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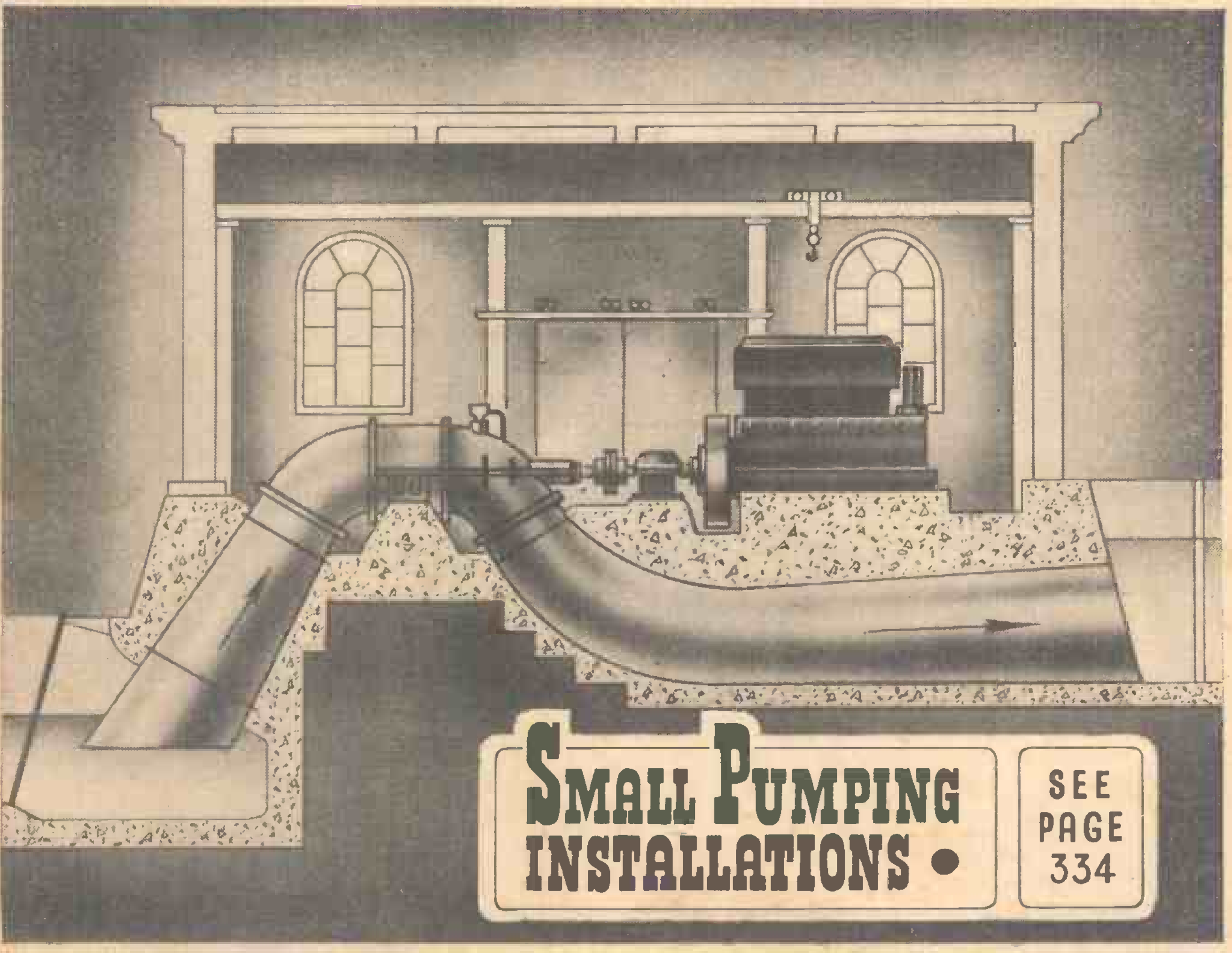
*EDITOR : F. J. CAMM*

AUGUST 1951

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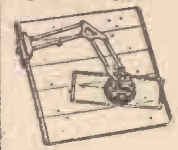

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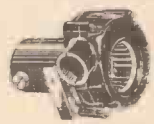

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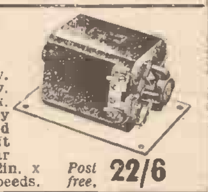

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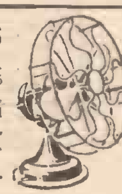

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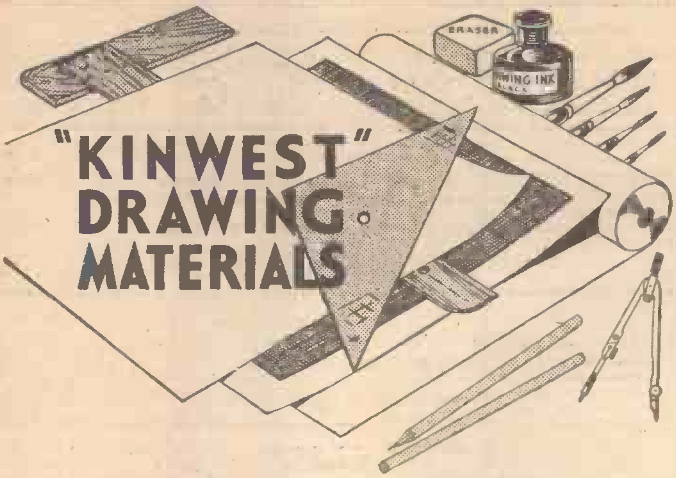


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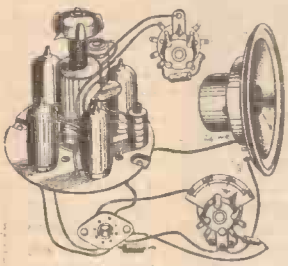

This 4-valve all-dry battery-operated receiver is of such small dimensions that it will fit into a cabinet only about 6in. x 4in. x 3in. and still leave ample room for batteries. The chassis is all wired and complete with speaker, volume control, wave-change switch, etc., etc., and only first grade components have been used. Prices are: Chassis complete with valves (three type 1T4 and one type 3V4)—ready to operate on long and medium wave-bands, 99/6. Ditto but medium wave only, 89 6. Chassis without valves, long and medium wave-bands, 59/6. Ditto but medium wave only, 49/6. Add 2 6 to cover postage and insurance.

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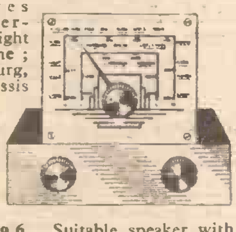

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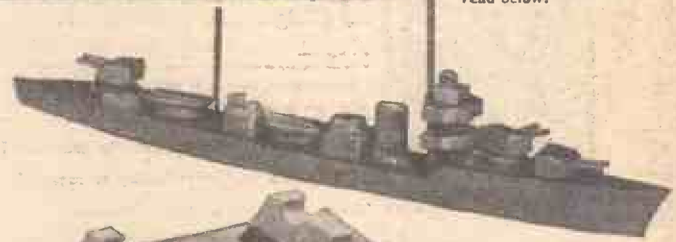

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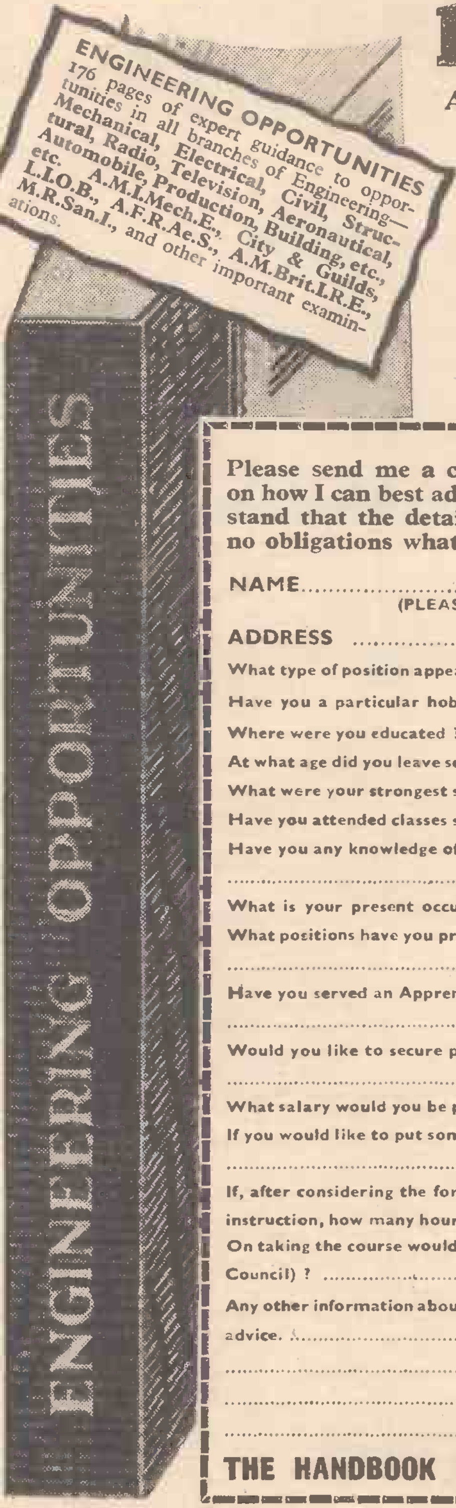


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PRACTICAL MECHANICS
EDITOR F. J. CAMM
AUGUST, 1951
VOL. XVIII. No. 212

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

FAIR COMMENT By The Editor

# A Ministry of Inventions?

IN the course of a lecture which I recently gave to technicians at Southend, and which afforded me the pleasure of meeting some of my readers, I made a suggestion that in these days of material shortages what is most needed is a Ministry of Inventions, and that the Government should by means of announcements in the Press, and by radio announcements, invite the public to submit solutions to technical problems of national interest. It did this once before, when it was a matter of importance to improve our methods of navigation. In 1713 the Government appointed a committee to consider the question of finding longitude at sea. They consulted Sir Isaac Newton, who told them that "One method is by a watch to keep time exactly, but by reason of the motion of a ship, the variation of heat and cold, wet and dry, and the difference in gravity at various latitudes, such a watch hath not yet been made."

Navigation at that time was crude, and it was only on very rare occasions that the navigator was closer than a few miles in his calculations. There were no time signals in those days, and no method of checking the accuracy of the crude timepieces of the period. The committee therefore persuaded the Government to offer a prize for an accurate ship's chronometer, the prize to be graduated from £10,000 to £20,000 according to the accuracy of the watch. Another condition was that it should be possible by means of the watch for the navigator to be accurate within 30 miles at the end of a six weeks' voyage.

Now, although all of the skilled horologists of the time endeavoured to produce such a timepiece, they failed. The prize was eventually won by John Harrison, who had never been trained in watch-making, and was the son of a carpenter. Thus he laid the foundation of accurate timepieces.

There is plenty of inventive ability in this country, but it is disorganised and uncoordinated. It should be the prime concern of the Government, through the Ministry I suggest, to set the brains of the British at work on the problems with which we are beset to-day. Necessity is the mother of invention, and I am certain that if such a Ministry were brought into being, new methods, new materials, new machine tools would be produced and help to make us once again the commercial centre of the world. What John Harrison did over 250 years ago can be done to-day, the more so since technical education has so much advanced by comparison with those years when few people could read or write.

We have a Ministry of Supply, a Ministry of Health, a Ministry of Education, a Ministry of Agriculture and Fisheries, an Air Ministry and many others. The Ministry which would be the most important of all, and to which others could submit problems for national solution, is non-existent. There is no department, Governmental or otherwise, in this country which sets out to help the inventor as does the Mellon Institute. In other continental countries inventors are regarded as a state asset, and aided in their experimental work.

It is unfortunately true that we only wrestle with problems when we are at war. We solve problems then quickly enough, why not solve them now? If by rearmament we believe that future wars are possible they could be considerably shortened by having the devices which will bring them to a speedier conclusion.

## A NEW BICYCLE FRAME

MY old friend Sir Alliott Verdon Roe has produced a new design of bicycle frame, making use of only two tubes, one extending from the head to the rear wheel spindle and the other extending from the saddle to the crank centre. He has built an experimental machine which has satisfactorily undergone its test. The idea of the crossed frame is by no means new. Indeed, it was patented by Paul Renouf in the latter part of the last century, but Sir Alliott's method of carrying it out differs in important particulars. He maintains that in the ordinary diamond bicycle frame there is a heavily stressed part where the top tube enters the steering head lug, and this is not offset by using large diameter top tubes and down tubes. The top tube has to withstand both compression load and bending stress because the ordinary frame is not perfectly triangulated.

Next month a description accompanied by drawings and photographs will be given explaining the design in great detail. The article will be written by Sir Alliott Verdon Roe, the pioneer airman and the famous aircraft manufacturer. I should have preferred shaft drive to be incorporated, because I believe that with modern steels and modern methods of gear cutting such a drive could be produced quite cheaply to-day. The old F.N. bicycle which employed shaft drive was ahead of its time, and no doubt it suffered from one or two weaknesses of design as well as wrong choice of materials. The fact that chains give such trouble-free service over a long period is a tribute to British workmanship, for an exposed bicycle chain is not working under the ideal conditions which modern engineering demands. No provision is made for lubricating it or protecting it from the lapping action of mud and dust, except when an enclosed gear case is fitted. This, however, introduces other complications, such as excessive side area, which can be troublesome with a side wind on a greasy road, increased weight and increased cost. The shaft drive has a minimum number of moving parts, can be made lighter than existing crank wheel, sprocket and chain with its multiplicity of moving parts, and it reduces side area. As it is totally enclosed adequate lubrication can be provided for.—F. J. C.

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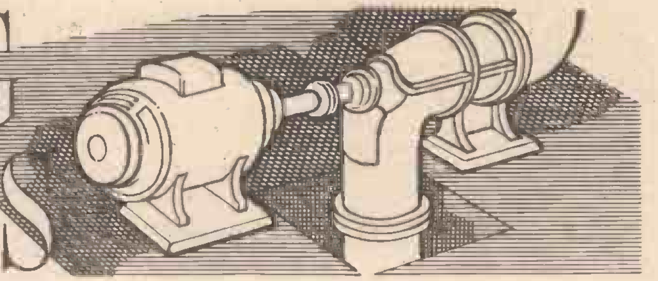
# *Small* PUMPING INSTALLATIONS



## The Various Types of Pumps Available, and Their Operation

By ROLT HAMMOND, A.M.I.C.E.

THOSE of us who are fortunate enough to have an ample supply of pure water take this for granted, but there are many places in remote districts where water supply is sadly lacking. Here ingenuity, combined with reasonable expenditure, can supply the want. There is a wide variety of pumping equipment available, and the making of such pumping apparatus is not by any means a difficult task, but one to which a knowledge of fundamental principles must be applied.

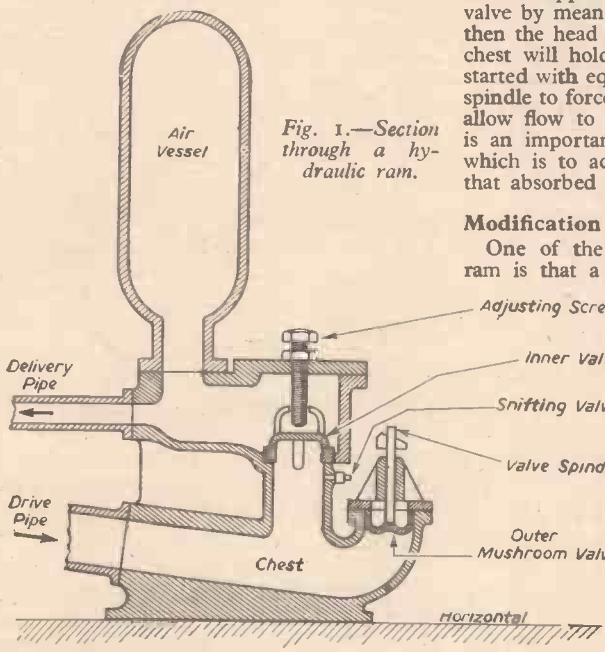



*Fig. 1.—Section through a hydraulic ram.*

### The Hydraulic Ram

One of the simplest and most reliable pumping units is the hydraulic ram, the sketch (Fig. 1) showing a section through this equipment. The hydraulic ram makes use of the water-hammer effect of a long column of moving water in a pipe; the ram was invented by Montgolfier, and it makes use of the momentum of a large flow of water operating under a relatively small head, raising a much smaller quantity of water against a very much greater head. This device can reasonably be classed as a pump, because the moving column of water in the drive pipe is the plunger which forces the water in the chest up the delivery pipe.

Water for driving a ram is generally derived from a small stream, and is led into the ram through the drive pipe. Water flow must have enough velocity to lift the outer mushroom valve sharply against its seating, which results in the momentum of the moving water column being suddenly arrested, whereby an immediate pressure rise is caused in the chest. The inner valve is then opened, when water will be driven up the delivery pipe until equilibrium of the hydraulic system is restored. This is followed by closure of the delivery valve, the outer mushroom valve then opens of its own accord, and the cycle of operations is repeated.

The air vessel fitted to the ram acts as a kind of hydraulic accumulator, and effectively prevents damage by shock; lift of both valves can be easily adjusted and flow to the drive pipe is regulated by a sluice valve. The ram is stopped by raising the outer mushroom valve by means of its projecting spindle, and then the head of water in the drive pipe and chest will hold it in that position; it is restarted with equal ease, by pressing down the spindle to force the valve off its seat and thus allow flow to continue. The snifting valve is an important component, the purpose of which is to admit cushioning air to replace that absorbed by the water.

### Modification for Using Polluted Water

One of the outstanding advantages of a ram is that a polluted supply of water can be used for the raising of clean water from another source, by introducing a suitable modification into the design of the ram. The dirty water actuates a plunger in a cylinder, the other side of the plunger being in direct contact with the clean water to be pumped. If the water used for the driving of the ram contains much suspended matter, such as leaves and twigs, then suitable screening and similar arrangements must be made to prevent clogging of the equipment.

Although a ram can operate under a head of only 18in., the practicable minimum is considered to be about 5ft.; a standard type of ram will readily pump water to a height of 200ft., but for any greater head than this a specially strengthened design will be necessary. If W denotes the available quantity of water for driving the ram in gallons per minute, H is the vertical fall operating the ram, and h is the height through which the water is raised by the ram, in feet, then the quantity Q of gallons raised per minute is:

$Q = W \times H/h$, multiplied by the efficiency of the ram. Typical efficiences for various ratios of H/h are:

| | | | | | | |
|---|---|---|---|---|---|---|
| H/h | 2 | 3 | 4 | 5 | 6 | 7 |
| Effy. | .85 | .85 | .80 | .75 | .75 | .70 |
| H/h | 8 | 9 | 10 | 12 | 15 | 25 |
| Effy. | .65 | .65 | .60 | .60 | .55 | .40 |

The efficiency will be less than that shown in the above table if the drive pipe is very long; internal losses of a modified ram for dealing with dirty water are very much greater than for the standard ram, and, therefore, the efficiency will be very much less, ranging from 35 to 56 per cent. Where maximum delivery is required with only a limited supply of water, a large ram with a short stroke of valve should be employed; where water is abundant it will be better to use a small ram with a long valve stroke. It is not considered good practice to use ball valves, and the design of the delivery valve is based on an empirical figure of one square inch of area for every gallon delivered per minute by the ram. Another important detail is the area of the annulus between the edge of the outer mushroom valve and the wall of the chest, which should be slightly less than the area of passage through the valve, so that the velocity of flow may be high.

Length of drive pipe is another empirical figure, and can be from 9in. to 12in. for every foot of head against which the water is to be raised; obviously, where the fall is very low then a longer pipe should be used, and vice versa when the fall is high. Experience has proved that it is preferable to have a short pipe in order to reduce friction losses to the lowest possible minimum. The usual rate of pulsation is from 40 to 60 beats per minute, but this may be as high as 200 beats per minute. In any case, before selecting the size and output capacity of the ram, a careful measurement of the stream flow which will operate the ram should be taken, and this matter has already been covered by the author in a previous article.

Care should be devoted to siting of the ram, which may be arranged above ground if sufficient fall is obtainable, but this will be risking trouble if the district is liable to heavy frost. It is, therefore, far better practice to install the ram in a brick-lined pit built in the bank of the stream; the position of the chamber can be determined from the main requirement that the waste water drain from the ram should have a fall of about 1 in 100. It is important to pay some attention to maintenance; periodically the drive pipe should be cleaned out, leaky joints in the drive pipe should be mended, and care should be taken to see that there is

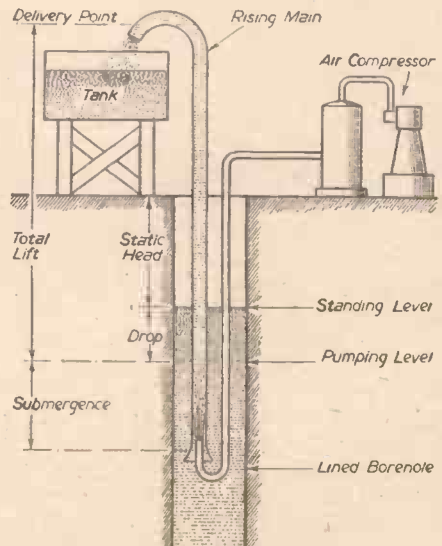



*Fig. 2.—Diagram of an air lift in operation.*

always sufficient air in the air-vessel. A choked snifting valve can also lead to faulty operation, and if air enters the drive pipe because of a fall in the operating head, the ram may cease to work properly.

The following table of operating results of hydraulic rams is taken from a paper presented to the Institution of Mechanical Engineers in 1922 by E. W. Anderson :

| Number of strokes per minute | Height of fall ft. | Height of elevation ft. | Water used cu. ft. | Water raised cu. ft. | Useful effect efficiency |
|---|---|---|---|---|---|
| 66 | 10.06 | 26.3 | 1.71 | .543 | .9 |
| 50 | 9.93 | 38.6 | 1.93 | .421 | .85 |
| 36 | 6.05 | 38.6 | 1.43 | .169 | .75 |
| 31 | 5.06 | 38.6 | 1.29 | .113 | .67 |
| 15 | 3.22 | 38.6 | 1.98 | .058 | .35 |
| 10 | 1.97 | 38.6 | 1.58 | .014 | .18 |
| — | 22.8 | 196.8 | .38 | .029 | .67 |

*Table showing operating result of hydraulic rams.*

The author would recommend that a hydraulic ram should always be bought from a specialised maker, because, although there may appear to be no difficulty about making one, all kinds of snags are likely to arise when it comes to proportioning the valves and erecting the installation. If all this is done by experts, a ram should work for many years without giving trouble, care being taken to see that the valves are kept in first-class condition and renewed from time to time. Many country houses depend for their water supply on a ram, and they are seldom let down, as this is a very reliable piece of equipment.

### The Air Lift Method

Those who have a small air compressor, or who have a works where compressed air is being constantly used, may care to consider the air lift method of raising water. This has two outstanding advantages, namely : there are no moving parts within the borehole or well, and a larger volume of water can be pumped from a smaller bore than would be possible with any other equipment for deep-well pumping. Other advantages are that the borehole does not have to be absolutely vertical or straight ; the presence of sand or silt in the water has no effect ; many boreholes can be pumped from one compressing plant, and water may be pumped at varying rates without much loss of efficiency.

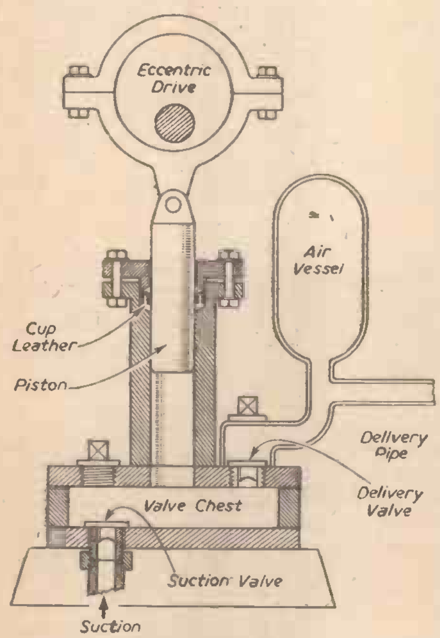



*Fig. 3.—Sketch design for a simple reciprocating pump : dimensions will depend upon the duty required.*

Yet this system of pumping has a very low overall efficiency, and 33 per cent. is looked upon as quite a good result. With a small pumping plant, this is probably not of very great importance, because the amount of energy being used is relatively small, but for large installations efficiency would be a much more important factor. Much study has been devoted to evolving a suitable formula, giving the volume of air required to raise a given quantity of water, and this depends mainly upon the height to which the water is to be raised.

In practice, a formula by Rix and Abrams has been found to give good results, and is as follows :

$$V_a = h/C. \log \frac{H+34}{34}$$

where $V_a$ is cubic feet of free air per gallon of water.
h is the total lift in feet.
H is the submergence in feet when working. (See Fig. E.)
C is a constant.

The values of C for various lifts are as follows :

From 30ft. to 60ft. ........ C=204.
From 60ft. to 200ft. ........ C=194.
From 200ft. to 500ft. ............C=180.
From 500ft. to 650ft. ............C=153.
From 650ft. to 750ft. ............C=130.

In Fig. 2 we have a diagram showing the air lift in operation, from which its essential simplicity can be appreciated. The submergence is an important factor, depending mainly upon the total lift and the following proportions are found to provide a good efficiency of operation :

| Lift in ft. .. | 50 | 75 | 100 | 150 | 200 | 250 | 300 |
|---|---|---|---|---|---|---|---|
| Ratio submergence/lift | 2.5/1 | 2.0/1 | 1.6/1 | 1.5/1 | 1.3/1 | 1.2/1 | 1.0/1 |

In designing an air lift, the two main points to be considered are the volume of water and the height to which it has to be raised, these two quantities determining the diameter of the rising main. If the diameter is too great, the combined velocity of air and water will be inadequate and slippage will take place, air rising through the water and causing loss of efficiency. The tendency in a small installation would probably be to have a rising main of small diameter, but if it is too small then the velocity of flow is high, and friction loss is considerable.

For all practical purposes, velocity of flow at the ejector should be between 5 and 12ft. per second, and at the point of discharge it will vary from 12ft. to 45ft. per second ; the nearest standard size of pipe should be chosen to give velocity of flow lying between the above limits. The following empirical formula is generally employed :

Velocity in ft. per second=Q/A, where Q is the combined volume of air and water at any point in cubic ft. per second, and A is the cross-sectional area of the pipe in square ft. It is also necessary to take into account the volume of compressed air at the ejector, and the air pressure, which depends upon the depth of the ejector below the pumping level.

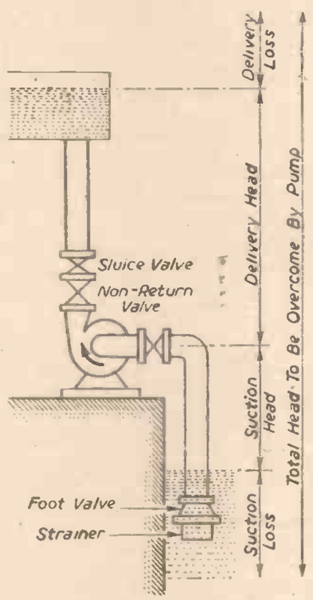
A number of formulae have been evolved for giving the most suitable size of air tubing, and the most reliable is found to be Johnson's formula, which is :

$$P_1^2 - P_2^2 = 0.0006q^2L/d^5$$

where L is the length of the air pipe in ft.
d is the bore of the air pipe in inches,
$P_1$ is the initial air pressure in lb. per sq. in. (abs).
$P_2$ is the final air pressure in lb. per sq. in. (abs).
q is the volume of free air per minute in cubic ft.

from this we obtain the expression

$$d = \sqrt[5]{\frac{0.0006q^2L}{P_1^2 - P_2^2}}$$



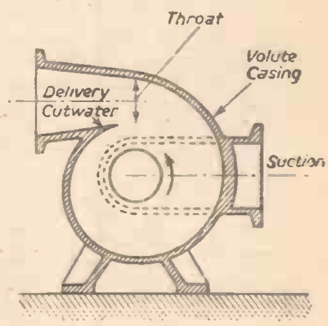




*Fig. 4.—Diagram indicating work which has to be done by a pump, and a section through the volute casing.*

One of the most important points to be borne in mind is that the air main should be large enough in diameter to avoid undue friction, and it is recommended that a proportion of 1 to 6.24 between the cross-sectional areas of the air main and rising main is reasonable. A single-stage air compressor is found to meet air lift requirements for a total lift of 250ft., and this depth will probably not be exceeded in a small plant.

Another important point about the installation is that the air receiver should be of ample size, and provided with a safety valve, pressure gauge and blow-off cock ; a stop valve should never be fitted in the air line between the compressor and the air receiver. The purpose of a receiver is the damping out of pulsations, but it also performs the very important function of acting as a trap for oil and moisture carried over from the compressor. Trapped oil should be frequently drained from the receiver. It is not unknown for a receiver to catch fire through this being neglected, and such a fire may be quite dangerous if it gets a hold, even with a small installation.

In operating an air lift, it will be found that a greater pressure is required at starting than for maintaining constant flow. At first there is a solid column of water, but this will soon be broken up into a kind of cloudy emulsion, which immediately clears when the water is drawn off. It would appear that a small air lift presents no difficulties in construction and should give reliable service over a long period of time.

### Mechanical Pumps

Mechanical pumps may be broadly classified into reciprocating, centrifugal and rotary types. In addition, there is the chain pump, in which a number of discs on an endless chain lifts water up a pipe, and the Archimedean screw, which is a very ancient form of pump, but is more nearly a water conveyor.

The height to which water may be forced by a pump is determined solely by the design of the pump and the power provided to drive it, but the suction lift which can be exerted by a pump is a function of atmospheric pressure, and therefore the height to which a pump can suck will depend upon its ability to produce a vacuum in the suction pipe. Theoretical maximum lift is 34ft., which is the height of a water column corresponding to normal atmospheric pressure of 14.7 lb. per sq. in. at sea level. In practice, air leaks, pipe friction and other losses combine to reduce this maximum lift to a practicable one of about 25ft., although it has been known for some reciprocating pumps to draw from a depth of as much as 30ft. It would probably be wise, therefore, to assume a maximum practicable suction lift for a reciprocating pump of 20ft. and a suction lift of about 15ft. for a centrifugal pump.

### Simple Reciprocating Pump

The author has worked out a sketch design for a simple type of reciprocating pump, as shown in Fig. 3, which he thinks should be suitable for house or estate water supply; if a large delivery is required, then three of these units can be coupled on a single shaft and together make a three-throw pump, with the eccentrics set at 120 deg. to one another. This design is intended to be carried out by welding, where available, and employing standard pipe fittings. The plunger, pump cylinder, pump chamber and valves could all be sprayed with bronze to resist corrosion and the piping could be heavily galvanised with the same object. It is thought that a pump of this simple design would present no difficulties of manufacture, its size depending upon the delivery required and the horse-power of the driving motor.

If a large electric motor, say 2 to 3 horse-power, happens to be available, or an oil engine of similar power, then this high-speed prime mover can be geared down to the pump through a worm and wormwheel gear of the type made by David Brown and Sons, Ltd., Huddersfield. A very satisfactory alternative drive is either a vee-belt pulley or Renold chain. The pump could be controlled from a No Flote or similar device in the water-tank, which would thus be kept at a constant level at all times. If the pumping set could be lowered down the well, this would be helpful in reducing the suction head, but it would be a disadvantage from the maintenance point of view. A foot valve should always be fitted at the bottom of the suction pipe to which a strainer of copper gauze should also be fitted.

The purpose of the air chamber on the pump is to provide a constant flow of water and to act as a cushion against pulsations, in the same way as is provided for in the case of the hydraulic ram. The complete set is mounted on a substantial welded baseplate, which is both strong and light. Such a pumping set has the further advantage that it can be uncoupled and mounted on a trailer for use on other duties. This may be a great advantage in the case of a farm.

The capacity of a reciprocating pump is given by the formula $G=\frac{D^2\times S\times N}{6}$ where G is the pump output in gallons per hour, N the number of working strokes per minute of the plunger, S the stroke of the plunger in inches, and D the diameter of the plunger in inches. This formula is only approximate and gives the output at a volumetric efficiency of 98 per cent.; although it is by no means impossible to attain this efficiency, it would be more reasonable to assume an efficiency of say 95 per cent., 5 per cent. representing leakage. The latter is necessary, because it provides a seal against ingress of air.

### Centrifugal Pump

In Fig. 4 we have a section through a centrifugal pump showing the main parts, the purpose of the volute casing being to maintain uniform flow around the impeller. The casing shown is of single-suction type, but it can equally well be made with a double suction or with open or shrouded impellers. This casing in the sketch is both simple and cheap to make, and the diagram shows the work which has to be done by a pump in overcoming the various heads.

*(To be continued)*

# A Handy Blow-torch

## A Simple Appliance Using Methylated Spirit

By R. G. ILSTON

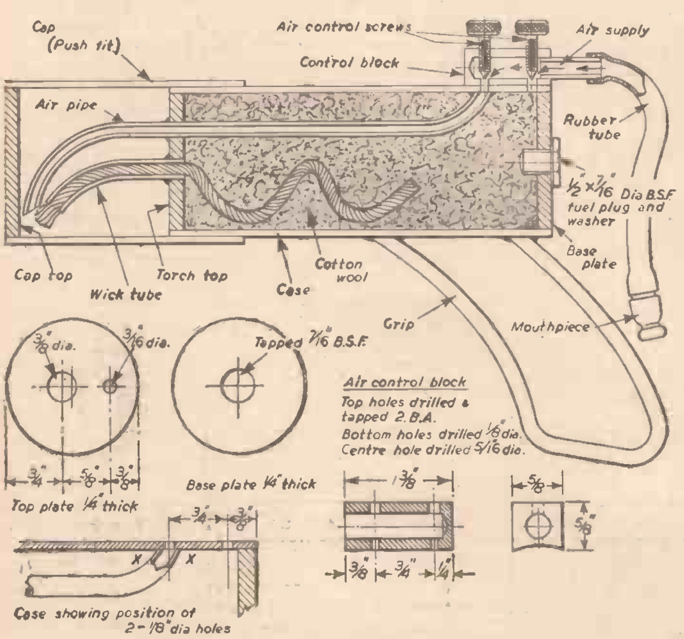
ON many electrical and gas-fitting joints which need to be soldered, it is often awkward to use an ordinary blowlamp which is cumbersome.

The accompanying sketch gives details of a very successful blow-torch which I have used for a number of years. It delivers sufficient flame and pressure for the job, and its design makes it easy to manipulate.

### Constructional Details

The case is a 5in. length of 16G copper tube, 1¾in. bore, with top plate and baseplate of ¼in. thick copper brazed in. The air pipe is a 7in. length of 3/16in. O/D copper pipe, the wick tube being a piece of ⅜in. O/D copper pipe 1¾in. long, both bent and cut as shown in Fig. 1.

Having made the above items, the air pipe is brazed to the inside of the case at XX (Fig. 2), the top plate is fitted, and the wick tube and air pipe are brazed in position, the baseplate being fitted last.




*Sectional view of the blow-torch, and details of air-control block and end plates.*

### Air-control Block

Next, the air-control block is made from a 1⅜in. length of ⅝in. sq. brass, and the air connection from a 1in. length of 5/16in. O/D copper pipe brazed into the end of the block.

The block is radiused along the bottom to fit the case, to which it is brazed so that the ⅛in. holes in the case and block are in alignment.

Two 2 BA knurled screws are machined from brass and their ends pointed as indicated in Fig. 1.

A hand-grip is formed of ¼in. O/D copper pipe and brazed to the case opposite the control block; then a cap to protect the nozzles when the torch is not in use is made from a 3¼in. length of 1⅞in. bore copper tube with an endplate of ⅛in. thick copper.

A 2ft. length of ¼in. I/D soft rubber tubing is procured, one end of which is forced on to the air connection, and in the other end a mouthpiece made from the stem of an old pipe or a piece of plastic is fitted.

The wick is made by unravelling a short piece of ½in. diameter soft cotton rope, and after it is put in the rest of the torch case is tightly packed with cotton-wool through the bottom by removing the fuel plug, which is a 7/16in. dia. × ½in. long B.S.F. brass set-screw fitted with a fibre washer.

### Operation

After the torch has been filled with methylated spirit and the end of the wick lighted, the mouthpiece is used to create constant or intermittent pressure, and by turning the control screws up or down as required a wide variety of flames can be obtained which, due to the light construction of the torch, can be directed with an accuracy unobtainable with a standard type of paraffin blowlamp.

# Mains Operation of Small Motors

## The Use of Transformers and Rectifiers Explained

By F. G. RAYER

THE small motors used in electric trains and models of all kinds are frequently driven by current from an accumulator or dry batteries, but this is not very economical, and where mains are available it is a great advantage to use them. Some care is necessary, however, if the installation is to be safe, and if proper running is to be

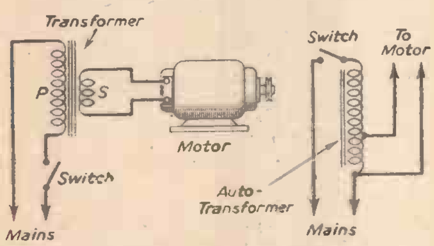



*Fig. 1.—Using a transformer with A.C. mains.*

obtained. Small ex-Service motors, usually for 12 to 24v. operation, are also obtainable very cheaply, and these have a wide field of usefulness. With all such low-voltage motors, including those in trains and other models, various circuits may be employed, according to circumstances, and those following can be used with confidence. In most cases transformers and other parts necessary can be obtained from ex-Service equipment electrical stores at low price.

### Transformer Operation

The mains supply of 200-250v. may be reduced to a figure suitable for the motor by using a transformer, and this is a safe, efficient and economical system, and can be used with any A.C. mains. (A transformer will not function on *direct current* mains.) The transformer primary, indicated by "P" in Fig. 1, has a voltage rating suitable for the mains supply; the secondary "S" is rated at the voltage required by the motor—this may be from 4 to 6v. for small model motors and up to 24v. or so for the larger ex-Service motors. The primary connections should be of stout flex, terminating in a proper mains-plug, as the full mains supply voltage will be present here.

If the transformer has separate primary and secondary, no danger of shocks exists at the secondary tags, leads, or motor terminals unless a breakdown arises in the transformer, which is very unlikely in a good quality component. Accordingly, this circuit is quite safe.

In the type of transformer known as an auto-transformer, primary and secondary are continuous, the latter being a small section of the larger primary. Here, a direct connection exists between the motor and mains, and this type is not recommended for railways or other models where metal parts may be touched.

### Series Resistance Operation

A transformer can only be used on A.C.; a series resistor may be used on either A.C. or D.C. mains, as shown in Fig. 2. The resistor dissipates the unrequired voltage, e.g., if a 24v. motor is driven from 220v. mains, 196v. will be dropped by the resistor. With very small motors it is possible to use an ordinary household-type bulb for the resistor. If the motor runs too slowly, the bulb should be removed and one of larger wattage substituted. A 100-watt bulb would allow approximately ½ amp. to pass.

If the motor uses much more than ½ amp. a bulb is scarcely practicable, and a small fire-bar element may be used in a suitable mounting. If necessary, the amount of element in circuit can be reduced by cutting a clip from brass or other metal and securing this round the bar by a bolt. When the motor runs normally, the resistance value is correct.

With this type of circuit the resistance and motor terminals are in direct connection with the mains, so proper care is necessary as regards insulation of leads, etc. Fig. 2 shows the best way of connecting the standard three-pin mains plug, so that resistor and motor are at the low-potential side of the circuit. The switch is included in the high-potential lead, and an earth-return is added

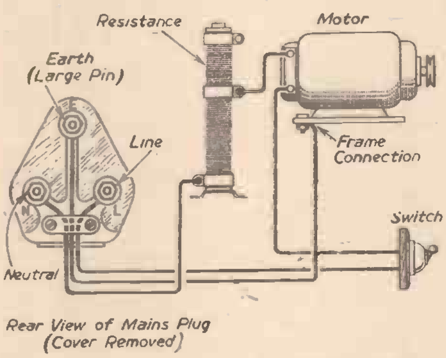



*Fig. 2.—Series resistance for A.C. and D.C.*

from motor frame to earthing pin as an additional safeguard; this can also be done with the circuits in Fig. 1.

A voltage exists, relative to earth, in most neutral, or low-potential mains supply leads, so this does not mean *no* shocks can arise from handling the resistor and motor terminals when the switch is off. It does, however, reduce the risk. Before adjusting the resistor, or touching bare leads, the supply plug should be withdrawn from the mains socket.

### A Safe D.C. Circuit

In many models there is no need to touch leads, etc., but with some models, specially trains, absolute safety may be desired, particularly where a child's toys are concerned. If a transformer cannot be used, the circuit in Fig. 3 may be adopted. This retains an accumulator for driving the model, and a double-pole double-throw switch is arranged so that when the accumulator is being used with the motor, it is entirely disconnected from the mains. In many cases an accumulator may already be in use, so the additional expense involved is very small indeed.

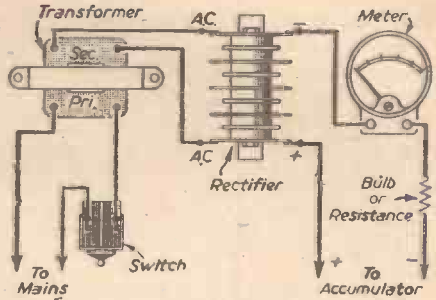



*Fig. 4.—An A.C. circuit for use with an accumulator.*

With the switch in the second position the accumulator is trickle-charged from the mains, the lamp limiting the current. With 200 to 250v. mains a 50-watt lamp would pass about ¼ amp., and a 100-watt lamp about ½ amp. The wattage is not critical; with a small lamp it will merely be necessary to allow charging to continue for a longer period, to keep the accumulator in proper condition. It is usually possible to arrange matters so that the lamp fills a useful purpose—for example, as a reading light.

### Accumulator and A.C. Mains

If it is desired to charge an accumulator from A.C. mains, the circuit in Fig. 4 can be used. A small transformer, rectifier and meter would cost about £1. The charging rate can be adjusted by the resistance, thus permitting various accumulators to be dealt with. Ready-made variable resistors of about 5 ohms may be purchased, or one made from thin iron wire such as is used for binding flowers. The more resistance brought into circuit, the lower will the charging rate be. The voltage and current rating of the rectifier should not be exceeded; operating at lower voltages and currents than that at which it is rated is quite in order. Positive and negative are frequently indicated by red and black markings respectively, with a sign similar to "S" for the A.C. (alternating current) tags.

As with Fig. 3, such an arrangement is actually one intended to keep an existing accumulator in fully-charged condition, and is, therefore, absolutely safe.

### A.C. and D.C. Motors

Many model motors have wound armatures and field magnets, and these can be operated from either A.C. or D.C. Some small motors, however, have permanent field magnets, and these will not run from A.C. A circuit with a rectifier (such as that already given in Fig. 4) is therefore necessary, if the motor is a D.C. type, yet the house mains supply A.C. current.

If it is desired to operate a D.C. motor directly from A.C. mains, the circuit in Fig. 5 can be used. The transformer secondary delivers A.C. at a low voltage, and this is rectified (changed to D.C.) by the rectifier.

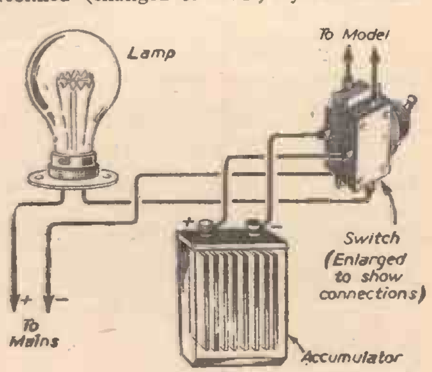



*Fig. 3.—A safe D.C. mains circuit for models.*

It will be seen that this is the same as Fig 4, with meter, resistor and accumulator removed.

### Reverse and Speed Control

Motors with permanent field magnets are favoured in model railways because the train can be reversed by changing the polarity of the supply, and a switch wired as shown in Fig. 6 will accomplish this. If a small variable resistor is also added the speed of the model can be controlled and this, with the reversing switch shown, is a popular arrangement.

Such a circuit may be used with any source of D.C.—dry batteries, accumulator, or transformer with rectifier. Motors driven from A.C. cannot be reversed in this way, though their speed can be controlled by a suitable resistor.

### Fusing

To avoid damage due to short-circuits caused by trains coming off the rails, or other eventualities, a fuse or circuit-breaker can be used. This can be included in one lead to the motor, or, with model trains, in one of the connections taking current to the rails. It can be employed with all the circuits shown, and cards of fuse-wire rated at various currents can be obtained for a few pence.

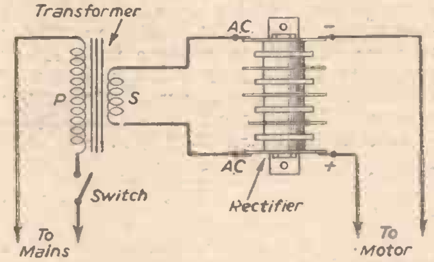



*Fig. 5.—Circuit for operation of D.C. motor from A.C. mains.*

### Loading

Whatever circuit is used, it should be capable of delivering the current required by the motor. In Fig. 1, the size of the transformer will depend upon the current taken by the motor. Small model motors consume about 1 amp., at 4 to 6 volts, rising to 2 to 3 amps. for the larger motors designed for use with an accumulator. Ex-Service motors vary, but the consumption is often about 1 amp. for the 24v. type, and 2 amps. for the 12v. type. Frequently the consumption is indicated on the motor, or it may be measured with a meter. If any doubt exists, use a fairly large transformer. If the latter becomes hot after a period of use, this shows that the motor is taking more current than the transformer can properly supply. However, the current taken by most model motors is quite low, especially when they are intended for operation from dry cells.

The circuit in Fig. 2 can be adjusted to supply current over a wide range, according to the type of resistor, as explained. Where an accumulator is used, as in Figs. 3 and 4, no special difficulty arises. The accumulator can be charged at *any* rate desired, provided the rate does not *exceed* that marked on it as maximum.

With the circuit in Fig. 5, both transformer and rectifier must be able to handle the current required, and this particular arrangement is the most critical of those described. If the transformer becomes hot, it is being over-run, as explained. This may also apply to the rectifier if this becomes unusually hot. After a period of use this will become *noticeably warm*, if full current is taken, and free circulation of air between the plates should be possible. With this type of circuit, it is wise to use a series resistor, and adjust this for exact operation, if the full characteristics of the motor are not known. Some voltage drop will arise in the rectifier, according to its type and the current taken.

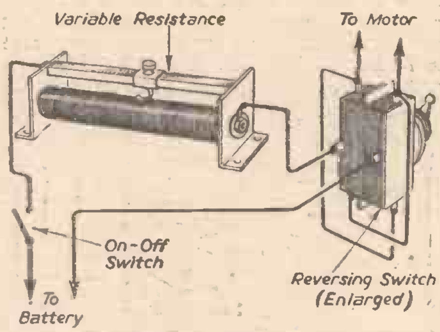



*Fig. 6.—Reverse and speed control.*

# Automatic Turning Lathes

## With Notes on Their Operation

By R. JOHNSTON

THE subject of automatic lathes is one which is far removed from the realms of model engineering. Indeed, one might even say that it is "divorced" from it entirely. Nevertheless, it is a fact that when visitors are being taken on a tour of inspection round a factory where these machines are in use, they find them a great source of interest and many tarry behind the main party, so engrossed are they in watching these remarkable machines perform their functions, quite unattended.

### Bar Auto-lathes

In these lathes the cycle of operation is continuous, the bar stock being fed through the hollow spindle, the projection of the stock from the collets being accomplished by the motion of a cam, and an automatic locking device operating immediately the stock is protruding the correct distance. Generally speaking, bar autos are run at a fairly high peripheral speed, owing to the fact that diameter of bar stock is small, relatively speaking, being anything from 1½in. to ¾in. in diameter.

There are several makes of bar auto-lathes, Butterworth, Brown and Sharpe, Churchill, and Fay, to mention a few; the chucking lathe shown at Fig. 1 was made by Messrs. Alfred Herbert, of Coventry, and this auto-lathe is designated the No. 4. A chucking lathe, as the reader will probably have grasped, completes only one cycle, after which the job in the chuck is removed, another piece of a similar nature loaded and the lathe started up again.

The underlying principles of all automatic lathes are the same, and the lathe in question is no different from others in this respect.

It carries several features, however, which render it at once as one of the most useful, and certainly one of the most fascinating, automatic turning lathes in use to-day.

### The Headstock

There are 28 spindle speeds available in seven ranges of four speeds each. Five sets of pick-off gears housed in a covered recess in the rear of the driving box give the seven ranges, the four speeds in each range being obtained automatically and, if desired, the change can be made while the tools are cutting. The spindle can be stopped automatically, either for withdrawing the tool without marking the work, or at the end of the cycle. The spindle restarts automatically in time for the next tool. By an ingenious system of trigger levers situated under the headstock, and just in front of the speed drum, a range of four different speeds can be brought into use during the cycle. These levers are fitted with detents which enable the plungers, to which they are attached, to remain out of action until the lathe dogs, so disposed on the speed drum, operate them. Five levers are in use, four for speed changing and one for stopping the lathe. The headstock is adjustable along the bed, a very useful feature in order to accommodate work of varying lengths, movement being obtained by means of a screw, after the clamp bolts have been released. The chuck is air operated, which makes for speedy loading, a regulator, and diaphragm for reducing or increasing the grip of the jaws, being adjacent to the operating lever.

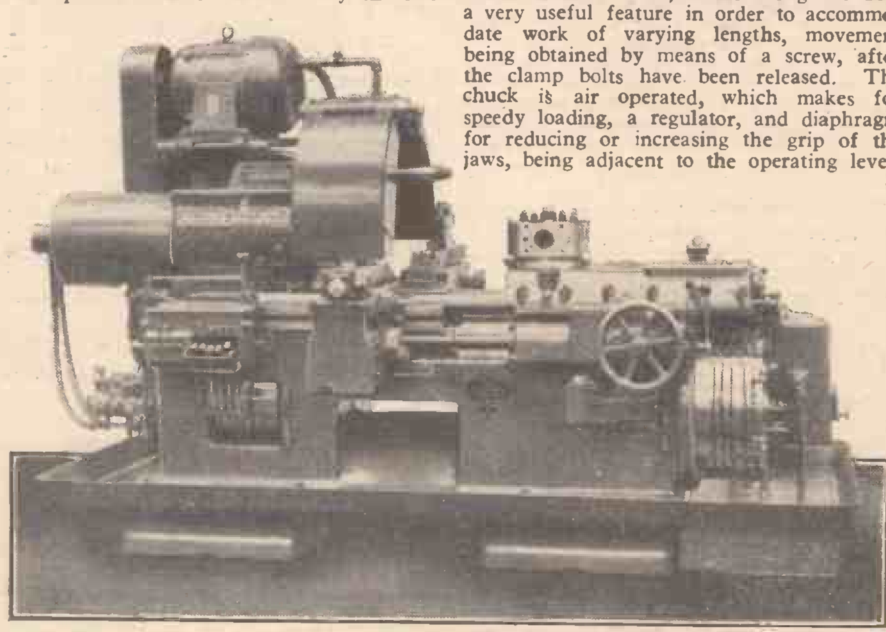


*Fig. 1.—The No. 4 Herbert automatic turning lathe. The turret is shown without the brackets and facings referred to in the article.*

### Feed Motion

Feed motion control is operated solely from the rear drum at the end of the main spindle (Fig. 2). Twenty-four feeds are available in fine, coarse and medium ranges of eight feeds each, and, during the cycle, three of these feeds are available if required. They can be effected during cutting, dogs on the drum operating the levers in the same manner as the speed changes are obtained.

### Quick-return Motion

By pushing forward the trip lever just above the rear drum, the idle motion of the turret and cross-slides is taken up when starting the lathe, dogs on the drum being set to stop the movement just short of the tools touching the work, then the feeding-in commences at once. When each turret face or cross-slide has completed its cut, idle or quick-return motion occurs automatically, the turret withdrawing and revolving into the next position, drawing up to the work, feeding-in and so on, till the end of the cycle.

### The Cross-slides

The cross-slides, back and front, are independent of each other, independently adjustable along the beds, and can be locked in any position. Unlike many other autos, the length of stroke of the cross-slides is adjustable, and can be regulated from a fraction of an inch to full capacity.

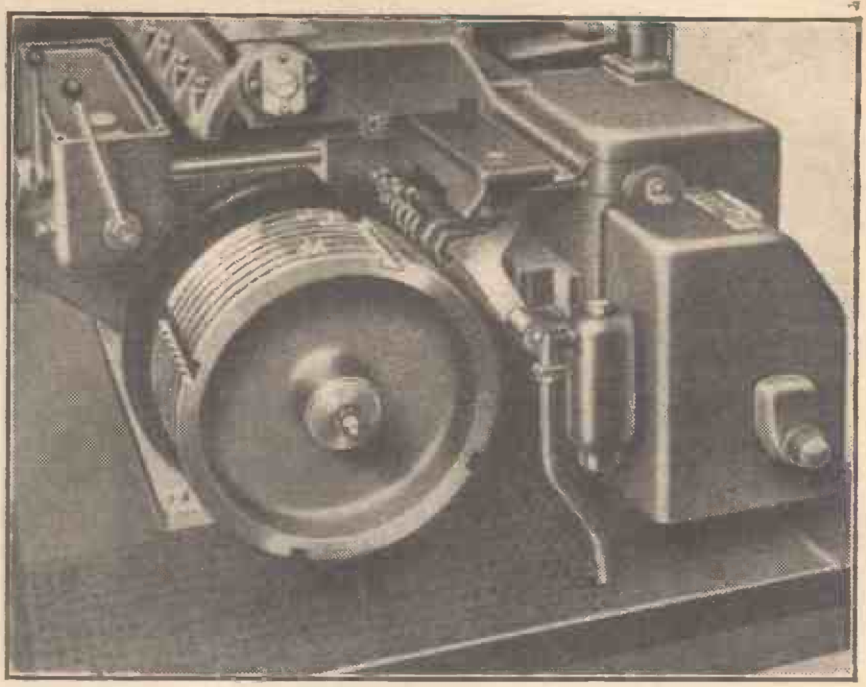


*Fig. 2.—End view of the lathe, showing the self-selecting feed motion.*

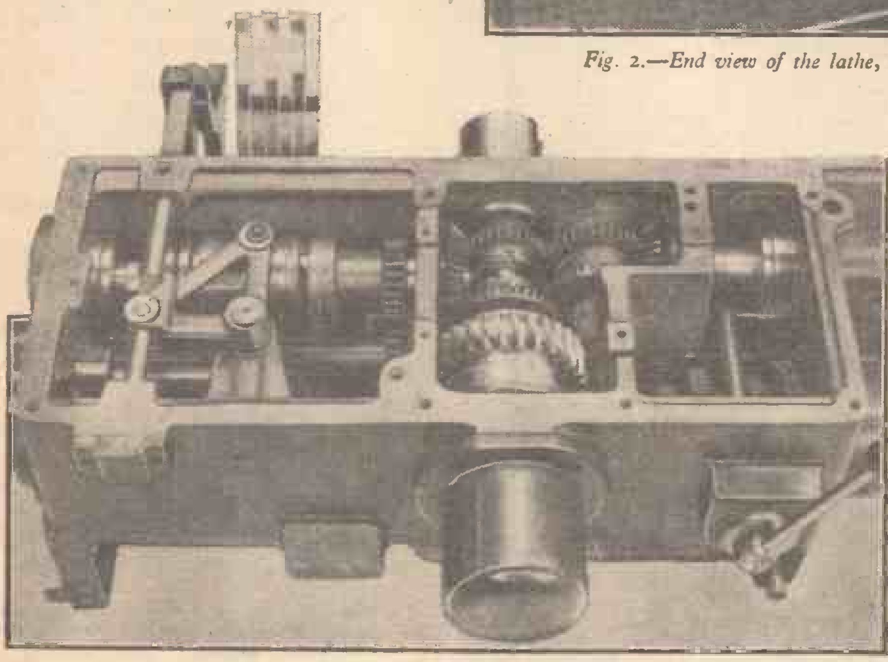


*Fig. 3.—View of the feed gear-box, with cover removed. This unit is a marvel of engineering skill, and in operation has a very beautiful movement.*

### The Turret

The length of travel of the turret is constant, a Geneva movement operating the turret into the next indexing position. The turret is four-stationed, and on three of the facings turning bars are provided which are equipped with overhead turning tools.

The remaining turret station is provided with an attachment which, perhaps for want of a better name, we called the "spring slide." As the name implies, it is spring loaded, enabling a steady cut to be maintained, besides being able to fall back upon itself after the cut.

### Triple Tool Posts

Briefly this is an ingenious device which can be fitted with no less than three tool-posts, should the work require it. As each tool-post can accommodate two tools the potentialities of such an attachment can be well imagined. It is used mainly for facing the work, although it can be used for turning and facing an inside diameter.

It is operated by the front or back cross-slide, the tool-post of which is securely bolted down, and bereft of tools, pushing it across the work. The cam operating the slide is set to push the "spring slide" across the face of the work only after the turret has reached the end of its stroke, the "kick-off" dogs (as we called them) being retarded to enable the spring slide to accomplish the turning required. With its capacity for dealing with all types of metals and its ability to employ a multiplicity of tools (it is quite usual for four, five, and even six tools to cut at one and the same time), this lathe has played a big part in post-war work, for home and export.

### Pump for Coolant

When the lathe is started, a cam on the rear drum brings into operation the pump for coolant, and at the same time a projection on this same cam cuts the power circuit for a red signal light situated above the headstock, a similar cam reversing the process at the end of the cycle.

There must be many readers of this journal who have seen these machines working at some time or other, and so, perhaps, the foregoing brief account of their operation will prove of interest.

# Re-painting and Re-cellulosing a Car

## How a First-class Job Can be Produced with Little Skill

WITH the new synthetic enamels now available skill is no longer necessary in order to make a good job of painting a car. With a little ordinary care anyone can make a first-class job of a car body, be it steel or fabric. The finish produced by these new enamels is like glass, and the brush marks melt away as you paint. As the film of enamel is flexible it will not chip off, and so makes a very permanent job.

The first thing to do is to select the colour. For mudguards, valances, lamps and the like, plain black is entirely suitable. For the body tastes differ, but in general it may be ruled that a small car is better painted a light and rather bright colour, whereas a large body looks better finished in a dark shade. For instance, olive green looks really well on an M.G. Midget, but would be completely out of place on a large Armstrong-Siddeley. There is one exception to this rule, and that is with a brown or rich stone colour. These look well on all cars, and, in addition, do not show the dirt.

*A convenient type of " gun " for spraying the car with enamel or cellulose. It must be used in conjunction with a small air container and a foot-pump.*

In the first place the main thing to remember is that the essence of success is scrupulous cleanliness. It is only with this very necessary precaution that a good surface can be guaranteed, as any small particles of dust or grit will ruin an otherwise perfect finish. The place where the car is painted should be as free from dust as possible. A good plan is to swill the floor with water some short time before starting the job. This keeps down the dust.

### Good Brushes

In addition to the enamel, all you require is two good brushes and a few sheets of No. 0 sandpaper. One 1in. and one 2½in. brush of good quality are the easiest to work with. They should be of the flat varnish-brush type, and it is a good plan to soak them well in water, thoroughly drying them before use.

First, wash down the car thoroughly and make certain that all oil is carefully removed with petrol. Now sandpaper the body all over until it is quite smooth. If there are parts where the old paint has been chipped off apply a good coat of enamel and let it dry. Then sandpaper down this patch and, if necessary, paint it again, and repeat the process until the part is smooth and level with the rest. Care in this operation makes all the difference to the finished job. Applying the enamel is only a small part of the battle. Efficient preparation is the very soul of success.

With a fabric body it is only necessary to see that the surface is free from oil and all traces of any polish which may have been used. Washing with clean petrol and clean rags is the best method, and the fabric should be rubbed hard where any oil is suspected. A light rub with sandpaper will then be all that is required.

After the sandpapering process is completed wash the car well, using plenty of water, and then allow it to dry out. Be very careful that all the water is removed from inaccessible places, as a wet surface is fatal. Parts like the radiator can be covered with paper to prevent the enamel getting on to them, and to obviate the necessity of having to remove splashes of colour afterwards. Such parts as door handles, mirrors, lamps and bonnet fasteners can be taken off. This is much better than painting round them as it gives a clear surface, and also the parts can be well cleaned before refitting. Any fitting that is rusty can be sent away for chromium plating.

The final stage in the preparation of the body is to make sure all dust is removed. A vacuum-cleaner is a very suitable machine for this, using the dusting attachment to deal with the corners. Lastly, give the body a light rub over with a cloth damped with turpentine. Be very careful not to touch the surface with the hand. The skin is always slightly greasy, and grease is easily transferred to the parts to be sprayed if care is not taken.

### Applying the Enamel

Painting is a job to be done slowly. Make sure the light is good and also that you have time to finish off at one sitting. Paint the body first and then the mudguards and other parts.

Soak the end of the brush to be used in the enamel for a short time and then wipe off the surplus on the edge of the tin. Do not keep the stock of enamel open, but pour a little into a clean, wide-mouthed container and fill the brush from that. Synthetic enamel should be allowed to flow on to the surface in fairly generous doses. Don't apply too much so that runs develop, but just enough to cover evenly. A good indication is the fact that when sufficient has been applied the brush should " drag " when pulled over the surface at an acute angle. If too much enamel is present it will " skate " with no resistance at all. If this happens the surplus should be worked over a larger surface. Do not " work " the enamel too much, and after you have applied it, it should be " laid off." This is the process of very lightly brushing the wet enamel with the brush held at an angle of about 45 degrees to the surface.

### Cellulose Finish

There can be no doubt that a cellulose finish is superior to paints and enamels, and that spraying is better than brushing because the cellulose can be evenly deposited without leaving brush marks, and it is certainly more economical and the work can be done more speedily.

Spraying cellulose should be used ; this is thinner than brushing cellulose. A small hand-spray can be used, but this is normally suitable only for touching up rather than for doing the whole body. Various spray guns are available for working from a vacuum cleaner of the type that can be used for " blowing " as well as for " sucking," and these are ideal. Another method is to use a small gun in conjunction with a foot- or hand-operated tyre pump and a pressure tank, as shown in the illustration. The tank can be made from a petrol can by fitting two ordinary Schrader tyre valves. The inside is removed from one of the valves and both are securely soldered in position after swilling out the can with warm water and allowing it to dry with the cap removed.

*The spraying " gun " must be supplied with air from a small reservoir. Many " guns " now available can be operated from a tyre pump.*

The air reservoir is necessary to obtain a steady pressure on the nozzle of the spray gun. It is of interest that certain suppliers of cellulose finishes will supply a complete spray outfit on loan for a few shillings a week.

When spraying, the jet should be held about 4in. from the work and moved across the surface in straight lines. As with brushing, do not go over the same place twice, since that might cause " running " due to the application of too much cellulose in one place. If this does occur the surface can later be smoothed down with the rubbing paper.

Cellulose of either the brushing or spraying kind can be applied to metal or fabric bodies, but with fabric rubbing down is not required. It is not always successful on a painted finish, so before treating the whole car it should be tried on an inconspicuous part. If it causes the paint to blister it will be necessary to remove the old paint before re-cellulosing. That can be done fairly easily with one of the many " strippers " or paint removers that are now available. After stripping, the surface must be rubbed down and given an undercoating.

# A Camera Curiosity

## A Prototype of Miniature Cameras

By J. F. STIRLING

WHEN Herr Oskar Barnack invented the Leica camera and first marketed it in 1925 through the German firm of Leitz, of Wetzlar, the photographic world in general hailed a new era in camera construction.

True it was that a precision-built miniature camera of extremely novel and accurate design had been marketed for the first time in photographic history, for here was a camera which utilised ordinary standard cinematograph film and which in virtue of a specially-designed lens of entirely new construction, an accurately-operating focal-plane shutter, and an ingenious built-in automatic range-finder, was able to produce miniature pictures of pin-point clarity, which were capable of almost any reasonable amount of enlargement.

Following the "Leica," which name quickly resounded throughout photodom in much the same manner as the "Kodak" had done years previously, came the Contax, made by the Zeiss-Ikon organisation, and with these two instruments modern miniature camera work may be said to have been thoroughly established, not only as a fashion but more especially as a new means of taking photographs which formerly would have been impossible of achievement.

Nevertheless, these two German-made instruments were by no means the first miniature cameras invented. There were others before them in our present century, but, lacking the precision construction of the German cameras, they failed in their functions and quickly found their way into that strange graveyard of camera inventions within whose historical confines many weird examples of misplaced practical ingenuity are to be found.

One wonders whether those stalwart pioneers of photography who clambered over hill and dale equipped with out-size cameras and equipment weighing half a hundredweight or more ever sighed amid their enthusiasm for a more diminutive instrument, for a camera, in fact, which would be really Lilliputian in dimensions and which could be carried about from place to place with as much ease as a box of matches or a tobacco pouch.

*The brothers William and Alfred Billcliff who made the camera.*

### The First Miniature

Presumably that now forgotten photographic fraternity did at times aspire to something smaller in the camera line, for occasionally some inventive genius among them would, now and again, make efforts to construct a dwarf camera which might take photographs the size of a postage stamp. The fact that such inventors never really succeeded with their diminutive cameras is not at all surprising, for they had everything against them. There were no films. Plates with insensitive emulsions had to be prepared on the spot and, moreover, which had to be exposed whilst the emulsion was still wet, and then developed immediately afterwards. Lenses which gave poor definition, and cumbrous and slow-working shutters. These and many other factors all contributed to making the often much desired miniature camera a practical impossibility in the mid-Victorian era.

Yet, in spite of these difficulties there were one or two enthusiasts who really did make miniature cameras of some degree of efficiency. The first of these was Professor C. Piazzi Smyth (1819-1900), who was at one time Royal Astronomer of Scotland and Director of the Edinburgh Observatory. Piazzi Smyth was a keen photographic enthusiast. In the summer of 1856 he went out to Teneriffe, one of the Canary Islands, which is really a mountain top, its highest point, known as the Peak, reaching nearly 11,000 feet out of the ocean. It was to this lonely spot that Smyth repaired, taking with him heavy photographic and astronomical instruments.

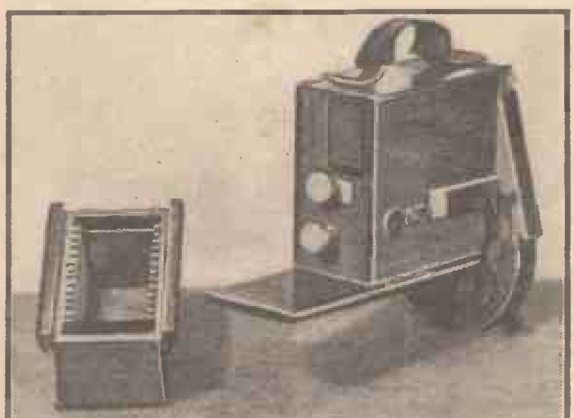
*The Brookes-Billcliff miniature camera which accommodates 12 glass plates, each 1¼in. square. Its shutter was worked by an elastic band. It was made about 1873.*

The eventual result of the expedition was a volume entitled "Teneriffe; An Astronomer's Experiment." It is a book which is much sought after nowadays, since Smyth illustrated it with actual stereoscopic silver prints of photographs which he had taken.

It was ten years after the Teneriffe voyage that Piazzi Smyth designed and constructed that which was probably the world's first practical miniature camera. Those interested will find the camera minutely described in the *British Journal of Photography* for 8th June, 1866. The camera accommodated 1in. x 1in. wet plates. Each miniature plate was exposed in the moist condition behind a window of optically-worked glass, being fixed rigidly in position by means of stops.

With this camera (which was fitted with a lens of 2in. focus) Piazzi Smyth managed to take photographs of the exteriors and interiors of the Egyptian pyramids, and the photographs permitted of considerable enlargement.

As a miniature-camera enthusiast, Professor Smyth subsequently wrote that he looked forward to "instantaneous photography on flat plates with definition, detail and development so good over their whole surfaces as to allow either the entire picture or any special part of the same to be magnified in the copying camera to ten or twenty times the size of the original negative, either for lantern exhibition or paper



*A rear view of the miniature camera prototype, showing the back focusing screen and plate magazine which has been removed from the base of the camera.*

publication.". A true prognostication of the modern miniature camera, indeed!

But while C. Piazzi Smyth, of Edinburgh, was causing a minor sensation with his Teneriffe stereo views and his Egyptian miniature photographs, two young brothers were being apprenticed to the photographic trade by their father, Joshua Billcliff, of Manchester, who was one of the world's first camera makers. The brothers, William and Alfred Billcliff, under the supervision of their pioneering father soon began to make a name for themselves as instrument makers to the photographic trade.

### A Manchester Miniature

There was, also, in Manchester at that time a professional photographer, by name Warwick Brookes. Being of energetic personality, enterprising and venturesome, Warwick Brookes eventually made his studio in Manchester one of the most renowned of these Victorian establishments.

Warwick Brookes, too, like others of his class, was of an inventive turn of mind. No doubt, he had heard of Piazzi Smyth's trial photographs with a miniature camera some eight years previously, and because dry plates had just at that time (1875) become commercially available, he set himself to bring out a dwarf camera which would be a commercial proposition.

Amateur photography at that period was on the increase, although it was still very much an occupation which called for considerable chemical and manipulative skill. Apparently Brookes thought that if he could enter the photographic market with a small camera which would fit into one's pocket, he might make money out of it. In a way, Brookes was a George Eastman, the Kodak creator, before his time.

But although Warwick Brookes could invent and design and take some of the best studio portraits in the country, he could not construct with his own hands. So off he went with his drawings and plans to the two Billcliff brothers who worked nearby. William and Alfred Billcliff made the camera for him exactly to his specification and in the choicest of well-seasoned mahogany.

The Brookes-Billcliff miniature camera had a brief popularity, after which it went the way of Piazzi Smyth's earlier 1in. x 1in. plate camera. Existing records fail to reveal exactly how many of these cameras were made and sold, but apparently the curious instrument illustrated in this article is the only one which has survived the nearly eighty years since its original production.

And what a quaint contraption this early attempt at a miniature camera now appears in modern eyes! An all-mahogany production, some 5in. high and 1¾in. in thickness, the camera is equipped with a short-focus single "landscape" lens and a shutter which apparently was originally intended to be operated by an elastic band! It has an extra lens above its shutter, this lens projecting an image on to a rear screen and so acting as a direct view-finder.

*A portable photographic dark-room of the 1870's. On this tripod-supported wooden tray, covered with a dark cloth, the photographic enthusiast coated and developed his plates as and when they were exposed in the camera.*

### Plate Magazine

Piazzi Smyth's camera only took a single plate at a time, but Warwick Brookes made provision for a magazine holding a dozen plates, each 1¼in. square, so that, in this particular, the Warwick Brookes camera was just a little less miniature than the Smyth instrument.

Two knobs extended at the rear of the camera. The one brought the unexposed plate into position, and the other gently dropped it, after exposure, into its magazine which was secured by a sliding fit underneath the camera.

Fundamentally, the Brookes-Billcliff miniature camera is as sound to-day as it was on the day of its creation.

The camera, of course, was much before its time. That was one of the reasons why it was not a commercial success. Another reason was the great difficulty of obtaining supplies of glass plates of the exact size and thickness required. Apparently, in those early days of dry-plate photography, the glass on which the emulsion was coated varied considerably in thickness, so that although one batch of the requisite plates might fit the magazine grooves of the Brookes-Billcliff camera, another batch would be too thick to do so.

This sort of thing caused endless annoyance. In the end, William Billcliff designed a simple type of gauge for cutting down the larger sizes of plates to fit the miniature of "pocket" camera.

But the remedy was of no commercial avail. Photographers still preferred to practise their art with cameras the size of a small table, and nearly thirty years had to elapse before the first of the "vest-pocket" film cameras arrived in our photographic shop.

### A Single Reminder

Warwick Brookes and the two brothers Billcliff lived on to see the birth of the Leica and of the other modern precision-built miniature cameras, the former dying in 1929, and the two others followings him to the shades about a decade later. Only one single specimen of their 12-plate miniature camera remains to act as a reminder of those long-departed Victorian days in which photography was the pursuit of keen enthusiasts only, and "D. and P." had not then been dreamt of.

# A Technical Book Occasion

MR. F. J. CAMM, Editor of "Practical Engineering," PRACTICAL MECHANICS, "Practical Wireless," "Practical Television" and author of over 40 best-selling technical books at present in print, visited Southend-on-Sea on Monday, June 25th. Mr. Camm entertained a keen audience of over 100 technicians with an informal survey of technical progress and opportunity in many fields. He afterwards spent nearly an hour answering a quickfire barrage of questions on many topics. He neatly completed the meeting by turning the tables on the audience and asking them a few technical questions and offering cigarette lighters (designed by himself) as prizes. The event was sponsored by Donald Bobin, local bookseller and book trade journalist. Mr. Clark Ramsay, Newnes' Book Publicity Manager, was in the chair.


*Our illustration shows Mr. F. J. Camm addressing his audience at Southend-on-Sea.*

# Some Facts About Synthetics

## Modern Science Can Make Almost Anything

By Professor A. M. LOW

"NYLONS" is to-day a magic word with apparently the same fascination for women as orchids had 50 years ago. To a woman of the first year of the Twentieth Century it would have been meaningless, and the idea that any product of a chemical factory could almost compare in beauty and texture with the "real" thing would have been laughable.

When the Topham spinning box was invented in 1900 she did not even read about it. Yet it was this invention that made possible during the first half of the century the growth of a new large-scale industry producing for the first time in history textile from materials other than animal and vegetable fibres.

The textiles were at first called "artificial silk." To-day they have a score of names and thousands of different synthetic threads and textiles are taken for granted, although their value is by no means confined to the fact that they rival in beauty, utility and price the textiles produced from natural fibres.

It would have been impossible to breed enough silk-worms to supply more than a tiny fraction of the world's women with silk stockings. There is no theoretical limit to the production of synthetic threads, because the raw materials are available in unlimited quantities.

In the second year of the century world production of artificial silks was a mere five million pounds. By half-way through the first 50 years British production alone was five times as big and world production was 174 million pounds. In 1946 production of rayon, nylon, etc., in Britain alone was higher than this world figure in 1925 and still soaring.

In the past ages have been labelled according to the materials they mastered and used most extensively. We have had Stone and Bronze Ages. The first half of the Nineteenth Century is sometimes labelled the Second Iron Age and the second half, after the great inventions of Bessemer and others, the Age of Steel.

But any attempt to label the Twentieth Century in this way breaks down because not one but hundreds of new materials have been invented and produced on a great scale.

It might, perhaps, be labelled "The Age of Synthesis" because a great number of these materials has been produced by building up new combinations of stuffs which already existed.

### Plastics

Synthetic textiles are only one branch of the still rapidly growing industry we call "plastics," in which atoms of very common elements are forced into immensely complicated new combinations to provide us with a thousand different materials, each with its own special qualities.

When the century dawned, the word "plastics" had quite a different meaning, and there were no "plastics" as we know them to-day. The first was really made by L. H. Baekeland in 1908.

To the Nineteenth Century the word "synthesis" meant virtually the production artificially of some substance that occurred in Nature.

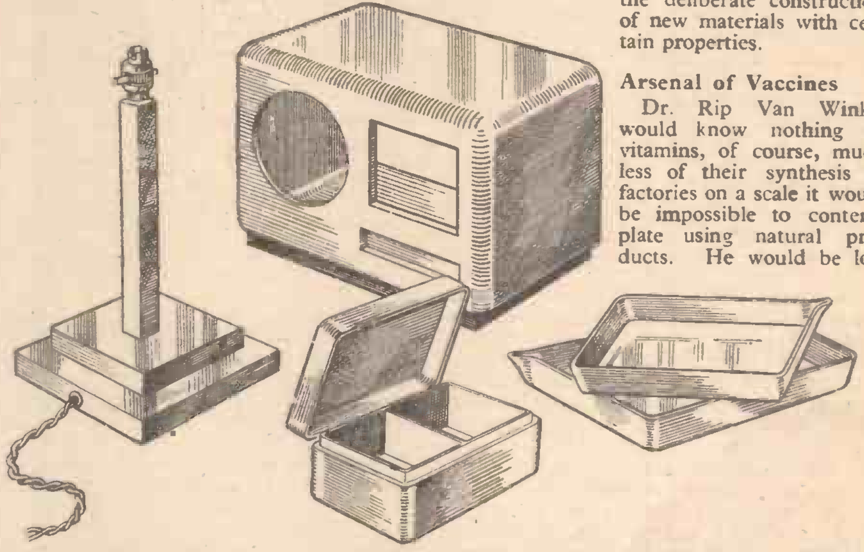
To-day "synthesis" means not so much producing some substitute for a natural material, as a completely new material that has never existed before.

Synthetic rubber, for instance, is not the same material as natural rubber and is made by chemists instead of by a plant. The synthetic rubbers are completely new substances, taking their name merely because they have certain qualities in common with natural rubber.

But they also have other qualities which natural rubber does not possess.

A mere catalogue of the new materials produced in the last 50 years would require a large volume. A Rip Van Winkle who had slept through the first half of the century walking into a store or factory to-day would not be able to name half the materials he saw. They would be as strange to him as were the steel, explosives and textiles of his generation to savages.

Apart from the hundreds of plastics and synthetic textiles indicated, he would not know the margarine we use so extensively, the innumerable synthetic soaps and shampoos, the knives of stainless steel, and the safety glass.



*Examples of articles that can be made with the modern plastic known as Perspex. The table lamp and box are built up from flat sheets. The dishes can be built up or moulded. The top of the radio cabinet is cut from a part that was blown in a mould.*

### New Metals and Alloys

To-day we are commonly using a score of metals that the beginning of the century were virtually laboratory curiosities—beryllium, the metal that makes springs almost everlasting ; tantalum, which combines great strength with maleability ; molybdenum, titanium, cadmium, and others. Aluminium and magnesium were being used at the beginning of the century, but they were comparative rarities, and the endless variety of alloys of these metals which have been made for lightweight construction are all products of the last 50 years.

The production of the new alloys of great strength at high temperatures which alone makes possible the jet engine would have been a ten years' wonder in the Nineteenth Century.

There are to-day thousands of alloys, each designed for its special purpose, that did not exist in 1900—and each year sees its quota of new alloys.

In terms of better living these alloys have meant faster and cheaper and safer transport, longer life for domestic utensils, greater beauty.

### Medicine and Drugs

The changes in the materials of medicine have been equally great. Dr. Rip Van Winkle awaking from a 50 years' sleep would be lost with a modern pharmacopœia. Roughly speaking, until the Twentieth Century, it was to the natural products, particularly plants and minerals, of the world that doctors looked for their drugs. Now it is to the synthetic chemist they turn, not for some substitute for a natural drug, but for new combinations of logical effects quite unobtainable with natural products.

The synthesis of the "sulpha" drugs marked a new era in medicine which to-day looks for progress not to the chance discovery of some new natural product, but to the deliberate construction of new materials with certain properties.

### Arsenal of Vaccines

Dr. Rip Van Winkle would know nothing of vitamins, of course, much less of their synthesis in factories on a scale it would be impossible to contemplate using natural products. He would be lost in the modern hospital's formidable arsenal of vaccines, serums and drugs, designed to attack a hundred different micro-organisms.

The public has reached the stage when it believes the chemist, the metallurgist, and the biologist can produce anything to order. And the public is nearly right.

Synthesis, which was born in the Nineteenth Century, has come to full flower in the first half of the Twentieth Century.

The important point to emphasise is that never before in the history of any civilisation has there been a period like the first half of the Twentieth Century for introducing new materials.

### No Finality

Equally important, there has been no finality about them. The technique having been established, a prospect of endless, even better and cheaper materials opens out for the second half of the century.

The materials of 2000 A.D. will be in many respects completely different from those of 1950. There will be metals, perhaps, with combinations of lightness, hardness and strength of which we can only dream to-day, synthetic textiles of a beauty and cheapness which we can only imagine, new foods, new drugs, and new building materials.

# A Simple Resistance Meter

## Constructional Details of an Efficient Unit for the Handyman

By R. D. PATERSON

MUCH of the electrical gear which comes under the handyman's care can be repaired and adjusted more efficiently if a suitable meter is available. What the handyman needs is a compact, robust instrument of reasonable accuracy, capable of dealing, in particular, with low values of voltage and resistance. The meter described in this article is an attempt to meet that demand at moderate cost.

### Ex-W.D. Components

The basis of the meter is the ex-W.D. filter unit, sold at about 10s. 6d. It contains, among other components,

- 1 metal chassis, 6in. x 6in.
- 1 5 mA. meter of internal resistance 10 ohms.
- 1 2-pole, 6-way switch.
- 1 5,000 ohm variable resistor.
- 1 5-point socket.

All of these components are used in the proposed meter, while the remaining parts, a 20-volt (or 40-volt) meter, a 5-point switched shunt, two other variable resistors and two sockets, can be laid aside for future use. The milliammeter is used to measure three ranges of direct-current voltage, and two ranges of resistance. The switch selects these ranges and has also a set zero position for use prior to making resistance measurements. The variable resistor also is used in the setting of zero, as will be explained later.

### Other Components Required

Three accurate resistors must be obtained, one for each voltage range. These ranges should be chosen to suit the work to which the meter is likely to be applied, and they, in turn, determine the value of the resistors. As a convenience, the ranges should also be linked to the meter scale by simple factors such as 5 or 10.

For instance, 0-6 volts, 0-30 volts and 0-150 volts, otherwise useful ranges, would require the meter readings to be multiplied by the odd-figure factors, 1.2, 6 and 30 respectively. These would be confusing and probably lead to costly errors. But the ranges 0-5 volts (torch batteries, accumulators and clocks), 0-50 volts (car batteries, model railways and other models) and 0-250 volts (D.C. lighting plant and high-tension batteries) involve only simple factors such as 1, 10 and 50. The value of the series resistor in each case must be such that the maximum voltage in that particular range produces a current of exactly 5 milliamperes, i.e., full scale deflection. Thus, in the 5-volt range, by Ohm's Law, R=E/I,

= 5 volts /5 mA.=1,000 ohms.

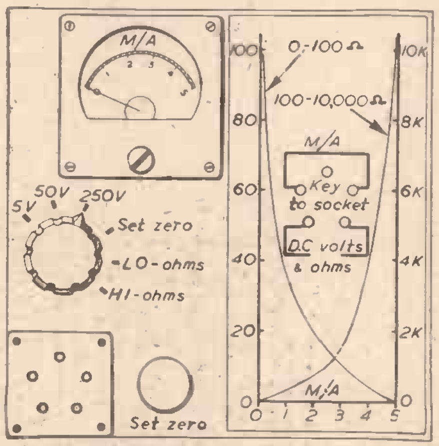



*Fig. 1.—The panel of the meter, showing the graph and key to socket in position.*

So the total resistance of the circuit in the 5-volt range should be 1,000 ohms, and for the other ranges, by similar calculation, 10,000 ohms and 50,000 ohms respectively. If the resistance of the meter movement itself were a substantial part of the total, say, 500 ohms, it would be necessary to obtain series resistors which were in each case 500 ohms less than the desired total resistance in order to make the meter accurate; but, as the meter resistance is low, in this instance 10 ohms, the error introduced by using series resistors *equal* to the calculated total resistances is less than the probable calibration error of the meter movement itself, and they are more easily obtained.

Ask your dealer to pick you out a set of resistances not more than 2 per cent. above or below their nominal values. Two flying leads are also required, each equipped with a banana plug at one end and a crocodile clip at the other; also a small dry battery, such as half a No. 8, to supply energy for the resistance ranges.

### Resistance Measurements

The handyman generally has to deal with electrical devices of low resistance compared with the thousands of ohms and megohms of the wireless enthusiast, to whose special needs most resistance meters are adapted. Study of the theoretical diagram will show how the present meter contrives to provide a range of 0-100 ohms in addition to the orthodox range from 100 ohms up.

The resistance to be measured is connected across the same two terminals as are used for voltage measurements. The switch is turned to set zero. This closes the circuit shown in heavy lines in Fig. 3. The variable resistor is then adjusted until the meter reads exactly 5 milliamperes. Next, the switch is turned to lo-ohm. This throws the unknown across the meter-movement, and if resistance is less than 100 ohms the pointer will fall to some intermediate position corresponding to the value of the unknown. If the pointer remains within the last degree of the scale the unknown is of too high resistance to be measured accurately on this range, and the switch must be turned to hi-ohm. The unknown is now in series with the meter, which will register its value unless it is greater than 10,000 ohms or is open-circuited. The translation of meter readings into resistance values will be described later.

### Setting the Meter

It may be found difficult to set the meter accurately to 5 mA. by means of the 5,000-ohm variable resistor. This is because only about 300 ohms of it are used. (The single cell employed provides a voltage which never exceeds 1½ volts, hence R circuit=E/I=1.5 x 1,000/5=300 ohms.) Three things can be done about it.

1. A fixed resistor can be wired across the variable resistor.

2. The 5,000 ohm variable can be replaced by another of maximum value about 350 ohms.

3. Better still, it can be replaced by a fixed resistor of 200 ohms in series with a variable of 150 ohms. The presence of the fixed resistor in the circuit ensures that the meter will never be used with the battery so far run down that its voltage cannot be depended upon to remain stable between the setting of zero and the subsequent reading of a resistance value.

This method is recommended and is shown in the wiring diagrams. The switch should never be left at the position set zero or lo-ohm as that would leave the battery continuously in circuit and thus shorten its useful life.

### Construction

Remove all the components from the chassis except the 5-point socket. Drill fresh holes for the switch and the variable resistor

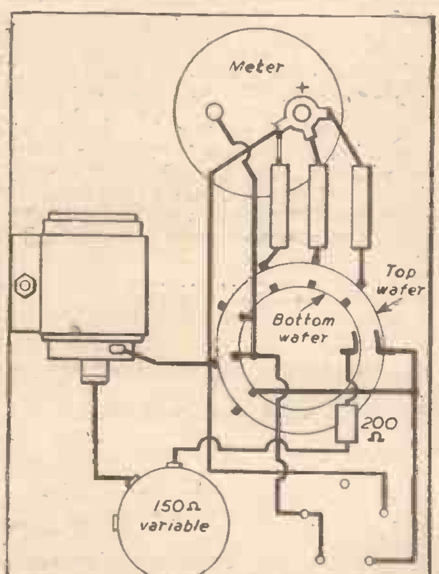



*Fig. 2.—Wiring diagram.*

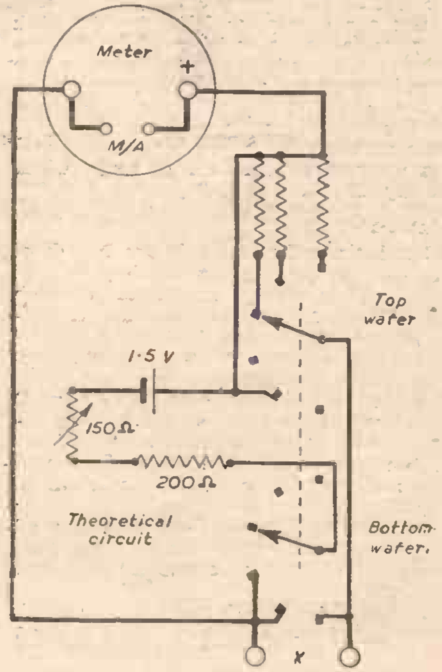



*Fig. 3.—Theoretical circuit diagram.*

in the positions indicated in Fig. 1. These positions are not critical. The idea is to leave free as much as possible of the right-hand side of the chassis to accommodate the calibration chart. Make a panel of white cardboard with appropriate openings in it for the components which protrude and fix it to the chassis. Fasten down the meter, the switch and the variable resistor, also a clip to hold the battery. Wire up according to the theoretical and wiring diagrams (Figs. 2 and 3), and avoid making the chassis part of the circuit. It is better for it not to be "live." The zinc case of the battery should be insulated from the clip by a surround of some non-conducting material, and the wires which connect it and the carbon pole to the meter, etc., soldered directly on. Note that two of the sockets are wired to the milliammeter itself so that it can still be used as such, if desired. Inscribe the panel as shown in Fig. 1.

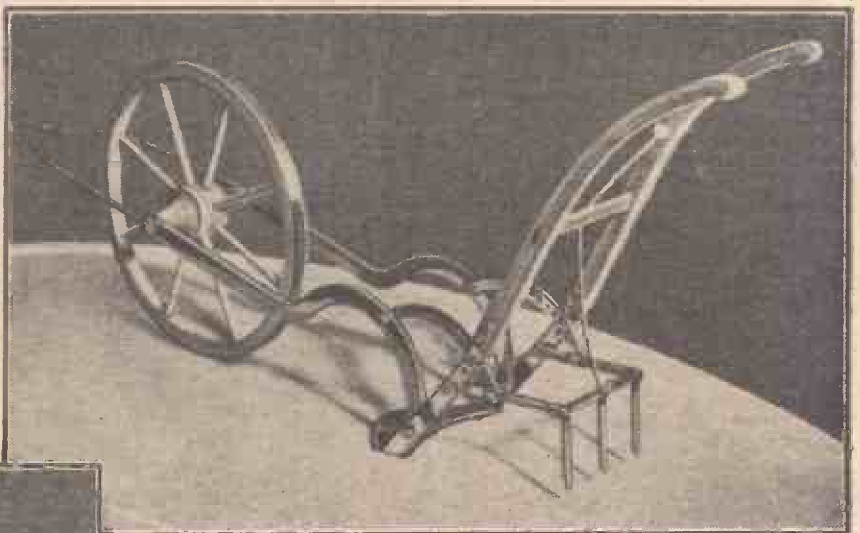
**Calibration Chart**

The voltage ranges need no calibration chart. The appropriate factors are shown by the switch. For the resistance ranges, fit a piece of graph paper into the vacant space on the right-hand side of the chassis. Let its scale be such that there are 50 units along the bottom, each unit representing 0.1 mA., and 100 units along each side, each unit representing 1 ohm on the left-hand side and 100 ohms on the right-hand side. The three precision resistors can be borrowed from the voltage ranges and used to fix three points in the hi-ohms range. Using them as "unknowns," the meter readings are plotted against the corresponding resistance values and the curve drawn in by hand. For the lower range a resistance accurately adjustable in steps of 1 ohm from zero to 100 ohms is necessary. Better still, if a good resistance meter or bridge can be borrowed, only two variable resistors are required. One should be capable of being set to any value between zero and 100 ohms, the other between 100 ohms and 10,000 ohms. The bridge is used to set one or other of the variables to as many suitable values as desired. These are in turn applied to the meter under calibration, and the meter readings are plotted against the resistances they represent. From the graph thus formed intermediate values can be read back as required. Space should also be found on the graph paper for a sketch of the socket panel, showing the purpose of the various sockets.

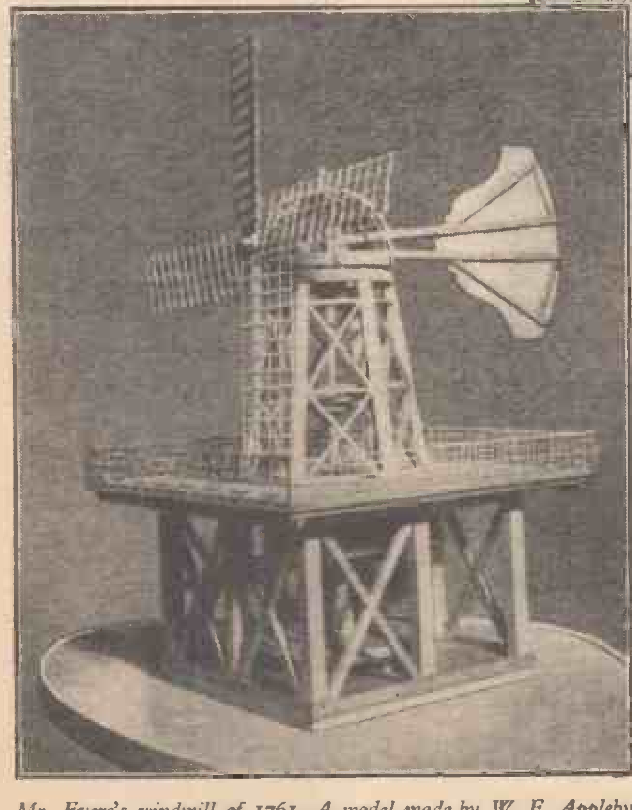
# Exhibition of Exhibitions

THE object of this unique exhibition, which was opened on May 1st at the Royal Society of Arts by H.R.H. The Princess Elizabeth, is to illustrate the origin and development of Exhibitions in Great Britain, and to commemorate the centenary of the Great Exhibition of 1851.

Five pioneer exhibitions altogether are represented in the exhibition, and they are commemorated by the display of models, pictures and numerous original exhibits. Among these latter are many which are of great intrinsic interest. They include, for example, one of the four paintings which, by being exhibited at the Society of Arts in 1760, first made Reynolds famous; an original photograph by Fox Talbot, the inventor of photography; a group of scale models of early industrial and agricultural machinery; a statuette of Hiram Power's "Greek Slave," the original of which caused such a sensation at the Great Exhibition; and one outstanding object—a large gilt centre-piece (lent to the present exhibition by H.M. The King), which was designed by Prince Albert and loaned to the society's exhibition of design in 1849 by Queen Victoria.



*A model of the Rev. Mr. Hewet's horse hoe and harrow of 1761.*



*Mr. Evers's windmill of 1761. A model made by W. E. Appleby from the original engravings in Bailey's Machines.*

The story of the Exhibition of Exhibitions is not confined to past history. It is also concerned with living traditions which are operative to-day, and the display also includes, therefore, representations of recent exhibitions such as the Royal Society of Arts Exhibition of British Art in Industry (1935)—the modern pioneer of design exhibitions in this country—and "Britain Can Make It" (1946), while the final item in the display is a fascinating series of photographs showing the development of international exhibitions in the century between 1851 and the present day.

The exhibition, which is at the Royal Society of Arts, 8, John Adam Street, Adelphi, London, W.C.2, is open daily until September 29th (Sundays excepted).

# Modelling Helicopters

## With Notes on the Various Motors for Supplying the Power

By E. W. TWINING

(*Concluded from page 297, July issue.*)

PROBLEM number three involves the placing of the whole power-plant on, or equally distributed around, the centre of gravity. This centre is, of course, on the vertical centre-line of the rotor shaft, provided there is only one shaft. With more than one shaft and set of rotors the case is different, and implies another scheme which I shall refer to later.

With one shaft and one engine it is very nearly impossible to get the centre of gravity of the power plant on the centre of rotor lift.

In the case of many arrangements of engine and gearing there is yet problem number four, namely, that of making provision for starting up the engine; but this I will deal with in connection with each of the several schemes which I shall illustrate. These schemes can only be taken as tentative because the application of them will depend almost wholly upon the particular make, c.c. capacity and horse-power of the engine which the experimenter is going to adopt.

It is realised by the writer that, as there are over a dozen reliable makes of engine on the market, varying from 1 c.c. to 5 c.c., and some experimenters may wish to try out engines which they already possess, it is not possible to give any definite dimensioned plans for models, but merely the several lines on which experiments can be made. I think it may be firmly laid down that the diesel type engine is the only one with which there is any hope or certainty of success, because with the ordinary petrol engine the ignition system involves the carrying of too great a weight. The diesel, by its high compression ratio, carries its own spontaneous ignition and its low gross weight is enormously in its favour.

For the purpose of making calculations and putting forward tentative arrangements, I have been obliged to illustrate an engine in my drawings and for convenience I have shown the Wildcat, not because I hold any brief for its makers, but because it is one of the few whose cylinders have the capacity which renders it most suitable for the purpose. There are at least two others of the same size: the Vulture and the Vulture Mk. III. All are of 5 c.c.

In a general way it follows as a matter of course that the larger the engine the better is the horse-power to weight ratio, though there are exceptions. The Wildcat develops .34 h.p. at 10,000 r.p.m., weight, with tank, 9.2 ozs. and has a ratio of h.p./weight of .70. The Weston, which is of 3.5 c.c., develops .204 h.p. and only 7,000 r.p.m., weight 4.25 ozs. without a tank and has a h.p./w. ratio as high as .76. The ED Mark IV, by Electronic Developments, Ltd., has a 3.46 c.c. cylinder, weighs 5.75 ozs., develops .25 h.p. at 10,000 r.p.m., and has a power-weight ratio the same as the Wildcat. From these figures it will be seen that all of the engines which I have named possess features which render them suitable for experimental work with helicopters.

### Centre of Gravity

The first scheme which I put forward for the application of an engine for driving rotors is illustrated in Fig. 5. I have mentioned the necessity for the centre of gravity of the whole power unit to fall on the centre of rotor lift; now I have considered this problem very thoroughly and I see no other way of arranging a single engine than this. It is perhaps not a very desirable attitude in which to place an engine; none of them is designed for running in this position, but I see no help for it, nor any definite objection to it. If the crank shaft is placed horizontally the cylinder and crankcase are bound to be offset to one side and to place a counterpoise on the opposite side involves dead-weight to be lifted. However, someone may see a way out of the difficulty so I will leave it at that.

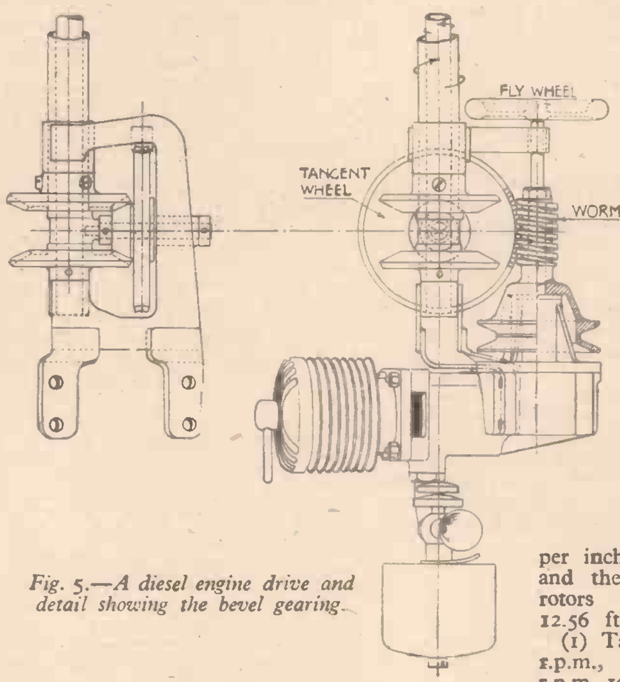



*Fig. 5.—A diesel engine drive and detail showing the bevel gearing.*

The high revolution speed of the small diesel engine involves either a long train of spur gears or the use of a worm and tangent gear; of the two the latter yields a very great saving in weight, both in the gear itself and in the framing and bearings, so it is the tangent gear which I have shown here.

### Weight, Areas and Speed Calculations

The analysis of the weight of the machine shown in Fig. 5 should be approximately as follows:

| | |
|---|---|
| Engine and tank | 9.2 ozs. |
| Gearing, etc. | 3.2 ozs. |
| Gear frame | 2.5 ozs. |
| Rotor shafts | 2.4 ozs. |
| Steel wire shock absorber | 2.0 ozs. |
| Rotors | 4.4 ozs. |
| Rotor Hub gear | .3 oz. |
| Total | 24.0 ozs. |

I have made three sets of calculations, each for a different gear ratio and area of rotors. In all cases the worm has a pitch of one sixteenth inch (16 threads per inch) running at 10,000 r.p.m. and the effective diameter of the rotors four feet, circumference, 12.56 ft.

(1) Tangent wheel 50 teeth = 200 r.p.m., differential 2 to 1 = Rotor r.p.m. 100.

$$\frac{12.56 \times 100 \text{ r.p.m.}}{60 \text{ seconds}} = \text{say, 21ft. per second,}$$

$21^2 = 441 = V$, therefore

$$A = \frac{1.5 \text{ lbs. (24 ozs.)}}{.300 \quad .00238 \quad 441} = 4.76 \text{ sq. ft. or}$$

686.16 sq. in.

$$\frac{686.16}{4} = 171.54 \text{ sq. in. per blade.}$$

As the lift of an aerofoil increases as the square of the velocity, and as the blades in

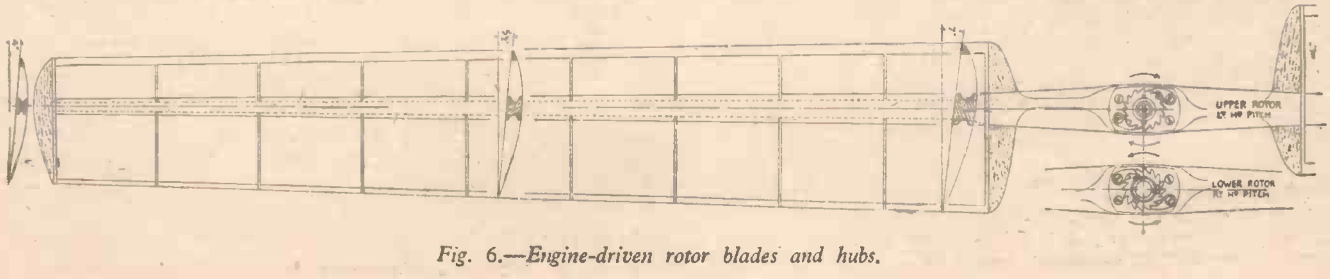



*Fig. 6.—Engine-driven rotor blades and hubs.*

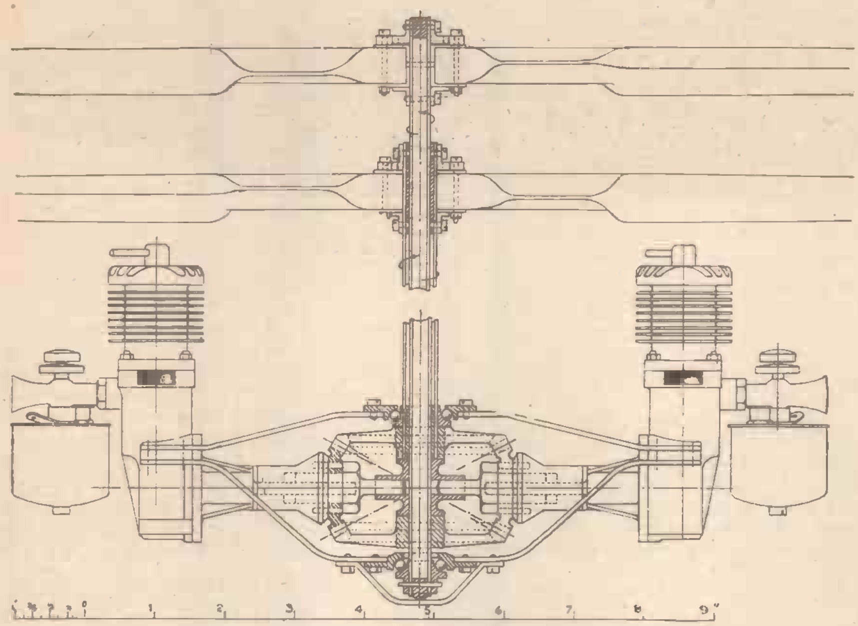


*Fig. 7.—The power units and drive for a twin-engined machine.*

the result given above would be inconveniently large, it would be better to step up the gear, so we will retain the same worm and tangent gear and make the differential ratio 4 to 3 giving the rotors a revolution speed of 150 per minute. The circumference will be the same, so:

$\frac{12.56\times 150}{60}=31.4$ ft. per sec. ∴ $V^2=985.96$.

(2) Then $A=\frac{1.5}{.300 \quad .00238 \quad 985.56}$

$=2.13$ sq. ft. or $\frac{315.36}{4}=78.84$ sq. in.

In the third calculation the differential is altered to 1 to 1 and the rotor r.p.m. becomes 200, still on the same circumference:

(3) Thus $\frac{12.56\times 200}{60}=42$ ft. per sec., this squared $=1764$.

and $A=\frac{1.5}{.300 \quad .00238 \quad 1764}$

$=1.19$ sq. ft. $=\frac{171.36}{4}=42.84$ sq. in. per blade.

Now, which of these three resulting areas had better be tried out? If the last will provide sufficient buoyancy in the descent, then that one will be the best, although we have to remember that the engine is running all out at 10,000; there is no reserve and the aerodynamic drag of the rotating blades is bound to put a retarding effect on the revolution speed of the engine, so reducing the power developed, and the larger the blades the lower the horse-power output.

In Fig. 5 I have shown on the engine shaft two items which will not be supplied by the engine makers; one of these is a pulley for use with a cord in starting up and the other is a small flywheel.

In the usual purpose to which these engines are put and for which they are made, at any rate for model aeroplanes, there is the weight and momentum of a propeller to carry the crank pin and piston over the compression, and the flywheel which I have shown, helped by the weight of the pulley, is put on to serve the same purpose. With worm and tangent gearing no help can be obtained from the rotors.

### Free-wheeling the Rotors

Turning now to the design for the rotors, a drawing for one of them and the hubs of both are given in Fig. 6. It is the ratchet arrangement on the hubs to which attention should be called. Obviously the engine must drive the rotors but, partly because of the tangent gear and partly by reason of the high compression, it will be impossible for the rotors to revolve the engine when fuel is exhausted. Therefore, the hubs are arranged to have a running fit on the shafts—the upper one on the inner shaft and the lower on the larger, outer shaft. Each shaft has a toothed ratchet wheel secured to it and, when the shafts are being revolved by the engine, two pawls on each hub engage with the ratchet teeth, which are slightly undercut. The pawls are not spring loaded and the action is this: when the engine is about to be started up, the pawls are engaged by hand and, when running, the engine will retain the pawls in the teeth because of the undercutting of the latter. When the engine stops from lack of fuel it will do so suddenly and the rotors, by their momentum, will overrun the stopped shafts by at least one-sixteenth of a revolution of the rotors; this will cause the pawls to become disengaged from the teeth and, as the machine begins to descend, the rotors will be free to reverse their rotation. They will run in reverse, free on the shafts, and so provide the necessary autogyro effect, and this drawing of the rotors and ratchets is equally applicable to the remaining schemes to be suggested.

### Twin Engines

The next scheme is illustrated in Fig. 7; here two engines are employed, coupled together and driving the rotors through mitre gearing. In this arrangement the weight of everything is perfectly balanced around the centres of lift and gravity. I think this scheme, as a whole, has much to commend it for experimental purposes. The gear shown has a ratio of only 2 to 1 so that the theoretical revolutions of the rotors run to nearly five thousand per minute, but they will have to be large for parachuting and so the speed will come down to, at the most, 4,000, when the engines will be developing together about .64 h.p.

Even if the revolutions come down to the region of 4,000, the calculated blade areas will be too small for support with stalled engines, in fact it works out at only a fraction of 1 sq. ft. for all the blades; so the logical thing to do will be to keep the engine revolutions up by providing a bigger reduction in the gearing. If the gear is stepped down by much more than 2 to 1, it will not be possible to start the engines by hand-turning the rotor hubs, which was the intention with this scheme, and the only thing to do then is to put a cord pulley on the engines. However, I think I have said sufficient to give the reader a line on which to think and devise.

The last scheme, shown in Fig. 8, though practical, bristles with problems, not the least of which is the starting up of the two engines, which though coupled by a shaft between the gears, drive their own respective pairs of rotors. The aforesaid shaft is only required in order to synchronise the revolutions of the rotors and, though it may not be altogether necessary to do so, to couple up the engine speed and compel them to uniformity.

The easiest way would be to separate the rotor discs so that they do not overlap and so that blades could never touch; then it would not matter if they did not synchronise as regards position in revolution so long as they did so in speed; the coupling shaft ensures that the rotor revolutions are uniform.

With the certainty of no mechanical interference of one rotor with the other, it would then be possible to interrupt the connecting shaft and fit upon it a sliding, notched or slotted tubular sleeve-coupling. By means of

(*Continued on page* 349)

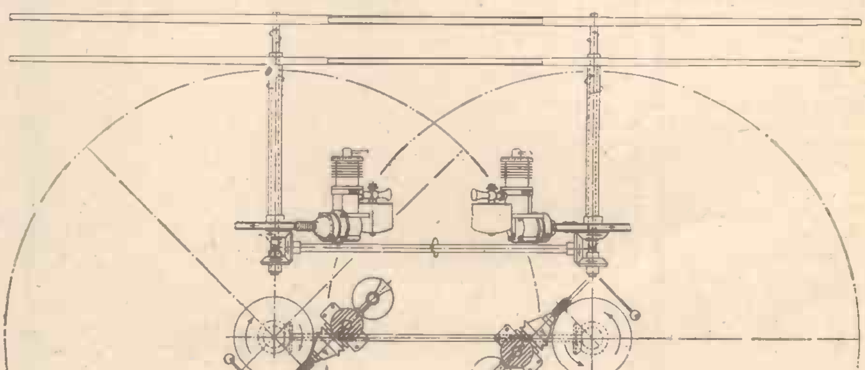


*Fig. 8.—A twin-engined four-rotored model.*

# A Photo-electric Exposure Meter

## Constructional Details of an Inexpensive Unit for the Amateur Photographer

By W. L. PEACOCK

THE components used in the construction of this meter were an A.E. thermo-electric ohm-meter 0-4 amps., available from any shop which deals in war surplus equipment. The one used was made by Sangamo Weston; a selenium cell 40mm. by 22mm. (G.R. Products, 22, Runnymead Avenue, Bristol, 4); a 100-ohm resistance and a few pieces of celluloid and Perspex, brass and nuts and bolts.

As the case of the meter is of ample size there is no necessity to make one, so eliminating what may have proved to be the most difficult part of the work.

The meter connections must first be unsoldered and the movement and switch taken from the case. The scale and meter body are held by the same two bolts, and after these have been removed the meter may be eased out with a screwdriver by prising up between the pillars and the metal frame of the meter.

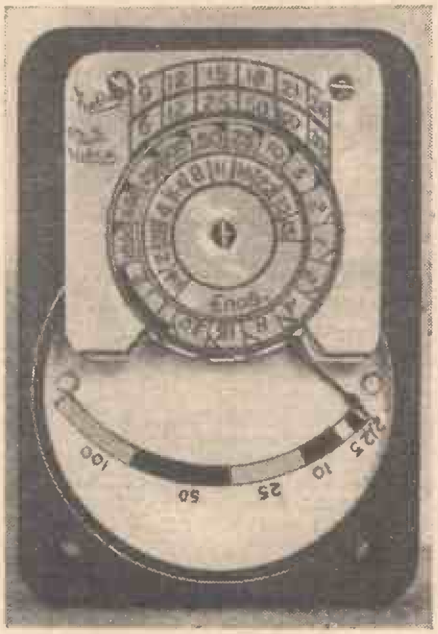
The projections on the upper surface of the case may now be removed with a file and the whole surface levelled up with fine sandpaper. The dull surface so produced can be restored to its original condition by rubbing in cobbler's wax with a coarse cloth, then polishing it off with a fine cloth.

### Cutting the Aperture

An aperture must now be cut in the bottom end of the case and the two large holes for the original contacts form a suitable line to mark out from. A line was scribed on the base and the horizontal line perforated with a line of drill holes. The vertical lines were cut with a small hack-saw, and the piece of ebonite removed by splitting it along the line of the drill holes.

This aperture can now be filed smooth and the corners squared up.

As the size of the cell employed is larger than this aperture it is necessary to cut out a small portion from the upper half of the case to make it in all 22mm. high by about 48mm. long.



*The completed exposure meter.*

### The Cell Unit

The cell unit (Fig. 4) is prepared by cutting two pieces of Perspex to fit the inside of the meter case, and two brass contacts with lugs, as shown. The cell can then be sandwiched between the contacts and the Perspex and bolted together with two bolts.

The soldering lugs are now bent over so that they do not interfere with the lid of the meter case.

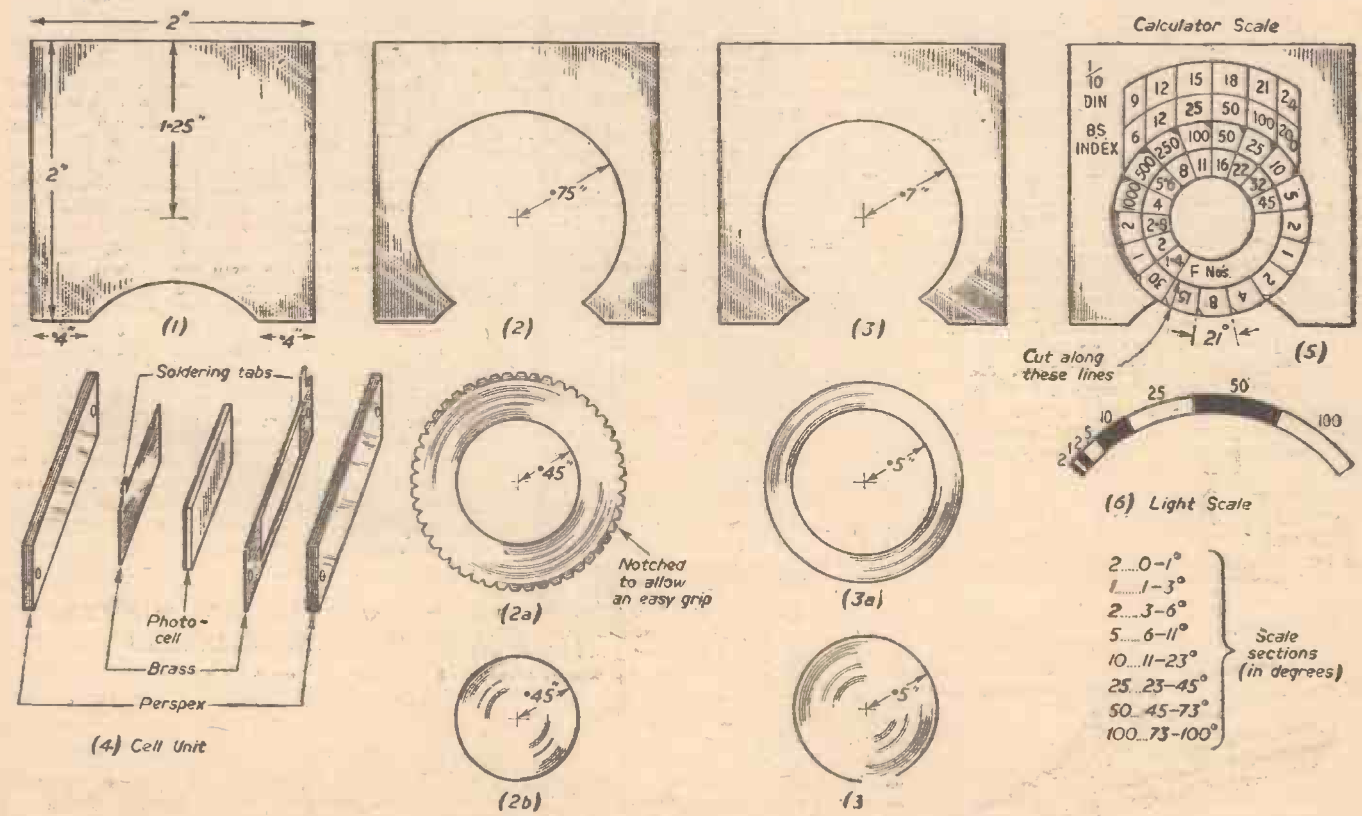
It is advisable at this stage to ensure that no short circuit due to a fragment of the metal used to obtain contact on the back and front of the cell is present. As the resistance of the cell is of the order of 1,000 ohms a flashlight bulb and battery will be sufficient to detect this when the bolts are loosened and tightened again.

The cell unit may now be cemented into the meter case and the meter movement and scale replaced. The cell, meter and the 100-ohm resistance can now be connected up in series. Point the cell at a light source and interchange the leads to the cell to ensure that correct connection has been made.

### The Calculator

The calculator is constructed from three 2in. squares of celluloid. To ensure correct centring, it is advisable to clamp the pieces together and drill a common centre before cutting out the circles as indicated in the diagrams, Figs. 1 to 3.

If a pair of engineer's dividers are sharpened to a point of not too great a thickness the circles may be cut out by scrib-




*Figs. 1 to 6.—Details of the various parts for making the exposure meter.*

ing from both sides and afterwards cleaned up with fine sandpaper. To ensure an easy grip when using the calculator the ring marked 2a should have a notched edge.

The scales can now be drawn and inked in on a piece of cartridge or similar paper and cut along the lines indicated in Fig. 5. This will produce three parts, an inner disc with the aperture on it, a ring with shutter speeds, and an outer portion showing film speeds.

### Assembling the Parts

The parts are now assembled as follows:—Part 1 is cemented to 2, and the outer section of 5 is cemented to the back of 3.

The ring with the speeds on it is sandwiched between 2a and 3a, care being taken to centre the rings properly.

The disc with the *f* numbers on it may now be sandwiched between discs 2b and 3b.

When these parts are dry the ring with the speeds may be placed in position on the main body of the calculator and the upper portion cemented in place. The central disc is now cemented in, care being taken to ensure that the 16 on it is in incidence with the 50 on the film speed scale.

The completed calculator may now be cemented or bolted on to the upper surface of the case, as shown in the illustration, Fig. 7.

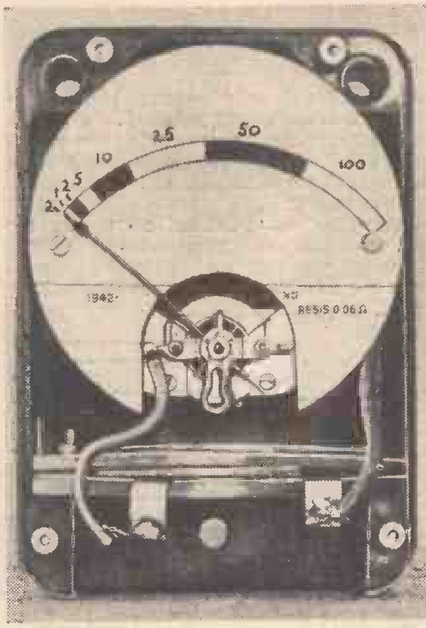
### Calibrating the Meter

Calibration may now be carried out, using, if possible, a meter such as Weston Master, or, if this is not available, the scale (Fig. 6) may be fixed and any errors due to the meter movement differing from the original can be adjusted by exposing a length of film under varying conditions.

If a meter is available, either using an evenly illuminated white card or suitable outdoor conditions, a set of results relating the deflection to the intensity of the light in foot candles can be obtained.

A graph is then drawn and, calling the 4-amp. point 100, the appropriate axis is split into 100 divisions.

The values now are read off along this scale: for 500, 250, 100, 50, 25, 13, 6.5 and 3.2ft.-/cd. respectively, and, using each of these points as the centre of the zone, a series of zones can be constructed (e.g., 250ft. candles extends from 350—175 ft. candles). The latitude of the film will be sufficient to give a well-exposed negative over this range for a particular shutter and stop setting.



*View of the meter with dials removed, showing the cell unit.*

Calling the 100 divisions degrees, a scale can now be prepared and affixed to the meter using the figures in Fig. 6 to mark off each zone.

It is not essential to mark the film speeds in ° Din. or B.S. index; any suitable system can be employed as each speed is double that of the previous one, and half that of the next one.

### Operating the Instruments

When the correct reading has been taken, the corresponding figure on the movable dial is placed in incidence with the film speed rating and any one of the "stop/time" combinations will give a correctly-exposed negative.

As black and white stock has a greater latitude than colour stock, more care must be exercised in calculating the exposure required for the latter.

As an exposure meter records the total reflected light from the subject, it will not give the correct exposure required unless it is used with care.

In general, it is advisable to expose for the shadows and to allow the highlights to look after themselves, and as the recordable brightness range of a film is 120:1 this rule is quite admissible.

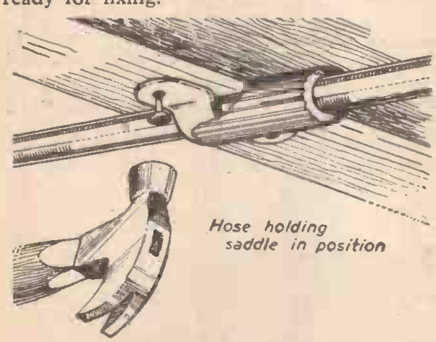
To determine the exposure required for an open scene, therefore, it is essential to exclude as much of the sky as possible by pointing the meter downwards. If it were pointed directly towards the scene the overpowering brightness of the sky would give a higher reading and a correspondingly shorter exposure, so causing the foreground to be only a silhouette in the print.

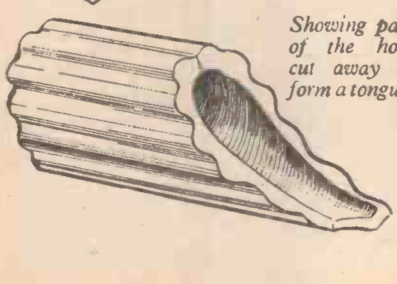
If a subject contains much foreground detail the exposure can be calculated on the average of the shadow and highlight readings.

# Hose Conduit Saddle

By M. LEROY

RECENTLY I had occasion to help an electrician friend to wire up his garden shed. We found difficulty in fixing the conduit by saddles to the overhead joists. To overcome this awkward part of the work I made a clamp out of a short section of rubber hose, split endwise, and one end trimmed to leave a projecting tongue, as shown in the accompanying sketch. In use, the clamp is slipped over the conduit, and the tongue slides over the saddle, thus holding it ready for fixing.


*Hose holding saddle in position*


*Showing part of the hose cut away to form a tongue.*

## MODELLING HELICOPTERS

(*Continued from page 347*)

this each engine can be started separately by cords over the pulleys shown and, when both engines are running, the sleeve coupling is closed and the two parts of the connecting shaft run as one.

Compression is overcome by fly-balls on a shaft extension beyond the worm for each engine.

Obviously, two power units, gears and rotor shafts installed as I have shown would necessitate some sort of frame to take all attachments and bearings. Such a frame could—though it is decidedly not recommended—take the form of a fuselage. A simple, light, wooden frame would be much better.

The calculations for this machine would be the same as No. 2 or 3 in connection with the subject of Fig. 5, but the area resulting would be for one set of rotors only. By this I mean that each end of this coupled-engine machine will, separately, weigh about the same as Fig. 5 and so can be separately calculated or, alternatively, the total weights of everything, including the wooden frame, can be added together and the resulting calculated area divided between four rotors instead of two.

I may well point out here that, unlike full-size machines at present flying, it is necessary on model helicopters to provide two contra-rotative rotors. Were one rotor only fitted, the whole power unit and gearing would revolve in the opposite direction to that of the rotors and, owing to the lessened air resistance, would do so at a greater rate than that of the rotors. I mention this just in case someone has the idea that he would like to make a single-rotor helicopter like a Bristol or a Sikorsky. In models, jet propulsion alone will enable one to do this, since there is then no torque on the machine.

I wonder how many of my present readers saw and perused the article, "Jet Reaction Power Models," by C. E. Bowden, A.I.Mech.E., and published in PRACTICAL MECHANICS issue of August, 1949? If it has not been read, then I recommend a close study of it, for I think that of all motors for driving model helicopters the pulse jet is the most suitable, the lightest, and the most powerful. At the time the above article was written, the smallest jet motor available had a length of about 13in. and this would be much too large and powerful for any rotor blade of reasonable or convenient size. I have heard of nothing smaller which has been produced since, but what is required is a jet unit of about one-half the diameter and length of, say, the British Juggernaut, that is to say, about 7in.

Such a pair of jets would drive a rotor having detachable blades, detachable for convenience in transport, of about 4ft. or 4ft. 6in. in length. Obviously, such a helicopter would have to be released on a line, and if properly designed would hover vertically overhead. It should also be capable of radio-control.

# Studies in Electricity and Magnetism

## Current Directions : Electric Distribution Mains : Electromagnetic Quantities

(*Continued from page 308, July issue*)

WE do not talk of wires being cut by electric fields, but as they are perpendicular to the earth's surface (*along* the length of a vertical rod), we might calculate the induced E.M.F. from electrostatic considerations.

However, a moving electric field *gives rise to a magnetic field at right-angles to it*, and hence horizontal as in Fig. 6. This is only a generalisation of the well-known fact that "moving electric charges" (=moving electrons=electric currents) create magnetic fields at right-angles to their direction of motion—the magnetic field around a current-carrying conductor.

So, we may think of a vertical aerial as being cut by magnetic lines—also moving at the velocity of light.

If the magnetic field is exactly at right-angles to the aerial, it is relatively a simple case of applying the BLv. formula to estimate the induced E.M.F. in volts—or, rather *micro*-volts ($\mu$V), since the field strength is minutely small.

### E.M.F. Induced in an Aerial

As we are dealing with field intensities "in air," the symbol "H" will be used instead of "B," where H=the density in lines per sq. cm. L is the length of the vertical rod in cms. or metres, and v=the velocity of light—the velocity of a magnetic field travelling through space, relative to a stationary conductor.

Radio field strengths (H) are often given a.c. *R.M.S. Values*, to enable us to calculate the induced volts as registered by an A.C. voltmeter—though such instruments are seldom used at radio frequencies. Then :—

Induced E.M.F. (in volts)=HLv$\times 10^{-8}$, where H and L must be expressed in the same units as v, e.g., if v=*metres* per sec., we must either express it in *centimetres*/sec., or convert the other units.

Now, v=$3\times10^{10}$ cms./sec., and if, as is usual, L is given in metres, we have :—

$$E \text{ (in volts)} = \frac{H\times(L\times100)\times3\times10^{2}}{10} = HL\times3\times10^{4},$$

where H=R.M.S. magnetic field strength in lines per sq. centimetre.

As the field is exceedingly weak, the answer will be some small fraction of a volt—a few millionths of a volt, or microvolts. To convert to $\mu$V, we multiply the above expression by $10^6$ (1 million), giving us finally the interesting result that :—

$$E \text{ (in } \mu V) = HL\times3\times10^{4}\times10^{6} = HL\times3\times10^{10} = HL\times \textit{Velocity of Light in cms./sec.}$$

As a numerical illustration : suppose the length of our rod is 10ft.=3 metres approx., and the measured magnetic field strength in a district is H=$1.11\times10^{-9}$ (=$1.11/10^9$). Then, as long as we may suppose magnetic lines cutting the rod at right-angles :—

$$E = 1.11\times3\times3\times10 = 1.11\times9\times10 = 99.9 \text{ or say } 100\ \mu V.$$

### About "Positive Directions"

Magnetic concepts as a whole are difficult to get hold of, and, indeed, we may doubt whether the mathematical theories depict "real" things. Many convenient theories "work" in practice, after physicists have discarded them.

In pure physics, the old conventional idea of current flow from + to − has gone by the board, while still retained in electrical engineering. Such hypotheses, such as the "ether," were found inadequate when it came to explaining certain baffling effects in light.

Those are the deep waters of science on which there is still much uncertainty. What I wish to discuss briefly are a few more magnetic concepts, for example, the "positive direction" of a field.

### Arbitrary Conventions

All positive directions—electric and magnetic—are arbitrary conventions. There is nothing "absolute" about calling one end of a magnet a N.-pole, or imagining lines of force emanating from that end and entering the opposite S.-pole.

Our right- and left-hand rules, etc., are built upon that convenient fiction. As long as we have a "fiction" everybody agrees upon, the rules may at least be consistently applied to practical problems.

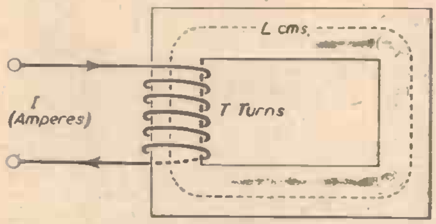



*Fig. 7.—Electric and Magnetic "Circuits." The electric current has a "copper path" via the coil ; the magnetic "flux" has an "iron path" (or "circuit") via the core. The coil gives rise to an M.M.F.=about 1¼ times the ampere-turns.*

It does not matter in the slightest whether "lines of force" (if they have any more than a mathematical reality ?) emanate from N. or S.- poles, or whether the earth's magnetic poles in the geographical meridians (or nearly so) are really "North" or "South."

But electrical engineering would be in a sad state if right- and left-hand rules were taught at one and the same time as applicable to the same phenomena !

As seen from the BLv. equation, physicists and electrical engineers have developed very useful ideas which can give us tangible answers in terms of other electromagnetic quantities. And that is all that is required.

### Magneto-motive Force (M.M.F.)

We will conclude by considering briefly one or two more magnetic quantities.

Early electrical engineers—the founders of modern electrical technology—followed Faraday's tradition of trying to conceive or form clear mental pictures of physical phenomena ; a method which still has much to recommend it, where "pictures" are possible at all.

Efforts were made to develop a sort of "Ohm's Law" for *magnetic circuits*. A magnetic *circuit* was regarded as any closed path, say a complete iron path, Fig. 7, in which a "magnetic flux" was conceived to "flow," like an electric current.

Current=Electromotive force÷Resistance, so, to simplify calculations, Magnetic Flux was thought of as something given by *Magneto-motive force*÷"*Reluctance.*"

The M.M.F. was treated as analogous to an E.M.F. ; not an electrical, but a magnetic force generated by a current-carrying coil, and expressed by :—

$$M.M.F. = 0.4\pi.IT,$$

where I=current in amperes ; T=the turns ; or, I$\times$T=*Ampere-turns.*

As $0.4\pi=1.25$ approx., the M.M.F. set up by a coil is about 1¼ times the Ampere-turns. Theoretical considerations show that it represents a "fall of magnetic potential," proportional to the work done in *ergs*, in carrying an isolated N.-pole (a "unit pole") along the coil axis against the attraction of the coil's S.-pole—or repulsion of the coil's N.-pole.

Then the magnetic circuit was given a "Reluctance" ; a quantity analogous to electrical "Resistance," which may be calculated from the dimensions of the core, and its magnetic *permeability*. Dividing the M.M.F. by this, gives the *total flux* N, i.e., the total number of lines set up, as distinct from the flux-density (B=lines per sq. cm.).

The latter is simply, N/A, where A is the area traversed by the flux. Dividing M.M.F. by the axial length (L) of the coil, gives another quantity, the *Magnetising Force* (*H*), which we will only mention in conclusion.

## A Radio-sonde

ONE of the many interesting exhibits shown by the General Electric Company at the Festival of Britain is the Radio-sonde Mark II. It is on view in the Dome of Discovery, and was manufactured by Salford Electrical Instruments, Ltd., a subsidiary company of the G.E.C. The Radio-sonde was developed in conjunction with the British Meteorological office. Elevated by a hydrogen-filled balloon it measures pressure, temperature and humidity up to a height of about 65,000ft. The instrument comprises, in the main, a radio transmitter, amplitude modulated by three units which convert pressure temperature and humidity into audio frequency. Each meteorological unit is successively switched in the modulation circuit of the Radio-sonde, and is picked up by means of a radio receiver and the frequency determined by an interpolation oscillator on the ground.

*The Radio-sonde, Mark II.*

# The World of Models

## Northern Models Exhibition : Model Railway Club Exhibition : I.A.C. Trophy

By "MOTILUS"

THE Third Northern Models Exhibition held last March brought together an amazing variety of models under the domed glass roof of the Corn and Produce Exchange at Hanging Ditch, Manchester. Apart from the many competition entries, which were judged by leading model celebrities, there were a great many loan models to swell the throng of fascinating, sometimes intricate and sometimes amusing exhibits.

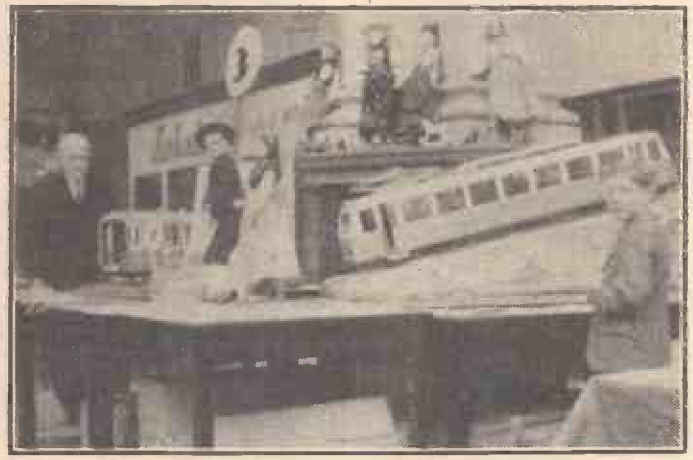


*Fig. 1.—This stand at the Northern Models Exhibition was devoted to international models and craft work. One of the Swiss railway models can be seen side view; it represents one of the coaches running on the mountain railway between Montreux, Caux and Rochers de Naye.*

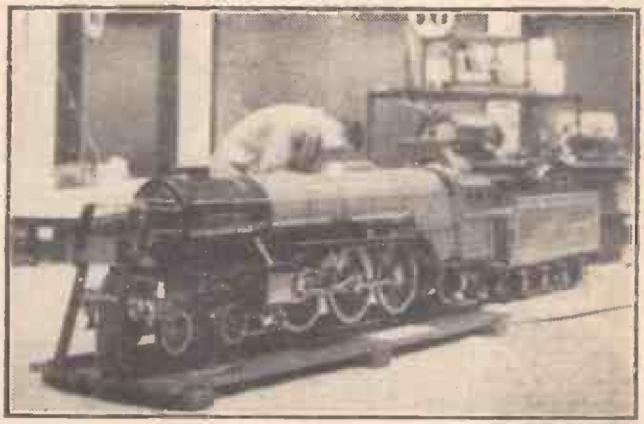


*Fig. 2.—Northern Models Exhibition. A finished model 4-6-2 Pacific locomotive, "Hielan' Lassie," built by Mr. A. G. Bates, of Coventry. This model won first prize for steam locomotives above gauge o size.*

An International Section was a praiseworthy addition to the attractions of this exhibition. This featured a selection of work and models from overseas, loaned through the co-operation of local Consulates (Fig. 1). Two large Swiss models of mountain railway coaches, perched at appropriate angles on their rocky bases, were outstanding. One represented the driving coach of the Montreux electric funicular rack railway to Rochers de Naye; the other was a 4in. gauge (10mm.) Bernese Oberland coach model. This international section also included a selection of craft work by European voluntary workers, now residing near Manchester.

Members of the Northern Association staffed a model engineering workshop throughout the exhibition, where visitors could watch them at work. The stand also featured various models working on compressed air, and an old favourite, the now well-known steam roundabout of Mr. W. Stables, of Ulverston, who was there to operate his model for the entertainment of young and old.

A working models arena was once more a central point of the well-filled hall, where demonstrations of working model aircraft, and of radio-controlled models, took place at intervals.

It seemed to me that there were a surprising number of entries in the competition model aircraft classes. The large number entered must surely indicate a high degree of popularity for model aeroplanes of all types. Many prizes were awarded and the Championship Trophy went to Mr. C. D. Fitzpatrick, of Southport, for his lovely semi-scale sailplane, which had a wing-span of quite 9ft.

In the locomotive section, Mr. A. G. Bates entered an excellent model of a 4-6-2 Pacific *Hielan' Lassie* (Fig. 2), which won him a well-deserved first prize in the class for steam locomotives over "o" gauge. Also first prize winner was Mr. L. R. Raper, of Horbury, for his incomplete 0-6-0 saddle tank contractor's locomotive, for which outstanding model he also won the Members' Cup and the *Evening Chronicle* Trophy.

*Fig. 3.—A fine 4ft. cabin cruiser model, for which Dr. J. W. Greenhalgh was awarded first prize in the class for working steam and power boats at the Northern Models Exhibition.*

### Model Ships and Power Boats

Marine models were of almost every kind one can think of: from gaily coloured galleons to practical, buoyant hydroplanes. A waterline model, of s.s. *Beaconstreet*, by Mr. D. S. Anthes, of Sheffield, was outstanding for its good detail work and won not only first prize in its class (non-working sailing ships), but also the Myford Trophy and the championship cup for marine models. In the class for working steam or power boats, Dr. J. W. Greenhalgh, of Withington, won first prize for his lovely 4ft. cabin cruiser model (Fig. 3). As always, Dr. Greenhalgh showed that a working model can also be admirable for its fine finish.

As previously mentioned, this exhibition showed an amazing variety of interest in models, and there were plenty of entries

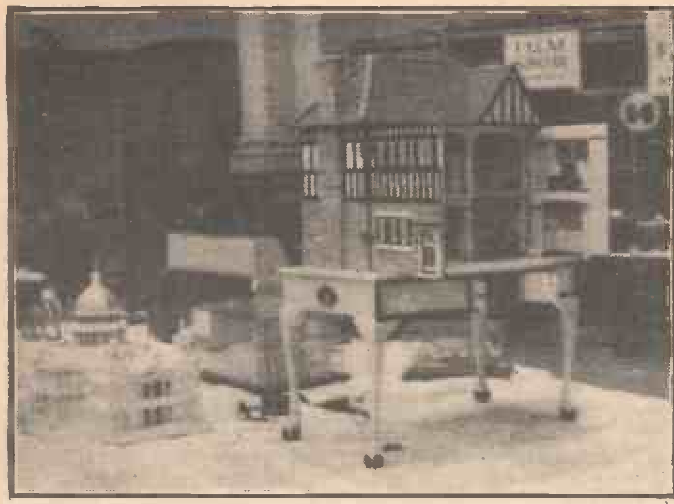


*Fig. 4.—Some interesting models in the architectural section of the Northern Models Exhibition. In the foreground is Mr. T. W. White's fitted doll's house, which included electric light and television. On the left stands a model of St. Paul's Cathedral, made by Mr. E. Morris.*

in the competition sections for general engineering models, marine engines, internal combustion engines, road vehicles, racing cars, tools and workshop appliances, scenic and architectural models (Fig. 4) and others in varied miscellany. The junior sections, too, were well supported.

One last attraction deserving mention was the periodical showing of a selection of 16 mm. sound films on models and other subjects, the series of shows being given by Mr. R. O. Harper, chairman of the Northern Association of Model Engineers.

### Model Railway Club Exhibition

Once again this year, Easter Tuesday saw the Central Hall at Westminster opening its doors on yet another Model Railway Club Exhibition, And once again the hall thronged with visitors from start to finish.

Rides on the passenger-carrying railway were as much in demand as ever by the younger folk. As for the rest of the show, there was no age limit for those who peered and pried with interested attention at models on all the stands.

There were few changes in methods of display. The usual trade stands appeared, to tempt modellers with their wares. The amateur railway models were largely grouped, as is the custom at this exhibition, under regional headings, or on stands devoted to the work of certain model societies and clubs. There still seems to be a wide interest in the small-scale railways: 00 gauge (4 mm. to 1ft. scale) and even smaller gauges. One showcase was devoted to a display of 2 mm. scale models—those miniatures which are so intriguing by the very reason of their tiny size.

Several complete model railway layouts were shown and operated in the Lower Hall during the exhibition (that is, if a layout can ever be said to be "complete," as the owner is always adding to it). These included a simple gauge 0 railway, Mr. P. B. Denny's 00 gauge railway and a still smaller railway to the scale of 2 mm. to 1ft. (9.5 mm. gauge).

Regular visitors would have been disappointed not to see some exhibits from the "K" Lines, Pantry Dockyard Railway of Mr. and Mrs. G. P. Keen. These models always give much pleasure to those who admire accurate, precise detail. There were not many of them on show this year, but they included some excellent steel wagons and a goods brake.

### Gauge 1 Models

The Gauge 1 Model Railway Association had a wealth of material for display on their stand. Many of the models were of special interest, being of various periods in the history of the steam locomotive and other railway stock.

In the London Midland Regional Section there was an interesting historical model of a L.N.W.R. goods train. This model was over thirty years old and was made for the 2in. gauge (7/16in. scale), which was very popular at one time.

Some neat, accurate, working signals for 4 mm. scale appeared on the London North Eastern Regional stand. These had been made by Mr. F. Reynolds and included a bracket signal with electric lighting.

The Medway Model and Experimental Engineering Society displayed an interesting collection of 4 mm. scale railway models, all made by their hon. secretary, Mr. R. J. B. King. These were all working models, made for a two-rail system, from drawings that Mr. King prepared himself. The series is planned to include one locomotive of each of the main companies of our railways at the turn of the century, with correct reproduction of pre-grouping liveries. It also includes a selection of private owners' wagons. All the models have been brush painted and hand-lined.

### I.A.C. Trophy

Trophies for presentation to prizewinners have become very popular during the past fifty years or so. Almost a tradition has been built up in the form that a trophy should take: sometimes it is a shield, sometimes a cup, bowl or case and sometimes a small-scale model, representing some aspect of the sport or hobby for which the trophy is awarded.

A most interesting trophy has recently been given to the Institute of Amateur Cinematographers in London by one of their oldest members, Mr. W. J. Bassett-Lowke. The trophy is a half-size reproduction of a cinematograph projector, based on the Ampro "Imperial" projector, and simplified for modelling purposes (Fig. 5). The model is made of hard wood throughout, except for the two reels, which are chromium-plated metal. The body of the model is finished in bronze colouring and mounted on a pyramid-type plinth finished in ebony.

The complete model makes a most attractive, ornamental trophy, which will be much appreciated by winners. It is being awarded annually for the best film made by any individual member of the Institute of Amateur Cinematographers.

### The Model Engineer Exhibition

The Model Engineer Exhibition will again be held this year at the New Royal Horticultural Hall, Westminster, from August 22nd to September 1st. I understand that there will be many models of a different type from those hitherto exhibited. Radio-controlled model aircraft, ships and tanks, in which so many of my readers are interested, will be the chief features of the exhibition, and indication of the changing scientific and technical interests of the present generation.

*Fig. 5.—A unique and interesting model, made throughout in hard wood, treated with bronze finish, with the exception of the two reels, which are chromium-plated metal. Mr. E. H. Clifton, of Northampton, was responsible for making this model, which was presented by Mr. W. J. Bassett-Lowke to the Institute of Amateur Cinematographers as a trophy for annual award.*


### Problems on Combustion

SIR,—Text books on applied thermodynamics usually give the "tubular" method for the solution of problems on combustion. In the writer's opinion and experience this method is clumsy and slow, and generally inferior to the method based on the equating of coefficients. As this method is not as generally known as it might be, I give below two typical applications.

*Problem* 1.—During the test on an internal combustion engine, using a fuel consisting only of carbon and hydrogen, the following dry exhaust gas analysis was obtained. $CO_2-9.6\%$, $O_2-0.3\%$, $CO-8.0\%$, $N_2-82.1\%$. It is required to determine (a) The fuel-air ratio and (b) The composition of the fuel.

*Solution.*—Write down the combustion equation :

$$\underset{\text{Fuel}}{a\,C+b\,H_2}+\underset{\text{air}}{c\,(O_2+3.76\,N_2)}=9.6\ CO_2+0.3O_2+8.0\ CO+82.1\ N_2+dH_2O.$$

Equating coefficient gives :

For C's, $a=9.6+8.0=17.6$.

For H's, $b=d$.

For O's, $c=9.6+0.3+4.0+\frac{d}{2}=13.9+\frac{d}{2}$

For N's, $3.76C=82.1$.

Solving these equations gives: $a=17.6$, $b=15.8$, $c=21.8$, $d=15.8$.

$\therefore$ Composition of fuel is $C:H :: 17.6\times 12 : 15.8\times 2 :: 87.4\% : 12.6\%$.

And air/fuel ratio $=\frac{21.8\ (32+3.76\times 28)}{17.6\times 12+15.8\quad N_2}=12.34$.

*Problem* 2.—A fuel whose composition, by weight was $C-80\%$, $H_2-12\%$, $O_2-6\%$ and ash 2% was burnt with excess air. The exhaust analysis gave $CO_2-10\%$ and no CO. Determine the percentage excess air, and the analysis of the "wet" products of combustion.

*Solution :*

Combustion equation :

$$\frac{80}{12}C+\frac{12}{2}H+\frac{6}{32}O_2+\ a\ (O_2+3.76\ N_2)=b\ CO_2+c\ O_2+d\ N_2+e\ H_2O.$$

Equating coefficients :

For C's, $b=\frac{80}{12}=6.67$.

For H's, $e=6.0$.

For O's, $\frac{6}{32}+a=b+c+e/_2$.

$\therefore a=9.48+C$.

For N's, $d=3.76a=35.6+3.76\ c$.

Also from exhaust analysis: $b=0.10\,(b+c+d)$.

Solving these five equations gives: $a=14.61$, $b=6.67$, $c=5.13$, $d=54.9$, $e=6.0$.

For theoretically complete combustion "a" would be :

$$\left(\frac{80}{12}+\frac{12}{2}-\frac{1}{2}\right)=9.67.$$

$$\therefore \%\ \text{excess air}=100\ \frac{(14.61-9.67)}{9.67}=51.2.$$

And percentage analysis of wet exhaust gas is given by :

$$CO_2=\frac{b}{(b+c+d+e)}\times.100=\frac{667}{72.7}=9.2\%.$$

$$O_2=\frac{513}{72.7}=7.05\%.$$

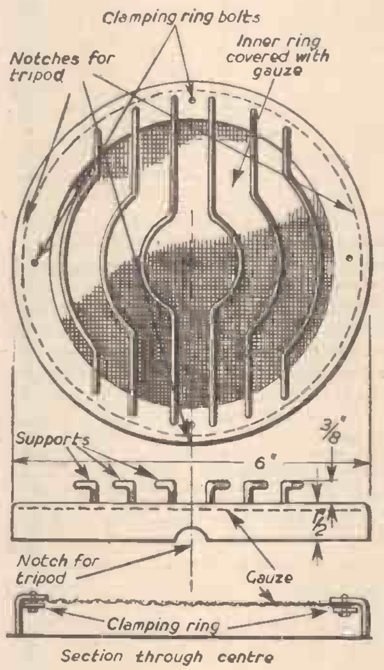
$$N_2=\frac{54.9}{72.7}=75.6\%.$$

$$H_2O=\frac{6.0}{72.7}=8.25\%.$$

—A. M. HELSDON, B.Sc., A.M.I.Mech.E. (Bournemouth).

### Toaster Attachment for Pressure Stove

SIR,—As a camping enthusiast I have many times sat in the tent during wet weather longing for a round of toast. But on a pressure stove this was rather out of the question, due to the flavour of paraffin imparted to the bread, and the difficulty of toasting evenly.




*A toaster attachment for pressure stoves.*

After a few trials I produced a toaster attachment which worked very well and was a convenient size for transporting with the stove.

The accompanying sketch gives a good idea of the attachment.

It consists of an outer ring of tinplate used for supporting the wire gauze and as a base for the wire supports which hold the toast. This was, in my case, made from a stout tin lid, 6in. in diameter, from which I cut out the centre leaving a rim of ⅜in.

Six rods were then bent, as shown in the sketch, and the rim drilled to receive them.

For these rods I utilised some thick wire from a well-known constructor's kit, fixing each rod by cutting a 6 B.A. thread on each end and clamping it to the rim with two nuts. This was done for convenience while experimenting, but the rods could be riveted with ease.

The next stage was to cover the inside of the rim with a fine mesh copper gauze, fastening this by means of a second ring of tinplate under the rim, held in place with four small bolts.

The gauze is best heated first before fixing as it tends to sag if fixed when new.

Finally, I cut three notches in the rim to drop over the three supports on the stove.

When placed on the stove the gauze diffused the flame and became red hot, no flame coming through to burn the bread. At first it tended to be hotter in the centre, but as the gauze sagged from expansion the heat was very well distributed.

Toast was browned very well all over and no taste or smell of paraffin was noticed.

The attachment was made of a suitable size to fit in the box of one of the portable stoves now on the market.—J. JONES (Walsall).

### Preparing Hydrogen Gas

SIR,—I notice that in recent issues of PRACTICAL MECHANICS there have been a number of letters concerning the preparation of hydrogen. A very easy way to prepare it is to allow a fairly strong solution of caustic soda to act upon aluminium, the reaction is :

$$6NaOH+2Al=2Na_3AlO_3+3H_2.$$

The reaction is very vigorous once it has started, and it is violently endothermic; arrangements should be made to cool the apparatus to prevent the reaction becoming too violent. The apparatus may be conveniently made of iron, which is untouched by caustic soda even when fused.—R. HOLLIS (Rotherham).

### Making an Electric Blanket

SIR,—In your issue of May, 1951, an article appears on making an Electric Blanket, by E. E. Cheetham, and I view the transformer circuit with some misgivings; as shown it is quite unsafe to use.

The circuit shows *no earth* on the secondary of the transformer, only an earth on the laminated core. Should a fault develop between primary and secondary turns, 230 volts will be imposed on the secondary winding, which, as you will appreciate, is highly dangerous.

It is standard practice on low voltage output transformers to earth one side of the secondary, then, if a fault develops, the circuit fuse will blow, thereby saving the user of the apparatus from a harmful, if not fatal, shock. —G. A. GODDARD (Slough).

### *The Author's Reply*

SIR,—In reply to Mr. Goddard's letter, re the circuit for the low-voltage electric blanket. I admit that an earth connection to the laminated core was not indicated, partly for the reason that the particular type of transformer used was left to the discretion of the constructor. If a proprietary make of transformer was used the instructions for putting into service are generally enclosed, and a terminal provided for earth connection on the case of the instrument. If an ex-Government transformer were used there is sometimes a separate screen winding interposed between primary and secondary windings to guard against the danger of a breakdown. The present-day transformer is a soundly-made piece of equipment, and is usually tested with a high voltage, much in excess of normal, for leakage between the windings and the core. In the experience of many years I have found that a breakdown between the two windings is a very rare occurrence provided the transformer is not overloaded beyond its rated capacity.

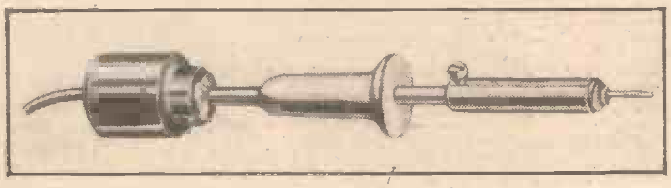
In the unlikely event of a breakdown, it will be obvious to most people that a heavy current from the mains would flow through the low-resistance of the heater elements,

(*Continued overleaf*)

# Trade Notes

### Acru Wood-engraver

THE Acru Electric Tool Manufacturing Co., Ltd., 123, Hyde Road, Ardwick, Manchester, 12, are now marketing a new tool known as the Acru wood-engraver, an electrically-heated pencil which can be used by craftsmen and amateurs for a variety of purposes, such as wood, leather or cork burning, forming plastics, sealing Cellophane, foil embossing, soldering, etc. The most general application of this tool will be for embossing purposes in many trades and industries. Any material as hard as glass or as soft as rubber can be embossed with foils which can be supplied in 10 different colours. A complete set is available, comprising the Acru wood-engraver with 5ft. of two-core cable, four different brass bits and one pad of eight different colours of embossing foil, in a cardboard box. Spare elements (30 watts) and kits are obtainable. Further particulars and prices are given in an illustrated leaflet which may be obtained on application to the address given.



*The Acru Wood-engraver. An electrically-heated embossing tool.*

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AS a result of the great expansion of their export trade Messrs. Chamberlain Industries Ltd., Staffa Road, Leyton, London, E.10, have now found it necessary to appoint agents for the U.S.A., Egypt, Italy, British West Africa, Tanganyika, Iran, Irak, and Turkey. An agreement has been signed with General and Overseas Trading Corporation Ltd., 50, Gresham Street, London, E.C.2, who will act as their agents for bending machines and other "Staffa" products already widely used in the U.K. by all associated with the garage and building trades. The agent will also deal with inquiries for the plant and steel divisions of Chamberlain Industries.

## Books Reviewed

**Basic Thermodynamics. By Charles Leonard Brown. Published by McGraw-Hill Publishing Co., Ltd. 266 pages. Price 38s. 6d.**

THIS volume, which is intended as a text-book for engineering students, is designed to teach the first and second laws of thermodynamics and their applications to the study of the devices which convert heat into work or use work to transport heat. It also includes a short section on the elements of heat transmission as they relate to power generation and refrigeration. The author has endeavoured to reduce formulas to a minimum in order that the student may spend more time on analysis and less on memorisation. Considerable space has been devoted to the gas turbine in its modern form, and the combination steam power and heating cycle is also discussed. Jet propulsion is briefly covered, and there is a chapter on elementary heat transmission.

**Cycling Book of Maintenance. Published by Temple Press, Ltd. 120 pages. Price 2s. 6d. net.**

THE third edition of this handbook has been fully revised, and contains up-to-date information on the upkeep of the bicycle, its fittings and accessories on the latest models. In the pages of this handy little book every part of the bicycle is "dismantled" to show how it works. The method of construction and the adjustments required are clearly explained. The book is illustrated with numerous line drawings.

## LETTERS FROM READERS

(*Continued from previous page*)

and the fuses in the mains plug lead would immediately blow before causing any damage.—E. E. CHEETHAM (Stockport).

### Moulding Composition for Making Dolls

SIR,—May I point out to your enquirer (J. Lane, London, E), that making dolls in anything like large quantities is a very complicated business. Whatever method is used quite a lot of equipment is necessary. Pumice and glue is the cheapest as far as material is concerned. It also requires special machinery, and there are heaps of little snags. Pinholes abound. Unless he is prepared to do a fair amount of handwork he will have a lot of scrap on his hands. Shrinkage is about 20 per cent.

Catacast is not now obtainable, and, anyway, it will take a lot of time to get used to it. The same applies to Catalure. And to make the dolls hollow, which is the usual practice, is no easy job.

Magnesite doesn't lend itself at all to hollow casting though it is very excellent for some purposes.

The competition in doll making is very fierce. I think your enquirer might try the spraying method. This only requires a good power spray and the necessary moulds. Here again the moulds are rather expensive, and they are for rigid dolls. But I don't see any reason why it should not be possible to get moulds for heads, torso, legs and arms all separate.

If Mr. Lane can make his own moulds, that's another thing, but doll making requires a lot of experience and artistic ability. I know some manufacturers who send out dolls' heads for process painting.

I have read one or two books on the subject but, like all books on similar subjects, they made it all seem so easy by not mentioning the difficulties.

A fair-sized workshop is essential, as the work is not the kind of thing one can do in a small room. If he uses a spray, ventilation is very important. Most people have a fan drawing the air from the worker to the object, and then out of the room.

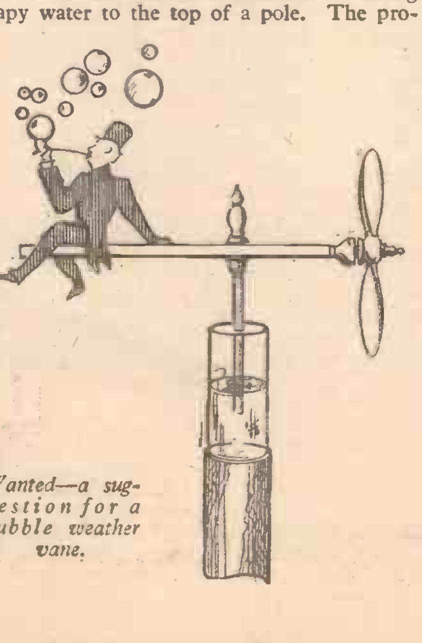
Of course in the glue pumice method the materials have to be mixed hot and then poured into a frozen mould, and after a short time (depending on the thickness required) the mix is poured out of the mould again leaving a thin hollow casting in the mould. But it has to be dipped several times in paint to preserve it from damp.—C. THOMPSON (West Kensington).

### A Bubble Weather Vane

SIR,—I shall be glad if any of your readers can help me in the design of a "Bubble Weather Vane," as shown in the accompanying sketch.

The idea is to mount a container containing soapy water to the top of a pole. The propeller will have to supply whatever power may be necessary to churn the liquid and produce bubbles through the pipe on the figure. The whole, will, of course, turn with the wind.

Bubbles should emerge from the pipe singly and not too quickly.—W. E. BROWN (Devizes).



*Wanted—a suggestion for a bubble weather vane.*

### Law of Gravitation

SIR,—I feel that the "Sidetracks," of Mr. Hart's and Mr. Bryant's letters (June issue), call for reply.

The only object of any language is to be understood, and my Concise O.D. gives:

Resist = repel.
Repel = repulse.
Repulse = drive back.

If Mr. Bryant stands in his "bucket" and extends the handle through "tackle" to the "basket of his balloon," he will find that he can elevate not only himself but me as well by pulling at the handle.

My best wishes to Mr. Hart and Mr. Bryant and I thank them very much for replying to my "Are you quite sure problem."—H. A. D. JOSEPH (Epsom).

## Club Report

**Aylesbury & District Society of Model Engineers**

THE May meeting, held as usual at Hampden Buildings, Temple Square, was devoted to a talk by Mr. F. R. Forest. Mr. Forest spoke with first-hand information on the techniques and snags of model boiler construction, and made his talk additionally interesting by following it with a demonstration braze-up of one of the members' boilers, which proved very successful.

An enjoyable evening was had by all the members present.—E. H. SMITH, hon. secretary, Mulberry Tree Cottage, Devonshire Avenue, Amersham, Bucks.

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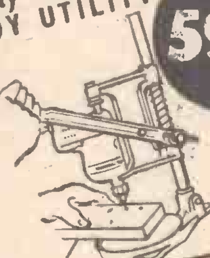

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## Calculating the I.H.P. of an I.C. Engine

**IN calculating the I.H.P. of an engine by using the formulae $\frac{PLAN}{33,000}$ what pressure does the exploding petrol vapour exert on the piston head of an I.C. engine ?—R. Simpson (Barnet).**

IT is not possible for us to give you a precise figure in reply to your query about explosion pressures in internal combustion engines, since such a figure would vary with the conditions under which the explosion occurs. It is influenced, for example, by the calorific value of the fuel, by the percentage of air or oxygen with which the fuel vapour is mixed, and by the extent to which the mixture is compressed in the cylinder head prior to its ignition, i.e., by the compression ratio of the engine.

Taking two instances, however, in which engines have compression ratios of 4 and 5 respectively and the fuel mixture at the beginning of the compression stroke is at normal atmospheric pressure (say 14.7 lb./sq. in.), the mixture pressure at the end of the compression stroke will be 85 lb./sq. in. in the one case and 105 lb./sq. in. in the second case. As soon as the mixtures are ignited the pressure above the cylinder head will rise with great rapidity to a maximum. With a compression ratio of 4 the maximum pressure rise is about 200 lb./sq. in., and with a ratio of 5 the maximum pressure will be around 260 lb./sq. in. To these figures must be added the mixture pressures before ignition, so that the total maximum pressures above the piston head will be 285 and 365 lb./sq. in. respectively for engines having 4 and 5 compression ratios.

These figures are not exact. They vary according to the composition of the mixture, its calorific value, the design of the engine, and other factors as well. Nevertheless, they form a good average, and they will be suitable to base your calculations on.

## Cellulose Acetate Adhesive

**CAN you inform me as to what is the composition of the quick-drying plasticised cellulose acetate adhesive used by the makers of glass fibre ? Also can you give the formula for making a satisfactory adhesive for jointing cast resin tubes to Perspex ?—R. Cox (Ormesby).**

WE cannot tell you the composition of the adhesive used by the makers of glass fibre. That is solely the trade secret of the manufacturers, and it has never been published.

You can, however, make a cellulose acetate adhesive by dissolving cellulose acetate in propylene oxide. This will give a very rapid-drying adhesive, but it is difficult to make on account of the volatility of propylene oxide. A more controllable and slow-drying cellulose acetate adhesive is made by dissolving cellulose acetate in methyl cellusolve. The quantity of cellulose acetate dissolved in either of the above-named liquids will depend on the actual viscosity which is required of the adhesive. In either case, the resulting adhesive is plasticised by adding to it about half per cent. of its weight (not more) of dibutyl phthalate.

The only satisfactory Perspex adhesives are obtained by dissolving scrap Perspex in trichlorethylene. These have a rubbery consistency and character, but are quite transparent. Perspex will not dissolve in the ordinary solvents used for synthetic adhesive making.

## Destroying Tree Stumps

**I SHALL be grateful for your assistance on the following problem :**

**I have a number of tree stumps to be removed. Is it possible to destroy these by chemical means and if so what are the necessary ingredients ? I have seen an advertisement in an American magazine for such a substance.—R. A. Wilson (Watford).**

IT is readily possible to kill tree stumps and to prevent their re-growth. This is effected merely by cutting out several hollows or large holes in the stumps and by filling these with creosote, copper sulphate solution, zinc chloride solution, sulphuric acid or any other corrosive and penetrant substance. It is altogether a different matter to destroy a tree stump so that it would not have to be removed mechanically. The American preparation which you mention would comprise an alkaline solution, such as a solution of caustic soda, which would penetrate the wood, dissolve out the constituent resin and gradually rot the wood fibre, reducing it to a spongy mass which could be removed with very little trouble. Our opinion is that such methods are hardly of any value. They are far too slow, taking months for completion, and the rotted portions of the stump still require removal.

The best way to remove tree stumps is to chop them up as far as possible with an axe. Those which still remain in the ground should be hollowed out to a small depth and treated by one or other of the above chemical solutions, all of which are common and inexpensive materials and are obtainable from any local firm of drysalters or wholesale chemists in the locality.

## Preparing Stonework for Painting

**I AM intending to paint over cast stone and cement pillars with oil-bound paint or lacquer. Would you kindly advise me as to :**

**(a) The preparation that is needed for cast stone and cement before painting.**

**(b) As to whether there are any proprietary brands of preparation for stonework, etc.**

**(c) Whether applying vinegar to the stonework is of any use as a preparation. The latter is supposed to be an old painters' tip.—H. W. Thomas (Croydon).**

WE would not recommend the treatment of real stonework with vinegar prior to painting, particularly in the case of a soft stone or a limestone, because the vinegar might set up corrosion which would proceed slowly under the paint.

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

In the case of a concrete, however, vinegar may be of some use because it will help to destroy the surface alkalinity of the concrete surface. You have to remember that concrete is essentially alkaline and that, in time, this alkalinity tends to saponify the binding oils of the paint, thus destroying them and causing the paint to powder and fall away. You cannot wholly destroy the alkalinity of the concrete. That is why paint on concrete does not last its full life without, at least, some type of deterioration.

In painting concrete, avoid at all costs a cheap paint. Use one having a good oil medium. We suggest that you give the concrete surface a good scrubbing down with plain water (nothing else). Let it dry out. Then apply your vinegar treatment, if you wish. Let this dry out. Subsequently, give the surface a coat of any good priming paint (grey primer, white lead, red lead, red oxide paint, etc.). Even aluminium paint can be used as a very effective primer. Finally, after this coat has dried out and hardened, apply the surface coat. One substantial coat will be quite sufficient, particularly if you can renew it periodically. A good oil paint will be the most satisfactory for this purpose. There are no proprietary paint brands made specifically for stonework; at least, there are no high-gloss oil paints, but there is a preparation known as "Snowcem," which is a sort of distemper-like paint for cement and concrete surfaces. This is obtainable at most large paint shops.



## Removing Tar from Bacon-curing House

**I HAVE a bacon-curing (smoking) house which in the course of years has become thickly coated with wood tar. This tar drips from the roof in damp weather, and needs removing. For years the procedure for removal has been with blowlamp (the tar is not inflammable) and scraper, a long and arduous task.**

**Can you suggest a chemical or any better means of removing the tar ?—S. Johnson (Hull).**

YOU can only remove the excess of wood tar from the roof and walls of your factory either by mechanical scraping, by solution methods or by chemical treatment.

If regular scraping methods are not desirable, you may be able to dissolve the tar away by treatment with paraffin or solvent naphtha. Most tars are soluble in these liquids. The solvent would have to be brushed on to the tar deposits in order to thin them, after which the area would have to be mopped with an absorbent mop and finally washed down with paraffin. This is a fairly easy treatment, but it has the objection of giving rise to fumes of paraffin or naphtha which may be very undesirable in a food factory such as yours.

A third, and a chemical, method is to dissolve the tar by means of caustic soda. Dissolve 1 part of caustic soda in 5-6 parts of water and swab this solution (preferably hot) over the tarry areas. The tar will dissolve in the caustic quickly and can thus be mopped away. The areas will require plenty of fresh-water swilling afterwards in order to get rid of the caustic. The disadvantage here is that the caustic solution attacks the underlying parts, window frames, metal parts, wood, paint, etc. It will not, however, give rise to any odours, and it can be bought cheaply from any druggist or pharmacist.

For maximum safety we can suggest nothing better than your present cautious blowlamp and scraper method of removal.

## Eradicating House Bugs

**I AM moving into a house which is not new, and I have been told that it is not clean and there are bugs in the walls. Could you tell me an effective remedy for removing these ? I might add that I intend to strip off all the old wallpaper.—A. Robinson (Leeds).**

THE speediest method for the eradication of house bugs is the method of hydrocyanic acid fumigation. This, however, you cannot do yourself, since, owing to the excessively poisonous nature of the fumigant, the method is now legally surrounded by all sorts of restrictions.

However, there is no cause for alarm because you cannot apply this certain method. If the house has been empty a long time (which is hardly possible in these times !) you would find it quite free from bugs. Otherwise, you will have to undertake the systematic elimination of these pests yourself. Begin by scattering a good D.D.T. or Gamexhane powder into all cracks and crevices in the house—particularly at the back of picture mouldings, skirting boards and door frames. Having done this, get on with the job of de-papering the rooms and, this done, brush hot creosote on to all the floorboards.

All this should be done before you take your furniture into the house. In carrying out this work you need not fear any personal contamination with the bugs, since these creatures do not normally live on the person, their habitat being usually the chinks and crevices in woodwork as above indicated.

The creosote will be absorbed into the wood very quickly and, at this stage, the house can be decorated, either by re-papering or, preferably, by distempering. The woodwork can be re-painted if necessary, otherwise it should all be washed down with paraffin containing just a little creosote—just sufficient to colour it a strong yellow or light brown.

This done, scatter more D.D.T. powder on to the picture mouldings, etc.

The house can now be lived in quite safely. It is true that any bugs which have escaped the above treatment and have buried themselves in the walls may attempt to return, but the constant use of the D.D.T. powder will entirely eradicate them before they have had any time to make their presence felt. Remember that the bugs tend to confine their attentions to bedrooms. It is these rooms, and the passages leading to them, which should be given especial attention.

## Miniature "Snowstorm"

**I HAVE been experimenting with a small "snowstorm" novelty—a snowman or some such figure enclosed in a glass sphere, together with a substance that when shaken gives the appearance of slowly falling snow.**

**I have tried benzoic acid and water, and also naphthalene plus water as "snow" mediums, but neither are successful.**

**Can you please give me any information on this subject ?—J. J. Brown (Cardiff).**

FOR your experiments you require a white material of suitable particle size which is insoluble in water and which is able to resist the disintegrating effects of water. A white barytes would be suitable for you, although this material is very heavy and, for your requirements, it might sink too rapidly after being shaken up in the water. Alternative and light materials are: white quartz, marble, white spar, white granite. It is important that you use any such materials in a constant particle size. You should not have the material in the crushed or ground condition, because such material will contain coarse, fine and "dust" particles. It will, therefore, be necessary for you to purchase the material in the "coarse lump" condition and then to powder it yourself in an iron mortar, subsequently sieving the material through the mesh which will just pass the particle size which you require. The material passing through this mesh is then sieved on the next finer mesh. This will result in the particle size of material which you want being retained on the latter mesh. This latter material will be of "constant particle size." It will be free from the smaller particles and from the larger particles. A No. 32 standard mesh should give you the right size of particle.

Any of the above materials can be obtained in small lots from Messrs. Vicsons, Ltd., 148, Pinner Road, Harrow, Middlesex.

## *Soapless Detergent—for Window Cleaning*

**CAN you inform me if there is a liquid, or oil, that I could use to make window cleaning easier, especially when the windows get very dirty and difficult to dry off to a nice shine ? I have been window cleaning for several years and the method I have found best for cleaning is to use a pail of clean water, a leather and scrim cloth ; the leather to clean the dirt and the scrim cloth to wipe the smears off and bring a polish on the glass. I find a spoonful of paraffin in the water helpful at times, although the paraffin seems to lose its effect if used regularly. Is there something that could be used to loosen the dirt, speed up drying in a muggy atmosphere, and make it easier to polish the glass ?—S. W. Barnaby (Hounslow).**

CONTRARY to common opinion, the practice of adding a little paraffin to the water which is used for window cleaning is not good. As you say, you get, perhaps, good results the first few times, but usually the good results are not maintained.

Paraffin is not soluble in water. When added to water it breaks up into small globules when stirred and, because of this, it exerts a slight lubricant effect on the contact between window and wash leather. If perfectly pure paraffin could be obtained, things might not be so bad but, usually, paraffin contains traces of heavier oils (paraffin itself being an oil of a volatile nature). Now, these oils gradually get absorbed into the wash leather and, being insoluble in water, they are not removed by the normal washing and cleaning of the leather. Consequently, the leather becomes more and more charged with these heavy oil impurities in the paraffin. A heavy oil film gets on to the window glass. This attracts dirt and, as you say, it makes the window difficult to dry off. In bad cases, you will have noticed that the window surface actually takes upon itself an iridescence or rainbow-coloured appearance, this being directly due to the presence thereon of a film of oil.

For ordinary windows use clean water only. If the windows are very dirty and greasy, add a little washing soda to the water or, alternatively, a little soap.

If you want to try out a new material, there is a very effective degreasing liquid known as "Teepol-X." This is a synthetic detergent of a soapless nature. Add 1 teaspoonful of Teepol (not more) to each pailful of your washing water. This material is non-oily and it is a highly-active dirt and grease remover. It will speed up your work. The degreasing action of this material is so powerful that, even at the above dilution, you may find that it will extract the oil from your hands, causing them to chap. If this happens, use less Teepol to each pail of water.

Teepol-X is produced by Shell Chemicals, Ltd., 112, Strand, London, W.C.2, price about 15s. per gallon. This would last you a long time, and for your own experimental trials it would certainly be too large a quantity to get. Perhaps this company might let you have a small sample if you stated your case. Alternatively, you may be able to procure smaller amounts from one of the London chemical and laboratory dealers, such as Messrs. Griffen and Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2.

## *Engine-noise Reduction*

**I HAVE a watercooled I.C. engine which is covered in with sheet metal and, in an endeavour to reduce noise, am considering covering the outside of the casing with felt glued to the metal with silicate of soda.**

**In your opinion will this result in an appreciable improvement, and can you suggest alternative or additional methods ? The general mechanical condition and rubber engine mounting are satisfactory.—R. T. Lawrence (Hornchurch).**

THE cementing of a felt layer to the inner sides of your sheet metal cover would not appreciably damp out the noise of the engine, although it would prevent the sheet metal cover from rattling and/or vibrating in sympathy with the engine vibrations. The only way to alleviate the trouble is to construct a sort of double cover, leaving about a 1in. space between the two surfaces. This space should be filled loosely with fibrous material—loose felt, hair, kapok, fibreglass, etc.

## *Black Etching Acid*

**CAN you give me the addresses of any firms who produce black etching acid for use with rubber stamps, for etching identification marks on polished cast iron parts ?—L. G. (Leeds).**

THE etching fluid which you require is usually a dilute solution of hydrochloric acid or sulphuric acid, although sometimes it contains both these acids. You will be able to obtain these acids from Messrs. Reynolds and Branson, Laboratory Furnishers, of Leeds. If not, apply to Messrs. Goodwin, Tidswell, Ltd., Cheetham, Manchester, or Messrs. Vicsons, Ltd., 148, Pinner Road, Harrow, Middx.

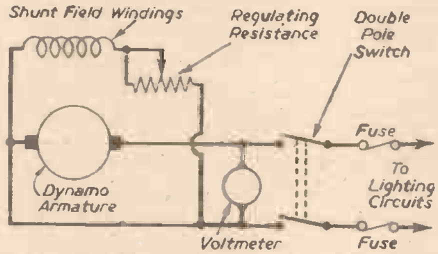
## *Petrol-driven Generating Plant*

**CAN you advise me how I could use my D.C. dynamo (24 volts, 1,500 watts) and petrol engine of 1¾ h.p. and 1,000/3,000 r.p.m. to ensure that the right revolution is maintained at low engine speeds, as I doubt the rating of the dynamo which is supposed to be between 2,000/2,500 r.p.m. I used a 9in. pulley on the engine and a 3½in. pulley on the dynamo. After connecting the dynamo and starting the engine I find no lighting results, and I ask :**

1. **What simple wiring may I use ?**
2. **What gauge of wire ?**
3. **Is the arrangement of pulleys effective ? Note : The distance between centres of dynamo pulley and engine pulley is 21in.**
4. **What fuses and other accessories must I use ?**

**I do not want to bother about batteries as I wish to start lighting direct by running my engine and dynamo all the time.—J. W. A. Egbe (Warri, Nigeria).**

IN order to obtain maximum output from the engine it should be run about its maximum speed. The dynamo, however, should not be run above its normal speed, unless it is of the third brush type and used with batteries, because an excessive current would




*Circuit diagram for a small petrol-driven generating plant.*

otherwise flow through its shunt field windings and damage them. From the information forwarded it would appear that the best plan would be to use pulleys of similar size on the engine and dynamo.

The failure of the dynamo to build up voltage may be due to causes such as loss of speed due to belt slip or engine fault, or the dynamo being run in the wrong direction. This could be remedied by reversing the rotation or by reversing the connections between the shunt field coils and the brushes.

Refusal to generate may also be due to loss of residual magnetism of the field iron system, in which case the field magnets may need to be re-magnetised by connecting a 12 or 24-volt battery across the shunt field coils alone. The failure to build up voltage may also be due to poor contact between the brushes and commutator resulting from causes such as dirty commutator or brushes, commutator out of truth or having projecting intersegment micas, brushes sticking, brushes worn, or having inadequate pressure, or to the brushes being in the wrong position.

The full load output of the dynamo (62.5 amps.) could be carried without overheating by cables of 0.3 square inch cross-sectional area, i.e., 19/0.044. It is important, however, that the dynamo be fairly near to the supplied lamps because this size of cable will have a volt drop of 1 volt for every 28ft. run of cable, when loaded to 62.5 amps. On a long run larger cables may be necessary to minimise volt drop on the cables, unless the load is constant at all times, in which case it might be possible to adjust the dynamo to generate a rather higher voltage in order to compensate for the cable volt drop. For the protection of the dynamo, fuses rated at 60 amps., melting at about twice this value, are suggested.

The accompanying sketch shows the connections. The equipment advised is a double-pole switch of 60 amps. rating, two fuses of 60 amps. rating, a variable shunt field resistance for voltage control, and a voltmeter.

## *Sulphurisation of Copper*

**I WISH to copper-oxydise a number of small articles, and would be glad if you could give me some information concerning the process.—D. R. Davidson (Brentwood).**

COPPER is not ordinarily an oxidisible metal, and the term "copper-oxidise" is a meaningless one. We take it that you refer to the darkened copper effect with which many articles of an ornamental nature are turned out. This effect is not an oxidation of copper, but rather a sulphurisation. It can be produced in the following manner on the majority of metals which can be copper-plated.

The thoroughly cleaned and degreased article (you do not mention of what metal they are) are plated in the following simple bath :

| | |
|---|---|
| Copper sulphate .. | 75-100 grams. |
| Sulphuric acid .. | 15 ccs. |
| Water .. .. | 500 ccs. |
| Phenol .. .. | ½ gram. |

(½ gram of gelatine can be used in place of the phenol mentioned above, if desired.)

The above bath is used cold, a sheet of pure copper forming the anode and the work itself comprising the cathode of the bath. Use a current of about 4 volts e.m.f. and plate for about four minutes, afterwards washing in water. The articles are then darkened by transferring them into the following bath :

| | |
|---|---|
| Sodium sulphide | 1 part. |
| Water .. .. | 10 parts. |

In this way the articles will be uniformly bronzed. Non-uniform bronzing is obtained by spotting the above sulphide solution on to the plated articles in restricted areas by means of a small paint brush.

By using the above solution at three or four times the dilution given, lighter shades of bronzing will be obtained. By using the solution stronger, very deep brown-black colourations can be obtained. All these colourations are due, not to the formation of copper-oxide, but to the formation of copper sulphide on the surface of the plating.

## *Waterproofing Paper and Cardboard*

**WOULD you please recommend a method capable, on a commercial scale, of temporarily waterproofing or rendering impervious to "running" a quantity of paper and/or thin cardboard sheets lettered by a carbon paper and spirit duplicator process ?**

**I wish to mark the surface afterwards with pencil or charcoal and require a quick and easy way.—P. M. Coyle (Dublin).**

DISSOLVE 5 parts of gelatine in 95 parts of water. Brush it lightly (when warm) over the sheet or card and allow it to dry slowly without heat. This will NOT waterproof the surface, but it will fix the written characters thereon and will stop them from "running." If you wish to waterproof the sheet, dissolve 1 part of potassium bichromate in 5 parts of water and then add this to the gelatine solution drop by drop until the gelatine solution is coloured faintly yellow or orange. Brush this solution lightly over the sheet as before, and then expose the sheet to strong light (sunlight, if possible) for two or three hours. The action of the light and of the bichromate will completely insolubilise the gelatine, this waterproofing the sheet.

The bichromated gelatine solution must be prepared in artificial light, and it must also be stored away from daylight, otherwise it will slowly precipitate the gelatine as an insoluble mass. If the gelatine solution is to be stored for more than a week or so, add a few drops of oil of cloves or of carbolic acid to it to prevent it from turning mouldy.

Another method of waterproofing the sheets would be to dissolve 5 parts of aluminium naphthenate in 95 parts of white spirit. This is brushed lightly over the sheets, which are then allowed to dry. They will now be waterproof and water-resisting.

Aluminium naphthenate is best dissolved by shaking it in the cold white spirit for a prolonged time. It may take a week to dissolve, being shaken up every day. This material costs about 5s. lb., and is obtainable from Messrs. Thomas Tyrer and Co., Ltd., Stratford, London, E.15.

## *Electrolytic Gas*

**I REQUIRE to construct apparatus to make 126,000 ccs. per sec. of hydrogen and oxygen mixture from the electrolysis of water. Can you tell me what form the apparatus should take, and the volume of water required per minute to run the apparatus ?**

**I have current available, the two following values :**

**12 volts × 200 amps. D.C.**
**12 volts × 20 amps. D.C.**

**—J. Brook (Birmingham).**

THE mixture of oxygen and hydrogen which you mention is produced for trade purposes under the name of "Electrolytic Gas." You appear, however, to require a truly enormous quantity of this gaseous mixture. You would want a very high amperage current, far exceeding your current supply available, to produce electrolytic gas at the rate of 126,000 ccs. per sec., which rate, as you will appreciate, equals a matter of 7,560,000 ccs. of the gas per hour. This would require a very large scale apparatus with either carbon or platinum electrodes. In principle, the electrodes would be mounted on a common insulated base at the bottom of an enclosed vessel, through the top of which the gases would escape. Pure water could not be used for the purpose, because pure water is not sufficiently conducting. You could use water containing about 0.5 per cent. of sulphuric acid and, in your apparatus as we visualise it, the acid would have to be injected continuously into the water as it flowed past a certain point. The electrolytic gas produced by the electrolysis of solidified water would not be quite pure : it would contain traces of ozone and hydrogen peroxide, and a very much purer gas would be evolved by the electrolysis of a dilute solution of barium peroxide. Unless you have a special purpose in requiring such an enormous production of electrolytic gas, we are inclined to think that the figure which you state for your requirements is a misconceived one.

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# Comments of the Month

By F. J. C.

## THE FESTIVAL OF CYCLING

OVER 30,000 people attended the Festival of Cycling at the Dunlop Sports Field, at Erdington, Birmingham. Cyclists from all over the country, lone as well as club, made the journey, and together provided the largest assembly of cyclists ever to attend for a similar function. The events commenced on the Friday evening with an official dinner at the Grand Hotel, Birmingham, with over 220 guests. Representatives of nearly all the leading cycle, accessory and component firms in the cycle trade, cycling organisations, and local dignitaries, including the deputy Mayor of Birmingham, were present.

It was appropriate that the Festival should have been held in Birmingham for, as the chairman, Mr. F. A. Kimberley, said in proposing the toast of the city, Birmingham is the second home of the cycle industry, its first home being Coventry. To-day, of course, it is the greatest centre of bicycle production in England and probably in the whole world. Our contributor, Frank Urry, proposed the toast of "This Cycling Game," and said that the bicycle was the nearest thing to something for nothing, and that the Festival marked the marriage of the sport and pastime of cycling to the industry.

We have already outlined the various events which together made up this noteworthy occasion. But a disappointment came in that the award of the principal trophy, the Festival of Cycling Trophy for 1951 for the Best Cyclist of Festival Year, was postponed until the end of the season in order to widen the competition to cover every cyclist in the country. It is to be presented at an event during the forthcoming social season. We hope that it will be found possible to hold one of these festivals at least once every three years. The support accorded to the Festival indicates that such events would be well supported by the trade and by cyclists.

## A PRICE-CUTTING WAR

THE legislation threatened by the Government making retail price maintenance agreements illegal may mean a price-cutting war in which you will be able to buy a branded bicycle at one price in one street, and at a different price in another. All industries which operate such agreements will be affected by the proposed legislation should it reach the statute book. Undoubtedly, it will be fiercely attacked when it is debated in Parliament.

Price maintenance agreements operate in the cycle industry. If such legislation is passed the result must be that retailers not wishing to reduce their annual turnover will press manufacturers for higher trade discounts. Moreover, large purchasers of bicycles and accessories, such as the chain stores, because of the better terms given to them by manufacturers, will be able to indulge in a price-cutting war which could, in the long run, put the small cycle retailer out of business. The object of the proposed legislation is to reduce the cost of living, but in the long run it will be found that the public will suffer because manufacturers will be compelled to reduce quality. It will be a disincentive to introduce improvements. Such a scheme could only work if workpeople were released from *their* price maintenance agreement, namely, fixed union rates of pay. Increased wages have contributed in part to rising prices, and now the Government proposes to penalise only the retailers for these increases, and this is manifestly unfair. If it is equitable to abolish selling agreements which fixed prices it should be equally so to abolish trade-union agreements. The Government should take stock of the position in various industries which caused price maintenance agreements to be brought into existence. Such agreements protect the workers and the public and help towards stabilising prosperous industries which can keep workpeople in regular employment. Prior to such agreements many firms went bankrupt in an effort to compete on a price-cutting basis with larger firms. The contention of Sir Hartley Shawcross that the abolition of retail price maintenance will benefit efficient traders at the expense of the inefficient simply will not hold water. It will put a large number of small traders out of existence. It is all the more surprising that a Government representative of trades unions, which have introduced more restrictive practices and more price-maintenance agreements than manufacturers and retailers, should sponsor such proposals, which are intended to benefit one section of the community at the expense of another.

*The Festival of Cycling Trophy, to be awarded later in the year for the Best Festival Year Cyclist. The terms of the contest have not yet been announced.*

## THE LAW OF THE LAND

IN our comments last month on the recent C.T.C. antic we quoted R. C. Shaw, secretary of the C.T.C., who wrote in a contemporary: "It is the law of the land that the protection of cyclists cannot be combined with an interest in the welfare of motorists."

One of our readers thinks this refers to the judgment (to which we have referred, and on which we have commented on a number of occasions) given in 1907 when it was proposed to alter its memorandum so as to enable the C.T.C. to extend its activities to the protection of motorists. It was then held that the new object would be inconsistent with the original object and could not, therefore, be allowed.

To suggest for one moment that this judgment means that it is the law of the land that the protection of cyclists cannot be combined with an interest in the welfare of motorists is altogether fantastic and legally insupportable, and is all the more surprising coming from an association which claims to have a legal department. The judgment means what it says, namely, that as the C.T.C. was started with the main objects of encouraging cycle touring and protecting the interests of cyclists it could not at the same time, in fairness to those who joined the club with those objects in mind, also include motorists amongst its members.

It would be as logical for the C.T.C. to argue that the Royal Society for the Prevention of Accidents is an illegal body because it combines an interest in the welfare not only of cyclists and of motorists but also of pedestrians. The Roadfarers' Club draws its membership from cyclists, pedestrians and motorists. Does R. C. Shaw believe that these bodies are flouting the law?

A bicycle manufacturing firm may wish to alter its memorandum and articles of association to enable it to manufacture motor cars. The shareholders could call an Extraordinary General Meeting and defeat the proposal, or they could apply in the law courts for an injunction restraining the directors from taking such a course. Would the C.T.C. in such circumstances say that it was the law of the land that cycle manufacturers must not manufacture motor cars?

When the matter was discussed at a recent meeting of the Roadfarers' Club, a famous lawyer who is a member riddled the C.T.C. statement with ridicule.

It *is* the law of the land, may we inform R. C. Shaw and the members of the C.T.C. generally, that they *must* combine an interest in cycling with an interest in the welfare of *all* other road users. Indeed, the Highway Code adjures them to do so. There are severe penalties imposed by the law if they do not.

# LIGHT or HEAVY?

## *IS WEIGHT OF IMPORTANCE?*

A LIGHT bicycle is only worth while if its light weight does not mean disadvantages in other directions. which means in its turn that it should be built by an experienced builder. As there are quite a number of these the problem of obtaining a good, light machine is not difficult.

But, at the same time, it is easy to exaggerate the importance of weight. Let us take a definite instance, and for this purpose suppose a cyclist weighs about 190lb. and the weight of the bicycle is 29lb. with tools, etc., their total weight ready for the road being 219lb. When he goes on a tour a full touring bag is added, and the weight of this is about 15lb. Therefore, when touring, the weight of the complete outfit goes up from 219lb. to 234lb. What difference does this make?

### Resistances

Suppose under conditions of no wind you happen to be pedalling down a level road at, say, 15 miles an hour. The pedalling work you are doing is overcoming three separate resistances. First the resistances of the air, for you are producing an artificial wind of 15 miles an hour; secondly, the resistances of the tyres on the road, and thirdly, the resistance due to the friction of the bearings, chain, etc. Of these three the resistance of the air is much the most important. Anyone who doubts this statement can easily check it by pedalling along a level road at the same speed as a following wind. There is then no air resistance whatever, and the amount of work required to overcome the two other resistances will be extremely small.

Now, strapping a touring bag on to the back of a bicycle is not likely greatly to alter the air resistance, but on the other hand, it will certainly increase the other two resistances which we already know to be small, and the ratio in which these will be increased is in the ratio of the weights, i.e., $\frac{334}{219}$ or by 7 per cent. Obviously, increasing an already small resistance by such a comparatively small amount as 7 per cent. is not going to make any appreciable difference, and a cyclist would have to be supernaturally sensitive to easy running before he would even notice it.

### Hill-climbing

The hill-climbing case is different. Here it is assumed that the road resistance and the frictional resistance are small compared with the resistance of the gradient, and that as we shall be climbing slowly the air resistance will be very small also. For the purpose of getting a general comparison we shall not be making a very large error if we neglect everything except the gradient resistance, as the others will be very much the same whether the touring bag is there or not.

Let us take a gradient of 1 in 15. Then the gradient resistance of the outfit without the touring bag is $\frac{219}{15} = 14.6$lb., and with the touring bag is $\frac{234}{15} = 15.6$lb. So that on the average the machine equipped for touring would want an additional one pound of thrust to push it up the 1-in-15 hill. But this is not the full story, for the question of the gear comes in.

### A Better Way of Assessing Gears

The present method of assessing gears, a legacy from the "ordinary" days, is obsolete, and should be abolished. A much better one would be to divide the normal gear in inches by twice the length of a crank. Suppose the gear was 65in. and the crank length 6½in. then the answer would be given by dividing 65 by 13, which is exactly equal, in this case, to 5. Those who have other gears and other crank lengths may get a different figure.

This figure, once obtained, is really useful, for one can do something with it. For instance, it tells you at once that if 5 is the figure, the bicycle will be travelling along the road exactly five times as fast as the rider's feet are moving, and that whatever the resistance of the bicycle happens to be, the rider must push his pedals about five times as hard. Rather more than five times actually, if one were to take account of the loss due to friction.

Let us apply this to the bicycle which we assumed was being pedalled up a 1-in-15 hill. We will take it that the machine is geared to 65 with a crank length of 6½in. as above, so that 5 is the important figure. We learn at once that in ordinary trim the rider has to produce a force of 14.6 x 5 = 73lb., and in touring trim 15.6 x 5 = 78lb. This is a difference of 5lb., and it is important.

When one is working hard every extra pound makes things more difficult and in any case, the real difference in the two cases is certainly more than 5lb. This is because it is assumed than the cyclist is keeping a perfectly even pressure of 73 or 78lb., as the case may be, all the way round the pedal circle. However expert he is at ankling, he could hardly do this, so what he loses in pedal pressure at the top and bottom of the stroke, must be made up by pushing harder in the middle.

So we have reached the general conclusion that adding an ordinary touring bag to a bicycle will not make any particular difference on a level road, but will make itself felt on hills to an extent which may easily be important, especially toward the end of a long day. Let it be understood that this refers to touring only. In the case of the racing man additional weight might easily be much more serious, but his is a case apart.

### Touring

From a touring point of view a bicycle is required which will take the minimum amount of work to propel at the speed required. The maker can provide a light machine, light tyres and good workmanship, but he can do nothing about the resistances due to the gradient of a hill, or even about your riding resistance of the air. As a good and experienced tourist, dictate to him exactly how you propose to sit on the new machine he is making for you. As, of course, you should do.

Weights have an unpleasant habit of being cumulative. If you bought a lamp for a touring machine which was 8oz. heavier than the one you generally use you would not be able to notice the difference but if you got careless about weights and started buying items of new equipment all of which were 8oz. or so heavier than before, you would be surprised to find how soon your bicycle would gain 5 or 6lb. of weight.

The only thing to do is to keep down the weight of every single item, and only to increase it when you are quite sure that you are getting full value for the increase.

This is a matter in which the trade should be ready and willing to help. It would be good to see every cycle dealer's counter equipped with a pair of scales, so that the cyclist could himself check the weight of everything he buys.

### Weights in Advertisements

It would also be an advantage to see weights given more frequently in advertisements. If you wanted to buy a new lamp more powerful than the best you have now, you certainly should not complain if it weighed more, but you would like to know definitely what the extra light is costing in weight.

The manufacturers, especially the specialist lightweight builders, are turning out better and lighter bicycles than ever before. They have appreciated the fact that, like an aeroplane builder, they are entitled to be paid for every ounce of weight that they can remove from a bicycle, provided, obviously, that they can remove it without detriment of strength or stiffness, and, as far as can be seen at present it is not expected that the best type of touring bicycle will be any lighter in the immediate future than it is now.

A lighter frame would almost certainly mean one that is not so stiff, but for touring, steel rims are more satisfactory than others, and they are worth the small increase of weight.

Tyres are on rather a different basis, for a light tyre not only weighs less than a roadster, but owing to its flexibility it is faster.

# Measuring Yourself for a Bicycle

## Some Practical Hints for the New Rider

IT is an undeniable fact that there are many cyclists who are failing to extract the maximum amount of pleasure out of cycling because they have not taken the initial small amount of trouble to select a bicycle suitable for their stature, their physique and their strength. A bicycle is very much like a suit of clothes, the fit of the clothes proclaiming the well-dressed or the ill-dressed man. When you see a cyclist ankling easily along the road without apparent effort you perhaps wonder why it is that in your particular case you are unable to simulate his rhythmic effort-free travel. There is no great secret in this. He has been measured for his bicycle. It is, so to speak, tailor-made, though mass produced. Every manufacturer supplies a wide range of bicycles, and it is possible that you have picked one having the wrong frame height, or perhaps the wrong type of saddle. Perhaps the gear is not quite right for your strength.

### Dealers to Blame

It is strange that so many people are still content to buy a bicycle without careful consideration of sizes. They will take the greatest trouble concerning the fit of clothing or shoes, etc., which may last a year or so and fit better with use, but a bicycle, which costs many pounds and is expected to last several years, is frequently bought in such a casual manner that there is a risk of its being a misfit throughout the whole of it use.

For some of this the cycle dealers and salesmen have been to blame. They are better now, but until recent years many of them were satisfied to put the prospective customer in the saddle and ask him "if he can reach the pedals." Some had a different test. They believed that if a man could reach the ground with his toes while sitting in the saddle, then the bicycle suited him! This idea has persisted, and a surprising number of people still entertain it. It is an excellent thing to be able to reach the ground while remaining in the saddle—indeed it is essential in modern traffic—but it has no relation to pedalling position.

The principle of choosing a bicycle by testing if one can reach the pedals while sitting is quite wrong and very risky. The ill effects of "over reaching" are very great, and this means strain and possible injury, especially to a juvenile rider; and in any case too high a bicycle could not be ridden comfortably or efficiently, and it would be very awkward in traffic, especially nowadays when there are so many compulsory stops at crossings, etc.

### Too Small

Many people have had a fear of finding themselves on a bicycle that looked too small for them, and that fear has, in the past, been reflected by the anxiety of the salesman to put their customers on the tallest bicycles they could ride. Ideas have changed so much in recent years that the makers do not list many tall machines. Instead of a range of 22in., 24in. and 26in. frames we find that the majority of standard models are produced in sizes up to 22in. Larger sizes are an exception.

To measure oneself for a bicycle, then, the first thing to consider is the frame height. For this purpose it is necessary to take the inside leg measurement, from the fork to the bottom of the heel. A little assistance may be necessary to get it accurate. To arrive at the suitable frame height it is necessary to deduct from this measurement 6½in. for the crank, and another 2½in., to cover the saddle-pin and saddle. That makes 9in. Suppose the leg measurement is 31in., it means that such a person can comfortably ride a 22in. and, unless an exceptionally deep saddle is used, there will be scope for a slight raising of the saddle-pin which will be no disadvantage.

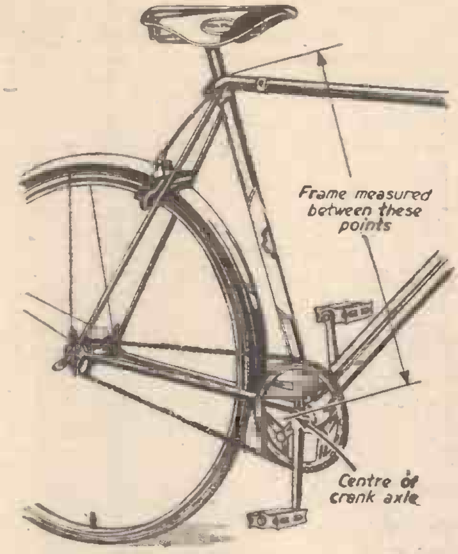


*Diagram indicating what is meant by "frame height."*

Anyone who wants to make a test on the bicycle itself should sit upright in the saddle and endeavour to follow the pedals round with the heels. If this can be done comfortably, without stretching or swaying, but still without cramping, the bicycle is correct for frame height.

Note here that frame height is measured from the top of the seat lug (under the saddle) to a point corresponding with the centre of the bracket spindle.

### Frame Height

Many readers studying our formula for choosing frame height may be surprised to find that they can apparently ride a higher frame than their leg measurement would seem to indicate. This is due to the use of the ankle joint, which allows the foot to bend downwards and virtually adds to the leg length, but such additional length should be disregarded in choosing a bicycle, for if a pedal cannot be properly reached without using the ankle-joint the rider is sitting too high.

Now leg length is not the only measurement to be taken when choosing a bicycle and accessories. Arm length is important. The frame proportions of the standard bicycle and the shape of most handlebars in use are suitable for persons of average proportions. Anyone with exceptionally long or short reach needs a little modification. This can be arranged through the shape of the handlebars and the use of a forward extension or not, as necessary. The fact that a rider possesses arms of abnormally long or short dimensions is not in itself a reason for insisting upon a frame of a special non-standard length. It is best done (for the long-reach man) by the use of a handlebar sliding on a forward extension. The short-reach rider will have no difficulty with a suitable handlebar. It is better to avoid special frame proportions if possible, as it affects the second-hand saleability of the bicycle, but this consideration must not influence a rider into buying a bicycle that he cannot sit properly.

Of course, there is still the question of body length. This is usually proportionate to leg length, and the average man in choosing the right frame height will therefore automatically obtain the right frame length.

Normal relation of leg length to height is about 43 per cent. and 48 per cent. Those whose dimensions are substantially outside those limits should seat themselves on a machine of the right frame height for their leg length, put the saddle-peak three inches behind a vertical line taken from the bracket spindle and see whether they can obtain a comfortable position, not too stretched or too cramped, by the use of such handlebars as are available.

The same experiment may be made on account of arm length if the proportions (from armpit to tip of fingers) vary considerably.

Pedal width is important. Most makers now fit 3½in. pedals as standard to the ladies' machines, 3¾in. pedals to the racing models, and 4in. to 4½in. to the touring and roadster classes. The width is measured between the inner side of the end plates. Many new riders, on taking delivery of their bicycles, find that they cannot get the ball of their feet squarely on the pedals, and they either continue pedalling with their toes or ride with one end plate digging into their sole. Whereas the remedy is simply to get a wider pedal. Therefore, make sure before you buy; it is better to have a pedal a trifle on the wide side than too narrow, but there is no need for either.

You cannot measure yourself for a saddle, as this depends upon the width between the pelvic bones and other factors which are not easily ascertainable. Anyone of exceptionally heavy build or amply fleshed, however, should specify a size larger than the standard.

As to crank length, it is now almost invariable to fit 6½in. for all size machines and for both sexes. It is a good and efficient compromise, and will not be far wrong. Anyone who is exceptionally tall, however, and long in the leg and foot to correspond, would probably be better suited with 7in. cranks, especially as such persons are usually, by temperament, slow and deliberate in movement, and therefore better adapted to a longer crank and slightly higher gear.

Hardly any male rider is likely to need a shorter crank than 6½in., but women can be of very diminutive build, and it is safe to say that any woman who has finished growing but who, according to our formula, needs a frame less than 20in. in height would do well to try and get cranks of 6¼in. or even 6in. They are available, but some makers are reluctant to alter their specification in this way unless they are strongly urged to it.

AROUND THE WHEELWORLD

# LONDON TO HOLYHEAD SURPRISES

## New Stars Shine in Longest Road Race

By ICARUS

THE London to Holyhead mass start cycle race organised by Percy Stallard was run without a hitch, and was a complete vindication of their policy, a tribute to the efficiency of the organisers and a potent answer to the waspish critics who have done their best to kill this form of racing. Due to start at 5 a.m. from Marble Arch, the race actually commenced at 5.18 a.m. due to the late arrival of the French riders, who had mistaken the figures on our signposts for kilometres instead of miles. The race was started by the Marquis of Donegall, with F. J. Camm as official timekeeper. It was the first Festival of Britain cycling event to be run, and it was eminently successful in every way. It attracted considerable publicity in the newspapers, on the films, and along the route, large crowds lining the course throughout its 267 miles of A5 Telford route, which included 20 miles of détour through Wolverhampton. The course is 60 miles longer than any other race ever promoted in this country, and there was some conjecture before the start as to whether more than two or three of the riders would be able to stay the course.

*The Marquis of Donegall (with flag) and Timekeeper F. J. Camm, at the start of the London to Holyhead Mass Start Cycle Race, Marble Arch.*

Of the 33 entrants, however, 28 started and only five failed to finish, and the time for the first three over the finishing line was 12 hours 25 minutes 10 seconds, or approximately 21½ miles per hour average for the whole journey. Indeed, the last man's time was the very creditable one of 13 hours 34 minutes.

The winner proved to be Leslie Scales, of London. Although a previous London Centre N.C.U. grass track five-mile champion, this is his first season as a massed starter, and the only previous indication of his staying powers was the fact that he was the best amateur in last year's "Brighton to Glasgow" stage race. In the final straight, the promenade at Holyhead, where thousands of people lined the streets, he used his track ability to pass Clark and Nicholls, sweeping between these two and pushing his front wheel across the line two lengths ahead of Clark. This is Nicholls' first independent season and he provided the second surprise of the race, showing himself to be a stayer and a good team man. At one point he dropped back to assist his team mate Jones, who had gear trouble.

Scales contested hotly at all the primes. The first one he secured from Clark at Tettenhall (6 hours 9 minutes 23 seconds) from a bunch of eight who were, at this point, no less than 9 minutes 22 seconds ahead of the main bunch. At Chirk (7 hours 24 minutes 42 seconds from the start) Clark was over the line first, and the bunch was 13 minutes in arrears. Llangollen was reached at 1.55 p.m., the race having started at 5.18 a.m., whilst a time-check taken at the 202 miles mark showed that this distance had been covered in 9 hours 20 minutes. At the start a very slight contrary breeze was blowing, and on reaching the outskirts of London a thick mist hampered the riders until 7.20 a.m. Unluckiest rider in the race was perhaps Eric Mitchell, who in the last few miles punctured his rear tyre when riding well within himself in close company with Scales, Clark and Nicholls. The last 50 miles was ridden in heavy rain and a crosswind from the sea, despite which the roads were lined with eager sports enthusiasts. Harry Genders, ex-Olympic rider, and F. J. Camm were co-timekeepers. Over 50 officials and helpers accompanied the race throughout in 22 cars and on motor-cycles. Gaumont-British News filmed shots of the start, feeding stations and finish. Of the five authorised feeding stations three were stocked with food supplied by the organisation. The presentation of over £250 in prizes was made by the fourteen-year-old British Railways Beauty Queen at a banquet given by the Mayor of Holyhead in honour of the event. Two large country hotels housed the 93 riders and officials for the night.

The French riders were penalised 10 per cent. of their winnings for not being at the start on time and causing the race to commence 18 minutes late.

Here are the final results :

| Position | Name | Sponsor | Time H. | M. | S. |
|---|---|---|---|---|---|
| 1 | Les Scales | Dayton | 12 | 25 | 10 |
| 2 | Geoff Clark | I.T.P. | at 2 lengths | | |
| 3 | Fred Nicholls | Viking | at 1 length | | |
| 4 | Ted Jones | Viking | 12 | 32 | 10 |
| 5 | Johnny Welsh | Viking | 12 | 32 | 33 |
| 6 | Eric Mitchell | I.T.P. | 12 | 40 | 20 |
| 7 | Bob Thom | Viking | 12 | 47 | 33 |
| 8 | Clive Parker | Dayton | 12 | 47 | 50 |
| 9 | Bob Drinkwater | Hateley | 12 | 48 | 00 |
| 10 | Ken Jowett | I.T.P. | 12 | 48 | 01 |
| 11 | Frank Seel | I.T.P. | 12 | 48 | 02 |
| 12 | Ben Whitmore | Viking | at 1 length | | |
| 13 | Len Hook | Dunstable | at 1 length | | |
| 14 | Arthur Cook | Hateley | 12 | 48 | 03 |
| 15 | Len West | Dayton | 12 | 48 | 12 |
| 16 | André Laurent | France | 12 | 56 | 06 |
| 17 | Dick Lewis | Hateley | 12 | 56 | 10 |
| 18 | Harold Binfield | Mount | 12 | 58 | 05 |
| 19 | Hubert Cabrolier | France | 13 | 10 | 05 |
| 20 | Georges Damiens | France | 13 | 10 | 06 |
| 21 | Ken Russell | I.T.P. | 13 | 13 | 58 |
| 22 | André Barbier | France | 13 | 18 | 35 |
| 23 | Roger Ollivier | France | 13 | 34 | 00 |

The winner's average speed for the 267 miles was 21.5 m.p.h.


*Over the finishing line. Leslie Scales, in a fine sprint, drops the field along the finishing straight.*

*SIGNPOSTS IN CYCLING HISTORY*

# Nº1 The Hobby or Dandy-Horse

In the gay days of the Prince Regent, anyone who was anyone had a hobby-horse. Every park and garden was crowded with elegant young 'bucks' taking their constitutionals astride the first of the "steerable velocipedes". A luxury model cost 8 to 10 guineas, and included front-wheel steering and a crudely-sprung saddle—but no pedals. This remarkable machine was perfected by a German, Baron Carl von Drais. His "Draisine", as it was originally known, was an improvement on the Frenchman de Sivrac's "Célérifère", which consisted of a rough wooden bar mounted on two fixed wheels. But it is unlikely that this latter invention, dated 1790, was the first of its type—witness the illustration on the right.

*Dating back to 1642 or earlier, this stained glass window in the Church of St. Giles, Stoke Poges, Bucks, shows a representation of what is generally accepted to be the most ancient bicycle-form vehicle known.*

*ISSUED BY* **DUNLOP**—*MAKERS OF THE FIRST PNEUMATIC BICYCLE TYRE*

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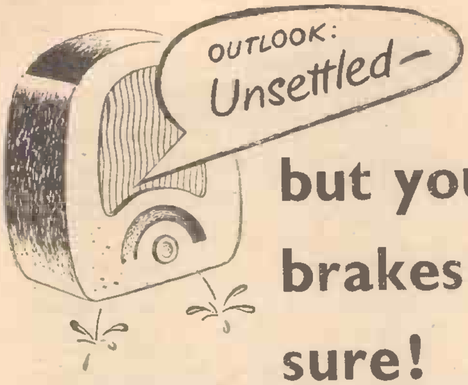
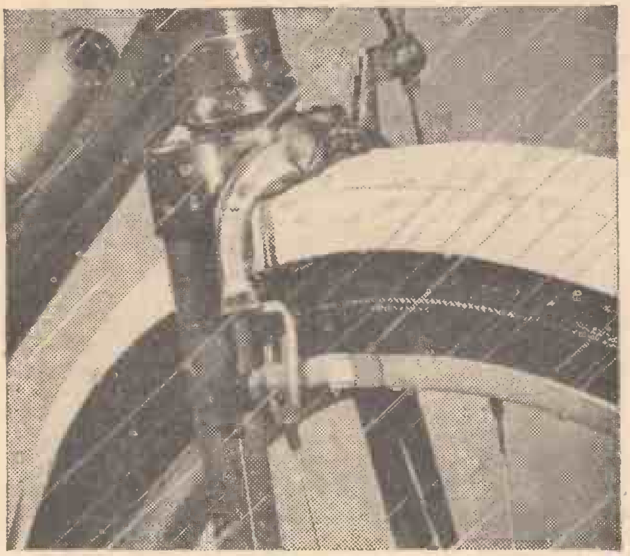



## but your brakes are sure!



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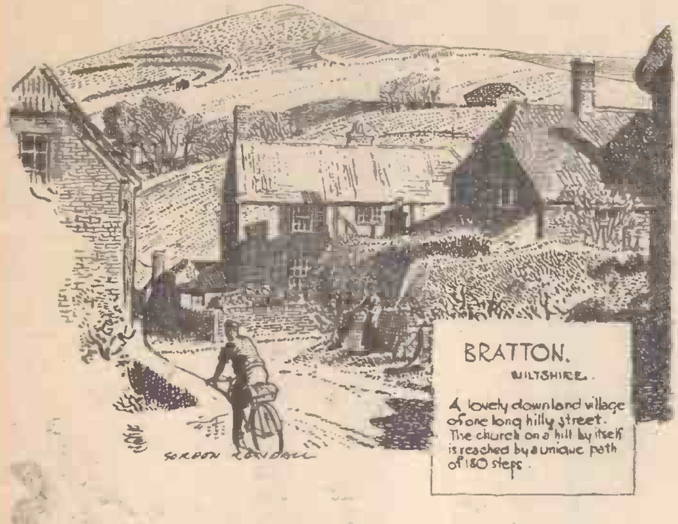


# Wayside Thoughts

By F. J. URRY

### This Weather

I SEEM to remember my parents once told me that a cold May was healthy, so according to that ancient adage we all ought to be very fit. Personally I would prefer to take the risks attendant on a more sultry atmosphere and be wrapped round with the warm airs of a delightful spring, so that I could sit and smoke in comfort and watch the sunshine play at shadows with the waving young grain of the filigreed woods. There must have been springs of this temper or "winter lingers in the lap of May" would never have been penned, and Byron's caustic description of the English elements—"the English winter ending in July to recommence in August"—have made the stay-at-homes dislike him. I thought of these things the first Sunday morning in May when a friend of my own years joined me in making a thirty miles round before lunch. The conditions were arctic; gloves and caps, and no stopping to glance down the shimmering glades, for the wind was like a whetted knife and the air hung with a grey dreariness and occasionally sprinkled with a dampness which was neither rain nor fog. There were daffodils nodding in the sheltered corners and primroses on the banks, but they had lost the reflection of the sun and seemed to scorn the weather as much as we did. The day was really quite good for riding, but seemed a disappointment when one remembered the calendar, for the expected weather for the merry month had not arrived. I want sunshine to penetrate my skin, to feel the moisture of exercise on my brow as a relief and a benison to the troubled state of living.

### The Great Values

I DON'T often grouse at the weather, but really we have had enough winter conditions to make almost a whole year, for the mixture has been consistently bad since July, 1950. That it will come to an end we all know, but faith needs renewing on such a week-end as the one of which I am writing, and the best thing to do this is a row of brave days of flaunting sunshine. Probably they are with us as you read, and I for one will rejoice by disappearing, soon after an early tea, to seek the old haunts for ever new under the influence of spring. That is the best feature of a bicycle; you have no one to consult, no money to consider, and time and miles are only bounded by your need for rest. I am aware we don't all think in that sense—perhaps it is as well, or roads would be still more congested—but I am convinced that if a few more people looked on cycling as a game to play at any odd moment of leisure they would be far happier folk. On the law of averages we should be presented with a lovely summer, and apart from holidays there are dozens of hours of daylight—not to mention the silver dusk of moonlight—which we can use for our quiet enjoyment and the benefit of our health, mental and physical. This indeed is the phase of cycling I love to-day, to wander into the lanes—any lanes — and refresh the spirit, and sometimes to mix the interest with the sporting side of the game and, by proxy, live over again the hectic days of my youth. Many of my older friends say they are too tired at the day's ending to even think in the terms of cycling, but the old adage, "change of occupation is rest," is never more true than when applied to these evening jaunts that round off the glory of a summer's day.

### The Complimentary Vehicle

I WAS recently speaking to a company of business men on the subject of "Cycling," under a title "the Beloved Silence," and was a little amazed and, in a sense complimented by their attention. Apparently they had never given much thought to the fact that the bicycle was the only silently travelling vehicle, which in itself should be sufficient to make it distinguished in a world where noise is predominant. I mentioned all the values I attach to cycling, comparing them with other forms of travel, particularly stressing the healthiness of the game and specially to people whose years have piled up behind them and who have discarded exercise and thereby reduced activity. I expected comment at the end of the short talk, and all I got was confirmation by several old riders, coupled with the several remarks bearing on the same matter, and saying that road traffic had scared them from even a modest dip into the cycling magic. I am afraid that latter deduction is true, and it is a pity. Personally I do not know anything about it—that feeling of nervousness in tight traffic conditions—but I can understand the maelstrom of present-day road conditions being wearing to the nervous system when the years count up to mid-life and the pastime has been neglected for a long time. It is one more reason, and a prominent one, why an individual should keep on cycling and never "let up" on the game, though he may slow up. I know that it is an easy thing to write and far more difficult one to carry out, but I think the latter business is too frequently exaggerated until it becomes an excuse for neglect. I do quite a lot of motoring for convenience, and particularly for speed in business, but I ride to work every day, and the car is kept at the works, going home only when non-cycling friends visit me for a little local sight-seeing. Therefore I know what I am talking about in reference to this subject, and that is specially true when it comes to a question of health, the greatest single value of the regular use of a bicycle.

### Why Not the Elders?

THIS is a subject so personally applicable to-day that I sometimes wonder why nearly all the stress on the service of cycling to the community is aimed at the young folk. They, of course are of the age to want to ride—there never was a youngster who didn't—but having persuaded them into the ways of cycling, its fun and its sport, it seems to be unwise not to point out to them to continue in that way of life and hold to an individual joy that will never disappoint. Here is a thing that never palls if you take it in good part; like the machine with you aboard it, it goes on and on. True, you may become more of an individualist as you grow older, a rider with no set timetable to the place, the day, or the hour, and that development is a gain rather than a loss because you can always conform to the pattern of club life if you so desire. The delight in your early cycling travels will never desert you; the scenes may be familiar, but your observation of them is keener, the light and the shade, the texture of the atmosphere, the differing patterns of the seasons impose their variety, and it is the slower tempo of the going that persuades you to look and listen without being completely aware of your wider interests until reminded. These subtle things, the inexplicable, can never be wholly captured by the motorist, however slowly he may travel; only the walker can come into a similar heritage, and you possess the greater mobility, and the power to become one with him when the occasion demands. These are a few of the reasons why you should keep on riding and never allow this gift of "something for nothing" to fade from your life. It provides the best playground I know for people of more advanced years.

### The Way of Going

I THINK this pleasure of riding depends very much on the equipment of the bicycle as well as the reasonable fitness of the individual. To-day I am not concerned with lightness in the sense of the least possible. I like a good bicycle, well shod with light tyres, and fitted with a saddle of goodly proportion, for seating accommodation is very important. I like, also, the slightly dropped bar, giving me the easy posture of a comfortable writing position, and a backward position—so opposed to the modern notion of straight thrust pedalling—so I may use the old type of ankling to the fullest extent, and with a normal gear of 60in. and a four-change hub or derailleur, I am a happy cyclist if no longer a fast one. With a low gear of about 40in. I can climb the hills without hard breathing or hurtful pedalling; climb them at six or seven miles an hour and have time to look around and, if desirable, get off and smoke a pipe and absorb the view which is too often missed by the fellow in a hurry. My idea of touring to-day is not concerned nearly so much with the matter of miles as the paradise of country scenes into which they lead you, which is the reason why touring to me is a greater pleasure than ever. You can go in a car over the same roads and miss so much from the very fact that you are static, for I believe it is the effort of exercise, the consciousness of individualism, creating the appreciation that makes such means of travel so delightful. It is the same sensibility that makes the walker and the fell-climber understand the values of roaming, and his handicap in the limitation of area, and the inability to change it in an hour as we cyclists can.

# CYCLORAMA

By H. W. ELEY


### Buckets and Spades

BY tradition and long custom, August is the Englishman's holiday month, though for myself I much prefer to take my holidays in June, when the land is fresher, and the fields more green. In August, though it may be grand to laze in the sun, the countryside has lost a little of its green glamour, and the first whispers of approaching autumn are heard in the trees. But it is the sea which calls the Englishman with insistent call when August arrives, and in a changing world, there is still the pilgrimage to Foamville or Seaview, with the inevitable buckets and spades, the building of sand castles, the games of cricket on the broad stretches of hard sand . . . and, for the spartan, the plunge into the sea before breakfast. But for me, the countryside has a greater lure than the sea, and this year I am planning a little tour of the Staffordshire-Derbyshire borders, through winding lanes and little villages where time has dealt kindly with cottages, and farms, and inns, and grey old churches. I shall ride to ancient Tutbury, where the crumbling remains of the castle still stand as a reminder of past splendour . . . it was there that ill-fated Mary of Scots was imprisoned. It is a goodly land, green and fertile, and lacking the grimness of northern Derbyshire, with its stone walls.

### Festival Parade

ONE of the noteworthy features of "Festival" year has been the enthusiasm of local communities in linking up with the big London event, and in many small towns, excellent carnivals, sports meetings, regattas, and other functions have been arranged, all designed to capture the "festive spirit" and re-create the glory of Britain . . . which, to listen to the "dismal Jimmies," has departed! In one small country town I visited, one of the events was a fancy dress parade, in which decorated cycles formed a major attraction. It is a long time since I saw a procession of gaily decorated machines, though it used to be quite a common thing in the old days. Colourful crêpe paper, ribbons, flowers and rosettes had been pressed into service, and the effect was quite alluring. A bicycle lends itself to such decorative treatment, and the organisers of local carnivals might do worse than include a "fancy cycle parade" in their programmes.

### Village Cycle Shop

IT is really a shed . . . this "shop" where the cyclists of my village can obtain their spares, their cycle accessories, and get their repairs done. But a very well-equipped shed! The proprietor is a farm foreman, and this cycle business is his side-line . . . and, I imagine, a profitable one! Anything from a new cycle to a packet of valve rubber: and smiling service thrown in! When one's nearest town is some six miles away, it is useful to have a "shed" like this, where the owner is as skilled in dealing with a 3-speed gear as he is in milking the Shorthorns and Ayrshires on the farm.

### The Disappearing County

MIDDLESEX continues to be swallowed up, bit by bit, by Mother London, but there is a surprising lot of good green countryside still left in the county, and the Londoner in search of quiet lanes, and wide fields, and noble shady trees, can still find these good treasures in Middlesex. Mill Hill provides charming walks and rides still, and whenever I stroll by the famous school and along the Ridgeway, I feel that Middlesex has never received its due meed of praise as a beautiful county; it *is* still beautiful in parts, and well wooded; not all of it has been eaten up by ever-growing suburbs, tube stations, factories, and estate development . . . and we may be thankful that some rural loveliness remains to us, even if only in patches. A mile or two from the Edgware tube station, there are green glades, and patches of woodland, and old farms, as good as any in larger and more distant shires, and the birds sing as sweetly in Middlesex hedgerows as in Hampshire or Surrey.

### Tyre Tips

RECENTLY, I saw two instances of tyre misuse . . . and was led to give a little homily about tyre care which I hope will prove of benefit to the boy who owned the bike. First of all, his machine, a bright and beautiful Raleigh, was standing in a shed . . . in pools of oil. Now, oil is a menace to tyres, and ruinous to rubber. I rubbed that point home. Then, a spare cycle cover, unwrapped, was hanging on the wall of the shed, in glaring sunlight. I rubbed *that* point home . . . bright sunlight, too, is bad for rubber. It is strange, in view of the great amount of literature on tyre care which has been, and still is, issued by our tyre manufacturers, that so many riders neglect and ill-treat their tyres. The points to observe are so simple!

### Bicycle Design

TALKING with a little bunch of riders the other week, in a charming little inn not far from glorious Dovedale, the chatter turned to bicycle design, and there was some interesting discussion as to when the last fundamental change in design took place. One of the company, a seasoned rider of about seventy, said that he could not remember any real fundamental change for many years; little "niceties" . . . yes; but no serious alteration of basic design. I am afraid I could not contribute much of value to the discussion, but it would be of interest to know what the experts think. To me, the general design of the bike seems to-day to be much the same as in my early youth.

### Essex Enchantment

ONE seldom hears eulogies of Essex as one of our beautiful counties and most folk regard it as flat and rather uninteresting. Personally, whilst I would not give it pride of place in any list of lovely English counties, I do know that it has many charms. I have always loved the good country around Ongar; and I revel in those lovely place-names like Stanford-le-Hope, and Hatfield Peverel, and Tolleshunt D'Arcy. One should not judge Essex by its London suburbs—get out into the heart of the county, and it will be found that it is astonishingly rural. Little villages, with cottages lit by oil lamps; old manor houses, touching the Suffolk border; pleasant little streams, where the willows kiss the water and the kingfishers dart like meteors of blue in the sun. There are old inns, where aged farm men foregather and talk a dialect all their own. This is the essential Essex . . . and it isn't far from London!





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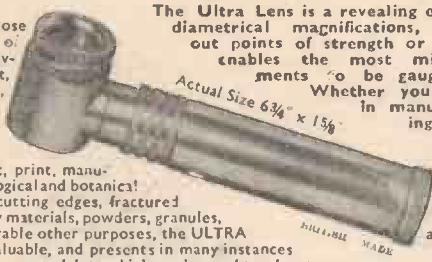


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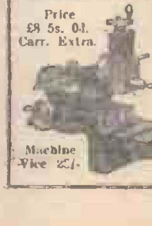

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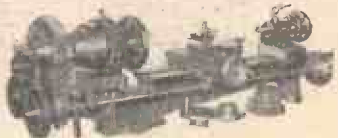

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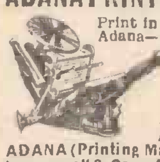

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