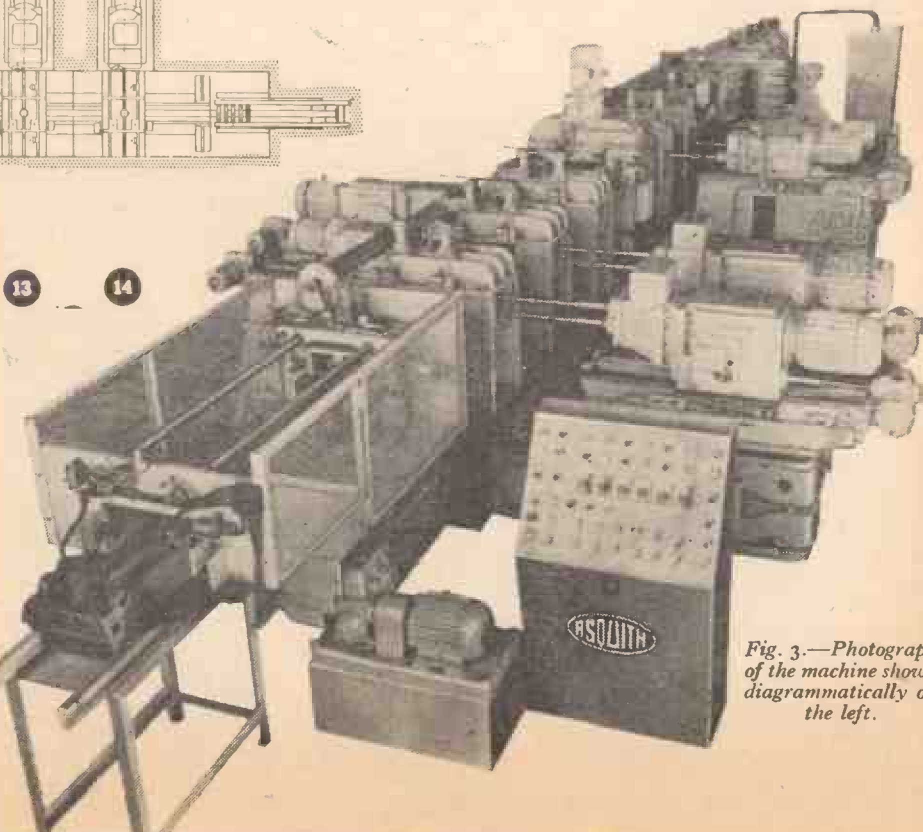


Fig. 3.—Photograph of the machine shown diagrammatically on the left.

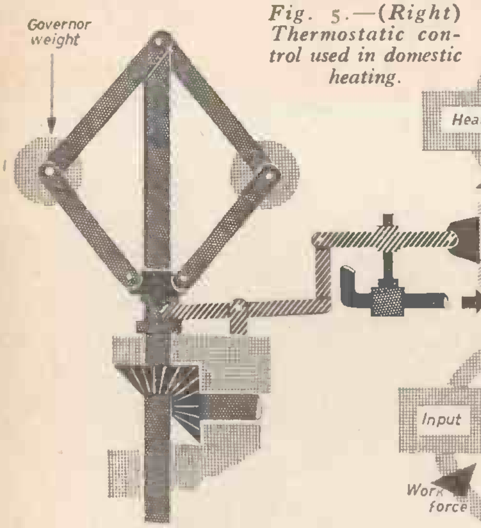


Fig. 4.—A centrifugal governor.

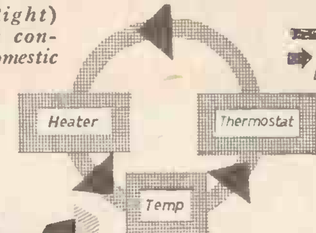


Fig. 5.—(Right) Thermostatic control used in domestic heating.

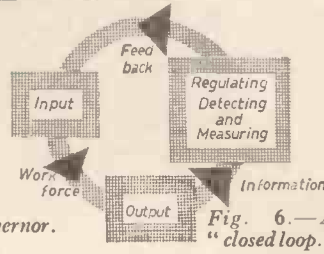


Fig. 6.—A "closed loop."

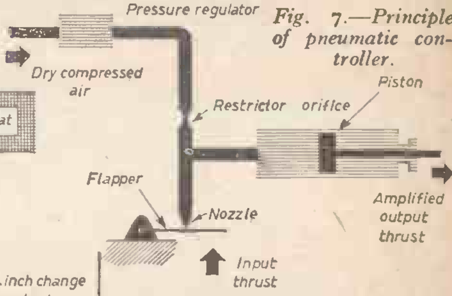


Fig. 7.—Principle of pneumatic controller.

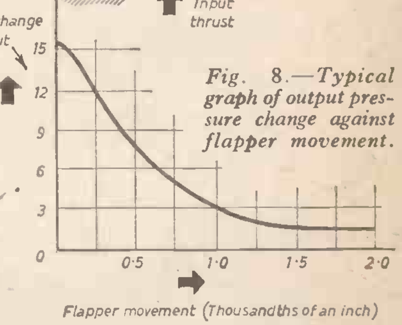


Fig. 8.—Typical graph of output pressure change against flapper movement.

Apart from pneumatic controllers there has been a great advance in recent years in the field of electronic controllers which can be made even more sensitive.

The aspect of automation which has caught the public imagination is the extension of automatic operation to the heavy, awkward and unyielding shapes of components used in the production industries.

The functions of production can be divided into three groups each of which is capable of being brought under automatic control.

Materials Handling Operations

This covers not only the movement of materials up to and through the individual phases of production, but also the assembly of the parts into the final product. It will perhaps be easier to understand how materials handling can be achieved automatically if we consider some of the basic movements required and see how these may be carried out. Figs. 10, 11, 12, 13 and 14 show how various movements can be mechanised simply using hydraulic cylinders and rams. In these examples movement of the rams would be controlled by valves operated either by a time switch or by a mechanical device triggered from the previous operation.

The development of automatic devices for manipulating parts into and out of machine tools, and devices for assembling these parts is one of the main features of the trend towards automation.

Fabricating Operations

The second group of production functions is the various fabricating or processing operations performed on the materials such as cutting, drilling, grinding, etc. The highest degree of automation is achieved when the fabricating and handling operations are fully integrated so that the work parts are not handled by the operator throughout the production cycle. This is achieved in automatic transfer machines such as those shown in Fig. 1. and Figs. 2 and 3 (reproduced by courtesy of Drummond-Asquith Ltd.) which are typical multi-station transfer machines for machining motor car cylinder blocks. These machines are most suited to this kind of work where many machining operations have to be carried out on one component.

Quality Control

The third main group of production functions is quality control or inspection. Automatic methods are used to check whether components meet the specification. If not then corrective action is automatically applied and, if necessary, the work piece is rejected.

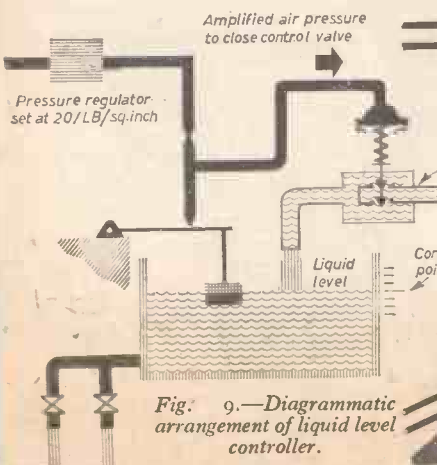


Fig. 9.—Diagrammatic arrangement of liquid level controller.

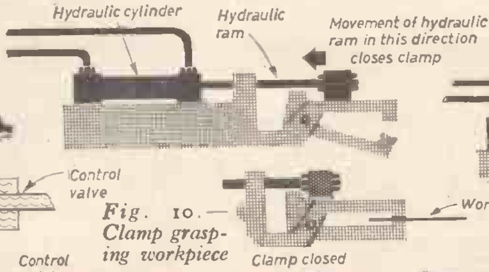


Fig. 10.—Clamp grasping workpiece

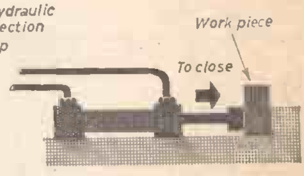


Fig. 11.—Holding workpiece.

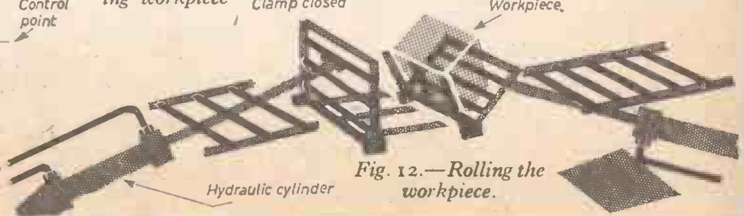


Fig. 12.—Rolling the workpiece.

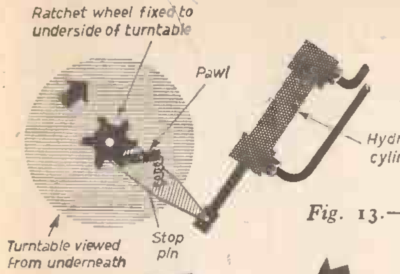


Fig. 13.—Turning.

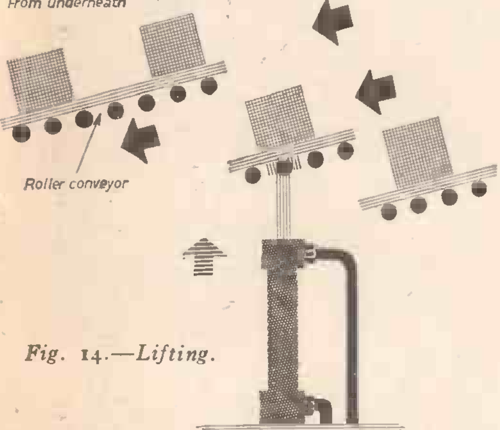


Fig. 14.—Lifting.

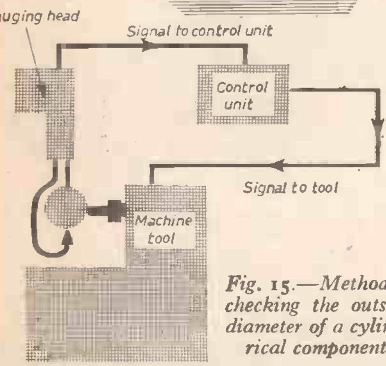


Fig. 15.—Method of checking the outside diameter of a cylindrical component.

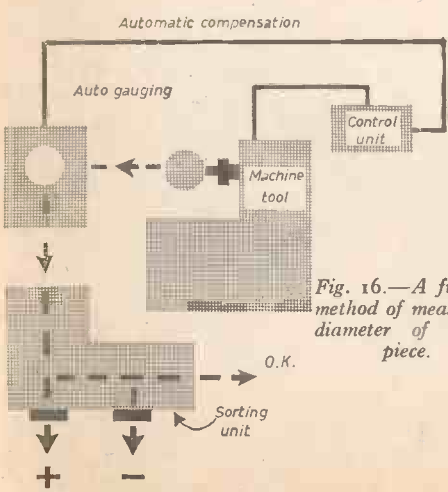


Fig. 16.—A further method of measuring diameter of workpiece.

Two ways in which the outside diameter of a cylindrical component may be automatically checked are shown in Figs. 15 and 16. In the first the gauging head measures the diameter during the machining operation and automatically stops the machine when the correct diameter is obtained. In the second case the measurement is made on the finished workpieces and suitable compensation applied to the cutting tool if the diameter deviates beyond the acceptable tolerance. The finished part then passes to the sorting unit. Of these two methods the first is more suitable when close tolerances have to be met but is a slower process. The second method is more suitable for mass production of components which have to be matched with other massed produced parts and can be sorted and graded in a range of sizes. As with control techniques, there are countless ways in which automatic devices can be used to assist in quality control.

The rapid progress of automation and its application should alarm no one. It will not cause redundancy and unemployment nor can it undermine man's intelligence. The machine will always be man's servant and automation can only bring increased economic prosperity.

PUZZLE CORNER

Piles of Piles

A miser divided his hoard of £1 notes into a certain number of piles, each pile containing the same amount. His wealth totalled £2,171.

Into how many piles did he divide the money?

Answer

The only factors of 2171 are 13 and 167. Therefore, he either had 167 piles each containing 13 £1 notes or—what is more likely—13 piles of £167.

DRILLING FOR

AS one exploration well can cost as much as three quarters of a million pounds, drilling in a new area can start only after the fullest consideration of the survey results. Even so, the decision is bound to be a gamble with the odds against success. In the U.S. for instance, seven out of every eight wells drilled are unproductive. In Canada more than 800 wells were drilled before the first satisfactory discovery was made.

The Drilling Rig

Often the search for oil is in difficult country and before drilling equipment can be moved in, access roads to the site may have to be built (in Nigeria the construction of a five-mile stretch of road through the swamps cost £155,000). Bulldozers level the drilling site and, in some cases, a camp site for the drilling crews.

The central part of the rig is the derrick, a strong tower of steel girders usually about 140ft. high with a 30ft. square base. The derrick is built up on a heavy steel substructure about 14ft. above ground level, high enough to allow for the installation beneath it of large valves, known as blow-out preventers, which can shut off the hole in case of an emergency caused by the release of high-pressure gases or liquids, or both, from below ground.

The drilling tools are like a carpenter's bit and brace and work in much the same way. When drilling begins the bit is screwed onto a 40ft. long, square pipe called the kelly, which is suspended from hoisting gear fixed to the top of the derrick. The kelly slides through a square hole in a heavy round steel disc, known as the rotary table, on the derrick floor. Engines—usually diesel but sometimes steam, gas or electric—turn the rotary table and the kelly turns with it twisting the bit into the ground. The number and size of the engines used varies; they can provide up to 3,000 h.p.

When the bit has bored its way down for thirty feet it is hauled up again by the hoisting gear, which is powered by the same engines. A length of round drill pipe, 30ft. long, is screwed between the bit and the kelly and lowered into the well so that the kelly again rests in its square hole in the rotary table.

Once again the table turns and the bit penetrates further into the ground. After another thirty feet more pipe is added, and so on. The kelly, the drill pipe and the bit together make up what is known as the drill string.

The Importance of Mud

An essential feature of rotary drilling is the continual circulation of a drilling fluid. This is generally a specially-prepared mud—a mixture of clay and water and various chemicals. The progress and efficiency of drilling depends largely on the use of the right drilling fluid for the rock being drilled through, and its preparation is a highly skilled job carried out by a "mud engineer."

The mud is pumped down through the hollow drill pipes under high pressure and a powerful stream enters the bore hole at the bottom through openings in the drilling bit. It returns to the surface through the space between the drill string and the bore hole wall, carrying with it the rock chips cut away by the bit. At the well head this stream of mud is passed over a sieve on which the rock cuttings are left behind; it then passes on to the pump to be recirculated. The mud also cools and lubricates the bit and makes a kind of plaster up the walls of the hole to prevent them caving in. Its weight stops water or gas entering the bore hole from porous formations pierced by the bit, and thus provides the main safeguard against a blow-out.

Samples of the rock cuttings brought to the surface by the mud are collected from the sieve and carefully inspected to determine the type of rock the drill is penetrating. This information is supplemented by electrical or radioactivity logging techniques, which provide a photographic chart of the rock layers.

A helicopter flying a drilling crew and supplies to a rig in Alaska. (Right) Drilling mud returning to a storage tank on a rig in the Sahara. (Far right) On the drilling floor of a rig on La Concepcion Field, Venezuela

OIL

Inserting Steel Casing

Despite the protective layer of mud the walls of the bore hole would in the long run still tend to collapse, specially in loose sands or similar formations. To prevent this, steel casing is put into the well at various stages of drilling: soon after a well is started sometimes at intermediate depth and again at final depth.

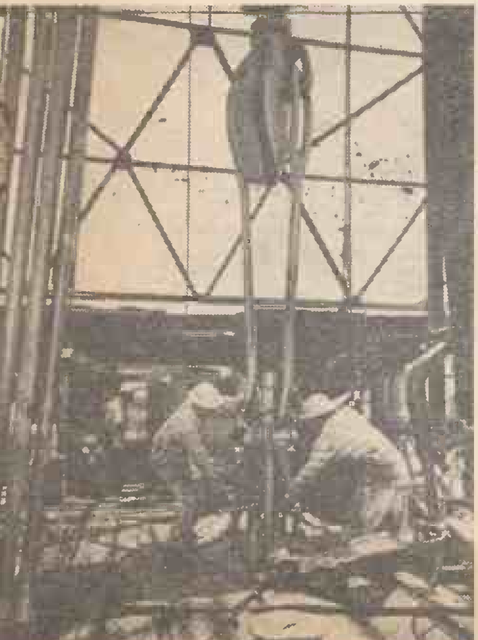
The drill string is drawn up and stacked in the derrick, normally in 90ft. lengths—three lengths of individual drill pipe. Sections of steel casing are then lowered and cemented to the walls of the bore hole. The drilling string is let down inside the casing and drilling continues with a bit of smaller diameter.

This stacking 90ft. lengths is the main reason for the height of the derrick; as the drilling string is withdrawn the lengths are unscrewed by mechanically-operated tongs and one of the drilling crew stands on a platform near the top of the derrick to guide them into racks.

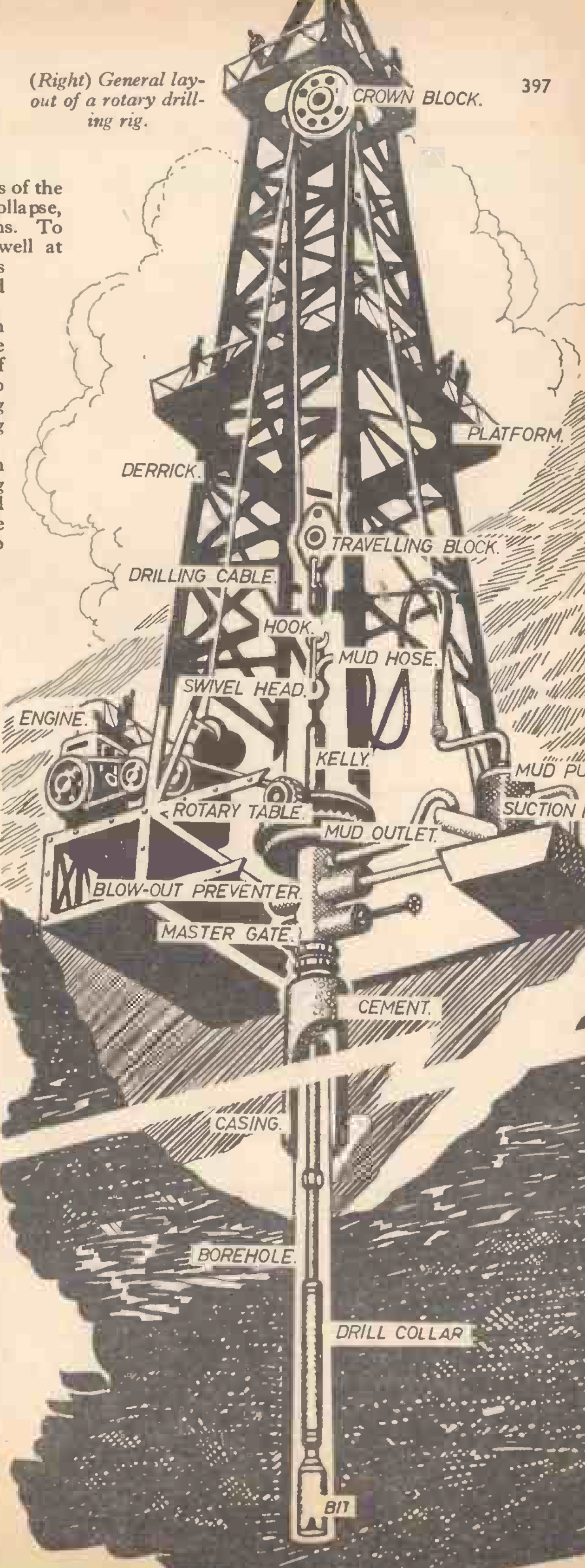
Drilling Bits

The string has to be withdrawn and stacked not only when the casing is put in the well, but also when the bit needs changing. The frequency of this depends on the hardness of the rock. Sometimes the bit may cut through as much as 330ft. in an hour, but if it is cutting through a very hard layer, progress may be slowed to less than one foot an hour.

There are many types of bits. Soft-formation or " drag " bits, for use in sand or clay, have two or more fixed blades with cutting edges. Rock bits have two or more conical cutters with rows of very hard teeth; as the cutters rotate on ball and roller bearings the teeth crush the rock. Some bits even have diamonds as their cutting edge.



(Right) General layout of a rotary drilling rig.



Four Miles Down

The depth at which oil may be discovered varies. Many wells reach between 3,000 and 8,000 ft., but they can go very much deeper, as far as 25,000 ft. (more than 4 miles) down into the earth. If all goes well, it may be several months before the bit reaches the formation judged capable of holding oil or gas. If drilling is difficult, it could take up to a year or more.

Appraising the Field

Drilling continues until the well reaches the depth at which the geologists and other experts consider, on the available evidence, that oil might be found.

A small discovery is not much better than a dry hole. It has no economic value itself and a lot more drilling will be necessary to find out if it is an indication of oil in bigger quantities.

Only part of the total weight of the string is brought to bear on the bit during drilling, the rest being taken by the brake of the hoisting gear. Nevertheless a bit of 8½in. dia. may be subjected to a load of 50,000lb.

In spite of the high-quality steel used, the drilling string may occasionally break. If this happens the remaining pipe is hauled out and the broken part is then fished for with special gripping tools.

When the broken part cannot be recovered the hole is continued at an angle from the point where the blockage occurs by placing a steel wedge, called a whipstock, above the broken section to guide the bit past it. This technique is also used in directional drilling: for instance, if a chosen site cannot be obtained—perhaps it is in a built-up area—then a slanted hole is drilled by the directional method from a site some distance away.

Drilling is a round-the-clock operation, seven days a week, and continues from the moment the drill enters the earth—known as spudding-in—until the well is completed. For this reason there are normally three crews per rig, each crew working eight-hour shifts. A head driller, called a toolpusher, is in overall charge and other specialists are called in when necessary.

If large quantities are found by the first well—which rarely happens—the chances are fair that a new oilfield is about to be developed. But many more wells will have to be drilled before this is at all certain.

These wells, drilled with the object of evaluating the importance and extent of the discovery, are known as outstep or appraisal wells. They are sited according to the geological data gained during the earlier drilling. For instance, on what is thought to be a large accumulation, appraisal wells may be as much as a mile apart; on smaller finds the distance between them might be less than half a mile.

Usually the derrick has to be dismantled before it can be moved, then re-erected on the next site. On flat, hard ground, however, it is sometimes put on rollers and pulled by tractors to the new location. Increasing use is now being made of portable drilling masts.

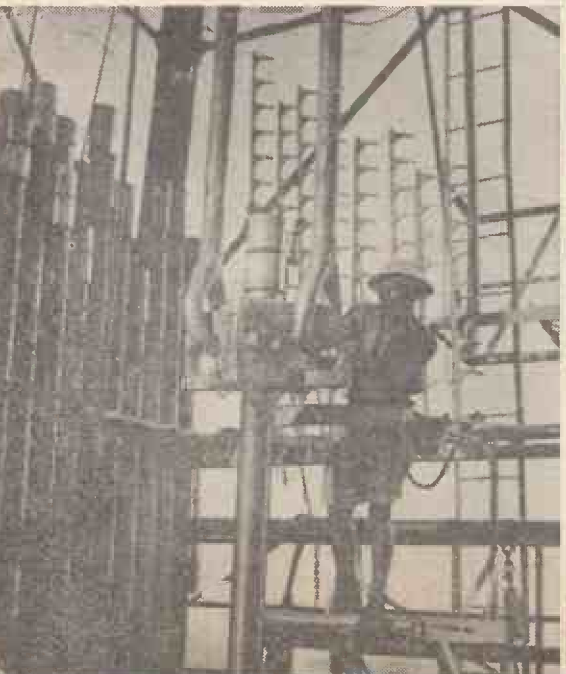
As soon as appraisal drilling has proved a field to be sufficiently large for economic development the drilling of development wells begins. Estimates are made of the amount of oil recoverable from the field and the wells are spaced accordingly.

In most cases the earlier wells of a field will flow by the natural pressures within the oil-bearing rock formation. At a later stage, however, the natural pressure decreases and may have to be replaced by various methods, such as injecting gas back into the formation. Finally, plunger pumps may have to be used to bring the oil to the surface.

Automation is playing an increasing part in production, particularly in remote and difficult areas.

(This article and photographs are reproduced by courtesy of Shell Petroleum Co. Ltd.)

Derrickman at work 90ft. up a rig in Nigeria.



A Cia. Shell de Venezuela deep drilling rig at La Paz field.

BY P.G. COLE

LUNAR PHOTOGRAPHY

QUITE good photographs of the Moon may be taken with a small telescope. Any telescope larger than a 2in. will be good enough for this purpose, provided that the eye-piece is removable. Any camera with a removable lens and provision for focusing by direct vision will be suitable. Single lens reflex cameras are best, but an old plate camera is quite good enough to give satisfactory results. Some means of coupling to the telescope is essential, and a really rigid apparatus is required. It is essential to keep the film or plate perpendicular to the axis of the telescope, otherwise distortion of the image and unevenness of focus will result.

The prime focus method of photography is unsuitable for small telescopes on account of the smallness of the image and consequent difficulty in focusing and enlargement. This method was tried and proved unsatisfactory. The method adopted was similar to the method used to observe sunspots—the image of the Moon was projected onto the film via an eyepiece. This gives a magnified image very suitable for this kind of work.

Method of Clamping Camera to Telescope

It should be possible to obtain an adaptor tube to fit in place of the camera lens, and also a tube to fit in place of a suncap. There is a thread to take a suncap on most eyepieces. When the two tubes have been obtained, gummed paper should be wound round the smaller until the two tubes are a tight fit one in the other. The two appropriate surfaces should then be covered with impact glue and fitted together. This gives a hard and long lasting adaptor tube and the arrangement has worked well for a number of years.

Releasing the Shutter

When taking photographs it is essential to have some means of setting off the shutter without touching the camera and thus setting up a vibration which could ruin the negative. Exposures should be kept as short as possible, and great improvement will be noticed when a faster film is used.

With a projection distance of up to 6in., a magnification of ×40 will give an image of the Moon 2in. dia. or less; ×80 will give an image of 4in. dia. or less; ×80 is only suitable for exposures of ½ second or less; there is no advantage in using so high a magnification.

Exposure

The table below gives the exposures for a 3in. telescope of 40in focal length.

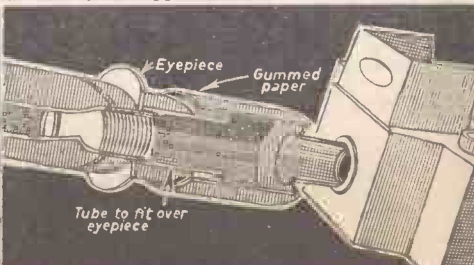
Film	Mag.	Exposure
H.P.3.	×40	½ sec.
H.P.3.	×80	½ sec.
H.P.S.	×40	½ sec.
Tri X	×40	1/25 sec.
Tri X	×80	1/10 sec.

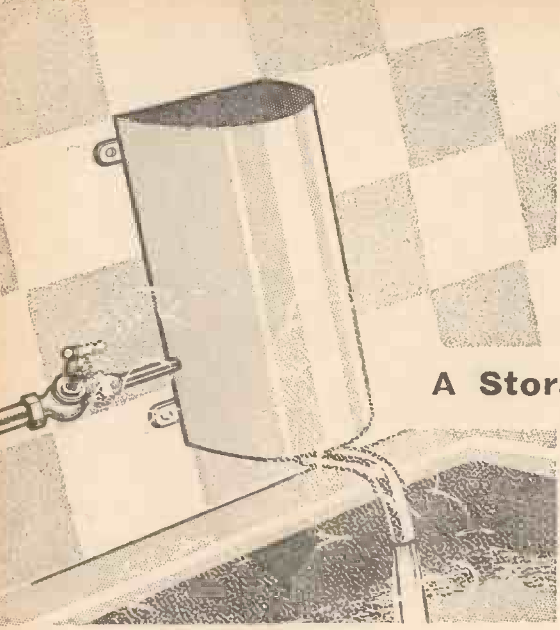
This is only intended as a guide, exposures must be found by trial and error.

The telescope should be set up as described with a counterpoise to balance the camera if required. If a counterpoise is used, a rigid mounting is best because the weight is very liable to vibrate and ruin the exposure. If a rigid mounting is not possible, great care should be taken to ensure that the weight is as still as possible during the exposure. When the Moon is in the centre of the field of view, focus by concentrating on its edge. Later it may be found that the ground-glass screen may be improved on by using an exposed developed plate, or some other suitable substitute. Vary the exposure and to minimise wastage have the films developed, but not printed, because in the first few films, few negatives will be successful.

The method described above may be used with almost any instrument that has R.A.S. standard thread eyepiece. With larger instruments a clock drive is necessary because of the rotation of the earth. The southern portion is particularly worth photographing.

The heading photograph above shows the south of the moon, approximately ten days old. x 128. *(Below left) The moon aged seven days.* x 40. *This photograph was taken on a 3in. telescope. (Below centre) The moon five and a half days old.* x 40. *(Below right). The arrangement of the apparatus used.*





HOT WATER AT THE SINK

By E. W. Monarch

A Storage heater you can make

IN this unit the water heats slowly to about 180 deg. F. and then the heater cuts out. It cuts in again when the water cools to about 150 deg. F. If the unit is throughly lagged, the standing heat loss will cost less than 6d. per week. It is intended to be left switched on all the time, and would be ideal for use by the small family in the kitchen or bathroom.

Parts Required

Aluminium or copper container, the taller the better, about 1½ gal. capacity. The prototype was made in a " Crude Acetate Container " purchased from Messrs. Thomas Foulkes as surplus. Some saucepans, tea urns and similar containers would also suit.

An old or new motor car thermostat.

A small immersion heater. An electric kettle type would suit if it could be got in the top of the unit and would not be so large as to need fixing near the thermostat. The prototype uses a cheap surplus heater rated at only 350W. made for use in absorption type refrigerators. It was obtained from Messrs. Finex (Overseas) Ltd. It is not possible to use heaters of over 1,000W. in this unit. London Wholesale Warehouse can supply a similar alternative unit (Fig. 1).

A leaf-operated microswitch, normally closed or change over. The prototype uses BULGIN type S511 obtained from Messrs. Henries Ltd.

Various odds and ends of copper pipe, copper pipe fittings, washers, nuts and bolts, strip metal, Boswhite, etc. Laggings and hardboard or metal for the outer casing. Most of this can be obtained from the plumber's merchants.

Fig. 1.—The Telsen heater dismantled.

Adapting the container.

If the top is not removable it must be cut off with a hack-saw to enable the various parts to be fitted internally. Fig. 3 shows three holes which have to be drilled, cut or filed, to take the cold water feed, the immersion heater boss and the hot water outlet. In the prototype these holes were ½in., 1⅜in. and 1in. respectively in diameter.

Fixing the Heater in Position

A brass flange of the type illustrated in Fig. 4 is readily obtainable from builders' or plumbers' merchants. It has a 1⅜in. thread, a nut and a outer flanged nut.

The projections, internally cast within the flanged part A of Fig. 2 must be filed away until the heater will pass in when the flanged nut D is off. A $\frac{3}{16}$in. washer of soft rubber (B) is fitted *tightly* over the flange A, lightly covered in Boswhite Compound and the flange fitted from the inside of the container. Nut C is now tightened.

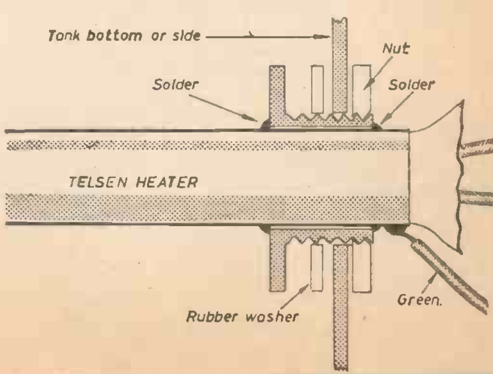
The heater is fitted with a small ring of $\frac{3}{16}$in. soft rubber (E), lightly covered in Boswhite Compound and fitted in place with a flanged nut (D). If the alternative heater is used (Telsen type) it may be mounted by soft soldering to the brass flange (Fig. 2) Remove the element (Fig. 1) while soldering.

Make a separate earth by soldering a lead to the brass flange on the outside after the nut has been fitted (Fig. 2).

The hot water outlet

The method used in the prototype is shown in Fig. 7. The flange is fitted inside with a rubber washer and the nut outside exactly as for the heater boss. It was found best to solder the inner ⅜in. dia. copper pipe to the flange before fixing and to terminate this pipe just

Fig. 2.—Fitting the Telsen heater into a tank.



inside the flange. (This is optional and is not shown in Fig. 7.) Another piece of piping is bent to shape (Fig. 3) and soldered externally after doing the flange up tight. The soldering must be perfect.

Bending the pipe.

The pipe to be bent (with 6in. to spare at each end) is plugged with a wooden bung at one end, filled with *dry* sand, and bunged at the other end.

The pipe is then heated to a bright red heat and gently pulled round any suitable former. The pipe must on no account flatten across the bend or there will be danger of water flooding the electrical connections. The length of the pipe and final shape will depend on the position of the sink, etc.

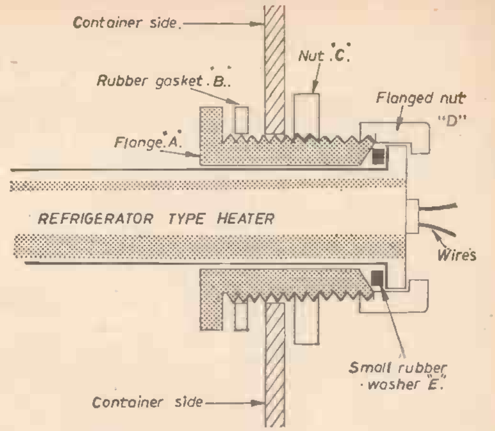
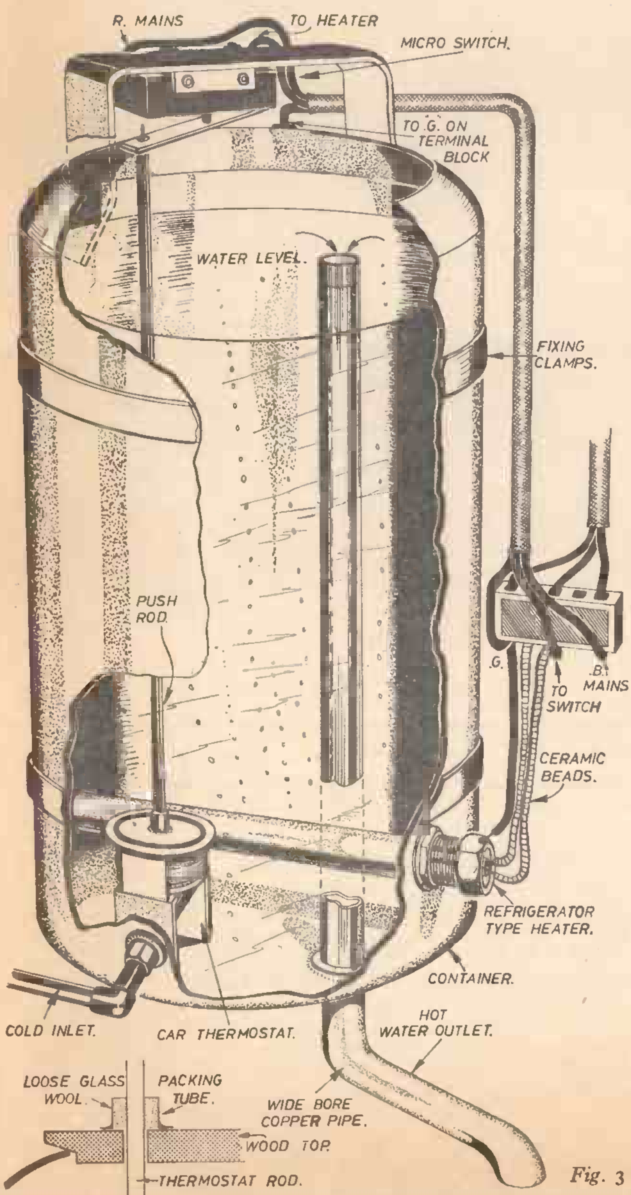


Fig. 4.—Surplus heater mounted in plumber's flange fitting.



Cold Inlet and Water Baffle

The cold inlet is a ¼in. or $\frac{3}{16}$in. petrol union with one nipple for the piping and a flanged nut to hold it in place. An extra nut or flanged nut is required for internal fixing (see Fig. 5). The nut is also used to hold in place a bridge piece of sheet brass which serves to baffle the cold water coming in *and* to support the thermostat very firmly. This is absolutely essential.

The bridge to hold the thermostat is bent from brass, aluminium or copper sheet of about 18g or thicker and is made to rest firmly on the base of the container so that the thermostat is slightly above heater level in the water (Fig. 3). A hole is drilled in the brass for the cold inlet nut which fixes it in position.

The Thermostat

A car thermostat is soldered in place with two blobs of solder, as shown in Fig. 5. Do not let it overheat in this process. A drilled bolt or cycle spoke nipple is soldered on top of the moving valve (A). The top and inside of the bolt must be tinned ready for later use. The thermostat should then be placed in boiling water when the top valve should move upwards at least ¼in. Put under the cold tap it should return immediately. It is fitted in the container, using washers and Boswhite, as shown in Figs. 3 and 5.

The Microswitch Bridge Piece

Some ½in. × ⅛in. painted mild steel strip or rather larger aluminium or copper is bent to the shape shown in Fig. 3, or to suit the container. The parallel top piece must be at least 2in. above the top of the container and 3in. above the hot outlet pipe (water level).

Some thinner aluminium sheet is cut to the shape shown in Fig. 6 to receive the microswitch. Two holes A and A are made to bolt the microswitch holder to the bridge piece.

Before drilling the holes in the bridge piece fix the latter temporarily in place so that a small copper rod fixed in the drilled spoke nipple on the thermostat will be just under the hole in the microswitch leaf spring. The assembly is then fixed in position and the exact length of copper rod (⅛in. dia. will suit) is cut off (see Figs. 3, 5 and 6). The rod is filed very small at one end to fit inside the leaf spring hole and is tinned at the other end.

Fig. 3 (left)—Perspective view of the completed heater.

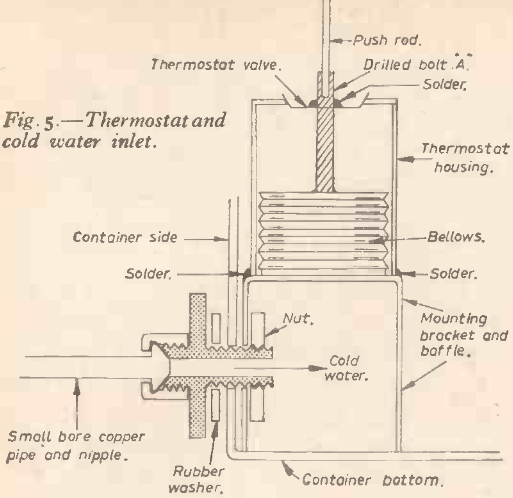


Fig. 5.—Thermostat and cold water inlet.

It is then fitted in position so that the microswitch is quite definitely not under pressure in the cold position. Small washers are fitted under the leaf spring to act as adjusters if necessary.

The tank is then half filled with hot water to make sure the switch " clicks over," the hot water is then replaced with cold to verify that the return " click " is heard.

The Tank clamps

The container is now fitted on to a good solid strong backing board (or a wall, etc.). Bands of painted mild steel strip or brass are taken round the container in two places (Fig. 3). The clamping bolt (Fig. 8) is done up first, the fixing bolts being countersunk and fixed last of all.

Wiring the heater unit

The heater may now be filled with water, wired up, and plugged into the mains for a test. A terminal block should be screwed to the board near the heater wires. Small *interlocking* ceramic beads (Messrs. Technical Services Ltd.) are then slid on the wires and they are taken to the block (Fig. 3). Well insulated mains wires are brought in, the red one going to the microswitch common terminal at the top and returning to the heater terminal block from the normally closed terminal of the microswitch.

Earthing the UNIT

It is most important to earth the heater sheathing *separately*. Using a large hot iron, tin and thoroughly solder a thick copper earthing wire to the flange nut (D) of Fig. 4, and test it by giving a good tug. This is wired via the terminal block to the green earth wire of the power plug. The container must also be *separately* earthed by bolting a thick copper wire to the container above the water level and taking it to the earth terminal already mentioned.

Testing the Storage Heater

Fill the unit with water, using a rubber pipe from a cold tap or by plumbing in to the small bore inlet. Make sure that the outlet can easily cope with the speed of water inlet or the unit will overflow.

Plug into the mains and leave for about an hour, the thermostat should then be operating, coming on for 4 minutes and going off for 12 minutes in a room of temperature about 60 deg. F. When the cold water inlet is fed with water, hot water should now come out of the curved copper outlet pipe.

Thermal Insulation

The unit may be used as it is if adequate insulation is given to the heater wires, terminal block and microswitch. Generally it is safer and much more economical to fit a wooden or metal cover 3in. larger all round than the unit. Holes are cut in it for the inlet and outlet pipes amd mains wires. Lagging is then placed in the space between. Vermiculite is very good and is, in addition, an electrical insulator; glass wool, cork chips, or even strips of old blanket will do.

Lagging must not be placed directly over the microswitch as moisture would shorten its life. A cover must be fitted in the form of blanket, etc., with a small hole cut in it for the copper rod, supported on some wire netting over the container. If vermiculite is used cloth may be firmly bound round the copper rod and the top of the container. The vermiculite being poured on top. If this system is used the copper rod must be soldered into the bolt or spoke nipple on the thermostat. The thermostat has plenty of power to " lift " and " lower " the layer of vermiculite. A system, using a wooden top is shown inset in Fig. 3.

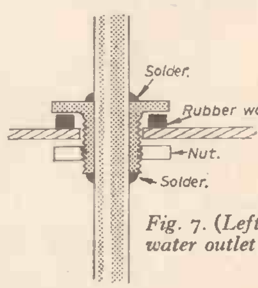


Fig. 7. (Left)—Hot water outlet details.

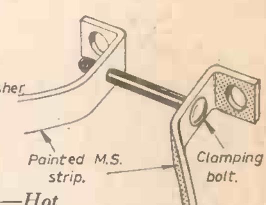


Fig. 8.—Clamp details.

Warning

Without proper earthing the unit could be dangerous. With proper earthing the unit is absolutely safe (when constructed as detailed by the author). The total cost of the prototype came to under £2, similar units on the market cost about £10.

Component Suppliers' Addresses

Finex Overseas, Ltd., 7 West End Lane, London, N.W.6.; Technical Services, Ltd., Shrubland Works, Banstead, Surrey. London Wholesale Warehouse, 163 Queens Road, London, S.E.15. Henries Radio, Ltd., 5 Harrow Road, London, W.2. Thomas Foulkes, Lansdowne Road, London, E.11.

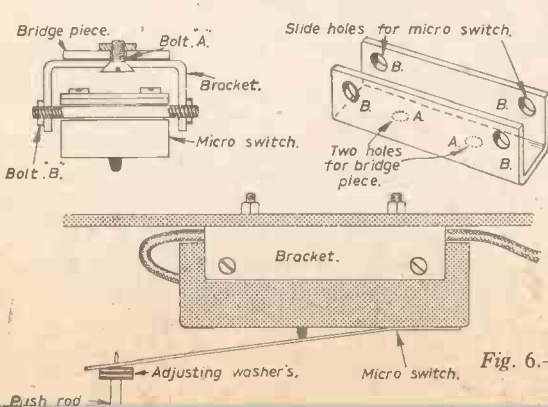


Fig. 6.—Method of mounting and operating the microswitch.

Moulding in glass fibre

The photographs on this page show the six essential stages in glass fibre laminating. A model boat hull is shown under construction, but the same procedure would be followed whatever the object being built up.

The photographs were supplied by Douglas Holt Ltd., Vulcan Walk, New Addington, Surrey, from whom all the materials may be obtained,

Photo 1 shows a female glass fibre mould made originally from a wooden model boat hull by the same procedure as will now be described for making the final mould.

Polish the female mould with a wax release agent and then give it a continuous coat of mould release agent with brush or spray-gun and allow to dry.

Photo 2 shows the process of mixing resin, thixotropic paste, hardener paste and colour pigment (if required). These materials are liquids and mobile pastes. A palette knife is shown being used, but a mechanical mixer is also suitable provided the rotation speed is slow enough.

Photo 3 shows the "gel" coat being applied to the inside surface of the mould, where it will be allowed to harden. This "gel" coat becomes the outside top surface of the finished laminate and is smooth and glossy. It should be of even thickness, and colour can be added if required.

During the next 1½ hours while curing takes place, cut and shape the glass fibre using a pattern or template. This should be ½in. to 1in. oversize to allow for trimming and overlap.

Photo 4 shows the process of laminating by brush. On top of the "gel" coat apply a thick layer of "lay-up" mixture which is the same as the "gel" coat with the thixotropic paste omitted. Follow this with a layer of glass fibre mat. Use the brush with a dabbing motion to stipple the "lay-up" through the surface of the glass fibre; this also removes air bubbles.

Photo 5 shows a multi-washer roller being used to roll out air bubbles. Continue until the roller begins to drag.

Repeat the "lay-up" sequence until the required thickness is obtained.

Photo 6 shows the female mould being removed after 12 hours have been allowed for hardening. The laminate should be eased from the mould gently and evenly.

home-made CHEMICAL LABORATORY APPARATUS

Part 9 — Making common salt and details of the extra apparatus required

By K. Given

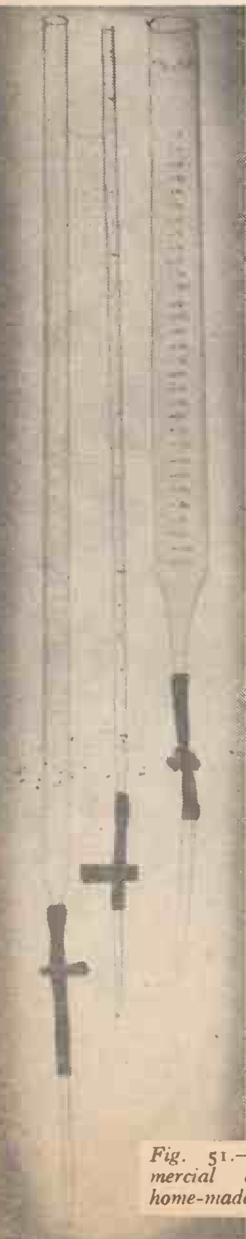
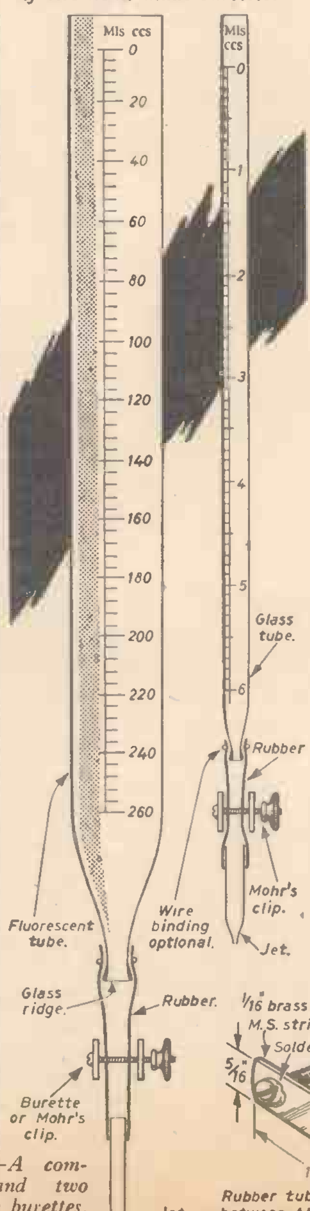


Fig. 51.—A commercial and two home-made burettes.

Fig. 52. (Below)—Details of two home-made burettes.



A strong acid solution is mixed with an alkali, a burette being used for one solution and a pipette for the other. A certain quantity of the caustic soda solution is placed in the dish or beaker with a pipette.

The acid solution is placed in a burette and a little run through to clear the delivery pipe of air. A reading is taken and acid is run in until the soda is neutralised as shown by Litmus, or better still by a few drops of phenolpthalein solution in alcohol. The latter will go red in the alkali and will be perfectly colourless when it is neutralised. The final reading of the burette is taken. The difference is the exact amount of acid required to neutralise the amount of soda solution used.

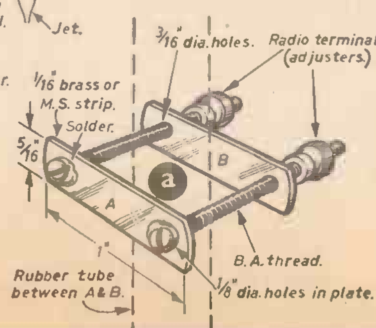
Another titration is tried, with an indicator, as a check. Then a final one is done with no indicator, but using exactly the amount of acid and alkali found necessary in the two former titrations.

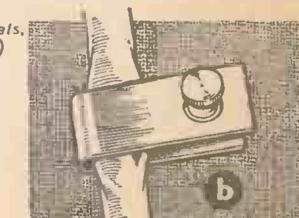
Burettes and Mohr's Clips

Burettes of fine bore tubing are the more accurate, but have a low capacity. Old fluorescent tubes, cleaned out as previously described, will do. Refer to Fig. 53 and heat the tube about the place marked "X" in a roaring flame turning all the time. Remove from the flame and rapidly draw out. The glass is cracked off as shown with a small file mark. The end is then heated gently so that the glass forms a small round ridge all round, or it may be gently opened out a little while hot with an old round file.

Tubes with finer bores down to even ¼in. are suitable and naturally the work is much easier. Small dia. tubes do not require drawing out. About 3in. of rubber tubing is slid on the prepared end and a suitable 2in. length of glass tubing is slid into the rubber. Between the burette proper and the other 2in. length of glass is a " Burette clip " or " Mohr's clip." Details of the 2in. glass and Mohr's clip are given in Figs. 52 and 54.

The Mohr's clips are used for many purposes and save the use of ground taps in apparatus; other uses include aspirators, Kipp's apparatus and fine control of Bunsen burners, especially where the gas tap is stiff. A crude, but workable one is very easily made





A simpler clip of springy bress.

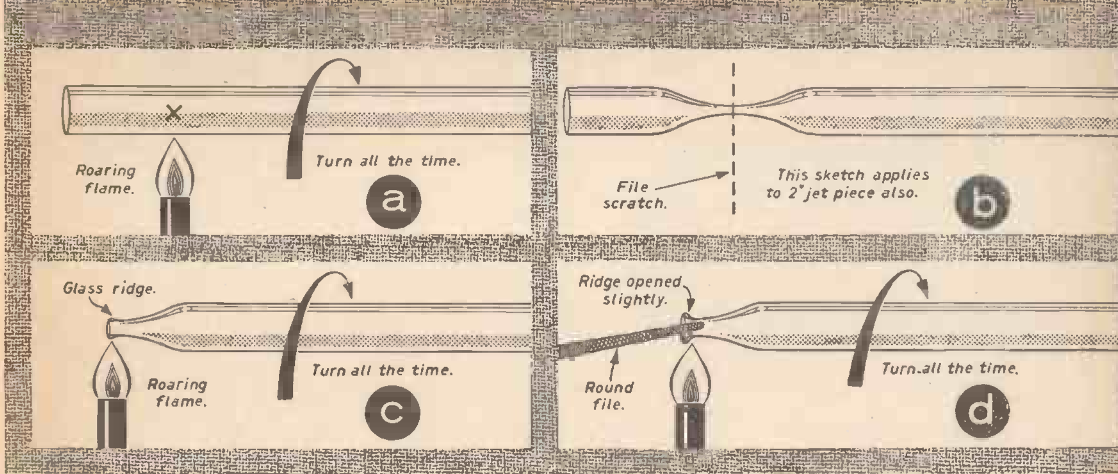


Fig. 53.—Stages in forming the lower end of a burette.

as shown in Fig. 54b, but a better one is made by taking two pieces of brass or steel approx. 1in. × 5/16in. × 1/16in. and drilling two holes in each while they are both clamped together in a vice. Two radio terminals are used for control. The threaded portions are soldered on to one strip and project through the other. The holes in the second strip may be made a little larger if necessary for easy clearance, see Fig. 54a. The rubber tube is clamped between the strips and the terminal nuts tightened slowly.

Calibration and marking is exactly the same as for the measuring cylinders described last month.

Burette Stands

Burettes, unlike measuring cylinders, have to be supported in a vertical position in some way. The retort stand already described, if fitted with rubber tubing on the clamp, may be used, but it is usual laboratory procedure to use wooden stands of plain white wood. A design is shown in Fig. 55.

Commercial stands use large wood screws. It is difficult to cut the necessary threads in wood at home and the author has devised other means of clamping both the burette and the movable clamp itself.

The stand consists of a base of white wood about 6in. × 4in. with a 15in. length of ½in. dowel glued in a hole as shown.

The clamp is a piece of ¾in. × 1½in. soft wood about 5½in. long. It is drilled through the 1½in. breadth with a hole just over ½in. dia. so that it will slide nicely down the dowel. A small piece of wood ¾in. × 1½in. × 3in. long is now attached to the clamp proper by a small hinge as shown. The clamp proper may now have two rounded location slots filed in the wood to receive the burettes, or the slots may be previously made, but they must coincide with each other. Gasket cork from a garage may be glued in these slots; this was not done on the prototypes.

A B.A. bolt or length of studding 2in. long is necessary for the "fluorescent tube burette." It is fitted so that it passes through holes with 1/16in. clearance in both clamp proper and hinged part, see Fig. 55a and b. The head end is fitted with a nut so that it may be lightly tapped into the soft wood to form a "retainer", see "P" in Fig. 55a. The thread is jammed, or the nut soldered to the thread, if studding is used. A large washer "Q" is put on the hinge side and a radio terminal fitted. This now forms a clamp to hold the burette, the prototypes shown will hold the fluorescent tube and burettes down to ½in. dia.

To fix the clamp in position, a small piece of 1/16in. or ⅛in. × ¼in. × about 2in. brass or steel is drilled with three small holes at each end and one in the centre as shown in Fig. 55c. In the centre hole is fitted a bolt with the head rounded off with a file and fixed to the strip with two nuts. A hole is drilled in the block at "Y" in Fig. 55b and d. so that the rounded bolt head may press on the dowel. The strip is held at one end with a small wood screw and the other end is adjustable by means of another B.A. screw and radio terminal. The clamp may now be raised and lowered at will and locked in position with the strip and terminal. Refer to Fig. 55b, c, and d. for details.

Readers who cannot obtain the necessary long B.A. bolts and terminals may use ⅛in. or 3/16in. Whit. set screws fitted with wing nuts. These should be obtainable locally at any ironmongers'. B.A. screws, etc., are obtainable by post from Messrs. Whiston, New Mills, Stockport.

(*To be continued*).

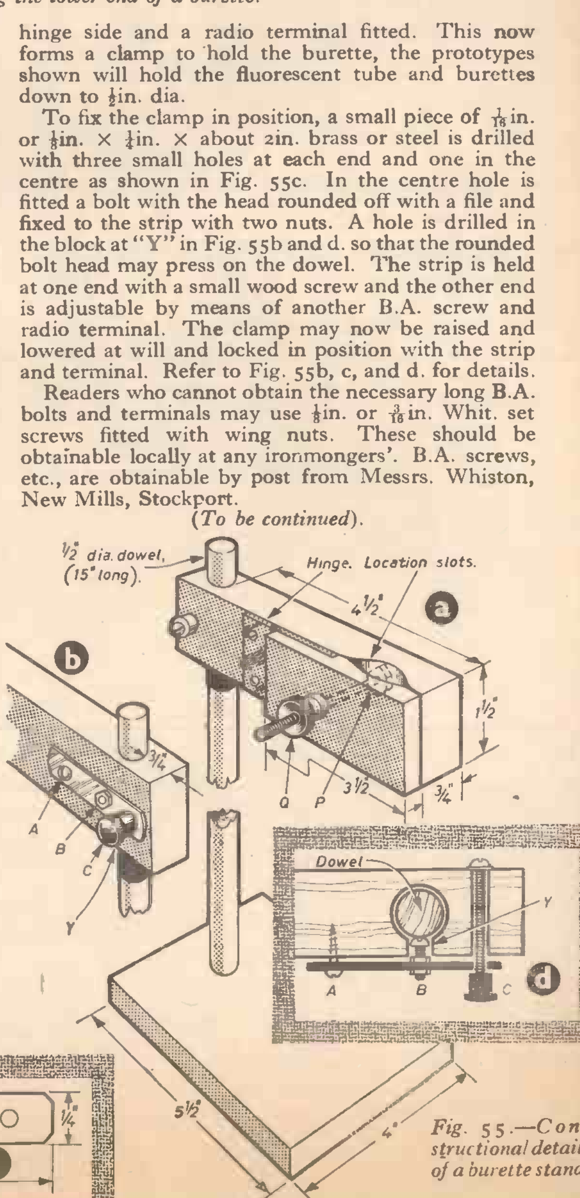


Fig. 55.—Constructional details of a burette stand

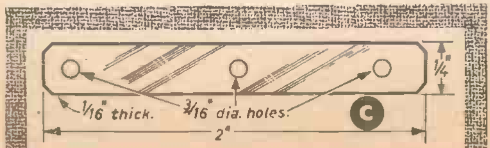


Fig. 54. (Left)—Two types of Mohr's clips.

FIRE ALARMS

Fig. 132.—Home-made fire alarm.

Part 15 in the Automatic House Series by E. V. King

A READILY available surplus flame switch, probably used as a fire warning device in aircraft, is shown in Fig. 133, and is available from Messrs. K. R. Whiston, of New Mills, Stockport. If a flame touches the red composition end the switch operates explosively, coming " ON " and ringing a bell. Batteries should be used in fire alarm systems as mains failure might already have happened, a safe method being to have a 6V. motor cycle accumulator continually on trickle charge (200mA.) (Fig. 134). A resistor included in one charger lead will limit the current and an ammeter may be inserted temporarily in either charger D.C. lead. If no ammeter is available, include a 2.5V., 3A. flash lamp in the lead labelled " L " in Fig. 134. Include plenty of resistance (old electric fire element wire will suit) in the other lead. Decrease the length of this wire with care until the small flashlamp lights not too brightly; about 200mA. will then be passing. The lamp may or may not be removed as desired.

Earth one side of the battery for safety against shock. The flame switch itself may be situated in some special place, i.e. above an oil heater, oil-fired boiler, on the hearth-rug at night (a flexible lead, or plug-in arrangement will be necessary), in the garden under cover where heath fires might occur at night, etc. In the automatic home it is also possible for the flame switch to operate other apparatus such as a solenoid water valve or fuel oil cut-out.

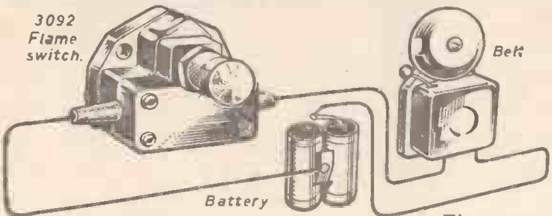


Fig. 133.—Using a "firework" type flame switch.

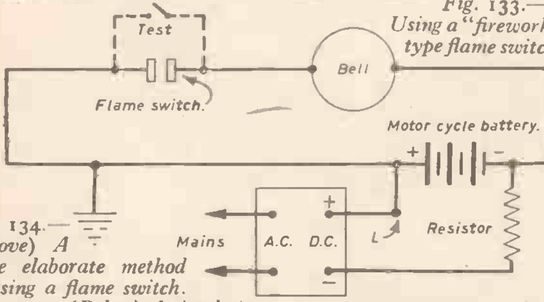
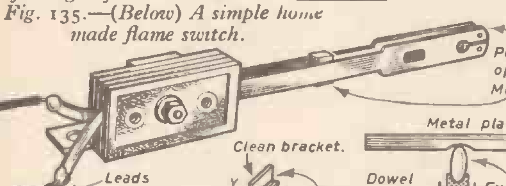


Fig. 134.—(Above) A more elaborate method of using a flame switch.

Fig. 135.—(Below) A simple home made flame switch.



Home-made Flame Switches

Take an old P.O. relay to pieces and use the contacts, or leave the unit complete and gently open a pair of normally closed contacts and put a small piece of " meta " fuel or other readily combustible material between the leaves to keep the points just open (Fig. 135). A trial run should be arranged to make sure the amount of fuel used does not buckle the metal, and cause the points to remain open. It is not known how quickly Meta fuel sublimes at room temperature, and probably it would be well to renew the pellet every year or use instead the " firework " material from self-vulcanising patches used by motorists.

An alternative type can be made with anv n/c microswitch, a length of *metal* dowel and a pellet of combustible material as shown in Fig. 137. The microswitch should be protected against fire by a metal shield so that sure combustion of the pellet will take place before any damage is done to the switch.

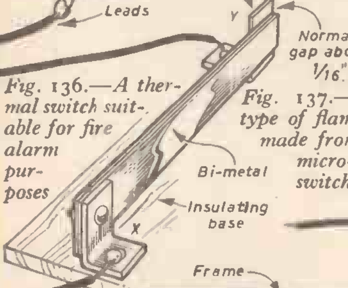


Fig. 136.—A thermal switch suitable for fire alarm purposes

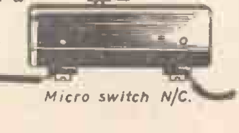


Fig. 137.—Another type of flame switch made from a micro-switch.

Operation of the Fire Alarm after the Switching Mechanism is Burnt Out

It is possible that if no one answers the " fire call"

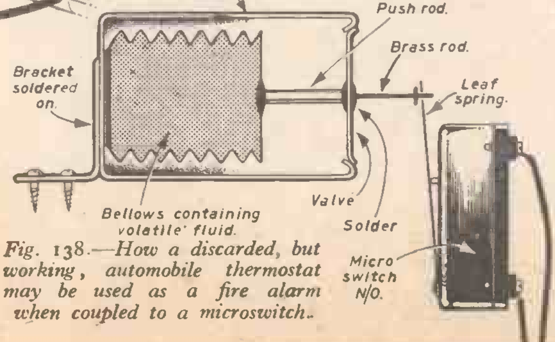


Fig. 138.—How a discarded, but working, automobile thermostat may be used as a fire alarm when coupled to a microswitch.

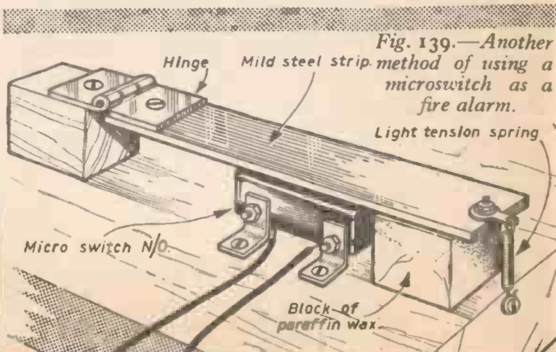


Fig. 139.—Another method of using a microswitch as a fire alarm.

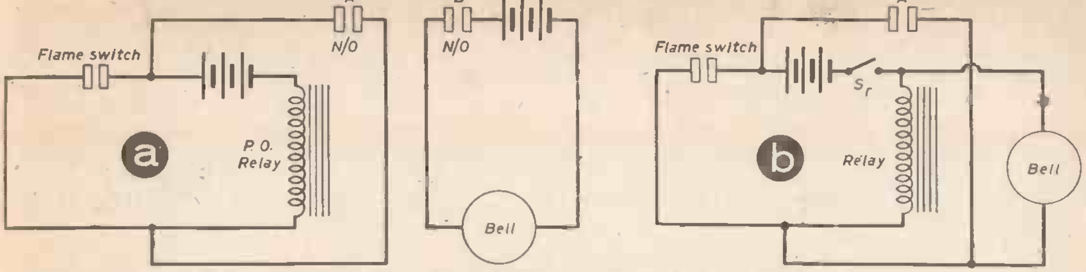


Fig. 141.—*(a) A simple circuit without test or re-set provision, using separate batteries for relay and bell. (b) A simple circuit using one battery, with provisions for re-set but not testing.*

quickly the switch itself might be destroyed by the fire. This can be overcome by a relay system as shown in Fig. 141a. If the flame switch closes, the relay coil is energised and contacts A and B in Fig. 141 close. The bell rings because the circuit, including contacts "B", is made and the relay stays in because the contacts "A" effectively short the flame switch contacts.

So that there is no fear of the wires to the switch melting before operation they may be of steel, or if very long of part copper and part steel. The plastic covered steel wire used by gardeners or for ex-Government telephone cable is quite suitable.

As shown there is no re-set switch and the battery operating the relay would have to be disconnected. A more comprehensive circuit is shown in Fig. 140, and a circuit using one battery is possible if the relay and bell both operate at the same voltage. In Figs. 140 and 141b S_r is the re-set switch which when put off causes the relay always to fall out and prevents the bell ringing. On putting S_r "on" the relay will not pull in until the flame switch operates. S_{t1} and S_{t2} are one ganged switch (2-pole, 2-way). Note that only five tags or terminals are used. When as in the diagram, the lamp will light showing that the bell and relay circuits are working, when S_{t1} and S_{t2} are changed over the alarm system is ready for operation.

Suitable bells for operation on low voltages are obtainable from most walk-round stores and the P.O. relay type 3000 of 200Ω or less will suit provided it has two normally open contacts (extra ones will do no harm). In some cases it may be necessary to adjust the tension of the leaves to get operation at low voltage (6-10V. is quite suitable). Suitable relays are obtainable from Messrs. A. T. Sallis, 93 North Road, Brighton, and other surplus dealers.

A Home-made Fire Alarm System

A battery-operated system that will ring continuously as long as the control box and bell are not in the fire area is shown in Figs. 132, 142 and 143 and the circuit used in Fig. 140. The inset in Fig 142 shows how a 9V. G.B. battery may be used in lieu of the two separate ones.

Parts Required

2ft. 6in., 1½in. × ⅜in. soft wood.
One square foot hardboard, panel pins, screws, etc.
S_r On/Off Toggle Arcolectric S600.
S_{t2} and S_{t1} This is one switch, double-pole double-throw, Arcolectric T630 obtainable from Messrs. Arcolectric Switches Ltd., Central Avenue, West Molesey, Surrey.
Heat Switch Use Whiston's 3092 or a magstat with the bi-metal reversed, obtainable from Messrs. Technical Services Ltd., Banstead, Surrey. Alternatively use any of those suggested in this article, a *normally open* arrangement is necessary.
Bell Messrs. Halfords, Cycle dealers.
Terminal Block 5C/430 from Messrs. H. Franks, 58 New Oxford Street, London, W.C.2.
Relay P.O. type under 250Ω, prototype uses 200Ω type 3000. Must have two normally open contacts, other contacts will do no harm.
Lamp Holder Arcolectric S.L.86, red.
Lamp Standard torch bulb, 3·5V.
Batteries Two flat type 4½V. or one 9V. G.B. type.

Case construction can be seen in Fig. 143. It measures about 10in. × 4in. × 1½in. A base of hardboard is pinned to it and a top prepared but not fixed.

The components are fixed as shown in Fig. 143 and the relay as in Fig. 142. A small metal bracket has been made to fix it to the panel near the relay coil tags. Alternatively a clamp may pass round the relay coil.

Wiring

Wire up the bell and lamp circuit of Fig. 140 first. The wires are all shown in the perspective diagram of Fig. 142. The layout is in no way important, but use insulated wire. Operate the relay armature by hand and the lamp or bell should operate according to the position of the switch S_{t1}.

The other circuit on the left in Fig. 140 is then wired. The complete circuit is shown in Fig. 142. Note carefully the wiring of the T630 switch and the diagonal "cross wiring."

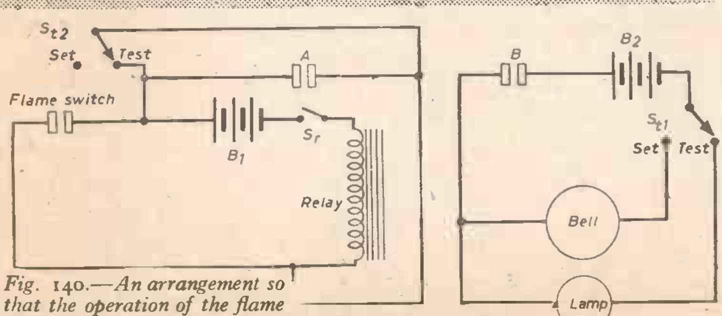


Fig. 140.—*An arrangement so that the operation of the flame switch may be tested periodically to make sure all is well.*

Testing the Unit

Connect up to two batteries or one G.B. as inset in Fig. 142. Put S_t to "SET BELL" and S_r to "SET." Now short the flame switch terminals with a piece of wire. The bell should then commence to ring, even when the wire is removed until the battery in the bell circuit is run out.

Putting S_r OFF momentarily should, however, re-set the instrument and it will not ring until the heat or flame switch again closes.

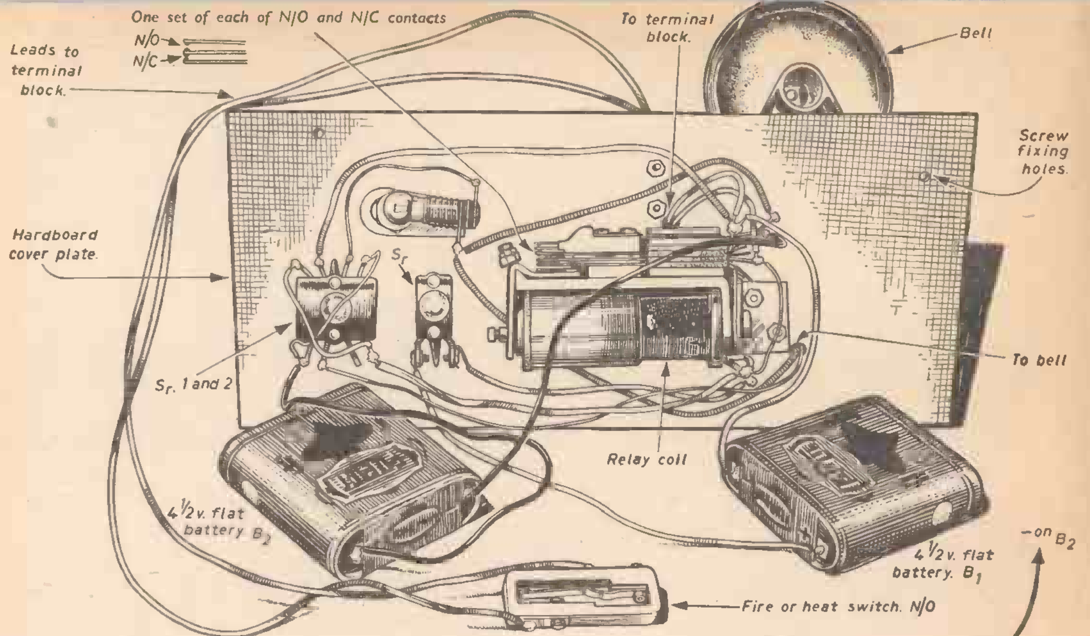
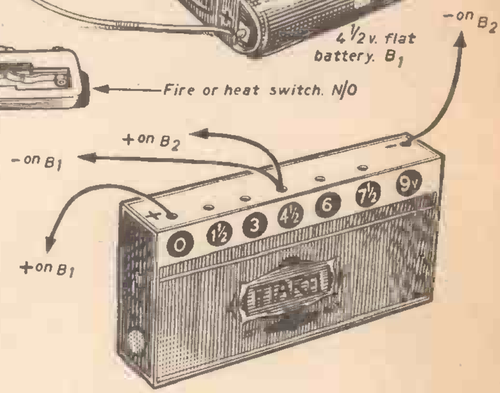


Fig. 142.—The underside of the control panel of the fire alarm showing box construction and wiring.



Future testing can be done in a few seconds by putting S_t to " TEST, LAMP " and S_r to " SET." The lamp should then light. This testing should be done every few months to make sure the instrument is functioning. No electricity is consumed until a fire occurs. The batteries will have shelf life.

Overheating Thermal Switches

Any air type relay, closing at an air temperature above about 150 deg. F. will suit, wired in the circuits of Fig. 141a, b or Fig. 140. However, very simple thermostats with large differentials and no snap action will suit quite well. Bimetal strip is readily obtainable from Technical Services, Banstead, Surrey, and will function as a thermal switch when fixed up as shown in Fig. 136 Test it out with a match to make sure the bi-metal bends the correct way. For accuracy test in hot water at the desired temperature.

Using Old Automobile Thermostats

Bellows type thermostats are fitted into the top header pipe of motor radiators and are available for a few pence from breakers. They open at 180 deg. F. and have a movement of ⅛in. which would break a normal microswitch, but which may operate a leaf type microswitch. Test out by putting the thermostat in hot water before commencing.

A bracket is soldered to the base of the thermostat and it is mounted on a piece of suitable wood or metal. A microswitch of the leaf type, such as the BRL made by Messrs. Burgess Products Co. Ltd., Gateshead upon Tyne, is suitable. It is fixed to the base in such a way that a small metal dowel soldered to the thermostat valve will operate the switch when the bellows get hot. The unit is easy to get working and no delicate adjustments are necessary, the bellows expanding by vaporisation of the fluid within and not by pure thermal expansion. See Fig. 138.

Using Melting Points to Operate Microswitches

Substances such as candle grease can be used to hold a microswitch in the Off position as shown in Fig. 139. A small tension spring just strong enough to operate the microswitch is fixed as shown and it is held just off the operating plunger of the switch with the block of wax.

A weight may be used to operate the unit instead of the spring (which could lose its tension in a very fast and vigorous fire).

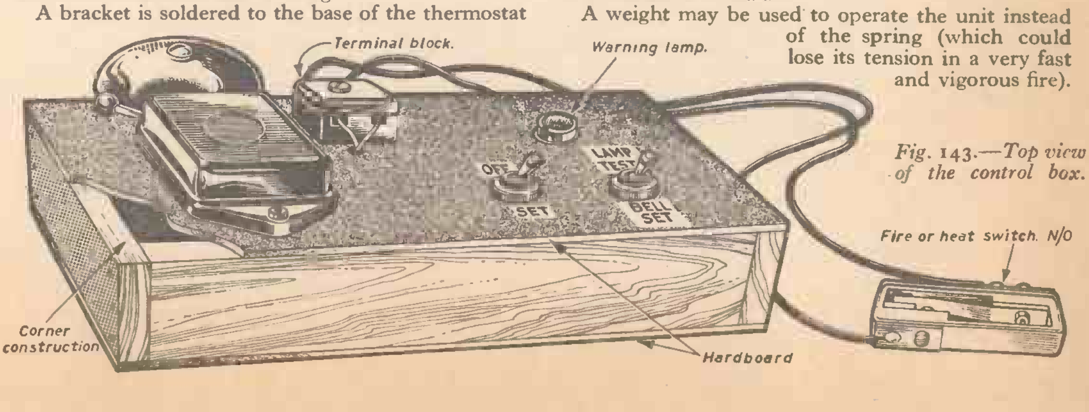
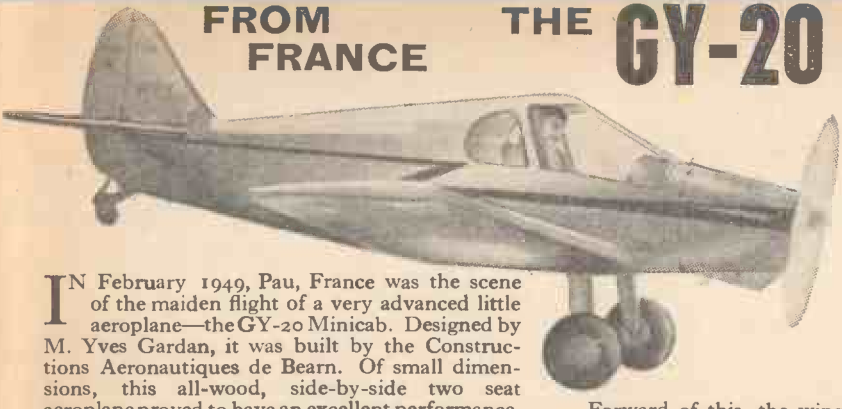


Fig. 143.—Top view of the control box.

FROM FRANCE THE GY-20 MINICAB

A PLANE FOR THE HOME MECHANIC



IN February 1949, Pau, France was the scene of the maiden flight of a very advanced little aeroplane—the GY-20 Minicab. Designed by M. Yves Gardan, it was built by the Constructions Aeronautiques de Bearn. Of small dimensions, this all-wood, side-by-side two seat aeroplane proved to have an excellent performance.

The C.A.B. company produced sets of plans for amateur construction and groups all over France built the Minicab.

Now plans are available for amateur constructors in England. The drawings are noted entirely in English with a detail drawing also showing jigging requirements. All measurements, however, are retained in the Metric system which sustains accuracy and is easier to work in after a little practice.

The set of plans comprises forty black-on-white sheets and costs only £20.

Fuselage Construction

This is a straightforward spruce box, the forward half being lined on the inside with plywood, the rear half open girder braced. The fin is integral with the fuselage structure which is fabric covered. The cockpit is very roomy and is entered through a large, forward-hinged Perspex canopy which opens forward. Immediately behind the two seats, between which is mounted the three-position flap lever, is a luggage compartment for 40lb. of baggage. Large three-quarter rear windows allow rearward view back over the tailplane. Dual control is fitted and the "U" shaped control column is easily accessible to both pilots.

The Wing

This is a one-piece cantilever structure affixed to the fuselage by four bolts. It comprises a laminated spruce and ply main box spar at 25 per cent. chord. Forward of this, the wing is ply covered to form a torsion-box structure. An 'I' beam diagonal drag spar and a false rear spar of similar section are also used. Open lattice ribs maintain the wing section which is NACA 23015 at the root end and NACA 23010 at the tip. Fully-slotted ailerons form the outboard half of each trailing-edge semi-span and split trailing-edge flaps run from the ailerons to the roots.

The tailplane is a one-piece ply-covered structure. Both the rudder and the one-piece elevator are fabric-covered.

Powered by a 65h.p. Continental engine or similar the MINICAB has a nominal range of 466 miles with its 11-gallon fuel tank. A larger tank may be fitted to increase this range to almost 800 miles.

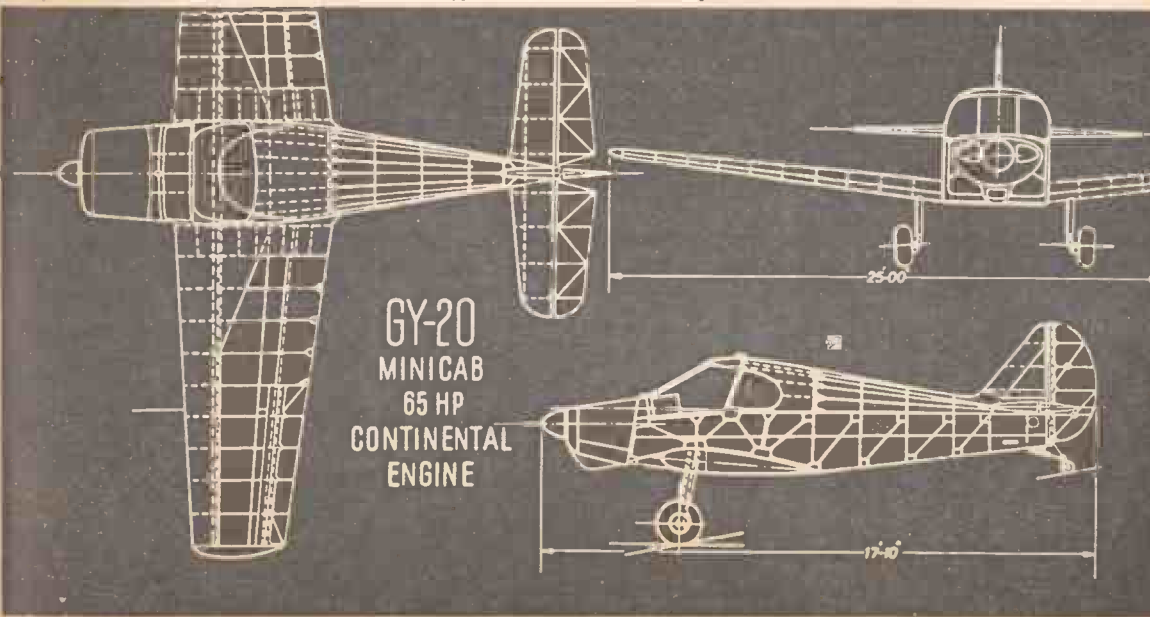
The undercarriage comprises two single-strut units and a steerable tailwheel.

The specification of the Minicab is as follows:-

Span	25ft.	Maximum speed	124m.p.h.
Length	17ft. 10in.	Cruising speed	112m.p.h.
Height	5ft. 5in.	Stalling speed (flaps up)	42m.p.h.
Wing Area	107·6 sq. ft.		
Aspect ratio	6·6	Initial rate of climb at max. all-up weight	680ft./min.
Empty weight	595lb.		
Loaded weight	1,069lb.	Service ceiling	13,100ft.

All inquiries regarding sets of plans for the Minicab should be sent to A. W. J. G. Ord-Hume, Rose Mead, Lake, Sandown, Isle of Wight.

Plan view, front and side elevations of the Minicab.



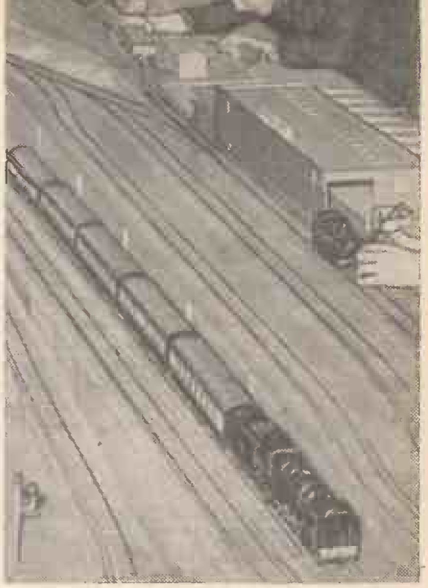
For the model railway enthusiast

PULSE POWER

By J. P. Waters

READER P. A. Lingwood asked, in " Information Sought " in the January 1961 issue, for details to enable him to add pulse power to a 12V. D.C. transformer/rectifier unit used for controlling a model railway. He did not give details of the unit, but, for simple pulse power, all that is required is the inclusion in his unit of a single-pole on/off switch to open-circuit one arm of the existing bridge rectifier. Pulse power is, in fact, nothing more than half-wave rectification.

A basic transformer rectifier unit is shown in Fig. 1.



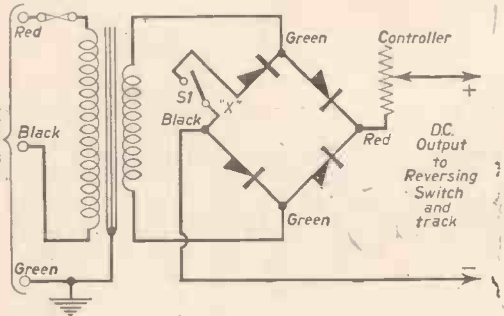


Fig. 1.—Basic transformer rectifier unit.

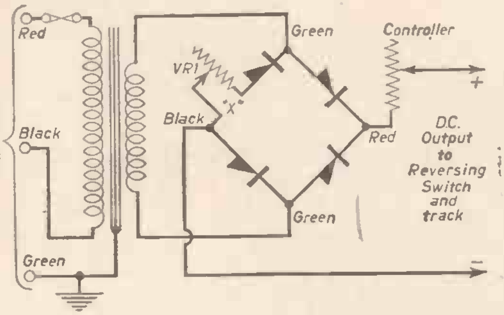


Fig. 2.—Substituting a variable resistor.

It will be seen that one arm of the bridge rectifier has been broken at " X " and a single-pole on/off switch inserted. When the switch is open, the unit gives half-wave rectification. When the switch is closed, the unit gives full-wave rectification. That is really all there is to it.

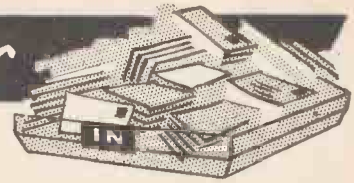
If the unit contains a standard spindle-mounted rectifier, then the necessary modification is straightforward, but where, as in the case of some modern units, each of the individual rectifier plates is separately mounted, it will be necessary to trace the rectifier circuit, before deciding the best point at which to effect the break. For this reason, the details which follow must be taken to apply primarily to units which contain spindle-mounted rectifiers, but the basic electrical principle is the same for a bridge rectifier, whatever its mechanical construction.

A spindle-mounted bridge rectifier will be found to have five connecting lugs protruding from it and two of the lugs will be connected together by a short length of wire. On some rectifiers, these two lugs will be the positive D.C. output lugs and will normally be marked with red paint. On other rectifiers, the lugs will be the negative D.C. output lugs and will be marked with black paint. However, positive, or negative, it makes no difference, as far as the modification is concerned. Cut the wire that joins the two lugs and then, for simple pulse power, connect a single-pole on/off switch in series with the ends of the cut wire.

If a variable resistor, with an " off " position, is substituted for the single-pole on/off switch, as in Fig. 2, then a continuously variable degree of pulse power can be obtained, dependent upon the setting of the variable resistor. The resistance value of this control will depend upon the current usually drawn from the unit, but, as a rough guide, a value of 50/100Ω should prove satisfactory for most " OO " gauge locos. The current rating of the variable resistor can be as low as one half of the rated D.C. output of the unit.

It should, however, be noted that if, for smoothing purposes, an electrolytic capacitor has been fitted across the 12V. D.C. output, it will be necessary to ensure that the capacitor is not left in circuit when the pulse power facility is required.

LETTERS TO *The Editor*



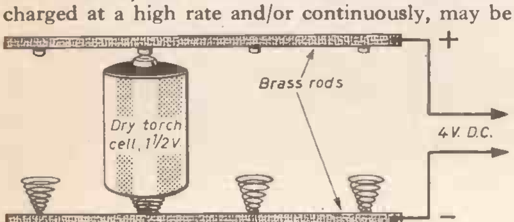
The Editor does not necessarily agree with the opinions expressed by correspondents

The P.M. Master Battery Clock

SIR,—I built this clock in 1939 and it has been going for the past 20 years and has never stopped once, even for power cuts and blown fuses. It is an excellent time-keeper and only varies by one minute in a month. My model, however, is a modified version of your original plans. I mounted an extra electric magnet over the top of a flash-lamp battery. The clock runs from the mains current, through a bell transformer and metal rectifier. The bell transformer has tappings 3, 6, 9V. The rectifier is 11V. input and 1½V. output. The extra magnet I wired straight to the rectifier. Whilst the mains is on, the magnet draws up a weight that is hinged to the clock case. When the mains is off the magnet lets the weight, which is wired to the clock itself, drop on to the battery completing the circuit and the clock carries on without any loss of time.—J. O'Hara (Glasgow).

Recharging Dry Leclanché Cells

SIR,—Re information sought in your March, 1961 issue. Dry cells cannot be recharged as can accumulators, but those cells that have been discharged at a high rate and/or continuously, may be



Charging dry cells in parallel.

" rejuvenated " by passing a current through them. Wireless H.T. batteries and others that have been discharged slowly and intermittently, do not respond to the treatment. An accumulator of 4V. can be used for the current supply for a 1½V. cell, via a variable resistor of a few ohms. Owing to the high internal resistance of the dry cell, which varies with individual cells, the charge current is usually under 1A. The regulating factor is the degree of heat that the cell attains and the aim should be to get the cell quite warm, but not hot, in from one to two hours. Allow to cool before use. The battery charger described in the March, 1961 issue of PRACTICAL MECHANICS, would be quite suitable for the job, using the 6V. supply. A number of cells could be dealt with in parallel, within the limits of the charger (see sketch).—W. H. Postlethwaite (Wilts).

SIR,—A method was once suggested to me of a way in which the recharging of Leclanché cells was possible with the use of a " rough D.C." The answers to the queries raised by your reader on this subject are:

1. Voltage required at A—B = 2V. to 3V.
2. Voltage required at C—D = 110V. to 120V.
3. Value (wire wound) of resistors E and F = 200 to 250 Ω.
4. Charging current = $\frac{1}{10}$ of the total capacity.
5. Length of charge in hours = $\frac{\text{Capacity}}{\text{Charge rate}}$.

The charging procedure is practically identical to that of a wet cell. The object of the resistors E and F is obviously to superimpose a small amount of A.C. on the D.C. The length of charge can only be assumed from $\frac{\text{Capacity}}{\text{Charge rate}}$ as no practical method exists of ascertaining the condition of the electrolye. A voltage measurement, bearing in mind the resistance of the meter, might also give a reasonable indication of the state of the charge. The initial outlay of time, money and final running costs, as small as they would probably be, would make the completed article uneconomical for personal, casual use. On the other hand the academic value of developing a charger with such applications would prove considerable, and if a really simple and cheap accessory of this nature was made available to the public, with its increasing use for dry batteries, the time and money spent would be rewarding.—B. A. Hinchliffe (Hamps).

More Science Required

SIR,—I read with interest the remarks in " Fair Comment " for March and would like to say how much I agree with the views expressed. This is indeed an age of science and technology and life is certainly becoming increasingly complicated. When the present drive to recruit more and more young scientists and technicians has achieved its purpose there will at least be one section of the community who is properly educated for the age we live in, but we who have been left school for many years and who received the normal education only are likely to be left floundering by the flood of complications constantly being introduced in all aspects of life. To keep up with development, the only chance we, the older generation, have is to read and it is here that a publication like PRACTICAL MECHANICS can fulfil an extremely useful purpose. I, personally, read avidly all the articles on scientific subjects which have been featured recently. I would particularly commend the excellent description of the Short S.C.1. and, in the April issue, the article about the relative advantages and disadvantages of steam and diesel locomotives. That the many excellent articles on space research and allied subjects are appreciated goes without saying. Keep up the good work!—A. J. Wills (London, S.W.19).

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

Home-Maker Tool Table

THE complete home-maker tool unit is stored in a useful and attractive table in contemporary styling and fitted with a serviceable laminated top of neutral colour. The table contains 32 essential tools for home-carpentry, decorating, metal-work, electrical work and lino-laying, as well as tools for a variety of general repairs. It provides for drilling holes in brick, wood and metal as well as cutting, shaping and finishing the same materials. The Taymar 55 Home-Maker Tool Table retails at £17 19s. 6d. and is available through ironmongers, tool shops and hardware stores.

The "Home-Maker" Tool Table, opened to show its range of tools.

Rocol Anti-Scuffing Products

A NEW leaflet entitled *Rocol Anti-Scuffing Products* has been produced by Rocol Ltd., Rocol House, Swillington, nr. Leeds. It describes the four main molybdenum disulphide lubricants and their uses. The four products are anti-scuffing oil, anti-scuffing paste, anti-scuffing spray and anti-scuffing powder. Diagrams demonstrate their efficiency and short descriptions of the products are given, together with a schedule of prices.

Prout Folding Boats

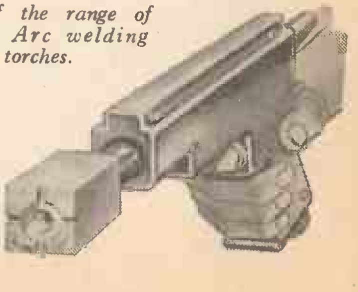
G. PROUT and Sons Ltd., of The Point, Canvey Island, Essex, have produced a new illustrated brochure, describing their range of folding boats. Their construction is of seasoned timber and special plastics-reinforced canvas. The smallest boat in the range is the 6ft. Scoprel rowing dinghy, which costs £16 16s. There is a 7ft. 6in. yacht tender, price £22, and an 8ft. 6in. rowing and outboard dinghy, price £26 10s. The 7ft. 6in. Seasprite costs £33 and the 10ft. Seabird, £48, both of these can be sailed. There are also three folding canoes with a price range from £17 8s. to £27 10s. Oars and paddles are extra.

This is one of the range of Prout folding boats. Note its lightness and the ease with which it can be handled.

"Pyrestos" Dribord

A FLAME-PROOF and moisture resistant fibreboard has recently been placed on the market. Called "Pyrestos" Dribord it is pressure impregnated throughout. This means that there is no risk of flame spreading unseen along the back of a lining, nor does cutting, rebating or grooving reduce its fire resistancy. The board is also impregnated with a moisture proofing agent in addition to "Pyrolith" the fire retardant preservative. It is available in standard sizes and thicknesses. The Dribord is marketed by Pyrestos Ltd., 8 Buckingham Palace Gardens, London, S.W.1., and manufacturered by Board Processors Ltd., Leyborne Wharf, Horton Bridge Road, West Drayton, Middx.

One of the range of Argon Arc welding torches.



Argon Arc Welding Torches

INTERLAS Ltd. of Ampthill, Bedford, are now marketing in Great Britain the full range of products of the Tec Torch Co. of U.S.A. This range includes air-cooled and water-cooled Argon welding torches in both pencil and angled types for manual welding, machine torches for automatic welding and spot guns with control units for TIG spot welding.

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The pre-paid charge for small advertisements is 9d. per word, with box number 1/6 extra (minimum order 9/-). Advertisements, together with remittance, should be sent to the Advertisement Director, PRACTICAL MECHANICS, Tower House, Southampton Street, London, W.C.2.

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YOUR *Queries* ANSWERED

Coloured Flames

I believe it is possible to immerse firewood in different chemical solutions so that when it burns it throws off different coloured lights. What are the chemicals used please?—D. B. Milligan (Ayrshire).

YOU can either make solutions from the following salts and "water" the firewood with the solutions, if you want mixed coloured flames; or you can sprinkle either the solution or the salts from which they are made onto the fire one at a time. The latter would be the more effective, since you can declare in advance what colour you are going to make the flames change to.

The following are the chemicals (salts) and the corresponding colour that they will each give separately when added to a fire.

Salts of strontium	Deep red flame—*crimson*
,, ,, calcium	Brick red
,, ,, barium	Green
,, ,, sodium	Yellow
Metallic copper	Violet

Formula for Polishing Plate Glass

CAN you give me a formula to use for repolishing the dulled surface of plate glass?—W. Harland (Co. Durham).

MAKE up the following mixture:

Substance	*Parts*
1. Am. Lineleate	20
2. Orthodichlor Benzol ..	100
3. Water	200
4 Infusorial earth	60

Dissolve (1) in (3) overnight and run (2) in while beating with high speed mixer Then beat (4) in until uniform.

Glass Polish (Dry)

Precipitated chalk	50
Kieselguhr	20
White Bole	30

Make into a slurry with water for use.

Cooling Compressed Air

COULD you advise me on the problem of condensation in an air line system in the form of water? I understand this is caused by heat through compression of air in the discharge pipe to the receiver and that the air should be cooled.—J. Austen (Berks.).

IT is correct that compressed air should be cooled. Generally compressed air comes in four stages of dryness:

(1) Compressed air in which no attempt is made to dry it. Usually there is a drain on the air receiver where water can be drained off at intervals.

(2) Compressed air which has been cooled by an aftercooler. In this case the compressed air is cooled to below the ambient temperature by a water cooled heat exchanger. The moisture in the air condenses in the cooler and is drained off. As the air tends to warm up after the cooler it becomes even drier.

(3) As in (2) but the air is slightly expanded after the cooler (say from 125 lb. sq. in. to 100 lb. sq. in.). The air at the lower pressure can hold more moisture, and so is drier.

(4) As in (3) but the air is passed through Alumina which removes the last trace of moisture.

For most normal work (1) or (2) are adequate. However, instrument air requires (3) or (4).

In your particular case, it would probably be sufficient to pass the compressed air over a bundle of water-cooled tubes.

RULES

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

A stamped addressed envelope, a sixpenny crossed postal order, and the query coupon from the current issue which appears at the foot of this page, 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.

Electric Horn Alteration

I am desirous of altering the note, or pitch, of an electric horn. It is of the "windtone" type and I should be pleased if you could tell me what alterations I could make.—H. E. Stone (Sheffield, 10).

THE note emitted by a windtone horn normally depends on the length of the air column, which is an inherent feature of the design and cannot satisfactorily be altered. However, the sound given by the horn may be unsatisfactory if the horn is loose, is mounted on a part of the vehicle which can vibrate, if the diaphragm is loose or the contacts dirty or incorrectly adjusted. We suggest that these points might be checked. Another cause of unsatisfactory sound is incorrect spring pressure on the contacts.

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Practical Mechanics. May, 1961

This should be 2½ to 3 lb. for the WT28/9, or 3½ to 4 lb. for the WT614, as measured at the end of the spring. If the pressure is outside these limits we suggest that a new set of contacts and spring be fitted. The push rod should also be kept lubricated with light grease. There should be 0·020in. clearance between the armature and base.

Sky-writing Smoke

WHAT is the name of the chemical, which when introduced into the exhaust system of an internal combustion engine, produces a trail of smoke? I believe it is used by aircraft for sky-writing. I intend to use the same system to scare birds, by linking a length of exhaust pipe drilled in various places, to the exhaust system of a tractor.—R. Green (Devon).

AEROPLANE sky-writing smoke is produced by injecting a drip of diesel oil into the exhaust. This should be suitable for your purpose.

Lighting a Garage

AS I have a mini-car I am able to use half of garage for a work bench. I wish to fix a light up, but as the garage is some way from the house an underground cable would be impractical. Could you suggest an economical method of fixing a light?—C. Taylor (Colne).

YOU could probably use a car headlamp bulb which is fed from the car battery through substantial leads which are as short as possible, and which are connected to the battery through bulldog clips. In this case, however, it will probably be necessary to use a charger in the house to give the battery an additional charge periodically.

Has Light Pressure?

WITH regard to the American balloon satellite which was launched last year. I heard that the balloon would gradually reduce height because of the pressure of sunlight. Is this true? Has sunlight, or any light, pressure? —G. B. Connor (Halesowen).

THE height to which an inflated envelope (balloon) can rise depends upon:

1. Its buoyancy; i.e. the difference between the weight of the balloon and the density of the air in its immediate neighbourhood.
2. Regulation of the volume of gas (hydrogen or helium) as it ascends (effected by release valves).

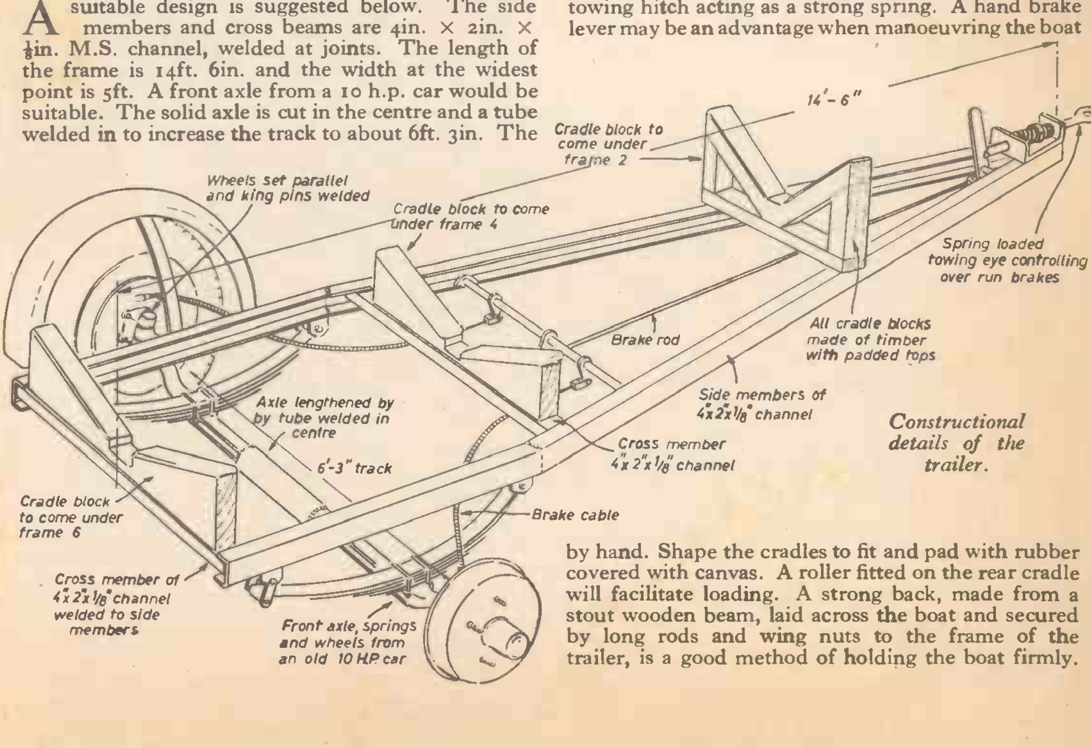
Finally it will reach a point of equilibrium; and if the envelope were not slightly porous, it would ultimately remain at a given height and only vary by virtue of alteration of atmospheric pressure which would affect the density of the air in the neighbourhood of the balloon.

Sunlight does not exert pressure; but the heat from the rays of the sun will cause the gas inside the balloon to expand. If this pressure were not released by valves the balloon would burst. But the sun's rays, by causing expansion, also causes loss of gas within the envelope and thus the initial buoyancy of the balloon is reduced. It therefore gradually loses height.

Trailer for P.M. Cabin Cruiser

I wish to make a trailer for the P.M. Cabin Cruiser. Could you please give me details of a suitable design?—H. Wernecke (S. Africa).

A suitable design is suggested below. The side members and cross beams are 4in. × 2in. × ⅛in. M.S. channel, welded at joints. The length of the frame is 14ft. 6in. and the width at the widest point is 5ft. A front axle from a 10 h.p. car would be suitable. The solid axle is cut in the centre and a tube welded in to increase the track to about 6ft. 3in. The tyre size is 5·00 × 16in. or 4·50 × 17in. Weld the swivel pins, making sure that the wheels are set parallel. The overrun brakes are controlled by the towing hitch acting as a strong spring. A hand brake lever may be an advantage when manoeuvring the boat by hand. Shape the cradles to fit and pad with rubber covered with canvas. A roller fitted on the rear cradle will facilitate loading. A strong back, made from a stout wooden beam, laid across the boat and secured by long rods and wing nuts to the frame of the trailer, is a good method of holding the boat firmly.



Constructional details of the trailer.

Published about the 30th of each month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, London, W.C.2, and Printed in England by The Garden City Press Limited, Letchworth, Hertfordshire. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia), Ltd. Sole Agents for South Africa and Rhodesia—Central New Agency Ltd. Subscription Rate (including postage): For one year, Inland 22s., Overseas 20s. 6d., Canada 19s. Registered for transmission by Canadian Magazine Post.