ELECTRIC WATER HEATING

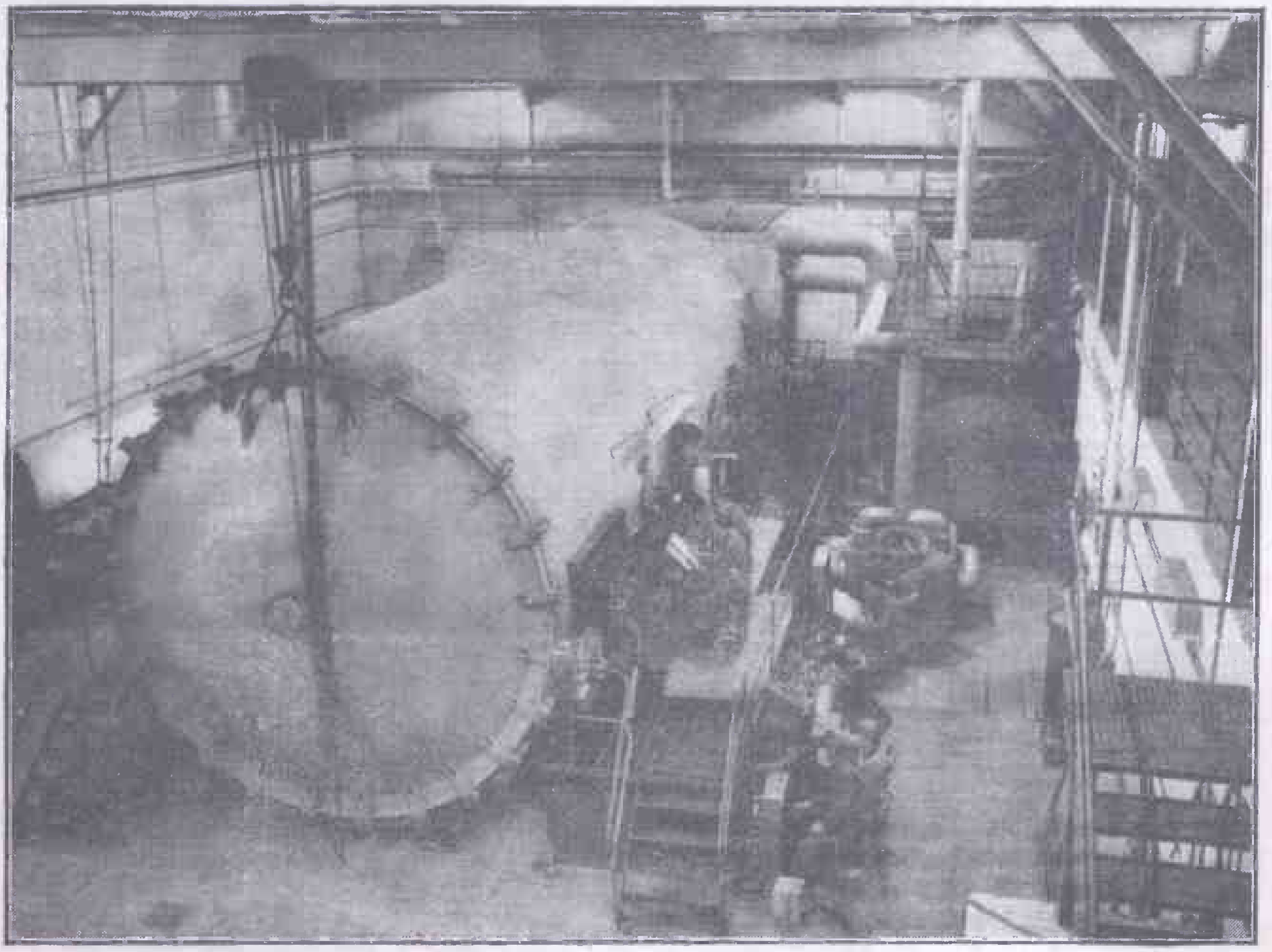
NEWNES

PRACTICAL MECHANICS

9d

EDITOR: F. J. CAMM

JANUARY 1948



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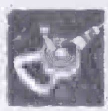

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XV JANUARY, 1948 No. 171

FAIR COMMENT—BY THE EDITOR

Link Between Inventors and Industry

MOST large industrial houses possess their own research departments, and many research associations have already been established which confine their activities to particular industries or types of product, but there has long been a need for a research organisation whose resources are readily accessible to the small industrial firm, whatever its trade, and to the independent inventor of limited means, who seeks an adequate division of the profits deriving from the exploitation of his idea or invention.

The recent formation of a new research and development organisation, known as the Amalgamated Research and Development Company, Limited, fills this need, and in addition provides between industry and inventors and inventions a new link through which the translation of ideas may be accelerated to the state of production.

Unlike most other development undertakings, the Amalgamated Research and Development Company, Limited, does not intend to limit the scope of its work to any one particular trade. Its main objects are to develop, through the initiative of its own workers or from suggestions and commissions from outside, new products for industry, which may involve the development of new processes and new designs and to obtain by a greater co-operative effort between scientific workers, engineers and business men, a more efficient use of scientific knowledge and endeavour.

The structure of the Amalgamated Research and Development Company, Limited, which is a private company, is conventional in that it has stockholders and a board of directors, but written into the Articles of Association are unique provisions for a generous division of profits as between the capital which is underwriting the activities of the company, and the scientists and inventors who may be associated with it.

Initially this company has been set up with the financial backing of Associated British Engineering, Messrs. Dawnay, Day and Company, Industrial Bankers, and the General Mining Industries, Limited, of South Africa, but the shareholders' interests are likely to be extended to include industrialists in other parts of the Empire.

Naturally enough it is expected that, to begin with, the work undertaken by this company will be designed in the main to increase the business activities of the engineering firms with which it is associated, but one of the main objects of the enterprise is to encourage independent inventors to take advantage of the opportunities which this company offers for their ideas or inventions to be developed and commercially exploited. An inventor whose idea is developed and eventually marketed by this company will be protected by an agreement assuring him of an agreed percentage of the eventual profits accruing from the exploitation of his invention.

The directors of the company are:—Reginald Percy Fraser, O.B.E., A.R.C.S., D.I.C., F.I.B.P.; the Hon. Alexander Campbell Geddes, O.B.E., M.C., A.R.I.S.M., B.Sc. (London), Charles Loraine Hill and John Montgomerie Hopkinson.

At present, the engineering and chemical engineering research units are housed at the engineering works at Staines, recently acquired from Lagonda, Limited, by an affiliated company. Existing well-equipped experimental shops and laboratories have been put at their disposal. The registered offices of the company are at Duke's Court, 32, Duke Street, St. James's, London, S.W.1.

Broadcast Reception in Schools

IN a report which preceded the establishment of the School Broadcasting Council for the United Kingdom it was stated that the great weakness in the School Broadcasting Service is the quality of the reception in the schools. An investigation showed that a correct standard of reception only applied to 20 per cent. of the schools, is just tolerable in 50 per cent. and quite unsatisfactory in 30 per cent.

The method of installing the apparatus is usually the cause of the trouble. Correct installation is as important as the selection of the apparatus itself. The Council has, therefore, arranged for a school at Tottenham to be equipped with a demonstration installation to show the best current practice. The installation may by arrangement be visited by members of the Education Committees, Directors of Education, School Architects and others concerned. A non-technical description of the installation has been prepared and copies may be obtained from the Council from 55, Portland Place, London, W.1.

Electrical Queries

IN spite of repeated announcements herein that our Electrical Query Service is temporarily suspended, we continue to receive large numbers of them. Apparently, because in our query section we publish replies to electrical queries, readers presume that we have reintroduced it. That is not so. Each month we publish a selection of interesting queries which have been answered through the post. They do not represent current queries, but answers to questions received when our electrical service was in being. The readers who asked the queries answered, of course, received their replies through the post at the time.

Improvements in Bicycles

IT has been considered up to three years ago that the bicycle had become a standard piece of apparatus, and that there was little room for improvement. During the war, however, many inventors have given time and thought to improvements, and large numbers of these are now in the production stage. High quality bicycles to-day incorporate some of the new alloys, effecting a saving in weight of some pounds. Although bicycle manufacturers do not always state the weights of their range of bicycles, it is known that tourist bicycles fully equipped may weigh over 30lb. This, of course, is very much less than the old Ordinary which weighed as much as 70lb. Before the war one or two Continental makers produced bicycles made entirely of duralumin, and one such machine weighed just over 15lb. It was, however, so "whippy" that the advantage of light weight was lost. Under the stress of pedalling the frame twisted badly, giving rise to great friction and the derailment of the chain.

Dynamo hub gears, car-type lighting systems incorporating batteries, stainless steel rims, thief-proof devices, more comfortable saddles, more scientific frame construction—these are but a few of the improvements now available. Up to the present, however, no one has yet produced a perfect thief-proof device, and a fortune awaits the inventor who can circumvent the cycle thief. Some thousands of bicycles are stolen every year and never recovered. It is impossible entirely to foil the cycle thief since some of them have highly organised the nefarious "business" of picking up unattended bicycles. They even run lorries and may collect during the day 50 or 60 bicycles, which are stripped down, distinguishing marks removed, and reassembled with different mudguards and fittings.

It is truly a fact that when the police do recover a stolen bicycle it often happens that the owner is unable to give a correct description of his machine. Few cyclists keep a note of their frame numbers.

I once ran a competition in *The Cyclist* for thief-proof devices and published in that journal a selection of the most ingenious. Few of them, however, were really effective. One of the latest devices makes use of a yale key, which locks the wheels, so that the machine cannot be wheeled away. Of course, a thief could carry the bicycle away.

Electric Water Heating Practice

Types of Systems : Converting Existing Installations : Thermostatic Control

By G. A. T. BURDETT, A.M.I.I.A.

MORE than half a million electric water-heating installations are now in daily use in Britain. These range from the simple immersion heater installed in the conventional domestic hot-water storage tank to the large commercial installations having capacities of many hundreds of gallons to supply hot-water requirements of large blocks of offices, cinemas and so forth.

While the majority of hot-water installations conform to standard practice, so many diversions are possible in order to provide highly efficient installations that a wide variety of types of electric water heaters are made to suit particular requirements.

Types of Systems

The chief types of electric water-heating systems are:

(a) Immersion heaters, which are installed in the existing hot-water tanks in a horizontal position to provide hot water to one or more outlets. These may, in certain circumstances, also be installed vertically.

(b) Circular types of immersion heaters which are always installed vertically in existing cylindrical hot-water tanks and provide hot water to one or more outlets.

Both of the above types may be used solely as electrical systems, or may operate in conjunction with a back-fired solid fuel boiler or independent solid fuel boiler of the "Ideal" pattern.

(c) Self-contained storage water heaters, factory made, which serve one hot-water outlet.

(d) Self-contained storage water heaters, also factory made, which serve one or more hot-water outlets.

(e) Self-contained storage water heaters (factory made) which are connected to existing installations and operate in conjunction with solid-fuel, back-fired or independent boilers.

(f) Self-contained water heaters (factory made) which are combined solid fuel storage tanks and electric water heaters and may be used in dual form or independently.

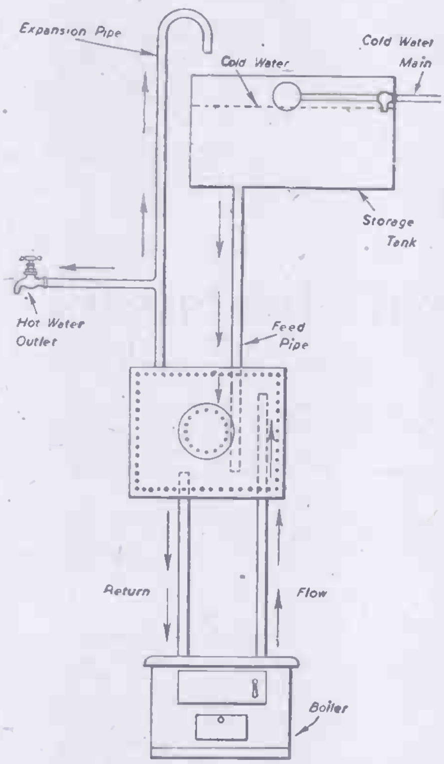


Fig. 1.—Diagram of a simple hot-water system showing how cold water from storage tank flows down the return pipe to the boiler, where it is heated, and rises up the flow pipe and is drawn through the expansion pipe upon the opening of a tap. A circulating system is created through the boiler and storage tank, which are linked as a complete circuit by the flow and return pipes.

(g) Electrode boilers, which are beyond the scope of this article.

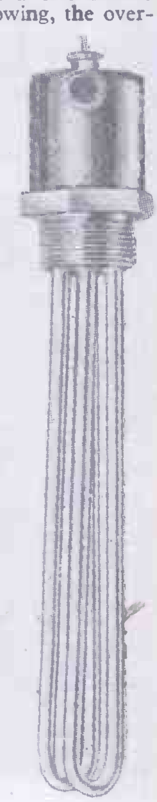
No general rule can apply as to which system is adopted, since each proposed installation must, after careful inspection, be judged on its merits.

Hot-water Systems

Main essentials of a hot-water system are: Boiler, storage tank, cold-water cistern with ball valve, overflow expansion and connecting pipes. Cold water flows at mains pressure into the cold-water cistern, the height of the water in the cistern being regulated by the ball valve, and should this fail to operate when the water is flowing, the overflow pipe prevents damage from flooding. Cold water by force of gravity, flows down the feed pipe, Fig. 1, fills the boiler storage tank, flows down the return pipe to the boiler and is forced, by gravity, up the flow pipe and eventually finds it own level in the expansion pipe, as predetermined by the position of the ball valve. Water in the pipes is maintained at a pressure depending upon the "head" of water between cistern, tank and boiler.

Should one of the outlet taps be opened cold water will flow, due to the pressure of the system. When the temperature of water is raised its volume increases. Increase in volume of water is at the rate of approximately 4 per cent. from tap temperature to boiling point. A given volume of water (for instance 1 pint) which weighs about 1¼lb. when cold will weigh less when heated.

Being lighter, hot water also rises to the top of a vessel as it is heated. This is due to the heavier cold water sinking to the bottom of the vessel and forcing the



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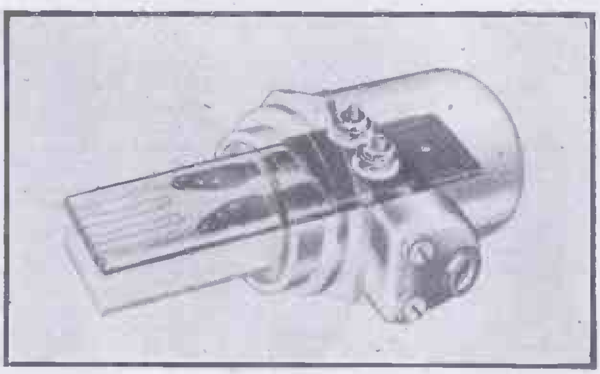

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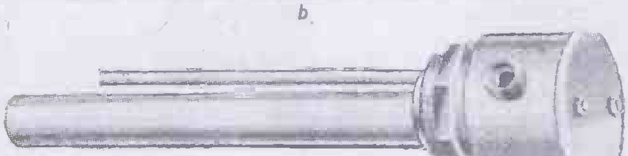

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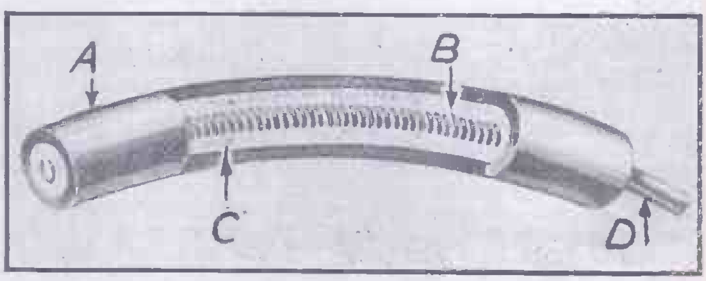

(*A*) *Protective sheath* (*B*) *Nickel-chrome element*
(*C*) *Magnesium oxide insulators* (*D*) *Non-corrosive metal terminal*

e

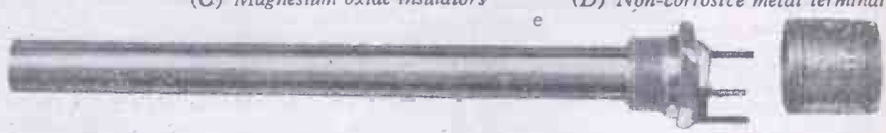

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Fig. 3.—Types of immersion heaters. (a) Cement filled sheathed element type. (b) Flat bladed type. (c) Removable core type with thermostat. (d) Removable core type showing core removed. (e) Sectional view of Metrovick Torribar sheathed element.

lighter and warmer water to the top. This principle applies in the domestic hot-water system. When the boiler fire is lighted the temperature of the water in the boiler is raised and increases in volume. This is forced up the flow pipe into the storage tank by the colder and heavier water "falling" down the return pipe. This system of primary circulation continues during the whole time the boiler fire is alight and heat is applied to the water flowing through the boiler. Unless water is drawn off at the outlets or the boiler fire carefully regulated, the water in the storage tank will tend to boil and hot water and steam flow out of the expansion pipe.

Difficulty of heat control is one of the chief disadvantages of domestic solid fuel systems.

Converting Existing Installations

In London and S.E. England, which are hard-water districts, hot-water storage tanks are usually rectangular in shape and are made of 16, 14, ⅛ and 3/16in. gauge galvanised iron sheeting.

In Manchester and other soft-water districts, galvanised iron tanks cannot be used for the chemicals in the water would corrode the metal. Instead, light gauge copper tanks are employed. For strength, these are cylindrical in shape with domed top and concave base.

The hot-water installation in a small house is simple and normally supplies three hot-water outlets: Bath, bathroom basin and kitchen sink. Fig. 2 shows a simple layout of the small installation from either a back-fired or independent boiler, with each outlet supplied from the expansion pipe.

Such an installation does not, for electrical conversion, require much, if any, alteration to the pipe work. Many small installations of this nature, while they may at first glance appear to be piped as in diagram, upon investigation are found to have "short cuts" for reasons of economy in plumbing. The most usual "short cut" consists of "bleeding" the main flow pipe from the boiler to supply the kitchen tap (Fig. 2a). When the solid fuel boiler is in operation this method has the advantage that small quantities of hot water can be drawn off direct from the boiler a few minutes after the fire is lighted, although the user has not the storage tank capacity from which to draw.

When an electrical conversion is made where the flow pipe has been bled, the user cannot satisfactorily draw off hot-water supplies. More often cold water only is drawn and flows from the cold-water tank *via* the boiler, the boiler, of course, not being in operation. This pipe, XY, Fig. 2b, should be removed and a new pipe (dotted lines) installed from the expansion pipe direct to the kitchen hot-water tap, Fig. 2b. Alternatively, a small storage heater, 1½-3 gallon capacity, may be fitted over the kitchen sink in addition to the immersion heater in the tank. The main tank then supplies bath and wash basin, and the small storage heater supplies the kitchen sink.

using electric immersion heaters compared with the factory-produced storage heater, is the reduction in capital cost.

One 3kw. immersion heater (Fig. 3), complete with thermostat, costs approximately £7 10s., exclusive of purchase tax, and is quite suitable for the standard 20-30 gallons storage tank. A 20-gallon factory-produced self-contained storage water heater costs about three times this amount.

Work is entailed in fixing and plumbing the immersion heater type, particularly when the tank is lagged, but the initial cost of the converted system is still far below the self-contained type.

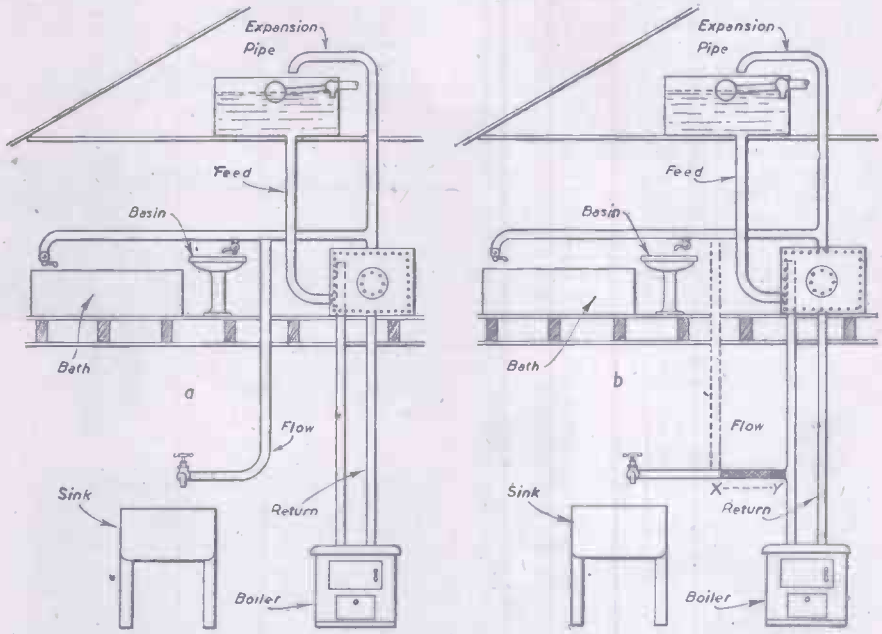


Fig. 2.—(a) Solid fuel hot-water system showing the correct method where each draw-off point has been taken from the expansion pipe. (b) Shows how in some cases one tap, usually supplying the kitchen sink, is bled from the flow pipe. The section XY is removed and a new pipe (dotted line) is inserted.

Existing water-heating systems in small modern houses are rarely difficult to convert, and pipe work is necessary only in those cases where the kitchen tap is taken direct off the flow pipe.

Secondary Circulation

All secondary circulating systems, towel rails, hot-water radiators and such equipment, must be cut off when electrical conversions are made. Radiators can be isolated with suitable valves for use only when the solid fuel boiler is alight, and the same with towel rails, although electric towel rails often provide a better alternative to the use of the hot-water system for heating towel rails.

Converting Existing Systems

Chief advantage of converting an existing hot-water system by

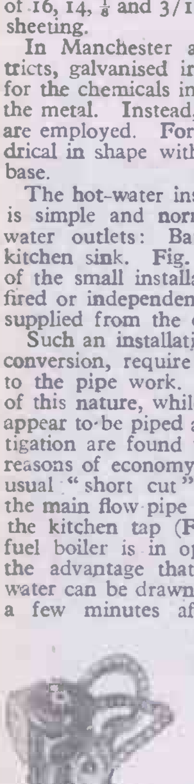
Inspecting the Existing Tank

Before deciding to fit an immersion heater or circulator in an existing tank, a thorough inspection must be made to ascertain the condition of tank or cylinder, whether a secondary circulation is connected to the system, and whether any hot-water outlets are connected to the boiler flow and return pipes. If the tank is rusty inside, a new tank will be necessary, because disturbance caused by fitting the immersion heater would still further shorten its life.

Internal rusting is usually apparent by the appearance of white spots on the outside. Where it is not practicable to renew the tank, it is best to leave well alone, not to carry out an electrical conversion, and on no account to touch the white spots. The alternative then is to install self-contained electric water heaters.

If a new hot-water storage tank is purchased, it is advisable to choose a good one of at least ⅛in. plate, which will last for many years.

The immersion heater should, of course, be fitted



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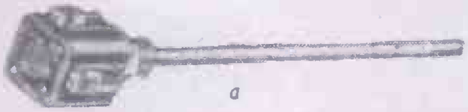

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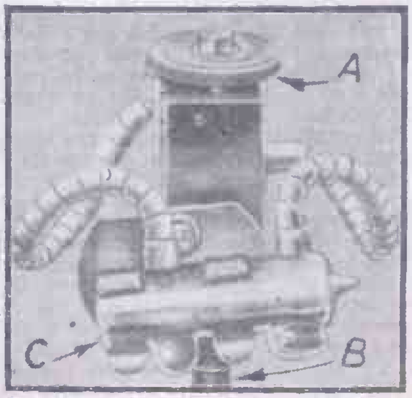

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Fig. 4.—Water heater thermostats. (a) Typical A.C. thermostat. (b) View of head, showing coin adjustment slot. (c) Typical D.C. thermostat. (d) Close-up view of typical head showing mercury vacuum switch and temperature adjustment.

into a new tank before fixing the tank into position.

Before removing the inspection cover of an existing tank, whether it has been decided to fit an immersion heater or not, a new gasket should be purchased, because rarely can the old gasket be refitted. Such an inspection cannot be made of a copper cylindrical type of tank, for there is no inspection cover; but as a copper tank does not rust, usually it can be assumed that the tank wall is suitable for conversion.

Position of Immersion Heater

Immersion heaters may be fitted either horizontally or vertically in the tank. Horizontal mounting is almost invariably used for rectangular shaped galvanised tanks. In fact, unless the immersion heater is specially designed for vertical mounting no attempt should be made to install it other than in a horizontal position.

If the whole of the contents of the tank are to be heated, the immersion heater must be fitted a few inches from the bottom, since the water below the heater remains at the incoming temperature, e.g., approximately 45 degrees Fahr., and will not be heated. Where an excessively large tank is installed, the capacity of which exceeds normal requirements, it is not always economical to heat the whole contents, in which case the element should be fitted higher, its actual height depending upon the maximum amount of hot water required.

The position of the thermostat also is important. Where this is incorporated in the immersion heater flange there is, of course, no alternative position. Otherwise, the thermostat should be mounted about 6ins. from the heater in the same horizontal plane. Below this position it will not "switch off" because the temperature will not reach the predetermined figure at which the thermostat is set. Above this level it will operate too early, for the contents heat up from the top of the tank downwards. The thermostat must not be placed in the hot-water stream immediately above the heater.

The circulator type of immersion heater must, of course, be fitted in the top of the tank, Fig. 7. This should be placed in the most convenient position, and where no inspection cover is available care must be taken to ensure that the position chosen will not be fouled by pipes. Normally a copper cylinder is free of internal piping.

Where circulators cannot be fitted into a cylinder, due to lack of head room, which must be sufficient to allow the heater to be placed in or withdrawn, circulators for external fitting may be used.

Principle of the Thermostat

The thermostat performs two functions: To measure the temperature of the water and to control the current to the heater. This is achieved by a sensitive element which operates a switch. Normal position of the switch in water-heating types of thermostats is "On." Therefore, current flows through the heater immediately it is switched on from an external source.

The sensitive element of the thermostat normally employed for water heating consists of a bi-metal rod which, upon expanding, opens the switch contacts which are held together by a spring. To give a range of predetermined temperatures from 90 deg. Fahr. to 200 deg. Fahr., an adjustment is incorporated in the switch portion or head of the thermostat. Adjustment is made with a coin or similar "tool" (see Fig. 4).

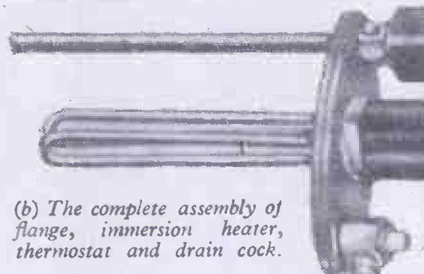
Although a thermostat will break a circuit at its predetermined setting, e.g., 160 deg. Fahr., it will not re-make the circuit until the temperature of the water drops to 150 deg. Fahr. This characteristic is termed its differential, and is the difference between cutting-out and cutting-in temperatures. Differential varies between different types of thermostats, but for water heaters is usually about 10 deg. Fahr.

When setting the thermostat, consideration must be given to the "hardness" of the water. In Manchester and district the water is soft, but in London and most southern districts it is hard. The "degree" of hardness can be obtained from the local water authority. In soft-water districts where little or no scale is formed, thermostats may be pre-set up to 190 deg. Fahr., which gives the maximum effective storage capacity, but in hard-water districts 170 deg. Fahr. is the recommended maximum since at this temperature most scale begins to form. In very hard-water districts 160 deg. Fahr. is the limit, unless the heater is specially designed for hard-water districts.

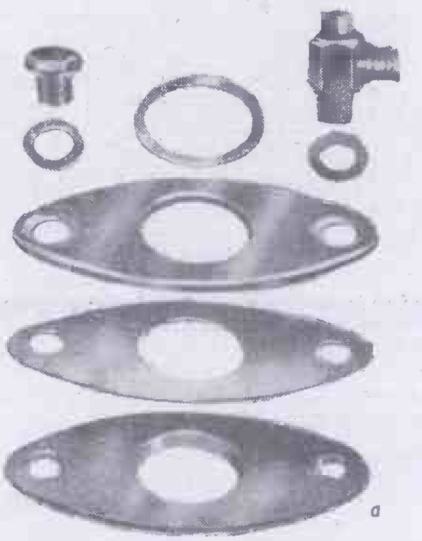
Local electricity supply authorities and municipal authorities often require a maximum setting of 140 deg. Fahr. where the heater is their property.

When purchasing a thermostat it is important to remember that a thermostat *designed for A.C. (alternating current) will not operate on D.C.* Most A.C. thermostats incorporate micro-gap switches, but if used on D.C., arcing will occur and the switch will burn out and possibly weld the two contacts together. If the current were not switched off owing to the thermostat not operating, due to welded contacts, damage from overheating of the water would occur.

D.C. thermostats usually operate on the mercury vacuum switch principle where no arc can occur (Fig. 4). This switch, which is more expensive than A.C., is universal and can be used on both D.C. and A.C. A.C. thermostats having micro-gap switches can be made to operate on D.C. by placing a suitable condenser across their terminals, but this method is not completely satisfactory because the condenser may break down and the thermostat will burn out.



(b) The complete assembly of flange, immersion heater, thermostat and drain cock.



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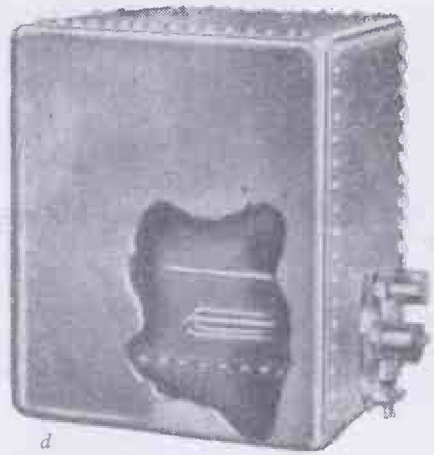

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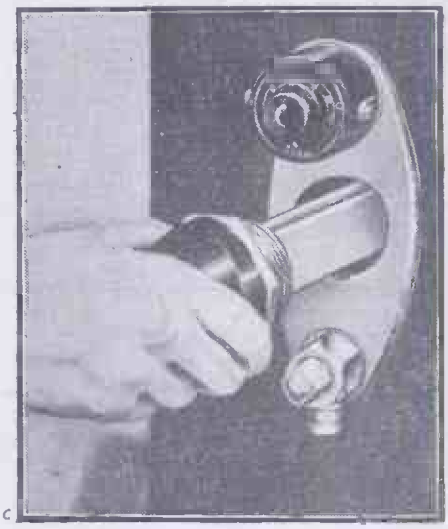

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Fig. 5.—Special three-way flange. (a) "Exploded" view, complete with drain cock. An elliptical hole must be cut in the tank (template is supplied by the makers). (c) Screwing the immersion heater into the flange. (d) This type fitted to a tank.

Fitting a Heater

Where an inspection cover is available this should be removed by unscrewing each bolt, after first marking both tank and cover to ensure that it is replaced in exactly the same position. Having decided upon the position of the heater and thermostat, a template is cut and the tank accurately marked.

A special tank-cutter should be used and saves a lot of time and trouble. This consists of a special tool having a twist drill for making a "pilot" hole, followed by a tank-cutter for the final hole.

The flange is then bolted to the tank—brass bolts only should be used to prevent corrosion—and the immersion heater and thermostat screwed in, using a small quantity of jointing material. A new gasket should be obtained for the inspection cover and a mixture of red lead and white lead or special jointing paste used to complete the joint.

Special flanges, made in various forms, are available to overcome the disadvantage of removing the inspection cover. Here a special hole is cut, the flange is pulled on to the tank and the work is now complete (Fig. 5d).

(To be continued)

An Adjustable Lighting Stand

A Useful Accessory for the Amateur Photographer

By L. C. MASON

EVERY photographer, sooner or later, is tempted to take some pictures by artificial light. Whether he already knows it or finds out from experience, results soon show that controlled lighting is the key to a successful picture, be it a portrait or a still-life study. It is essential to be able to adjust the lights to produce the desired effect of light and shade before the exposure is made. When taking photographs by ordinary room lighting this can be done to a certain extent by moving the subject, but the range of such movement is generally limited by considerations of background and camera distance.

The obvious alternative is movable lights, and the stand illustrated is sufficiently versatile in its movements to enable it to be used in a great variety of positions, giving complete control of the lighting. The design and construction are both simple and conventional, the actual stand being made of wood with metal for the adjustable clamp and reflector. The three pieces forming the stand are cut from a length of 2in. by 1in. timber, planed to shape and sandpapered to a smooth finish. Both joints in the base are straightforward mortice joints, the one forming the "T" shaped base being glued. It is worth while taking some pains over the fit of the upright in its slot in the base, as it is very convenient to be able to pull this out to pack the stand flat for storage or transport. It should fit tightly enough to make sure that there is no risk of the lamp falling out in any position. The stem of the "T" forming the base has a $\frac{1}{4}$in. hole drilled at the end for use with a stiff wire hook, by which it can be hung from the picture rail or the top of a door. Less elegant and convenient, but probably as effective would be a loop of string.

Protection to polished table-tops or wall paper is afforded by fitting three small rubber feet to the base. Finish on the woodwork is a matter of taste, but if a surface other than plain wood is required it should be remembered that the finish will have to withstand a fair amount of handling.

Constructional Details

The wooden upright carries at its top end a metal strip through which passes the clamping screw. This screw is a short length cut off a $\frac{3}{8}$in. bolt. Choose a bolt with half an inch or more of plain shank below the head and drill a hole through the plain part of the shank so that one side of the hole almost cuts into the start of the thread. The size of the hole will depend on the rod selected to hold the reflector—about $\frac{1}{4}$in. diameter is suitable. To start the drill on a rounded surface first file a small flat on the shank, then centre-punch the spot where it is desired to start the hole.

"Sight" the drill through the middle of the shank, keeping the hole as square as possible with the bolt. Cut off the bolt head with any unnecessary part of the shank, and also any excess threaded portion. Procure a wing nut and two washers to fit (Fig. 1). The order of assembly is: pass the rod through the hole in the bolt, slide on a washer from the threaded end, pass the bolt through the hole in the stand upright, fit the second washer and screw on the wing nut. The nut will try to draw the bolt through the hole in the plate, pinching the rod tightly against the washer. The rod carries the lamp holder on a pear-shaped plate to which it is soldered. Both this plate and the one on which the clamping bolt is mounted can be either of stout sheet brass or steel, a strip $1\frac{1}{2}$in. wide and about 8in. long being sufficient to make both parts. A useful source of material for such jobs as this is an old brass name plate. These can occasionally be picked up quite cheaply from junk dealers or sign writers. A generous flat, half an inch long, is filed on the rod where it is to be soldered to the plate to provide a strong joint. The hole in the plate is a bare $1\frac{1}{8}$in. diameter to fit the standard lampholder. This plate and the base of the reflector are both clamped under the shade-ring on the lampholder. A thick cardboard washer between the two ensures a snug fit. The base of the reflector, which is held by the lampholder, is merely the bottom of a cocoa tin. This has a spun-over edge, giving it a useful stiffness.

The completed flood-light stand, with all-metal reflector.

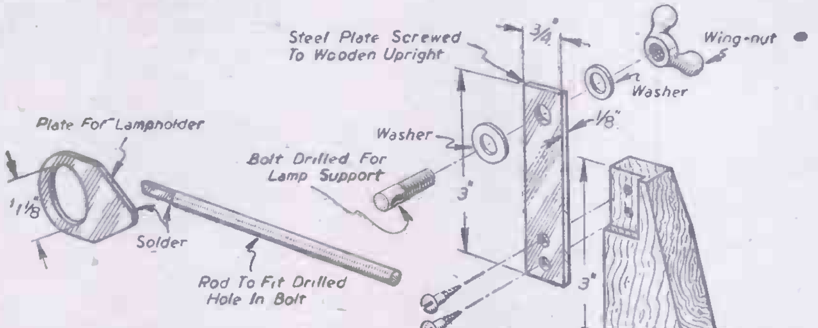


Fig. 1.—Details of the component parts for the adjustable flood-light stand.

Metal Reflector

The reflector itself is of sheet zinc. Sheet tin could be used, or aluminium—with its advantage of lightness and good surface. However, in this case tin was not available, so zinc was chosen for ease of soldering. The diagram (Fig. 2) shows the reflector laid out in the flat before bending, the dimensions given being suitable for most purposes. It can be bent to form a plain cone, of course, if that is preferred to a series of flats. To form the bends cleanly, mark off the lines along which it is to be bent and lay a steel ruler along as if it were intended to score through with a knife. Press the ruler down heavily with one hand while lifting the metal against the edge with a slight pull with the other. Start the bending by dealing with the *left* hand one first, working from left to right. This ensures having a flat piece to grasp to be bent up each time, which will be found much easier than trying to bend an already shaped area. The two surfaces at the join —one inside, one outside—are tinned and sweated together. Bend in the bottom tabs, tin their outer surfaces and sweat to the tin base.

A coat of paint inside is desirable to make the most of the light, especially if sheet zinc is used, as this goes very dull after a time particularly on exposure to the heat of a high-power bulb. Either plain white or aluminium paint is suitable, a matt surface being quite effective. A coat of black enamel outside adds greatly to the appearance, hiding surface marks or irregularities in soldering.

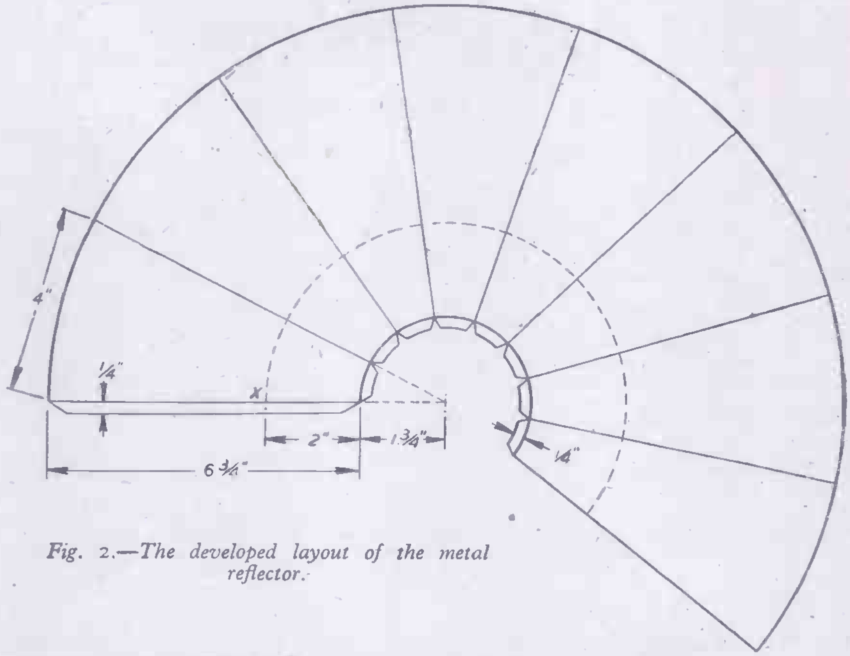
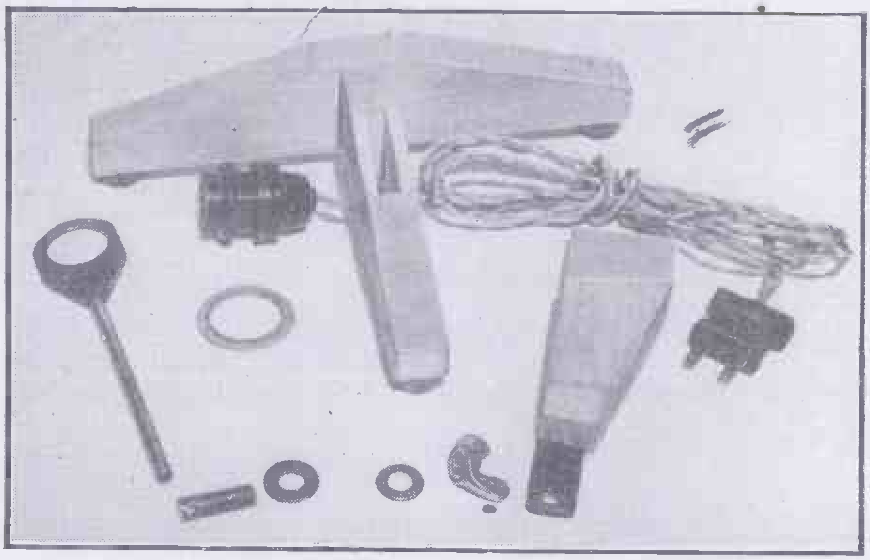


Fig. 2.—The developed layout of the metal reflector.



The component parts, less reflector, ready for assembling.

Cardboard Reflector

A much lighter type of reflector, though not so durable, can be made from thin, white cardboard such as Bristol-board. The same measurements apply as for the metal one, except that the soldering tabs at the base are omitted. The best way of mounting this reflector is to attach it to a miniature edition in metal, which is held by the lampholder in the same way as the all-metal version. The same diagram of the reflector in the flat is used, making the length from neck to outer edge 2in. only, as indicated by the dotted line at "X." This is small and light enough to be cut out of a piece of cocoa tin. Before bending for the flats, punch or drill two small holes in the middle of each flat. These are for attaching the cardboard reflector by means of wire fasteners from magazine bindings. Collect sufficient fasteners before punching the holes, so that they can be used as a guide for the spacing of the holes. After completing the tin adapter, fit it over the neck of the cardboard reflector, prick through the punched holes in the tin, insert the wire staples and clench over inside.

The only dimension at all fixed is the diameter of the hole in those parts which fit on the lampholder, but as a guide, the lengths of the wooden pieces in the stand illustrated are: base, 6in.; base cross-piece, 10in.; upright, 3in. above the base.

Electrical Drainage of Soils

THE electrical drainage of fine-grained, water-logged soils for stabilizing excavations and cuts is dealt with in "Building Research Technical Paper No. 30—The Application of Electro-osmosis to Practical Problems in Foundation and Earthwork," published recently by H.M.S.O., Kingsway, London, W.C.2, price ninepence, by post elevenpence.

This report has been prepared at the Building Research Station, D.S.I.R., and deals with work undertaken mainly in Germany during the war. A laboratory investigation of the electro-osmosis in soils is now being carried out at the B.R.S., in order to supply an adequate theoretical background for the application of the method to particular practical problems. This work will form the basis of a further report.

The action of electro-osmosis consists in a forced movement of the water in fine soils from one electrode sunk in the ground to another. The negative electrode is designed as a drainage well and the moisture is compelled to flow into it so that it can then be pumped out. In the paper various practical applications are described, such as a railway cutting, bridge foundations, a U-boat pen at Trondjhem, and a tunnel.

The method is particularly applicable to soils of the silt type, which cannot be treated by normal ground water-lowering methods and which are difficult to deal with in excavations because of their tendency to flow even on flat slopes. Experience has shown that the application of electro-osmosis is both economic and effective with silt soils.

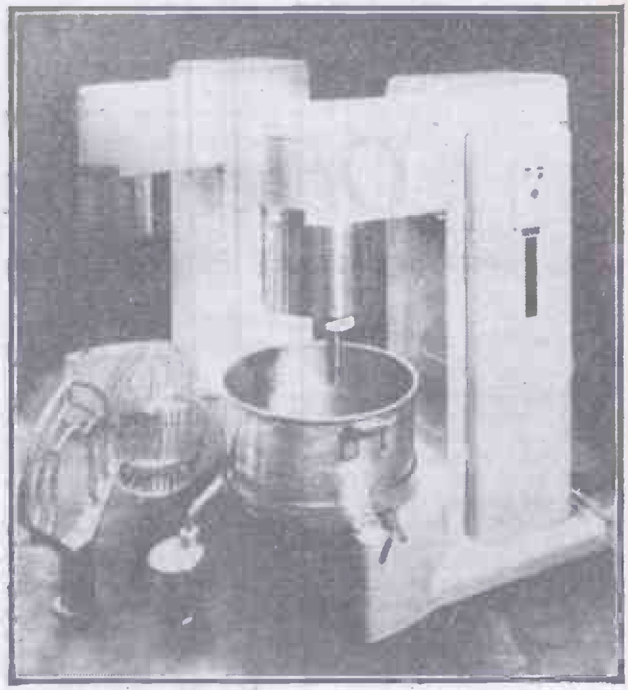
It has been noted that on the one hand the possibilities of electrical drainage are often over-estimated and that on the other hand the importance of the method is sometimes belittled. It is not intended for or suited to the extensive removal of moisture from large masses of soil, since this entails an unecomomically high consumption of current. The amount of water removed is not a measure for the usefulness of the method. What is more important is that, by proper placing of the electrodes, the flow of the water is directed away from the face of the cut.

The possibility of decreasing the earth pressure behind sheet piling is discussed, and a note on the cost is also included. For large excavations an energy of between 0.4 and 1.0 kilowatt hours per cubic metre of material excavated has been found to be required. For a very small excavation the energy amounted to about 10 kilowatt hours per cubic metre.

"Enterprise Scotland"

A Few Afterthoughts on This Interesting Show

By THE MARQUIS OF DONEGALL



A dough mixer, of new design, shown at the Exhibition.

IN my opinion, "Enterprise Scotland" was far better organised and laid out than "Britain Can Make It" from the ordinary layman's point of view. True, "Britain Can Make It" was so vast that it was difficult for the planners to do anything but shepherd people round in herds. But there was undoubtedly a gaiety and nonchalance about "Enterprise Scotland" that was regrettably lacking in "Britain Can Make It."

Of course, as usual, it is rather heart-rending to find the majority of the goods on display to be "For Export Only." But I take the view—very personal view—that I would rather see the things, even though I cannot get them, than not know what goes on.

You wandered down Princes Street and saw all those things that they make in Scotland, such as cashmeres, tweeds, and quite a lot of machinery labelled "For Export Only."

Now you might think that I am being facetious when I start my talk on the Exhibition by saying that one of the things that impressed me first was the Fishing Flies. Personally, I am a very incomplete angler, and I never realised what a work of art these flies can be. The presentation was extremely good, because they were suspended from a tree, so to speak, and in front of each one there was a magnifying glass so that you didn't have to pick up the glass and focus it, but could study in detail with the minimum of trouble.

Model Ships

Of course, the models of ships were superb and interesting to the land-lubber by the very attractiveness of their show-case display and historical biographies. It was a display of famous ships that were built in Scotland.

Sirius was the first ship built to cross the Atlantic by steam alone and was built by Menzies of Leith in 1838. The *Charlotte Dudas* (1802), the first successful steamship, built at Grangemouth. The *Comet*, which was the first successful passenger ship in Europe, built in Port Glasgow in 1812, and the *Bullolo* which directed operations on the D-day Invasion.

There was also an enormous model of the *Queen Elizabeth* with a plan of her up above and a model town in front of her. This was to show the comparison between a floating town and a town on land. Another thing that struck me was that it seemed odd to see all the jewellery entirely unguarded and looking — I didn't try—as though you could grab anything that you wanted to.

The revolving toys, inside red and yellow giant bricks, were enough to drive any youngster from eight to 80 crazy. The whole inter-revolving business on a revolving turn-table . . . just to make it more difficult . . . and fascinating.

A considerable emphasis was rightly laid on mining, and that occupied a whole section. One two-ton block, especially hewn, representing 36 hours of a miner's produce, was given as a display of the pits concerned.

A model of the main hydro-electric scheme—the Tummel-Garry—to culminate in the Pitlochry dam and power-station was given in a very graphic form.

There is a lot more to be said about this particular subject, and I found it absorbing.

The entrance hall, with the shields of the Burghs as a decoration, was extremely interesting; and also the large compass which showed where prominent Scotsmen have spread all over the world. For instance, Carnegie, in the United States; Stevenson, in Samoa; Livingstone, in Africa; Byron, in Greece; Campbell, in India; John Galt, in Canada; and Cameron, in Russia.

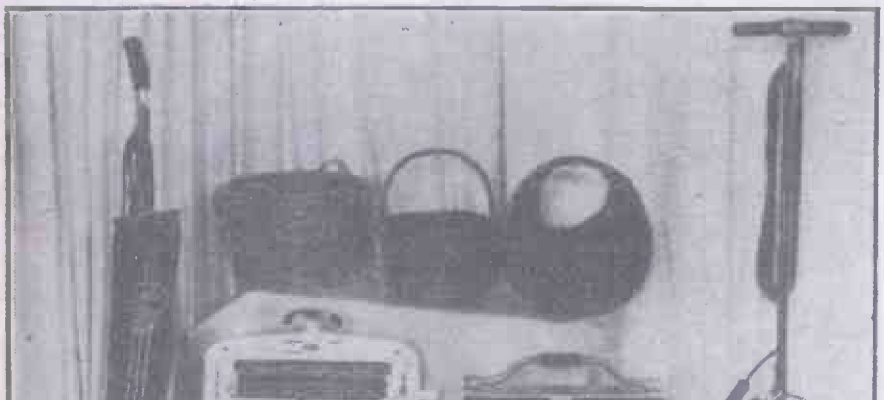
In the next room there was a map of Scotland on the ceiling with the various chief towns flashing up as points of light.

There was a model of the "Denny Brown" stabliser, to prevent ships rolling. After that the display of model ships which I have already described.

Perhaps I should mention the statue of 12th-century King David made entirely of cartridge-paper.

It would be ridiculous to try to describe the entire range of articles which were displayed in "Enterprise Scotland." You would have found precisely the same range in "Britain Can Make It" or in any other exhibition of goods all over the world.

They did, however, make great play of things that are exclusive to Scotland. For instance, the display of Scottish tartans was extremely well done in the Hall of Fashion. Cascades of Royal Stuart, McGregor, Douglas, Macintosh and McLeod, draped from way up above, with a Niagara Falls impression. It was an impressive blend of tradition and modern nudities of fashion.



Household appliances, mats and baskets were among the numerous exhibits.

Hydro-electric Scheme

I would just like to say a few words about the hydro-electric scheme.

The North of Scotland Hydro-electric Board's area water-power resources are capable of supplying at least six million units more than the nearly four million units of electricity which Scotland annually consumes.

The Board was set up in 1943 to develop hydro-electricity in Scotland and will eventually produce some 738,000,000 units. The Scotsman will tell you that the various schemes will bring household electricity to over 10,000 potential consumers in the remote Highlands and in the Islands as well as supplementing domestic supplies elsewhere in Scotland.

The idea is to provide cheap electricity out of the undoubted water-power of Scotland for encouraging new industries—especially industries requiring large bulk supplies —and through the Central Electricity Board's grid will add to the resources of the industrial belt of Scotland.

A great expansion is planned in the coal-mining industry in Scotland to take place in the Forth basin and, to a lesser extent, in South Ayrshire. This is dramatic, and will probably take time. It will mean in the east a rise from 16,000,000 tons to 20,000,000 tons of coal per year with more than 15,000 additional workers in the pits. It will also mean houses, shops, food transport, public services and recreational facilities for up to 100,000 persons, which is the expected increase in the population over the next 40 to 50 years.

Altogether I came to the conclusion that "Enterprise Scotland" was neater, cleaner and better organised, from the tourist's point of view, than any of the great English exhibitions, including "Britain Can Make It," that I have had the privilege of writing about.

Observations

Interesting Scientific Facts About Everyday Topics

By Prof. A. M. LOW

(*Continued from page 93, December issue*)

NATURE demands constant change to secure life. I have a garden in which grass seeds were planted at a cost of a week's earnings. I found that the net result in no way resembled the illustrations upon the packet; indeed I have produced a crop of food which only appeals to the type of animal I never patronise. Let me save you the trouble of suggesting that I have any personal use for thistles!

I have watched these things, I mean the thistles not the donkeys, and I find that it takes countless thousands of seeds to produce one really good thistle on a bare patch of land. The interesting thing is that this seems a similar manner in which the human stomach is employed. Here we have unbelievable wastage, but as in the case of more quickly living creatures the means provided to secure this wastage are of unlimited complication.

Just imagine all the functions which are necessary for you yourself to secure that out of every two lettuces you eat the microscopically useful portions shall be extracted. Then think of the wonderful fashion in which some seeds are supported by a parachute-like structure which possesses all the attributes of a well designed girder bridge, so that the wind can be quite sure to remove the seed without fracture.

To our ignorant minds it seems strange that so delicate a mechanism should be necessary to secure an end through a whole series of wasteful processes, and it is for this reason that I always feel that waste cannot really exist other than in our ignorant minds. Then we realise with the physicist that matter is indestructible and begin to think what part is played by fertilisation, and what would be the characteristics of the ultimate thistle were specialisation to take place instead of casual dissemination?

We believe that the answer to this problem is indicated by creatures like the elephant and giraffe which have specialised in order to retain life within their fold and which, in consequence, are definitely dying out. So, surely science should tell us how we can accelerate, not direct, the processes of nature and devise a method of breeding from both plants and animals which gives us selection without extinction. Dr. Voronoff found one answer.

Cost of Millions

AN amateur inventor, and they are the best, telephoned me to say that he had found how to light gas fires without matches. He then proceeded to describe the well-known device of a very, very fine platinum wire carrying at intervals little blobs of spongy platinum.

It is, of course, an example of catalytic action and I tried to explain this when he asked me if the result was due to friction and what would be the cost of 20 or 30 lb. of the material.

I pointed out that he might have to arrange another lease-lend loan before he could supply many people with a few yards of heavy platinum rod, and then I told him how this principle has been applied to mines and even to submarines.

The great trouble always used to be that hot gases or hydrogen gases in mines disturbed gas indicators as much by their temperature as by their chemical composition. The problem was solved by making a balanced indicator using one platinum wire and one glass wire. Both expand at the same rate, so only a difference in expansion due to the presence of escaping gas would cause the bell to ring. Platinum was always used for sealing in glass tubes before new alloys were discovered for expanding at the same rate, so that no cracking would occur.

Burn it Twice

IT is astonishing how uneconomical we are in order to satisfy our demands for savagery. Look at the way we chew half raw steaks and choose live fish. Is this not a throw-back to animalism? Certainly it is very wasteful.

A coal fire is abominably destructive of many hundreds of valuable medicaments, oils, scents, tars, lipsticks and many other things.

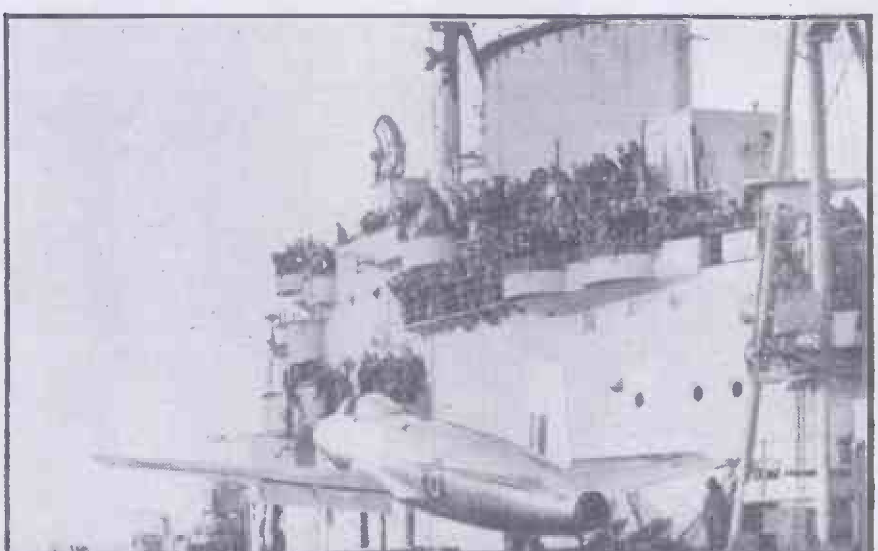
I saw the result, a few years ago, of some experiments made on the incubation of chickens and it was well established that more lived when warmed by coal fires. No doubt something to do with the variations of temperature which encouraged the chicken to harden itself, as under natural conditions when the mother leaves the nest.

Think of the common candle. Light it and place a small tube with one end at the centre of the flame and the other end sticking outside the flame by a few inches. You will find you can light the gas which comes off the flame centre because it is just unburned hydrocarbons, most of which go to waste. It was perhaps a little test like this which resulted in the incandescent mantle.

Peace from Submarines

THIS peace has nothing to do with the excellent scheme which Russia has brought out for opening new trade routes under the sea. I am thinking of the queer cellular, putty-like plaster with which German submarines were covered at one time in order to keep in the oscillations of sound so that the noise, or even voices, could not be picked up by electric listening gear situated in anti-submarine vessels.

A very similar plaster can be spread on roofs, ceilings and walls. Even on to girders. The idea is to prevent the appalling concatenation of loathsome noise from which we all suffer. How I wish we could teach everyone that no one wants their noise! Voice is largely used to express thought. Do I wish, other than in a few cases, to sense everybody's thoughts? You may say that they would do me good. Maybe, but I cannot shut my ears, and we all know that there are occasions when to shut the eyes is a matter not only of policy but of good manners.



Britain's latest jet fighter, the 600 m.p.h. Supermarine "Attacker," has recently successfully completed one of the most difficult tasks—the landing-on and taking-off from the deck of an aircraft carrier. Our illustration shows the "Attacker" landing on the deck of the aircraft carrier "Illustrious" during recent trials.

The Elements of Mechanics and Mechanisms—3

By F. J. CAMM

(*Continued from page 83, December issue*)

THE quantity of matter which any body contains is called its *volume*. A piece of iron measuring 6in. x 6in. x 6in. has eight times the volume of a piece measuring 3in. x 3in. x 3in. A body containing 6 cu. in. of matter contains twice the quantity of a piece containing 3 cu. in. It is important to remember, however, that the mass of a body is not always in proportion to its volume. For example, a piece of wood containing 10 cu. in. would contain less matter and therefore have less mass than a cubic inch of platinum. Fortunately we have a ready method of estimating the masses of different bodies. We know that gravity attracts bodies in proportion to their mass, and therefore when any two bodies containing the same quantity of matter are placed in the pans of a pair of scales they will be equally attracted by the earth and will, of course, *balance* one another irrespective of their *size*.

Now the strength of the earth's attraction for a body is called its *weight* and therefore mass is usually measured by weight. The unit of mass or standard of weight is a piece of platinum kept in London, copies of which are preserved in various parts of Great Britain.

What is the difference between mass and weight? The quantity of matter in a body or its mass cannot change, no matter whether it be at the Equator, the Pole or any other part of the world, or even on the earth or on the moon. Weight, however, does vary. For example, a body weighing 200oz. at the Equator would weigh about 201oz. at the Pole. The weight of a body increases by about 1-200th in passing from the Equator to the Pole. The mass of the body, however, would be exactly the same at both places. Thus, we see that the weight of a body is used only as a measure of its mass, and it is not to be confused with mass itself.

Momentum

If a cricket ball and a cannon ball of the same size are moving with the same velocity it will be found more difficult to stop the cannon ball. The reason for this is that there is more *force* in the cannon ball than in the cricket ball, just as there is more heat in a quart of water than in a pint, though both may be of the same temperature.

We can therefore see that in studying bodies in motion it is necessary to consider not only the mass of the body in motion but also the *velocity* with which it is moving. If a 1lb. piece of iron were moving at the rate of 1ft. per second it is said to possess a certain quantity of motion. If it were moving at the rate of 20ft. per second it would have twenty times the quantity. Also if a body weighing 10lb. were moving at the rate of 1ft. per second it would have ten times the quantity of motion of the body weighing 1lb. and moving at the same rate.

The *quantity* of motion possessed by a moving body is measured by multiplying the weight of the body in pounds by its velocity in feet per second. The answer obtained is the *momentum* of the body.

The unit of momentum of a moving body is the quantity of motion possessed by a body weighing 1lb. and moving at the rate of 1ft. per second.

For example, a body weighing 1cwt. moving at the rate of 9ft. per second will have double the momentum of a body weighing ½cwt. and moving at the same velocity.

Composition and Resolution of Force

We have seen that force is that which moves or tries to move a body, or which changes or tries to change the motion of a body. In dealing with forces it is sometimes convenient to represent them by lines drawn on paper. We must, however, know three things about the force. One, the point of application of the force. Two, the direction of the force, and three, the magnitude of the force.

All bodies are made up of particles, and by the point of application of any force we refer to the position of that particle of the body on which the force acts. This particle can be represented in our force diagrams by means of a dot, which will also indicate the point of application.

When a force acts on a body it moves or tends to move the particle on which it acts in a certain direction. The line upon which the particle moves is called the direction of the force and if a line be drawn from the dot in the direction in which the particle is caused to move it will represent the direction in which the force acts.

We measure the magnitude of a force by stating how many pounds weight it can support. For example, the force exerted by a man's arm may be measured by the weight he can lift with it. If a weight is suspended on a steel spring or a piece of elastic, it will stretch the spring or elastic until it pulls the spring down and the spring pulls the weight up with equal force. Therefore, the number of pounds in the weight is the measure of the force the spring is exerting.

If, on the diagram, we fix a line of a certain length and agree that it shall represent a force of 1lb. the magnitude of any force can be represented by drawing as many of these lengths as there are pounds in the force.

Now hang a weight of 2lb. on a spring balance. There is thus a force of 2lb. hanging downwards and it may be represented by drawing a line from the point of application and twice the length of our standard line representing a force of 1lb. If we place on the spring balance a second weight of 2lb. this force will act in the same direction as the first and we can therefore draw a line of a length twice that of the first. Thus, the line represents a force of 4lb. acting in the same direction. If we put a 4lb. weight in place of the two 2lb. weights it will be observed that the pointer on the scale marks the same place as it did before. Here we have one force equal to two others, each producing the same result. This single force is called the *resultant* of the two others, and its magnitude is found by adding the former forces together. For example, three men pulling on a rope in the same direction, one with a force of 100lb., the second with a force of 150lb., and the third with a force of 200lb. would together exert a total force of 450lb. This can be called the resultant of the three forces.

Individual forces, however, may not always act in the same direction. They may act in opposite directions. Attach a 1lb. weight to each end of a piece of rope passed over a pulley. The part of the rope at the top of the pulley is subject to two opposing forces. If the piece of rope is cut into two pieces of equal length and loosely tied together, these two opposing forces, if the knot is loosely tied, would pull the knot apart. The two forces in such a case are said to be in *equilibrium*. Forces in equilibrium are said to be equal and opposite.

If the balance of the forces is destroyed by adding more to one of them the two weights will not remain in equilibrium and they will be out of balance. The magnitude of the two forces acting in this way is found by subtracting the lesser from the greater.

Forces Acting in Parallel Lines

Forces which act in the same direction but not in the same straight line are referred to as *parallel forces*. They may be represented by lines of a length equivalent to the force exerted and drawn parallel to one another. In the case of the two unequal weights suspended over the pulley they will be equal in their effect to a force of 2lb. This force is the resultant of the two forces, and it is found by subtracting the two as mentioned before.

Forces Acting at an Angle

A good example of forces *acting at an angle* with one another is when two persons endeavour to strike a ball at the same moment, one urging it into one direction, and the other in a direction at right-angles to it. The ball will obviously travel in a line representing the diagonal of a square.

Later on we shall explain how calculations are made in connection with forces, and it will be necessary to deal with the parallelogram of forces, the parallelogram of velocities, the triangle of forces, the polygon of forces, etc.

Resolution of Forces

It has been shown that several forces may be combined and that we are able to find a single force or resultant which is equal to several forces acting either in the same direction or in opposite directions.

It is also possible to resolve a single force into two or more other forces, whose combined effect will be that of the original force. This is known as the *resolution of forces*.

The Second Law of Motion

The first law of motion has already been explained. The second law discovered by Newton deals with what would happen if no force acted on a body. The second law says: *When* a force acts upon a body in motion, the change of motion is the same in magnitude and direction as if the force acted *on the body at rest*.

We may consider three cases under this law. Firstly that in which the forces cause motion in the same direction, secondly that in which the forces act in opposite directions, and thirdly that in which the forces act at an angle to one another.

(*To be continued.*)

Some Aspects of Mathematics

A Discussion of the Laws Stated by Simple Expressions and Equations

By H. R.

MATHEMATICS can be an interesting subject quite apart from its uses in solving all sorts of problems.

Of course, the difficulties will remain. We must first know something on "how to do maths." before setting out to inquire if it has a "meaning." That is always a task demanding concentrated effort. We may recall what Archimedes told a royal pupil who found the process of learning slow and arduous: "Let us proceed, for there is here no royal road for kings."

But this writer has always thought the art of "symbolic reasoning" could be given a little more colour even at school—were teachers not hampered by the syllabus to be covered in a given term. He remembers one of his teachers at a technical college; a specialist in his subject, who had the rare gift of "putting over" the most difficult themes. Before we knew it, we could differentiate and integrate quite complicated functions.

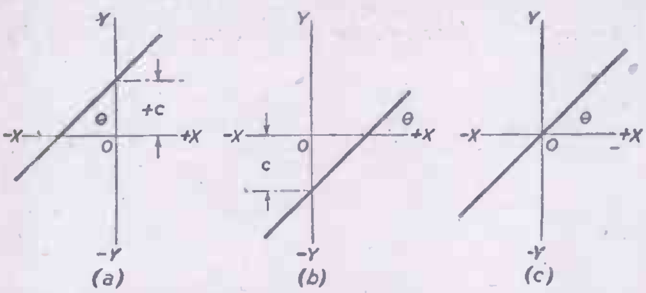


Fig. 1.—The simplest graph: that of a "linear equation."

The aim of this short article is not anything of that kind. It will be more in the nature of a "ramble" to discover the *language* mathematics speaks, or the *laws* stated by simple expressions and equations. Our expressions will have to be "simple," if, as intended, the article shall be of value to those who have hitherto groped with formulae without thinking if they have "meanings."

Let us start with the simplest "law."

Things in "Constant Ratio"

It has important applications in every branch of science, and says: the ratio of two (variable) quantities = *a constant*:

$$Y/X = \text{"k," say.}$$

What do you deduce from this bare statement? If, when X is changing, Y changes in such a manner that the ratio Y/X (or X/Y) is always constant, what "law" is exhibited?

Let X increase n-times. Then, to get a *constant-ratio*, Y must increase n-times, giving:

$nY/nX = Y/X = k$, the same as before the "change" was made.

Y varies in *simple proportion*, or in *direct proportion* to X. A *linear law* applies. A useful thing to understand is how this forms the basis for defining various units of measurement.

In Mechanics: space/time (s/t) = a constant v, the velocity—or average velocity if non-uniform; if v varies uniformly, v/t = another constant "a"—the acceleration or deceleration; also, "a" = *force/mass* (f/m), where *force* is defined as *mass × acceleration*. (A 1 lb./wt. falls under gravity with a force of 32.2 *poundals*, or 981 *dynes*.)

In electricity: *Voltage/Current* (V/I) = a constant, R, the electrical resistance of a simple circuit; *Quantity/Potential* = a constant C, the capacitance of a condenser; *self-induced E.M.F./Rate of Current-change* = a constant L, the self-inductance, etc.

The "Straight-line Law"

If Y is directly proportional to X, a graph connecting the two is a straight line (Fig. 1a)—hence *linear* law.

The intercept on the Y-axis (the value of Y when X = 0) is at a point c units above the origin; if below the origin (Fig. 1b), this would be written −c units. Thus one form of standard *linear equation*, is:

$$Y = bX + c.$$

E.g., $Y = 2X + 4$, or $Y = 2X - 4$.

The constant "c" (+4 or −4, etc.) simply defines where the graph crosses the Y-axis. The constant which we have been discussing, however, is "b." If c = 0, our graph will pass through the origin (Y = 0, when X = 0), Fig. 1c, and the equation then reduces to:

$Y = bX$, eg., $Y = 2X$, where $b = 2$.

Therefore, $Y/X = b$ = the *tangent* of the angle θ in Fig. 1—if X and Y are measured to the same scale. Obviously, X/Y = the constant b, wherever on the graph the ratio is found, and,

$$b = \tan\theta = \text{the } slope \text{ of the graph.}$$

Meaning of "Curvature"

It follows that *curvature* of a graph is indicative of things not in constant proportion.

The "constant" becomes a *variable*, having different values for every value of X and Y. Or, taking the relation Y/X = k, itself, suppose Y happens to be constant and we deliberately vary k. Then, the relationship between k and X will be non-linear, giving:

$$kX = Y = \text{a constant.}$$

We shall mention this again presently.

The most interesting examples of curved characteristics are found in electrical and radio engineering. It will be worth discussing some of them at little length to show there is such a thing as "mathematical meaning":

Magnetisation Curve of Iron

In Fig. 2a is shown a "magnetisation characteristic" of iron when placed in a current-carrying coil.

At first, the "Flux" (N) appears to be increasing approximately in direct proportion to the current (I)—this is never exactly true of any point on the curve, since there is curvature throughout. Eventually a state of magnetic saturation is approached—as all the molecules become "set" by the magnetising force. The curve bends over rapidly, showing lesser and lesser increments of flux per ampere of current.

Over a small part of the "straight" region, it is approximately true to write:

$$\text{Flux/Current} = \text{a constant,}$$

or, if we employ the magnetic units, *flux-density* (B), and *magnetising-force* (H),

$$B/H = u = \text{the } permeability \text{ of the iron.}$$

The permeability is not a constant, but a factor which varies with the state of saturation of the iron. At saturation, the slope of the curve becomes that of air or other non-magnetic material; an enormous current-increase, e.g., from I_1 to I_2, will be necessary to cause any noticeable increase in flux.

The last fact is of importance in certain types of A.C. transformers and chokes which, by design or accident, work with "saturated cores" (this may be deliberately arranged by means of an auxiliary coil carrying D.C.). The current tends to increase out of all proportion to the voltage, with resulting severe distortion of the current waveform. Alternatively, the *tendency* for the current to increase rapidly may be utilised for regulating the voltage—in what are called "flux-regulating" transformers.

From another mathematical point of view, curvature of a characteristic gives rise to waveform *distortion* (for example, in the current-wave as above), with resultant generation of *harmonics*.

Introducing "Infinitesimals"

However, we said just now that over a small part of the "straight" region (the so-called "straight region"), the flux varies approximately in direct proportion to the current.

If we make the part small enough, this statement is equally true of any curved region. Thus a "very small" part of the bend in the characteristic approximates to a straight line (Fig. 2b), and the smaller it is, the nearer will be the approximation to exact truth.

If we draw a straight line PQ touching or forming a "tangent" to this small part, its slope will represent, very nearly, the slope or steepness of this bit of the end. If the "bit" becomes smaller and smaller, contracting into a mathematical *point*, i.e., if PQ could be drawn to touch *a point* on the bend, its slope will exactly denote the curvature at this one point.

All this may help to suggest what the "calculus" is about—what mathematicians mean by "infinitesimals," or why such very insignificant "quantities" should receive so much attention.

The important thing, of course, is that the *ratio* of two infinitesimally small quantities is usually a respectable finite number. For

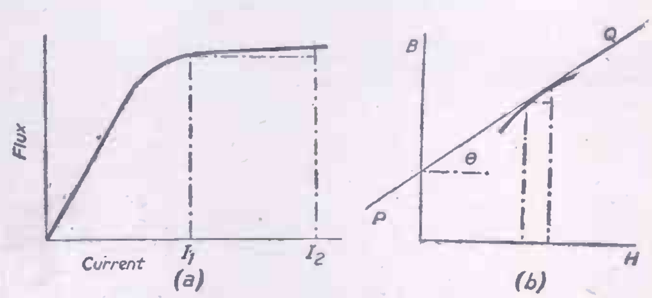


Fig. 2.—Simple examples of "non-linearity," or "curvature."

instance, $1/10^8$ is a very small number, but the ratio,

$$\frac{1/10^8}{1/10^8} \doteq 1$$

Hence, in spite of curvature, an infinitesimally small increment of magnetising-force dH will give rise to an increment dB in the flux-density (also infinitesimal), and the ratio,

dB/dH = u = the permeability *at that point*.

But then, there are an infinite number of points to a curve! The ratio dB/dH could —if we knew the equation of the curve—be expressed in algebraic form to give the slope of a tangent (=permeability in this case) at *any* point. This *derived* equation, or *derivative*, or *differential coefficient* is one of the first things students learn to find in elementary calculus.

Let us look at one or two more interesting aspects of curvature.

Radio Examples

As long as the resistance of an electric circuit is constant, "Ohm's Law" is a linear law : V/I = k, or R.

Suppose, however, we had a circuit device for which part of the graph connecting voltage and current is a curve, say, of the shape shown in Fig. 3. Like the permeability (η) in our magnetic example, this indicates that the resistance (R) is a variable—over the "bend" it will be different for every different value of V and I.

As before, we could only specify the resistance at some point. If we knew the equation of the curved characteristic it would be possible to derive the expression for the differential coefficient, from which the resistance at any point could be calculated.

Curvature of a voltage/current characteristic has far-reaching consequences in radio and audio-frequency engineering. First, it signifies distortion and production of harmonics, as already mentioned with reference to saturated cores. But for numerous radio purposes these effects can be put into good use.

Thus, harmonics provide a means of *frequency-multiplication*. Usually, in a simple *doubler*, the second harmonic is extracted from a waveform which has been deliberately distorted. A frequency 2f. is thus obtained, which may be "doubled" many times over by a chain of valves having curved characteristics. Alternatively, weaker harmonics can be picked-out from the distorted wave from a single valve up to the 10th, or much higher.

A certain type of curvature gives only *even* harmonics. Another kind, such as occurs in pentode valves, gives predominating *odd* harmonics—particularly the *third*.

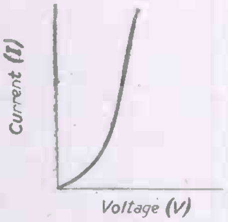


Fig. 3.—A Voltage/Current characteristic with non-linear portion.

Amplitude-modulation of a high-frequency "carrier" by low-frequency speech or music depends upon non-linearity or dissymmetry of some characteristic. It is not possible to "mix" widely different frequencies in such a manner that one *modulates* the other while working on a "straight-line" characteristic.

Rectification, or *detection* of the incoming modulated-wave at a receiver similarly depends upon one valve being worked under "curvature" conditions where it distorts the high-frequency component—though the resulting current at speech and musical frequencies can be largely distortionless.

So, altogether, "curved" characteristics" form an absorbing subject in the field of "electronics." Graphs themselves can also be extremely interesting when you get down to a proper study of them. There is no room left in this article but to note one more "law" mentioned earlier.

The Law pv = a Constant

It will be recalled that we said : if Y is constant, and "k" (and X) become the variables, we get a different relation :

kX = Y,

remembering that "k" is no longer the "constant"—it is Y.

Thus, if a gas is compressed by a piston, its pressure varies inversely with its volume, meaning that *pressure* × *volume* = a constant, the familiar law, pv = c. If in an electric circuit the voltage V is constant, whilst the resistance R is varied, the current varies inversely to R (I = V/R). Hence, what is obvious in this case, IR = the constant voltage V.

What form of graph connects R and I? It is a most interesting one in many respects. As a useful exercise, plot it, assuming some voltage, and giving R a range of values. Then write a list of the physical (or electrical) truths you can "deduce" from it.

I will conclude by giving the reader interested in radio something to do—to test his knowledge! Consider the expression :

$$Y = \frac{X}{X + c}$$

where c is a constant.

Plot the general shape of the graph. What sort of "law" is exhibited? Has Y a "maximum," a "minimum," or a "limiting" value? In what form does the equation apply to an important piece of radio equipment?

After all, we have only succeeded in barely touching upon one or two mathematical laws, but perhaps what has been said will prove of some interest.

Aviation Notes

The "Bristol" Helicopter

THE "Bristol" Type 171 helicopter has made its first test flight at Filton and has thus become the first British commercial helicopter to take the air.

Designed by Mr. Raoul Hafner, head of the company's helicopter department, the Type 171 is the first rotating wing aircraft to be built by the Bristol Aeroplane Company. Intended for use as an air taxi or feeder line aircraft for rescue work, the Type 171 provides accommodation for four people, including the pilot. Powered with a 450 h.p. engine, it has a range of some 200 miles and a normal cruising speed of 100 m.p.h.

In building this helicopter, the company has aimed at providing a foolproof aircraft, capable of operation not only by airlines, but also by the private individual. Many safety features have been incorporated, one of the most ingenious being a constant speed governor which controls the engine throttle, opening or closing it automatically to maintain the rotor speed selected by the pilot. The pilot is thus relieved of the necessity for adjusting the throttle whenever he makes an alteration in rotor pitch or aircraft altitude.

New Transport 'Planes

THE latest addition to the transport fleet of the Royal Air Force, the Vickers Valetta, military version of the Viking airliner, is the first type of aircraft to be powered by the 2,000 b.h.p. "Bristol" Hercules engine.

The Valetta, which made its first flight on the last day of June, closely follows the Viking in basic design. The two Hercules 230 engines, however, provide an extra 600 b.h.p. for take-off and show a marked improvement in the already excellent take-off, climb and single-engine performance of the Viking, despite an increase of 2,000lb. in all-up weight.

Six main rôles will be filled by the Valetta in its capacity of standard R.A.F. medium military transport: troop transport, paratroop dropper, supply dropper, glider tug, freight and vehicle carrier, and air ambulance. As the Vikings are displacing the Dakotas on civil air routes, so will the Valettas replace the American aircraft in British military service.

Production of this versatile aircraft has already commenced at the Vickers works at Weybridge. Early machines are to undergo extensive operational trials to ensure that aircraft delivered to squadrons in 1948 will be fully operational in all rôles.

"Star Lion," flagship of the Tudor IV fleet for B.S.A.A., on its first test flight recently. During a night flight of two and a half hours the aircraft flew at 20,000 feet for a routine check of the pressurisation system.

Dynamo and Motor Problems—3

Voltage/Load Characteristic : Separately Excited Generators : Compound Dynamos

By H. REES, A.M.I.E.E.

(*Continued from page 82, December issue*)

"CRITICAL Resistance" of the shunt field circuit was considered in the second article as a cause of failure to excite—generally as a result of leaving a field rheostat too far in the "Voltage Lower" position.

"*Critical Load*," is another, different, factor which we will now discuss. There is a critical resistance across the terminals, at or *below* which it is impossible for self-excitation to occur.

Note that this is a *low* resistance—or a large load *current*. Let us approach the Voltage/Load characteristic of a shunt generator along somewhat unusual lines.

A "Short-Circuit" Problem

What would happen if you "shorted" the terminals of a shunt dynamo with a piece of wire?

By electric circuit laws, an enormous current should flow. Indeed, the results would probably be catastrophic if such an experiment was tried on a machine normally running at full voltage—a large current-surge can do irretrievable damage in a short time.

But if a permanent short-circuit were applied before running-up or before switching-on the field, nothing much would happen. A self-exciting dynamo would simply fail to excite. The resistance of the "short" is considerably below the critical load resistance above mentioned.

In fact, it is a practical measure sometimes used on car dynamos if the battery is taken off for repairs or maintenance. The output voltage of a car dynamo is controlled (when the speed rises) by the battery charging *current*.

If the battery is disconnected, even for an instant, when the dynamo is normally running at full excitation, the voltage will rise far in excess of the 12v. or so required. Thus a bad connection in the battery circuit will cause lamps to be blown, by throwing them momentarily across a dynamo whose voltage kicks-up to some excessive value.

If the battery is removed, there is some risk of burning out the shunt should the generator be switched-on under these conditions. A "field fuse" is usually included on the dashboard as a safeguard, but it is obviously better to take precautions against all contingencies by preventing the machine exciting.

A piece of fairly thick heavy wire secured between the + terminal and the "earth" (framework) effectively does the trick.

Voltage/Load Characteristic

Why does a low resistance across the terminals stop self-excitation?

The usual answer given is that it "shunts all the current from the field": or that the low resistance path in parallel with the shunt prevents any appreciable current passing via the latter path. It is not an incorrect answer, but is too simple—it omits mention of other important factors connected with the working characteristics of generators.

A shunt dynamo has what is called a "falling" or "drooping" characteristic with load (Fig. 13a). This simply means that the output voltage (V) is not constant, but falls somewhat in the manner shown as we take more load current (I).

We might say that more current passing into the external load means less current through the shunt—the load "shunts-off" some of the field magnetising current, hence less e.m.f. is generated.

But is this really an explanation? Why should the load take any of the field current? If the machine is of adequate size to supply any load within its capacity, we might reasonably expect the armature to be able to supply all the "amperes" required without robbing the field. After all, the shunt is only one more parallel path taking a small fraction of an ampere, like the lamps, heaters, etc., connected in parallel across the external circuit.

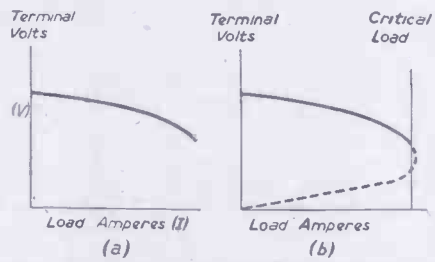


Fig. 13.—Voltage of a shunt dynamo falls with load as in (a). Dotted part in (b) shows unstable conditions at the "critical load," when the excitation falls off to zero.

In fact, if the ohmic resistance of the armature and brushes was zero, and if the armature ampere-turns exerted no distorting or demagnetising effect on the main flux, the output voltage and field current would be absolutely constant at all loads—assuming as well that the prime-mover is perfectly governed to keep the speed absolutely steady.

Causes of "Falling Characteristic"

In other words: The load robs the shunt of amperes, because the latter cause *a drop of terminal volts*.

It is putting the cart before the horse to start explaining matters in terms of current shunted-off the field as the *first cause* of a fall in terminal volts. It is an important contributory cause, but begs the question why the volts should fall in the first place.

Armature drop is the proper explanation.

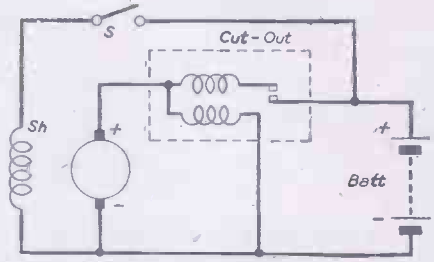


Fig. 14.—"Separate-excitation" of shunt directly off a battery—the battery normally charged by the dynamo. A field switch S may be used to stop a constant drain on the battery when the dynamo is not in use.

Armature conductors and carbon brushes possess resistance—a small fraction of an ohm, it is true, but enough to result in several volts "dropped" when the current is large. For example: 0.1 ohm absorbs 1-volt for every 10-amperes passing through the armature.

Next, in non-interpole machines, the 10-amperes will have a magnetising effect on the armature core. We will examine this later. Suffice it to say now that the core magnetisation may have two effects on the main field: (a) flux-distortion, which will alter the potential-distribution at the commutator as touched upon in our previous article; and, (b) a demagnetising effect—if the brushes are given a forward or backward "lead" out of the geometrical neutral.

Together, both effects come under the heading *armature reaction*. In properly proportioned interpole machines, the interpole polarities will be such as annul armature reaction completely, hence such machines have an improved voltage-regulation curve on load. But we may assume for the present that the 10-amperes will cause a larger drop than 1-volt (in resistance), owing to the "cross" and "back" magnetising effects of the armature ampere-turns.

Resistance *absorbs* "volts," pure and simple. Armature reaction may *weaken the flux*, and so cause *less e.m.f. to be generated.* In addition, flux-distortion results in less of the total e.m.f. being available at fixed points where the brushes are fixed—armature voltage-distribution altered.

Suppose the total loss is 2-volts due to all these factors. Finally, the field is robbed of 2-volts. The magnetising-current falls, in the proportion:—2v./Voltage of the Machine, e.g., in a 12v. generator the reduction would be 2v/12v=1/6th=nearly 17 per cent.; but in a 100v. machine it would be only 2 per cent.

Thus, in effect, the load "robs the shunt." But only because of the 2v. loss in the first place due to armature resistances and reactions. Still less e.m.f. will be generated, giving an overall "drop" of perhaps 3-volts or more according to the working-point on the magnetisation characteristic, etc. Observe, too, what was said above regarding percentage fall in field current in machines of different voltages.

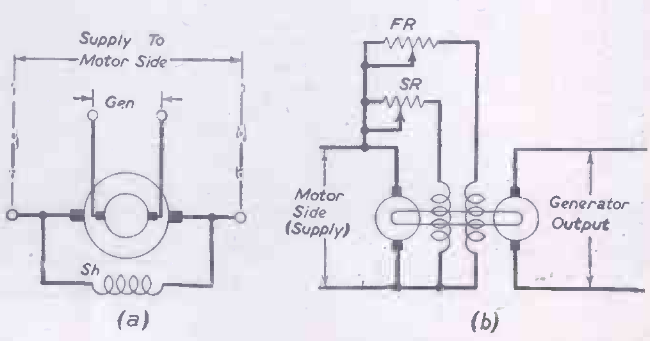


Fig. 15.—Two types of motor-generators. With two armature windings and a "common" field (a) field-control of the output voltage is not possible. With two independent machines as in (b), double-control is possible by rheostats F.R. and S.R. —S.R. being a speed-regulator for the motor.

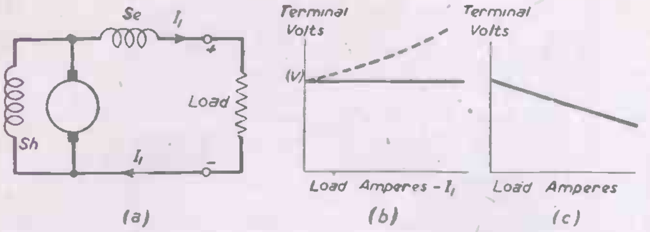


Fig. 16.—The Compound-Dynamo: (a) Level-Compounding; (b) Differential-Compounding; dotted curve in (b) shows a "rising characteristic" due to over-compounding.

Unstable Conditions

Now, a magnetisation-curve is not a straight line. As the field current is successively reduced at increasing loads, a point will be reached where a further small reduction will cause a large decrease in the flux and e.m.f.

As this point is approached, the terminal volts will start falling more and more rapidly as indicated by the curvature of the characteristic in Fig. 13a. The more rapid fall in the voltage at large loads may be ascribed to the fact that every ampere reduction in field current will cause the flux to fall in bigger steps—or, we are approaching an unstable state when the process will become cumulative.

The field and generated e.m.f. will start to fall so rapidly that one reacts upon the other, causing a further big reduction, and so forth until the output voltage drops-off to zero without any further increase of load.

The fact is shown by the bending-over of the load characteristic in Fig. 13b. The dotted part denotes the unstable state where self-excitation completely fails and the output falls off to zero.

While overheating would make it impossible to carry out a test on a shunt dynamo to this extreme limit—generators are not designed to supply currents anywhere approaching the critical load—a very low resistance "short" applied across the terminals, *initially*, will stop the field excitation building-up.

Without going into much detail regarding curves, tangents, etc., we may explain the effect somewhat as follows:

With such a low resistance circuit, any tendency for the e.m.f. to increase will *tend* to give rise to a large current. But the latter does not actually take place to any appreciable extent because all additional volts generated will be absorbed internally, due to the various causes mentioned.

The external circuit resistance is comparable with internal resistance, and (with the effects of armature reaction upon the weak initial field) will cause all the volts generated to be absorbed internally—at a comparatively small current round the circuit. That being so, no increase in terminal volts and shunt current is possible to build up the excitation.

This brief account is not complete, since it omits reference to the magnetisation characteristic, but should be more helpful than a purely mathematical dissertation.

Separately-excited Generators

Often it is possible to arrange for *separate-excitation* of the field from an external d.c. source; for example, off a battery of accumulators.

Thus, the shunt may be energised directly off the battery, as in Fig. 14. A field switch, S, or a rheostate having an "OFF" position would then be essential to avoid a constant drain on the battery during periods when the dynamo is not in use.

If the shunt was connected on the generator-side of the main switch or auto cut-out, the machine would be dependent upon residual magnetism and self-excitation to start generating.

Separate excitation provides an independent field supply. Residual magnetism is no longer important, and the remarks previously made regarding "critical resistance of the shunt," and "critical load" no longer apply—at least, so far as any question of providing a field is concerned.

Another advantage of separately-exciting is

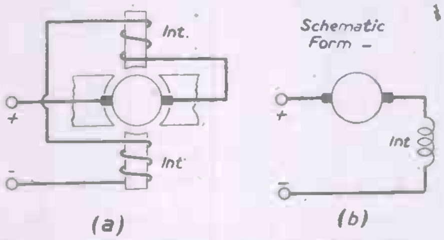


Fig. 18.—Showing how interpoles are thick-wire windings connected in series with the armature, like compound series windings (the main pole windings are omitted for clarity).

improved voltage-regulation at various loads. The internal drop of volts due to resistance and armature reaction can now have no secondary effect upon the exciting current, hence there will be less overall voltage loss.

Many machines for special purposes are designed for separate-excitation, i.e., the field winding is designed for a different voltage to the one supplied by the armature. Sometimes it may be advantageous to rearrange the field coil connections, in parallel or series-parallel, to suit some available lower-voltage source for separately-exciting.

Motor Generators

Of interest, perhaps, are d.c. motor generators, of which there are two main types.

In one, a double armature winding and two separate commutators are employed, with a common field winding (Fig. 15a). Obviously, the field must be energised off the motor side—off the supply mains. An interesting point to note is that no control of the output voltage of the generator side is possible in this type of machine by inserting resistance in the field circuit.

Thus, inserting resistance will weaken the field, cause the motor to speed-up and generate practically the same back e.m.f. (and generator voltage) as before. The same applies to d.c./a.c. motor-converters having a common field.

The second type, a "true" motor-generator, employs separate machines (Fig. 15b). Both field windings may be energised off the supply to the motor side, when dual control of the output becomes available: (a) By controlling the field current of the generator, using rheostat F.R., and (b) by varying the speed of the motor, using rheostat S.R.

For example: If the supply is at 240/250v., whilst the generator delivers output at, say, 50v., the generator field windings will be designed for connection across the main 240/250v. supply.

Where d.c. machines are used for supplying extra-high voltage, it is not very satisfactory to design field windings for the same high voltage. Separate excitation off some lower voltage source is invariably resorted to.

Compound Dynamos

As many of the remarks made here will be of interest to those buying second-hand machines, a few notes on compounded generators may be useful at this stage.

What we have said with regard to critical resistances applies to plain shunt dynamos—or to the "shunt characteristics" of more complicated types. A compound generator has a few thick wire turns on the poles, in addition to the shunt, and these are connected in series between the armature and external load (Fig. 16a).

The *series winding* carries whatever load current I_1 the machine is supplying. The load current is utilised to give extra magnetisation of the poles, the amount varying in proportion to the load at a particular time.

In a *cumulatively*-compounded generator, the series turns assist the shunt, increasing the flux and the e.m.f. to compensate for the causes of the dropping characteristic in a plain shunt type. "Level-compounding" means that this degree of compensation is pretty close; the dynamo will give nearly a constant output voltage at all loads as illustrated by Fig. 16b.

At large loads there will be considerable internal drop due to the causes above mentioned. But the large load current will be passing via the series turn, strengthening the flux and inducing into the armature extra e.m.f. just of the right amount to make up for the internal drop at all loads. Precise compensation from no-load to full-load is seldom possible, but a level-compounded machine will give a reasonably constant voltage.

If more series turns are put on, we get *over-compounding*. The voltage can be made to rise as more lamps, heaters, etc., are switched on—a useful characteristic for compensating for the further volt-drop, externally in long lines or cables. But obviously a rising characteristic can be troublesome if not carefully designed to cope with the somewhat uncertain drop in outside networks.

Differential-compounding, where the series *opposes the shunt*, exerting a demagnetising effect as the load current increases, is of some interest in aircraft dynamos and (now largely obsolete) car dynamos.

The voltage will fall with load worse than that in a plain shunt type (Fig. 16c). For ordinary purposes such worsened regulation is certainly not required. But, usually in combination with other windings, it has been successfully applied for controlling the output of generators which operate over wide speed ranges. The accumulator charging-current tends to increase rapidly with voltage increase; in doing so, it weakens the field via the differential series winding, so reducing the generated e.m.f. By suitable design

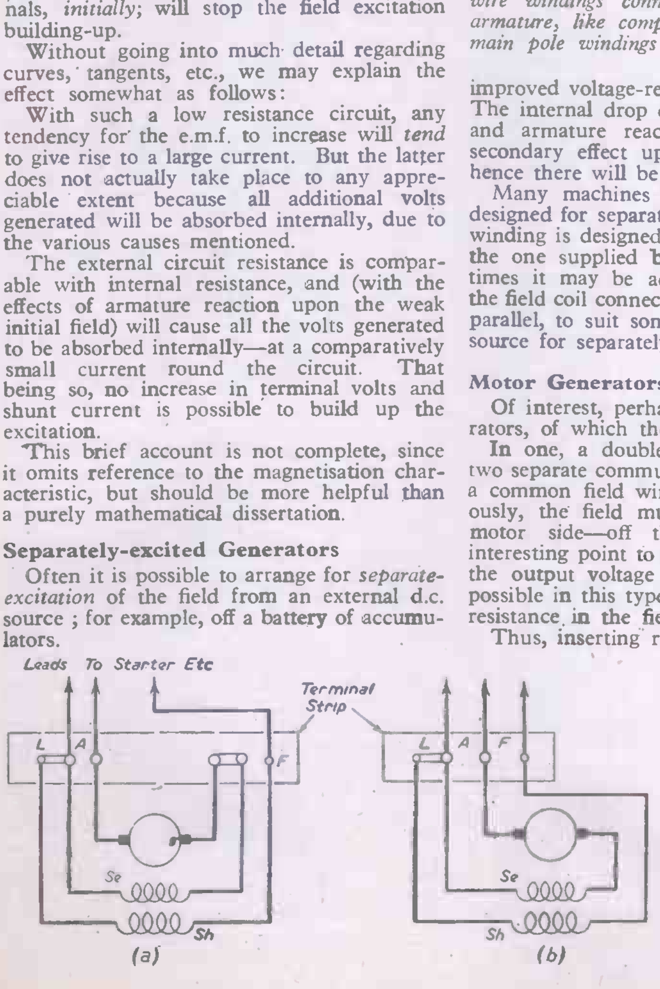


Fig. 17.—Some possible arrangements of terminal box connections in compound machines (dynamos are discussed in the text, but the external leads might also indicate the connections to a compound motor). In addition, most modern machines are fitted with interpoles.

the resultant current increase can be kept reasonably small.

Connections of Compound Dynamos

When buying a second-hand machine some care should be exercised to see whether it is simple shunt or compound, especially if to be used for battery charging.

In general, series windings are things to avoid for charging. Types of cut-out other than the magnetically-polarised switchboard variety require appreciable reverse-current from the battery to open them. Other possible causes of reverse-current exist, and it will be noted that such a current will be passing round the series coils of the dynamo in the *wrong direction*, tending to magnetise the poles to the *wrong polarity*.

Two results may follow. First, if the shunt has been broken, the reverse-current may just be sufficient to wipe out "residual," with failure to generate the next time the machine is started. Secondly—and generally—the residual magnetic polarity will be completely reversed.

In this eventuality the dynamo will come up to the wrong electrical polarity at the next start. If a cut-out closes under such conditions we would have an enormous short-circuit current flowing round the dynamo-battery path at about twice the normal voltage.

I have already outlined a case where a machine reversed polarity in the first article of this series. The above provides a little more information and possible ways of getting over the difficulty are suggested by what was said about separately-exciting the shunt directly off the battery—in which case the series winding could not overcome the strong magnetisation provided by the shunt.

Altogether, perhaps, the best plan would be to cut-out the series winding if charging is to be done. If it is desired to retain a compound-characteristic for other purposes, a short-circuiting switch or link may be connected across the ends of the thick wire turns. But the switch will have to be of very low resistance to divert all current from a winding of extremely low resistance (a few turns of wire). A better way is to disconnect, taking the main lead which went to one end of the series coils directly to the armature.

And this brings us to the question of internal connections of dynamos having compound windings.

In most cases everything will be fairly straightforward. The terminal box connections may be somewhat as indicated in Fig. 17a or 17b. The two ends of the series (Se) as well as the shunt (Sh) are brought out and correctly linked. All that remains is to make the external cabling to terminals 'L,' 'A,' and 'F'—'F' being taken to a Field Rheostat.

But what if things are not so neatly arranged? Suppose you get a "bargain" in a second-hand dynamo or motor whose terminal block is missing, or the internal leads badly disarranged with only a number of "ends" sticking out? Don't forget, of course, that motors will give excellent service as dynamos if connected-up rightly, and, though in good condition, such items as terminal strips and leads may have been mauled by long usage.

Important points to attend to are: (a) to connect the shunt to the armature the right way round to enable the machine to excite—to build-up, not wipe-out residual magnetism; and (b) to connect the series winding to assist, not to oppose the shunt.

I explained a method of doing (a) by means of a battery in the first article. As regards the series winding, matters may not usually be entirely uncertain. One end of Se may be joined to the brushes in the box or internally. Or only one end of Se is brought out, as in Fig. 17b.

Try these connections after the shunt has been put right to give self-excitation—or, why not start with separate-excitation if an accumulator-battery is available? If, then, the voltage falls badly as load is put on, you will have to swap-over the two ends of Se.

It is impossible to give details to cover every type and make of machine. In fact, as suggested earlier, I am not so concerned with giving rules-of-thumb, as outlining principles. In writing these few notes on compound-machines, the main object was to emphasise what the series winding does, and offer hints how to proceed if it should do quite the opposite to what was intended.

Interpoles

Internal connections appear still more complicated in modern machines by the inclusion of still more "poles"; small ones interposed between the main poles, Fig. 18a, and, like series windings, having thick wire turns carrying the main armature current.

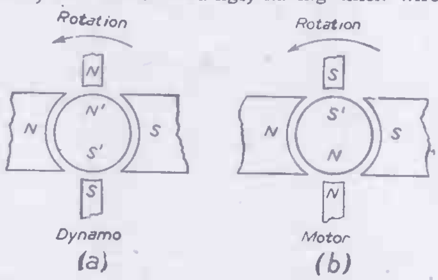


Fig. 19.—Armature cross-magnetisation and opposing interpole polarities in (a) dynamo, and motor (b).

We have frequently referred to them as *interpoles* or *commutation poles* ("com. poles.")

They were the ingenious devices which got over the one-time difficulty of keeping attendants to give brushes forward or backward "lead" at different loads. Modern dynamos and motors give sparkless commutation at all loads (and speeds, in the case of motors), with a fixed brush position. Generally, the brushes are fixed at or very near to the geometrical neutral position.

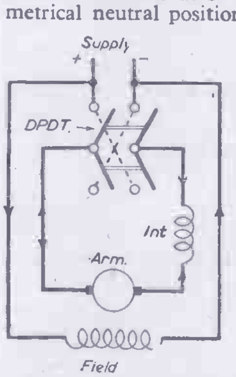


Fig. 20.—If a motor is reversed by means of a D.P.D.T. switch or a reversing controller in the armature circuit, the interpoles (Int.), being in series, will also be automatically reversed. With field-reversal, the interpoles must not be changed.

Space will not permit much discussion of commutation. Interpoles are things "to assist commutation"—as most students will write in their papers. An important way they do this is by annulling the effects of armature reaction, so let us now concentrate upon this aspect.

Consider the dynamo armature shown in Fig. 19a. When it is carrying current there will be a belt of conductors on each side (like a "coil" round a mass of iron) that will *cross-magnetise* the core to the polarity 'N' 'S,' as shown. This will lead to forward distortion of the main flux, necessitating a forward lead of the brushes to maintain sparkless commutating conditions.

But the whole trouble can be got over by using a pair of interpoles having the same magnetic polarity as 'N' 'S.' A "North" interpole will "try" to induce a 'S' pole in the armature core in the part whether there is already a 'N' and vice versa.

If the number of ampere-turns on the interpoles are also made equal to the cross-magnetising armature ampere-turns, it is evident that the induced polarities may be made to mutually cancel-out *at all loads*. It is the same armature current that develops the cross-magnetisation and the interpole field, and both effects may thus be arranged to increase in direct proportion to the load.

So, in the first place, interpoles actually prevent any forward distortion of the field by annulling its cause, namely—armature cross-magnetisation. The brushes can be left in a fixed position, and there will be no demagnetising effects consequent upon using a "forward lead."

Observe that dynamo cross-magnetisation must always be the same. For a given direction of rotation, the interpoles must have the same magnetic polarity as *the next "leading pole" forward in the direction of rotation, Fig. 19a.*

It will be worth considering this point in a little more detail, hence show why *motor* interpoles are *magnetically-reversed to the corresponding ones in a dynamo.*

Why Motor Interpoles are "Reversed"

Going back to basic magnetic principles, it will be recalled that, for a given field polarity and direction of armature current, a motor will revolve in a direction opposite to the corresponding dynamo.

By Lenz's Law, the current generated by the dynamo will be such as to tend to revolve the armature opposite to the direction it is being driven—causing a "magnetic drag" or mechanical load on the prime-mover.

If used as a motor having a *supply* current through the armature in the same direction as the current generated as a dynamo (and the same field polarity), rotation will be opposite to "the corresponding dynamo." Thus, to get the *same* rotation as the dynamo, either the armature current or the field polarity must be reversed.

It follows that the relative cross-magnetisation, and the interpole polarity to neutralise it, must be opposite in the motor. *Motor interpoles take the magnetic polarity of the trailing poles backward on the direction of rotation*, Fig. 19b.

This is true whatever direction the motor is revolving. We can effect reversal of rotation by changing the armature current, in which case the armature cross-magnetisation will also be reversed or by changing the field current direction, when the interpoles will automatically take the correct polarity of the trailing poles.

Rule for Reversing Interpole Motors

Suppose we wanted to reverse rotation of an interpole motor of the plain shunt-wound type. How should we deal with the interpoles?

There is one simple fact to keep in mind. Interpoles are *in series with the armature.* Though outside they are part and parcel of the armature for countering cross-magnetisation as explained. They also induce e.m.f.s in coils undergoing commutation, minimising sparkling at the brushes due to the self-inductance of these coils.

So, if we reverse any motor by changing the *armature current*, the interpoles must also be reversed. Armature and interpoles in series must be treated as *one circuit* whose *terminal connections* have to be changed-over. For example, Fig. 20 shows a reversing switch in the armature-interpole circuit. Being in series, the current in the armature and interpoles is reversed at the same time. The shunt field polarity remains fixed.

In this case of reversing the armature current, we have: (a) armature-current and the cross-magnetisation reversed, necessitating change-over of interpole polarity ; (b) rotation-reversal, which puts the new interpole polarity again the same as the trailing poles.

But suppose we changed-over rotation by swapping the *field* connections. *Interpole connections must not be touched.* The motor will reverse, but the relative interpole polarity *will remain correct*—the same as the trailing poles for the new direction of rotation. Why ?

Applying a little magnetic reasoning again: The main field N and S poles, *and* rotation, are reversed, which leave the *relative* interpole signs the same as the "trailing poles." Alternatively, armature current and cross-magnetisation are not altered, and the interpoles must always have a magnetic sign to neutralise cross-magnetisation.

Just remember the rule that interpoles must be considered part of the armature circuit, and the rest is easy.

If Interpoles are "Wrong Polarity"?

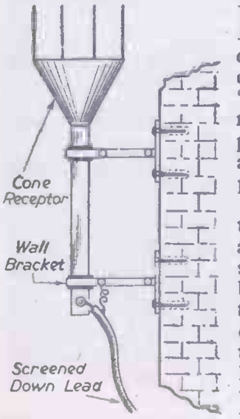
What if a mistake was made ? What would be the effects on motor- or generator-performance if the com. poles were connected-up to the wrong magnetic polarity ?

Obviously, we are going to get much worse commutating conditions than in a plain machine without interpoles. Armature cross-magnetisation will be strengthened, field distortion with the necessity for shifting the brushes with load will be greatly accentuated, and it will be extremely difficult to get sparkless commutation.

In fact, pretty severe sparking will occur on all brushes, which cannot be cured by brush-rocker adjustment, whilst in many cases there may be other effects on the speed of a motor (for example, "hunting"), or on the voltage output of a dynamo.

Trade Notes

The "Haydon" Radio Cone Receptor



The "Haydon" Radio Cone Receptor.

DESIGNED as an efficient radio energy collector, including television, the "Haydon" cone receptor has an equal pick-up effect from all points of the compass.

To have to increase the volume control on a set indicates that sufficient energy is not being obtained from the aerial, and in consequence of this the weak reception has to be boosted up to be able to listen with sufficient volume of sound.

This increases at the same time background noises, unwanted stations and signals together with all kinds of electrical interference, and such extraneous noises are superimposed upon your reception, thus marring the programme that you are trying to listen to.

Rainstorms, too, produce static electricity and charge up your aerial, thus causing further interference, and "atmospherics" generally are another unwanted trouble.

The new aerial gives freedom from all kinds of outside electrical interference, and provides the maximum tuning selectivity with all kinds of radio receivers. The aerial also acts as an automatic lightning arrestor.

The price, complete with two adjustable wall or chimney brackets and 50ft. of specially screened down lead, is £3 5s. Further particulars can be obtained from Herbert W. Haydon, Electra House, Moorland Road, Weston-super-Mare.

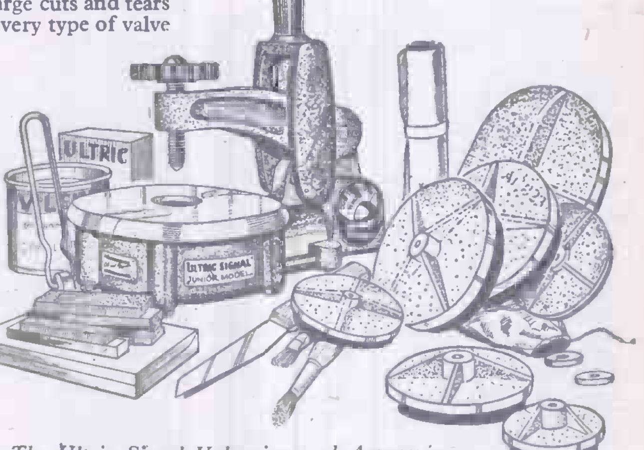
Ultric Signal Vulcaniser

THE Ultric signal vulcaniser (Junior Model) is specially designed for permanently repairing damaged motor tubes of all sizes, and can deal with large cuts and tears as well as punctures, while every type of valve can be efficiently reseated.

The electrically-heated vulcanising platen measures 6½in. by 5in. It consists of a silicon alloy aluminium casting recessed to receive a duralumin disc for flush repairs, and with five adaptors for reseating valves of all types. Heating is effected by a special element fixed in intimate contact with the under surface of the platen. The vulcaniser operates on 220-250v. A.C., but machines can be supplied for other voltages, if desired. The loading is 350 watts. An even temperature within close limits for any period of time is obtained by means of a specially designed thermostat. Automatic control is by a secondary thermostat which provides the correct temperature for the time required to deal with any repair of tubes up to $^1/_{16}$in. thick, which includes all motor-cycle and the majority of tubes as used on motor vehicles.

The whole of the mechanism is enclosed in a non-ferrous casting into which is also fitted the dual automatic time-control switch, the red and green signal lights, and provision for bench fixing. The link mechanism, fitted with a bakelite handle and handwheel provides unrestricted vulcanising surface, and rapid means of applying pressure.

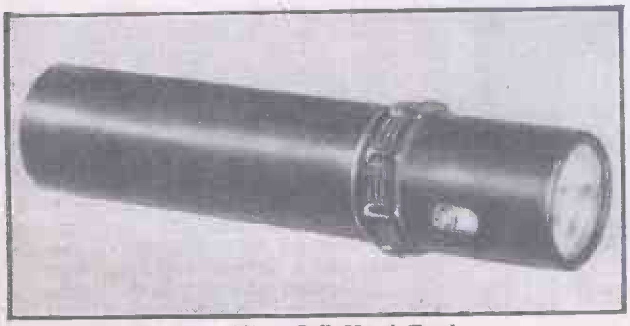
The appliance is supplied with 6ft. 3-core flexible cable, one pressure plate fitted with Kautex insulated pad, one set of valve adaptors, and one set of valve reseating moulds. Further particulars can be obtained from William Frost Products, Ltd., Fernhead Works, Fernhead Road, London, W.9.



The Ultric Signal Vulcaniser and Accessories.

New Dry Cell Hand Torch

OLIVER PELL CONTROL, LTD., are now marketing a robust "heavy duty" torch which has several noteworthy points to recommend it for domestic and industrial use. Careful design has obviated the need of a second spring at the base of the torch. A special sprung switch, with silver contacts, is vibration proof in all positions, and there are a number of projections round the barrel of the torch to prevent it rolling when placed on a flat surface. Strong spring plungers allow accurate bulb focusing with positive contact pressures. The parabolic reflector and glass are sealed so that the reflector cannot be fingered or tarnished. Further particulars are obtainable from Oliver Pell Control, Ltd., Cambridge Row, Woolwich, S.E.18.



The new Oliver Pell Hand Torch.

Our Cover Subject

A NEW altitude chamber has been built at the Hatfield works of de Havilland Aircraft Co., Ltd., makers of the famous jet aircraft, etc. The purpose of this chamber is the research into the use of equipment at high altitudes—altitudes that may be in common use in the future as more and more knowledge is gained of the stratosphere and jet engine performance. The main chamber is 35ft. long and 14ft. in diameter, and in it conditions of atmospheric pressure, temperature and humidity can be reproduced of varying altitudes up to 80,000ft. A team of technicians controls the tests ; a number of the observers are stationed inside the chamber, and a two-way system of communications with those outside enables a complete check to be made of the happenings to whatever material is being subjected to the tests. Confirming these reports is a complicated system of strain gauges and other indicators, supplemented by a microphone which amplifies the sounds of structure breaking up and transmits them to the outside observers. The illustration gives a general view of the main chamber. The end cover is attached by means of the hinged bolts seen around the periphery of the cylindrical portion.

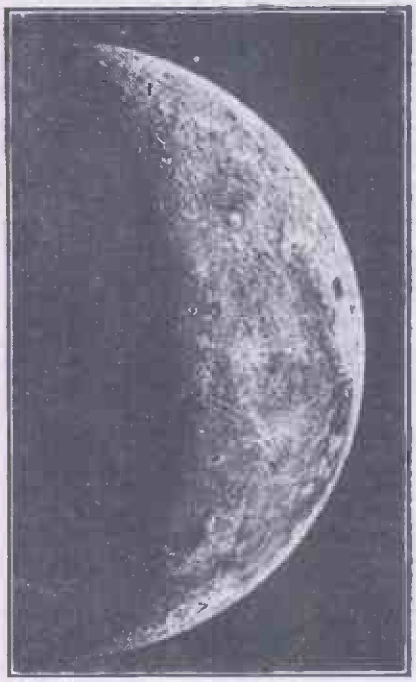
Planetary Atmospheres

Important Considerations for Future Pioneers of Interplanetary Travel

By J. F. STIRLING, M.Sc.

DURING the last half-century, astronomical science has tended to move the main focus of its interest outwards from our own system of sun and planets to considerations centreing around the stellar universe as a whole; but there are signs nowadays that astronomy is again returning to detailed planetary investigations and research. For example, the increasing interest which has been aroused within very recent years in the subject of the various atmospheres which may and, indeed, undoubtedly do, envelop many of the planets of our solar system.

It is a strange fact that up to the present time very little technical consideration has been given to the elucidation of the nature and composition of planetary atmospheres. Yet the whole question is inseparably bound up with all considerations of interplanetary explorations. Before any future interplanetary travel projector can seriously plan even the most straightforward voyage within the confines of our sun's system of revolving planets, he must necessarily be possessed of accurate and detailed information regarding the precise type and the extent of the atmosphere which he is likely to encounter when descending on to the surface of any particular planet.



A photograph of the crescent moon. Had the moon any atmosphere a star passing behind it would fade away in intensity and not be instantly extinguished as is actually the case.

The main tool in the astronomical investigation of planetary atmospheres is the spectroscope, the instrument which simply yet almost miraculously is able to split up the light proceeding from a planet and give definite information regarding the chemical composition of any gas which may surround it.

To the indispensable spectroscope must also be added the infra-red camera, for infra-red rays are, in some instances, able to penetrate deep down into the atmospheres of planets in a way which other light rays are unable to do. During the process, some of the infra-red rays are absorbed by the planetary atmosphere, and it is in consequence of this partial absorption that a good deal of exact information concerning the composition and amount of atmosphere surrounding the planet can be obtained.

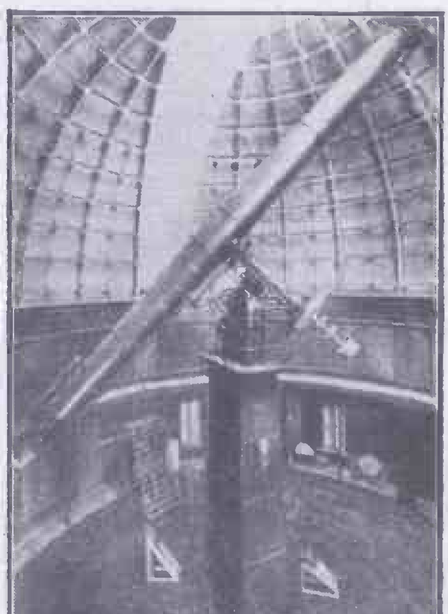
Hydrogen gas glowing in a gigantic nebula far out in space.

Moon Travel

The nearest body to our earth is, of course, the moon; and the moon will, without much doubt, constitute the first extra-terrestrial body on which the scientific space travellers of the future will land.

Now, the moon is, to all practical intents and purposes, atmosphereless. True it is that there may lurk, among the depths of its steep valleys, a few lingering traces of gaseous emanation, but the existence of such atmospheric remains has never been proved. In addition, despite statements to the contrary, the existence of any traces of water vapour on our satellite has never been demonstrated.

If the moon had an atmosphere, the spectroscope and the infra-red camera would reveal it. Furthermore, when a star passes behind the moon it would not, to us, appear as if it had been extinguished instantly, like an electric lamp being switched out. Had the moon an atmosphere the star in question would gradually fade out, the moon's atmosphere dimming the light of the star before the body of the moon obscured it altogether.



A spectroscopic telescope erected in Lick Observatory, U.S.A. It has been used for observations on planetary atmospheres.

Hence, it is certain that no atmosphere exists on the moon. Our satellite is a perfectly dead world in every respect. Space travellers to Luna Land will have, in view of the moon's lack of atmosphere, to equip themselves not only with very efficient breathing apparatus, but they will also have to devise some type of pressure suits enabling them to maintain the pressure on their bodies at approximately 15lb. per square inch, this being the earth's atmospheric pressure under which our bodies are designed to operate. Any violation of this strict requirement during an exploration of the moon or of any of the planets would rapidly have a fatal termination.

Quite apart from the evidences of the spectroscope and the infra-red camera, it is possible to deduce mathematically the existence of atmospheres of one type or another surrounding the planets.

An atmosphere consists merely of innumerable gaseous particles which are held down to a planet by the attraction of gravitation. Now, the natural tendency for any collection of gaseous particles is to place themselves as far as possible apart from one another. Hence, the tendency of a gas is always to diffuse into space. Ordinarily, however, an atmosphere cannot diffuse away from its planet in consequence of the holding-down or gravitational effect of the planet. For any particle of atmosphere to escape from the planet it must acquire a velocity which is greater than a certain minimum velocity, the latter value being determined by the mass and the radius of the planet.

Velocity of Escape

The minimum speed at which a particle of gas can diffuse into space from a planetary atmosphere is known as the "escape velocity." This varies from planet to planet.

It is well known that the constituent particles of any gas are in a state of perpetual motion, the speed of the particles increasing with increase in the temperature of the gas and vice versa; but not all the particles in a mass of gas move at an identical speed. Hence, calculations have to be effected by assuming an average or mean velocity of the gaseous particles. If, therefore, the mean velocity of these particles should happen to coincide with the gaseous escape velocity of a planet, the planet would lose its atmosphere very quickly, and if the escape velocity is very much higher than the mean velocity of the atmospheric particles the atmosphere will be retained by the planet almost indefinitely. It has, for example, been calculated that if the escape velocity of a planetary atmosphere is five times as great as the mean velocity of hydrogen particles, the said atmosphere will be almost completely immune from loss.

Now, the escape velocity of a gas from the moon is not much greater than the mean velocity of hydrogen. Hence, any light gas surrounding the moon would escape almost instantly. The same applies to any oxygen, nitrogen or water vapour which might at one time have surrounded the moon. If there are any traces of gas left on the moon such a gas will probably be carbon dioxide, although we have no direct evidence of this.

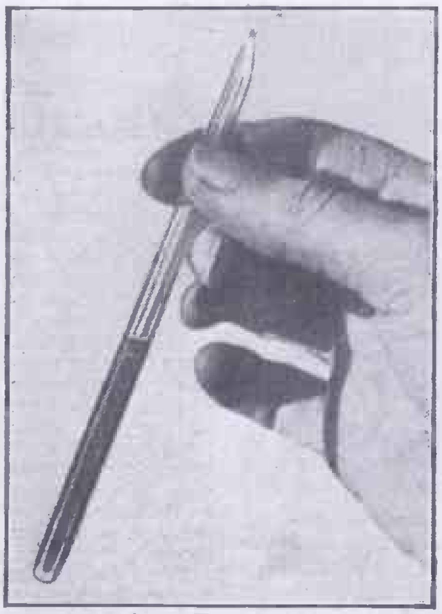
Practically the same conclusions apply to Mercury, the planet nearest to the sun. Hence, if any space-traveller in the distant future should ever succeed in landing on this diminutive planet his breathing and pressure equipment would have to be planned on the same lines as those necessary for a journey to the moon.

Astronomers do not affirm that Mercury is entirely without an atmosphere, but a conclusive proof of such an atmosphere has not been directly reached. In any case, if this planet does possess an atmosphere it must be one of the most tenuous kind, the terrific heat of the sun having long ago boiled off the more volatile gases.

Coming now to Venus, the bright planet which encircles the sun between Mercury and the earth, we have a planet whose atmosphere is something akin to our own.

Comparable Atmosphere

The escape velocity of an atmospheric particle from our earth is 11.2 kilometres per second, whilst the atmospheric escape velocity of Venus is 10.2 km/sec. For this reason, it may be concluded on theoretical grounds alone that Venus and the earth have atmospheres which are roughly comparable in density and in extent.



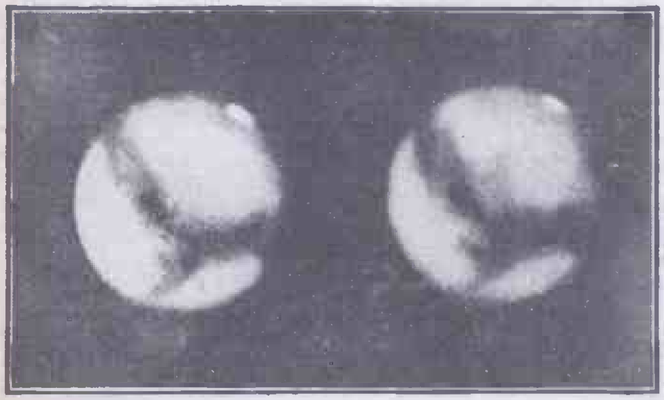
A tube of liquified gas (chlorine) existing under pressure. Liquifaction of atmospheric gas must exist on many of the planets under the influence of cold and pressure.

By photographing the planet Venus in ultra-violet light, cloud markings, which are continually changing their form, are recorded. This indicates the presence of winds or of some other type of atmospheric currents.

The surprising fact about Venus is the failure to detect water-vapour on its surface. Indeed, the presence of oxygen on Venus has never been satisfactorily demonstrated. If any oxygen is present around Venus, it must be not more than a thousandth of the oxygen content of the earth's atmosphere.

Although Venus may be lacking in oxygen, it possesses an abundant amount of carbon dioxide gas. Astronomers have estimated that the amount of carbon dioxide surrounding Venus is equivalent to a layer two miles thick, whereas the amount of this gas in the earth's atmosphere works out roughly equivalent to a layer of only about 30ft. thickness.

Because of the great amount of carbon dioxide gas surrounding Venus, the temperature at the surface of the planet will be greater than it otherwise would be, the huge blanket of carbon dioxide slowing down radiation of heat from the planet. The surface temperature on this planet has been estimated as being about 100 degrees C. (the temperature of boiling water) or even a little higher. Because of this temperature and in view of the apparent oxygen deficiency of the planet's atmosphere, there is probably little (if any) vegetation on Venus. Space travel to this neighbouring planet of ours would, therefore, entail innumerable technical considerations in respect of breathing apparatus and protective suits.



Two photographs of the planet Mars, our neighbour in space. Note the polar ice caps and also the surface markings of the planet.

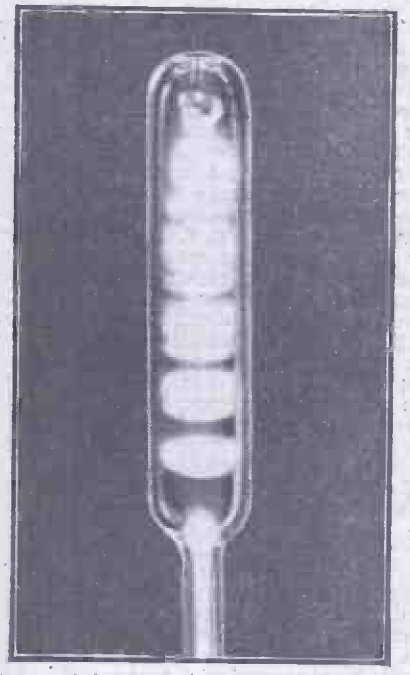
The Atmosphere of Mars

Our other planetary neighbour, more distant than we are from the sun, is Mars, perhaps the most generally popular of all the planets on account of the suggestion that some form of life may exist on it. The atmospheric escape velocity from Mars is only 5.0 km/sec. Consequently, Mars must have a much thinner atmosphere than that of Venus. Yet water vapour can be detected in the Martian atmosphere, although oxygen and carbon dioxide have not been directly noted. It has been suggested that the characteristic red colour of the planet Mars is due to the almost complete oxidation of its rocky surface, the amount of free oxygen surrounding the planet being very little.

If this suggestion has any truth in it, Mars must be a planet which has gone rusty, the majority of its gaseous oxygen having combined itself with the ingredients of the Martian rocks.

Although direct evidence of carbon dioxide in the Martian atmosphere is as yet lacking, the presence of this gas is at least generally inferred, since there is fairly satisfactory evidence of the growth of vegetation on Mars, and, so far as we know, carbon dioxide is essential to the organic life of the vegetable world.

Perhaps, to the future space traveller, conditions on Mars will turn out to be the most favourable of all the planets (the moon included), always, of course, provided that adequate oxygen supplies are taken by the planetary traveller when taking off from the earth.

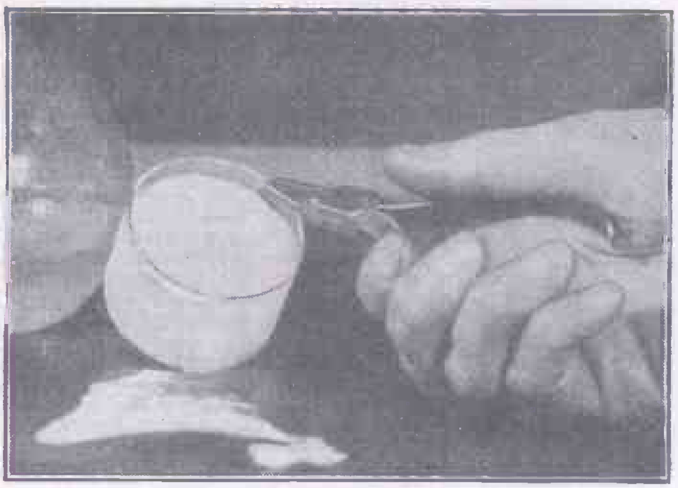


Hydrogen gas glowing under electric potential in a vacuum tube.

Omitting the amazing host of miniature planets existing between the orbits of Mars and the giant planet Jupiter, let us now consider the atmospheric conditions prevailing on the four major planets, Jupiter, Saturn, Uranus and Neptune—to name them in order, as we proceed outwards from the sun. To this list we might add the newly-discovered planet Pluto, which ploughs its lonely trail around the sun beyond the orbit or path of Neptune, and which, so far as we are yet aware, is the most distant of all our sun's family of planets. Pluto is so distant, however, that we know little about it as yet and we have certainly no knowledge of any atmospheric conditions which may possibly prevail on it.

The Prince of Planets

Jupiter is the well-known giant of our planetary system. It is a veritable prince of



Frozen carbon dioxide gas. Many of the atmospheric constituents of the more distant planets must be approaching this condition of low-temperature solidification.

planets, being about eleven times the diameter of the earth and taking nearly twelve years to complete its journey round the sun.

Jupiter only receives about 1/27th of the amount of heat which our earth takes from the sun, for which reason it must constitute an entirely frozen world. At one period astronomical opinion was that Jupiter was immensely hot, so much so as to be faintly self-luminous. More advanced opinion, however, has concluded that the surface of Jupiter has an ice coating of some 16,000 miles in thickness. That the planet has an extensive atmosphere is apparent from its telescopic appearance and from various features associated with this. Calculations indicate that the atmosphere of Jupiter is very dense, and that it may be about 6,000 miles high. For this reason alone, any possible descent by a space projectile through an atmosphere would have to be well controlled in speed, in view of the great hazard of the projectile's rapid and complete destruction by atmospheric friction. The same, too, applies in the case of the three other major planets—Saturn, Uranus and Neptune.

The problem of ever descending through Jupiter's atmosphere to the ice-bound surface of the planet is, however, almost impossibly formidable, for the atmosphere surrounding this planet is so dense that, at the planet's surface, an atmospheric pressure of about a million times that of the earth's atmosphere my be expected. Any possible means of resisting such a terrific pressure is certainly unknown to present-day science.

The same applies, also, to the atmospheres surrounding Saturn, the ringed planet (which, incidentally, has the densest of all planetary atmospheres), Uranus and Neptune. Thus the mere problem of gigantic atmospheric pressure of any of these planets would seem to preclude any possible human descent on their surfaces in the light of modern scientific knowledge.

Since the gaseous escape velocities from all these planets is exceedingly high, it is almost certain that even the lightest of all gases—hydrogen—cannot have diffused away in any substantial amount from these planetary bodies. Hydrogen must, therefore, be present extensively in the atmospheres of all these planets. And not only hydrogen must abound in these atmospheres but helium also. Nitrogen and carbon dioxide are there, it is thought, only in traces, and there is almost certainly no free oxygen.

Atmosphere of Ammonia

It is surprising to find in the atmospheres of Jupiter and Saturn a quantity of ammonia gas, NH_3, and also methane, CH_4, the simplest of all the hydrocarbon gases which is well-known on earth (or, rather, under earth) in the guise of the deadly "fire-damp."

There is less ammonia in the atmosphere of Saturn than there is in Jupiter's atmosphere. The temperature of these planets must, however, be so low that the ammonia vapour must be perpetually on the point of condensation. No doubt, indeed, the ammonia exists not as a true gas but as a whirling blizzard of minute particles of the frozen ammonia.

Ammonia has not been detected in the atmospheres of Uranus and Neptune. No doubt it does exist on these planets, but because their temperatures are even lower than those of Jupiter and Saturn, any ammonia present on Uranus and Neptune must be frozen solid on the surface of the planets.

Methane gas exists abundantly on all the four planets. It seems to be present in much larger quantities on Uranus and Neptune than it does on Jupiter and Saturn. One or two recent astronomical observers have essayed an estimate that there may be a 25-mile depth of pure methane gas on the planet Neptune; but at the mean surface temperature of this planet (more than minus 200 degrees C.) even the methane must be ready to condense to a liquid.

More complex hydrogen carbon gases than methane have been looked for in vain in the atmospheres of the above four planets. It seems as if hydrogen, helium, ammonia and methane make up the main constituents of these planetary atmospheres.

New Forms of Life?

Under such conditions any form of life known to us could not possibly exist. Reflecting on such a statement, however, we must realise the fact that what we may term "earth life" may not comprise the only variety of physical existence. Our forefathers were wont to conceive of a race of beings which lived and had their entire being in fire and flame. It may also be possible for some type of physical life (at present totally unknown to us) to live at a temperature nearing absolute zero, to exist by some as yet unknown solar radiations and to flourish exceedingly on a mixed atmosphere of hydrogen, ammonia and methane.

So far as we know at present, planets may be assigned to three groups in relation to their atmospheric characteristics, viz.—the smaller bodies such as the moon and Mercury (and, most likely, all the other planetary satellites) which are almost completely devoid of atmospheres, the medium-size planets, such as Earth, Venus and Mars, which have medium-density atmospheres consisting of oxygen and/or its compounds together with carbon dioxide gas, and, finally, the larger planets which have very dense atmospheres comprising hydrogen, helium, ammonia and methane gases but which are lacking in oxygen and its compounds.

A rough separation of planetary atmospheres, no doubt. Nevertheless, it gives us something to work on, and it suffices at the present time to furnish us with a rough idea of the intricate and highly formidable problems which must necessarily face any planetary voyager of the future who may hope to plan a journey outwards from the earth to any other member of our solar system.

Showing the effect of atmospheric penetration by infra-red rays. This landscape photograph was taken by ordinary light rays.

The same landscape photographed by infra-red light, after screening out all other rays. Note the greater penetration of distance. The same infra-red technique is employed for penetrating through planetary atmospheres in order to obtain information as to their constituents.

A Novel Electric Motor

Constructional Details of a Small Motor Particularly Suitable for Model Boats

By A. W. J. COBHAM

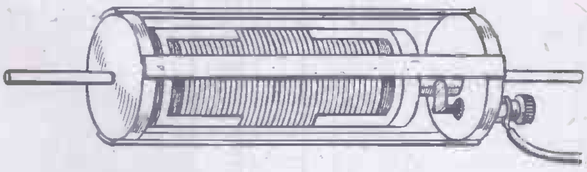


Fig. 7.—The completed electric motor, showing the bearing plates, soft iron strips and brush.

OF all the methods of propelling model boats perhaps the most satisfactory is the electric motor. Unfortunately most of the small motors to be purchased in the shops do not lend themselves to installation in model boats, due to their shape. It was with this point in mind that the following rather unusual design was worked out. It has the advantage of being of very simple construction, and no elaborate tools are needed, although a lathe, if available, can be of great assistance.

No measurements are given since they will be governed by the size of the boat to be driven.

The Armature

This consists of a bunch of soft iron wires

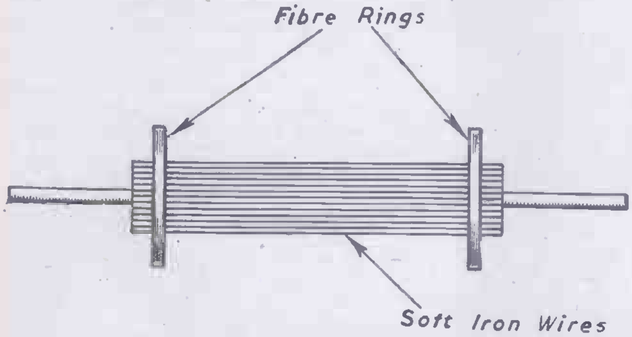
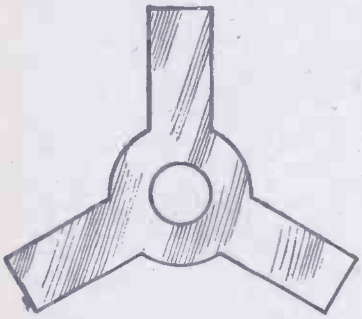


Fig. 1.—How the armature core is formed with soft-iron wires and fibre rings.



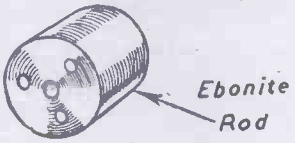


Fig. 4.—(Above) Piece of ebonite rod for making the commutator.

Fig. 2.—(Left) Soft iron blank for making armature poles.

arranged around a central steel spindle. These wires are kept in place by two fibre rings which fit tightly over each end. A little solder sweated into the ends will help to make all secure.

We now have a kind of former on which the wire is to be wound (Fig. 1).

Winding

The core is next covered with waxed paper, and is then ready for winding. Having soldered one end of the wire to the core, wind on about four even layers of wire; these should just fill the former. For a small four-volt motor of a few inches in length, use No. 26 gauge enamel or cotton covered wire.

The Armature Poles

These consist of two pieces of soft iron such as is used for stove pipes, and may be purchased at any ironmongers shop. Cut to the shape shown in Fig. 2 and drill a central hole the same size as in the fibre end pieces. Fit over core ends and solder in place after bending the six "legs" at right angles as shown in Fig. 3.

The Commutator

Through the centre of a short length of ebonite rod drill a hole a little smaller than the diameter of the spindle. Three other holes are now drilled equidistant around the central hole (Fig. 4). Through these three holes short lengths of brass or copper rod are forced so that they are a tight fit in the holes. The ends are cut off flush.

Two thirds of the ebonite rod is now filed or turned down until half the diameter of the brass or copper rods has been cut away. The three rods are then connected together by a brass washer soldered over the wide end (Fig. 5). An insulating washer is now pushed over the armature spindle followed by the commutator which is forced on tight (Fig. 6). The outer end of the winding is now soldered to the brass washer. This completes the armature.

The Body

Cut two brass discs a fraction larger than the outside diameter of the armature poles. In the centre of each drill a hole to take the spindle.

Now cut three strips of soft iron the same width as the pole pieces already made. These strips should be a little longer than the overall length of the armature and commutator. The three strips are now soldered to the brass end discs with the aramature within them, as in Fig. 7.

The Brush

This consists of a small strip of spring brass soldered to the head of a B.A. bolt, the size of which depends on the dimensions of the motor under construction. This bolt passes through an insulated bush in the brass end plate, and is secured with a nut and fibre washer. It also carries a brass terminal for connection to the battery, the second wire going direct to the frame.

This motor will be found to develop a reasonable amount of power, especially if fitted with a flywheel.

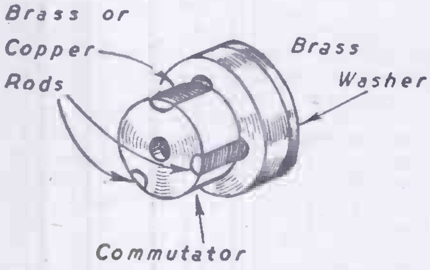


Fig. 5.—The finished commutator, showing method of forming the commutator bars

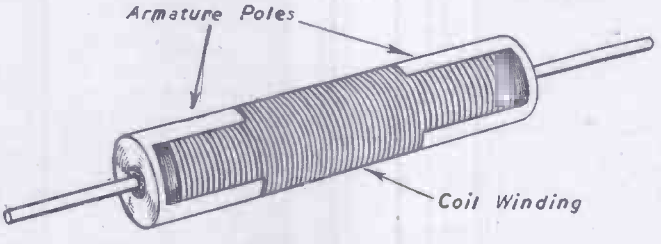


Fig. 3.—The partly-finished armature, showing how the pole pieces are bent over to embrace the winding.

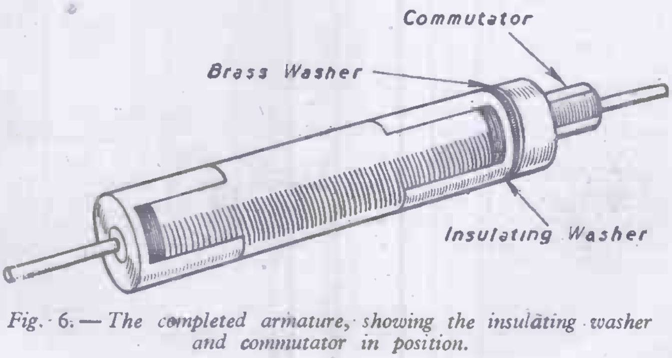


Fig. 6.—The completed armature, showing the insulating washer and commutator in position.

A Portable Water Softener

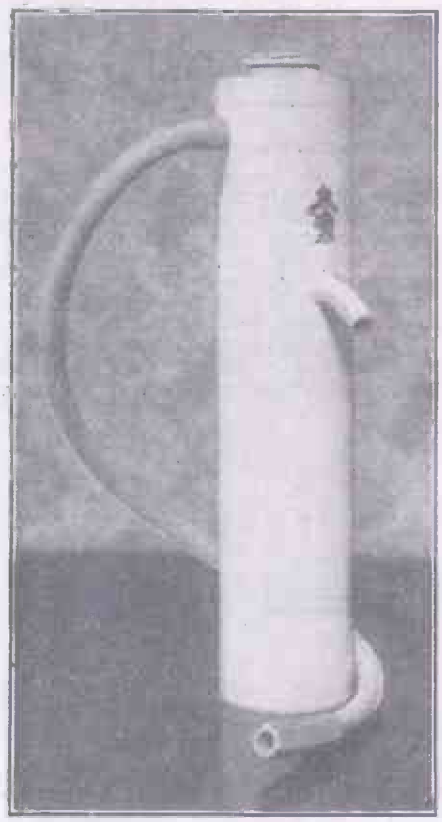
Constructional Details of an Easily-made but Efficient Appliance

By E. S. BROWN

IN those districts where the water is "hard" a water softener is undoubtedly an advantage. Considerable savings can be effected in tea and soap, together with a considerable reduction in the amount of work that is so often inseparable from household duties.

The running costs of a water-softener are very small. All that is required is an occasional handful of common household salt to cleanse the softening medium of the accumulation of lime and chalk which has been extracted from the hard water in its passage through the softener.

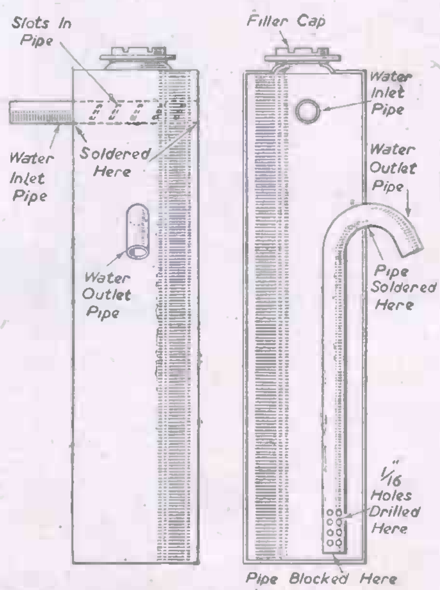
A water-softener is not very difficult to make. Indeed, a fairly satisfactory one could easily be made by filling a suitable container with the basic exchange material, slowly running the hard water through same, and drawing the softened water off at the bottom. Commercial water-softeners, although working on the same principle, are, of course, far more complex in their construction than this, and consequently give more reliable and dependable results. The following details of construction for a portable water-softener, although simple, will be found to give every satisfaction in use, and with average care will give lasting service.



The completed water softener ready for use.

Container

The container of the softener is constructed from a length of heavy galvanised sheet iron or steel flue pipe. The size usually stocked is 4in. by 24in. The tinned variety of flue-pipe is not suitable, as it very quickly rusts, therefore make sure that the pipe is galvanised, as the life of the softener depends upon this important point. With an hacksaw, cut six inches off of the end of the pipe, so that it leaves a cylinder 4in. in diameter by 18in. in length. The remaining six inches of piping should be cut along the seam and flattened out into a sheet to later make the two ends of the container. Next carefully solder along the seam of the container to ensure a water-tight joint. A heavy soldering iron or blow-lamp will be found necessary to ensure a satisfactory flow of solder.



Figs. 1 and 2.—Front elevation and section showing positions of inlet and outlet pipes.

Inlet Pipe

Next drill a ½in. diameter hole 6in. from the top of the container, and opposite the seam, and another, at right angles to the first, 2in. from the top (Fig. 1). A 23in. length of ½in. external diameter galvanised iron water barrelling is now required. This is cut into two lengths. One length being 17in., the other 6in. The smaller length is slotted along both sides with an hacksaw for a distance of 3½in. (Fig. 3). It is then inserted through the upper hole in the container, and pushed through until the slotted end is in close contact with the inner side of the container. Solder the end of the tube securely to the inside of the container, and also where it emerges through the opposite side. See that the tube is adjusted correctly before soldering so that the slots are in the position indicated in Fig. 1.

Outlet Pipe

The larger tube is bent over in a curve for a distance of 5in. from one end. The other end is blocked by soldering a metal disc into place. A number of 1/16in. holes is next drilled for a distance of 2in. from the blocked end (Fig. 2). These holes determine the rate of outflow from the softener, and should not number less than twenty.

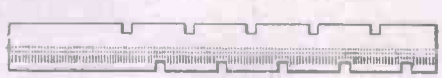


Fig. 3.—Water inlet pipe showing arrangement of slots.

The tube is then inserted into the container, and the curved portion pushed through the hole provided for it. The tube should be positioned so that it leaves an inch clearance between the tube and the side of the container, the water outlet pipe protruding about 4in. It is then soldered into position.

End Caps

The bottom and top end caps are cut from the flattened flue piping, and are soldered into position. Before fitting the top cap finally into position, it will be necessary to fit a screw-filler cap into same. The writer removed a petrol filler cap together with the neck from a redundant car, and had no difficulty in fitting them to the end cap. A walk around any car-breaker's yard would no doubt provide a similar fitting which can be purchased for a nominal sum, and which should be perfectly satisfactory in use. It is important, however, to see that the washer is in good condition, as otherwise an annoying water leakage will occur. The cap and neck should be thoroughly cleansed in boiling water.

The softener must now be washed out with several changes of boiling water to remove any soldering flux that may be present, then put aside to dry out.

Enamel Coating

Several coats of good quality enamel should next be given. Allow each coat to thoroughly dry, and remove the gloss with fine glass paper before applying the next coat. The final coat should of course be left glossy, and should be left as long as possible before being used. Quite a pleasing appearance can be given by affixing a transfer on the softener, a suitable transfer being obtainable from most cycle stores. To affix the transfer, apply a thin coat of gold-size where it is desired to apply the transfer, peel the protective backing from same, and when the gold-size is "tacky" apply the transfer, and press gently into place with the thumb. Leave for twelve hours, then moisten the thin paper covering with water, and gently remove same with a sliding motion. After drying, a thin coat of varnish should be applied over the transfer for protective purposes.

A piece of ½in. internal diameter rubber tubing of sufficient length must be pushed on to the water inlet-pipe for connection to the water supply tap. A 4in. length of garden hose is cemented with rubber solution on to the end of the softener tubing in order to make a satisfactory connection with the water tap.

Base Exchange Material

The softener is now filled with the basic exchange material to within 1in. of the water inlet-pipe, and the quantity required will be about 5lbs. The softening medium can be obtained from most firms who specialize in water softener equipment, but should any difficulty be experienced in this direction the writer would be pleased to advise readers as to where supplies can be obtained.

The softener is now ready for use, but it is advisable to allow a gentle flow of water into the softener for a few minutes, to remove any dust that may be present in the softening medium. When using the softener, regulate the flow of water so that it comes from the outlet pipe in a gentle stream. In this way, the maximum softening effect is obtained.

(Continued on page 138)

THE WORLD OF MODELS

Museum of Models : Old Figureheads at Gravesend : Good Work at Exeter

By "MOTILUS"

HERE we are on the threshold of a new year, and my first news comes from a young person who, if not exactly a "rookie," is still really on the threshold of his model-making adventures. Although we all know that the world of models is well peopled by thousands who are young in years as well as those who are "young in heart," we still like an occasional reminder from the coming generation as to their ideas and activities in the model-making hobby. I am very glad to be able to give readers this month a picture of a skilfully-built model sailing ship, made in 1946 by 14-year-old Master James Mellors, of Whaley Bridge, near Stockport. Master Mellors wrote to say he wanted me to see "what northern youth can make in the way of models"! If there are many young Northerners whose craft is as good as this, then we shall see some fine work in the years to come. The detail shown in this model (Fig. 1) will be appreciated when I tell you it is only 8in. long. The hull and masts are of ash wood, the remainder being balsa, and the only tools used were a razor blade and a pair of tweezers. The complete model only cost Master Mellors about five shillings out of his "pocket money."

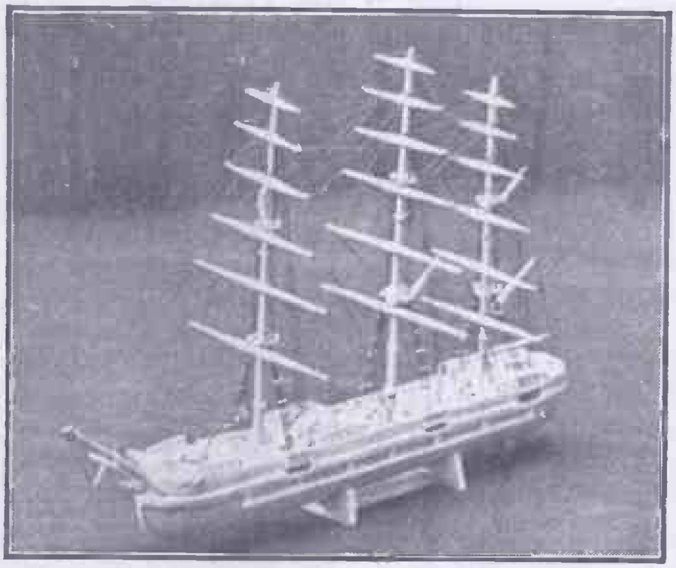


Fig. 1.—A sailing ship model built by Master James Mellors, of Whaley Bridge, aged 14 years.

Fig. 2.—Mr. James Laity, of St. Ives, working on repair work to his large model of the sailing ship "Bellerophon."

Museum of Models at St. Ives

During a visit to St. Ives, in Cornwall, last autumn I was able to call again on my friend, Mr. James Laity, who is already known to readers as a collector of relics of the past, including souvenirs brought from the Far East. Mr. Laity, proprietor of an old-established provision store on the waterfront in the harbour at St. Ives, has now retired from taking an active part in the business, and is devoting all his time to his collection of valuable and unique curiosities that he has gathered from time to time for his museum. When I saw Mr. Laity he was busily engaged in completing repairs to the large model of the sailing ship *Bellerophon*, which has been illustrated in these pages previously (Fig. 2). He had time, however, to show me one of the latest additions to his collection, a sea-going type of Chinese junk, which was brought here from China by a naval commander. This model (Fig. 3), which is 3ft. long and has an 11in. beam, has the traditional eyes painted on her bows, and is complete with a drop rudder which, in the prototype, would be dropped for deep-sea use and raised for shallow water. The first Chinese vessel ever brought to Europe, the *Keying*, was similar to this. She arrived at Gravesend on March 28, 1848, having taken 477 days from Canton, China. This ship was 160ft. long, with a beam of 33ft. and a burthen of 800 tons. Her main mast was 90ft. high and built of iron and wood. The sails were of strong matting, the mainsail weighing nearly eight tons in itself.

Visitors to St. Ives who are interested in old-world relics from far and near, especially when they relate to ships and shipping, would be amply rewarded by a visit to Mr. Laity's museum, and I am sure would be welcomed by Mr. Laity himself, who is a very keen collector. The museum is entered from the main car park in the harbour area, quite close to Mr. Laity's grocery store.

Scale Model "Queen Mary"

Returning to present-day shipping wonders, Mr. Joseph Gass, of Reading, was prompted by my remarks on the models made by Mr. Dennis Sears to send me some photographs of his own model of the liner *Queen Mary*, together with a full account of the amazing detail he has incorporated in his work (Fig. 4). All the ports are built in and finished with 1/32in. clear acetate sheeting, cut to fit over every bank of six portholes. The bollards are made from .22 rifle shot filed down to size, and the masts from bone knitting needles; the flags are of hand-painted tissue paper, and the anchors, which are workable, were filed from lead.

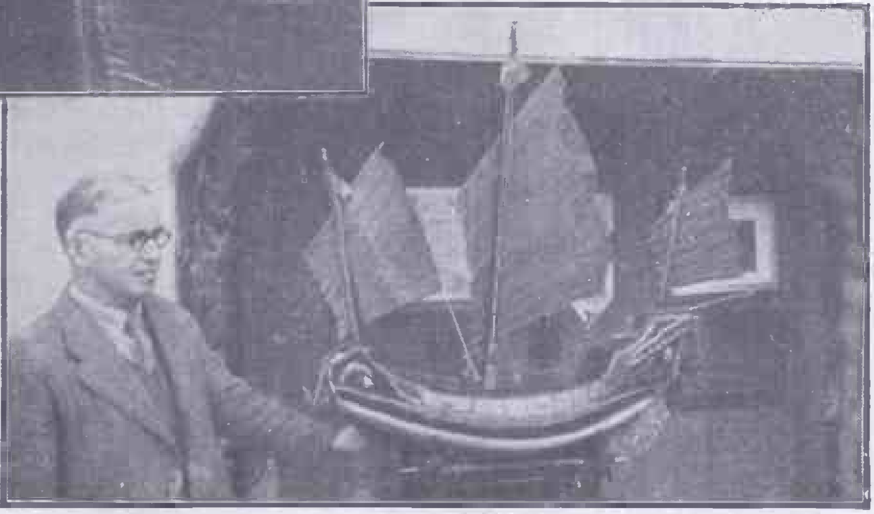


Fig. 3.—A model of a Chinese junk brought from the Far East by a naval commander and now an addition to Mr. Laity's collection.

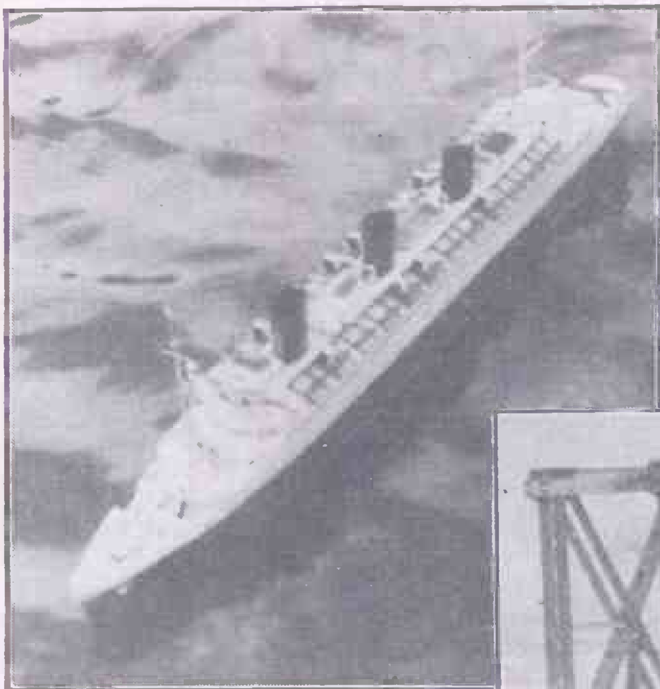


Fig. 4.—A scale model of the Cunard liner, "Queen Mary," made by Mr. J. Gass, shown during her trials. The screws are driven through reduction gears from a Bassett-Lowke marine motor and controlled by a seven-point rheostat inside the bridge cabin.

In the sun-lounge there is leather-covered furniture, all to scale. The propellers are driven through reduction gears from a motor supplied by Messrs. Bassett-Lowke, Ltd., of High Holborn, London, and this motor is controlled from a seven-point rheostat, ½in. outside diameter, mounted inside the bridge cabin. The speed of the model can be regulated from the bridge and increased in steps of 100 r.p.m. from zero to 600, and this will propel the model at 3½ knots. Each deck is illuminated from within by 2-volt bulbs of amber and white colouring alternately. All this work was completed by Mr. Gass in three and a half months from drawings he prepared himself from photographs of the *Queen Mary*. As a designer draughtsman with an aircraft firm, Mr. Gass naturally takes a keen interest in model aircraft. Some time ago he built an all-metal model of a Fairey Battle bomber, with a 54in. wing span and having movable controls. He is now endeavouring to form a model society in the factory, so I am looking forward to more news from this quarter.

Old Figureheads at Gravesend

Many readers may remember my old friend, Captain "Long John" Silver, and previous accounts of his collection of shipping relics and old figureheads at Gravesend. Hearing that he had been able to extend and improve the collection still more, I called at "The Look Out," Gravesend, before Captain Silver closed it for the winter months last year. I found several intriguing additions there, and also an entirely new room, the "Quarterdeck." Our illustration (Fig. 5) shows the "Quarterdeck" on the port side, looking for'ard. At the far end is the figurehead, "Lord Beaconsfield," and a large painting of a four-masted full-rigged ship, *Liverpool* (3,000 tons registered). The central figure, carved in the nude, is from the schooner, *Amphitrite*, but the two figures on either side of this are, unfortunately, of unknown origin. This room is indeed a valuable extension to the "Valhalla-by-the-Thames," as it gives Captain Silver opportunity for the better display of his large and original collection.

Unit Construction Model

Model engineers will probably like to study the photographs sent to me by Mr. B. E. Timmins, of Hereford, showing the ½in. to the foot scale model of Callender Hamilton Unit Con-

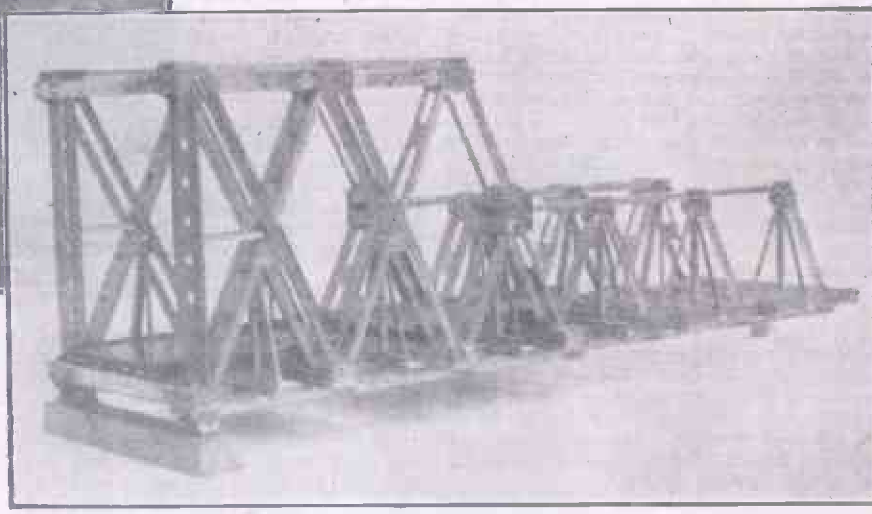


Fig. 6.—Model of the Callender-Hamilton Unit Construction Bridging made by Mr. B. E. Timmins.

struction Bridging, built by him (Fig. 6). Mr. Timmins made this specially for Messrs. British Insulated Callender Cables, Ltd., for display at the Engineering and Marine Exhibition at Olympia last year. The model is made throughout in hard brass, is 2ft. 6in. long, 10in. high and 9in. wide, and demonstrates three types of bridging: The double depth "through" type, the double truss and the single truss. Model-makers who have had any experience in building bridging models will realise the large amount of detail that is involved in what at first may appear in some respects to be quite a simple piece of construction. The angles and channels had first to be bent up from the strip; they were then all drilled in jigs of Mr. Timmins' own design and make. There are 330 angle pieces and 290 plate pieces. The main gusset plates at the junction of the ties each have two smaller plates soldered at right angles to carry the cross-bearers. After bending the channels, the flange formed had to be secured with solder and then hand-scraped to give a finished taper. The truss angles are ¼in. by ¼in. and are 5in. long. Two different types of roadway were laid: one with coarse ballast and two grades of "Tarmac," made from fine granite chips, black paint and glue, and the other from scale timber decking having a diagonal wearing surface with wood strip on top.

A Famous Liner

"Man in his time plays many parts, and ships in their time have many masters." The famous North German liner, *Europa*, will, in the near future, be under French ownership and captaincy instead of German. The two ships, *Europa* and *Bremen*, although not identical in every detail, were very similar in dimensions and power, and

Fig. 5.—The "Quarterdeck," a new room added to the "Valhalla-by-the-Thames," which is full of most interesting maritime relics.

the two are always regarded as having been "sister" ships. When the *Bremen* made her maiden voyage across the Western Ocean in 1929 there was quite a stir in the shipping world, not only because she was the first ship of an entirely new design to be built after the First World War but also because on that voyage she beat the record previously held by the famous Cunard White Star liner *Mauretania*. The following year the *Europa* crossed on her maiden voyage and, by a small margin, managed to beat her sister ship's record.

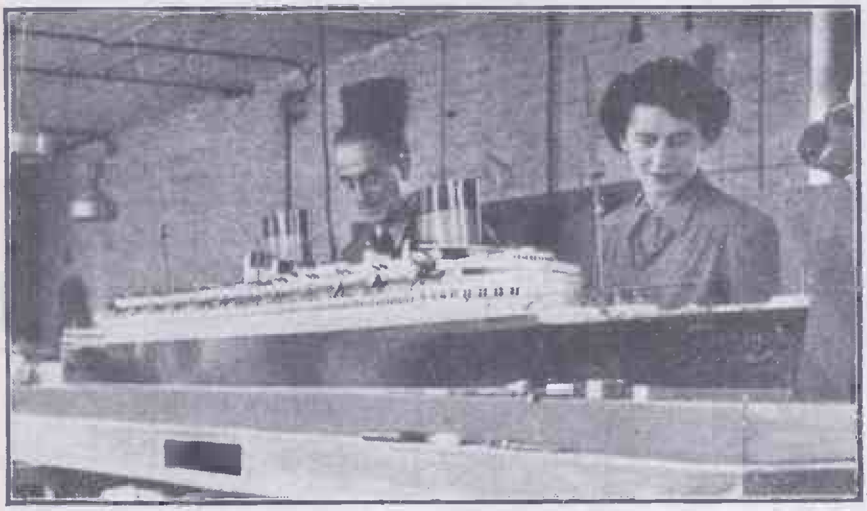


Fig. 7.—A fine German-made waterline model of the N.D.L. "ocean greyhound" shown here after the incorporation of alterations and improvements that have been effected on the liner "Europa" by the French Line and now renamed the "Liberté."

During the last war the *Bremen* was totally destroyed by the Allies, but her sister ship, *Europa*, escaped destruction and was used as a troopship after the cessation of hostilities. Later she was allocated to the French, and she is now being reconditioned in readiness for service with the Compagnie Générale Transatlantique, between Havre, Southampton and New York, after she has been renamed the *Liberté*.

There being no model available of the *Europa*, the French line secured a German water-line model of the *Bremen*, and this has now been converted as a model of the new *Liberté* by Messrs. Bassett-Lowke, Ltd. The model (Fig. 7) can be seen in the windows of the French Line House in Cockspur Street, London.

With the French cuisine and service, the *Liberté* will, no doubt, be one of the most popular ships on the Western Ocean. Her maiden voyage under her new nationality will be an event of great importance to the French Line after their sad loss of their "Queen of the Seas," the *Normandie*, in New York harbour during the late war while in the hands of the U.S. Admiralty, and in the course of conversion into a troop carrier.

Good Work—Exeter!

I offer my warmest congratulations to the members of Exeter and District Model Engineers' Society who, through their hobby, have become "fairy godfathers" to all the youngsters in the children's ward at Princess Elizabeth Orthopædic Hospital, Exeter. Searching for somewhere to build their permanent model railway track, they had the inspiration of requesting to be allowed to use a site in the hospital grounds, outside the children's ward. It took these enthusiastic West Countrymen 18 months' patient work to construct the 100 yards of straight track, although I have no doubt that the "permanent-way" men enjoyed the process throughout. The impatient ones must have been the curious children who watched the work progressing from their ward windows. At length, however, in September last year, the great day came when the locomotives and carriages arrived and the children were told that they could really spend an afternoon having rides behind the miniature steam locomotives. What a thrill for some of them who had never before even seen a railway or a train! Those who were unable to walk themselves to the trackside were either carried or pushed there in their beds and bath-chairs. The Exeter Society have certainly shown fellow modellers how we can make the most of our hobby by bringing so much pleasure to these sick children.

Despite the austerity conditions that beset us, the model world is still very much alive. The past year has certainly shown that the commercial model-makers are able to overcome to some extent difficulties caused by shortage of material and labour and to help amateurs with fittings and parts that they sometimes find beyond their own capacity. From my knowledge of the trade the prospects are better for the coming year. At least there is one advantage in the model business: the amount of material used is of necessity very small! Let our slogan for 1948 be: "Better models, more supplies and more devotion of leisure to constructive work in the model-making hobby."

Letters from Readers

The Time Factor

SIR,—W. J. Weston's mathematical problem (PRACTICAL MECHANICS, November) shows an obvious defect, his two example salaries being based on entirely different principles, thereby drawing a wrong conclusion.

The table of the first man's salary shows a "gift" each half-year of £10 over and above the basic £200 p.a., but the second man's table does not show a gift of £40 each year above the basic: it shows a half-yearly increase on the basic £200 p.a. *at the rate of £40 p.a.*

To put the first man on the same *principle* as the second, his salary should show a half-yearly increase on the basic £200 *at the rate of £10 p.a.* Because a rise of "£10 each half-year" surely means an increase in salary for the second half-year from the basic £200 p.a. to £210 p.a., which gives him £105 for that half-year, and so on. In other words, the first man's table should read:

1st half-year	2nd do.	3rd do.	4th do.	5th do.	6th do.
£100	£105	£110	£115	£120	£125

Thus, the comparative Tables given by Mr. Weston should have been as follows:

	1st half-year	2nd do.	3rd do.	TOTAL wage
1st man ..	£100	£105	£110	
	4th do.	5th do.	6th do.	
	£115	£120	£125	£675

	1st half-year	2nd do.	3rd do.	TOTAL wage
2nd man ..	£100	£100	£120	
	4th do.	5th do.	6th do.	
	£120	£140	£140	£720

J. NETTLETON (Leeds).

Electric Light and Power Installation

SIR,—As I feel that some of your readers, particularly those who are interested in the subject of electricity supply, may be somewhat confused after reading the article "Electric Light and Power Installations," by Mr. S. T. Corner, in your October issue. May I be permitted to make the following comments?

(1) Mr. Corner quotes the Control Board Standard Lighting System at 230 volts 50 cycles as likely to be the ultimate standard throughout the country. The Electricity Commissioners are the authority for determining the standard requirements for public electricity supply in accordance with the Electricity Supply Acts of 1899, along with additional powers and orders granted to them from time to time.

(2) Rather more than a year ago, electricity supply undertakings throughout the country were advised by the Commissioners that from October 1st, 1947, the standard requirements at the terminals of a consumer's single-phase two-wire service would be at a potential of 240 volts at 50 cycles per second, subject to the permissible limits of variation in frequency and voltage.

(3) The standard systems of supply being as follows, at a frequency of 50 cycles per second:

A. 240 volts on a 2 wire single phase circuit
B. 480/240 ,, ,, ,, 3 ,, ,, ,, ,,
C. 415/240 ,, ,, ,, 4 ,, three ,, ,,
D. 415 ,, ,, ,, 3 ,, ,, ,, ,,

(4) Mr. Corner comments upon conductor sizes with the assumption that the larger a conductor is in sectional area, the lower its resistance will be, but only within a limit determined by economy in cost. Here, Mr. Corner is confusing resistance values with cost values; obviously the greater the sectional area of a conductor of a given length the lower its resistance will be. Cost is another factor.

(5) Mr. Corner then states that when large amounts of power are required to be transmitted at a potential of 230 volts, the large sizes of cables required would be uneconomical, and therefore a three-wire 460/230 volt direct current system of distribution is employed. In view of the above some of your readers would quite rightly assume that the three-wire system of distribution is accepted practice, extensively used, and that development is built up on such a scheme. This is far from being correct. The direct current three-wire system is a relic of the early days of electricity supply.

(6) The direct current three-wire system lent itself particularly favourable to adaptation by conversion to a 460/230 volt three-wire single-phase supply, or by the suitable grouping of existing three-wire distributors to the phase and neutral conductors of the pre-standard 400/230 volt three-phase four-wire distribution network superimposed over the existing system. The latter arrangement had the advantage of providing a standard supply for all new development, while still making full use, where suitable, of the original distribution layout.

(7) Mr. Corner should have explained that the accepted and established practice is to transmit extra high-voltage three-phase energy from the generating stations to interconnected sub-stations, and transform locally to the standard 415/240 volt three-phase four-wire system for local distribution through interconnected networks in the denser areas of loading, and where industrial works require large amounts of power it is the practice to deliver extra high-voltage three-phase energy to transformer sub-stations sited on the premises, and transform down to supply the consumer's own 415/240 volt three-phase four-wire distribution system; and where there are large induction motors, it is the practice for them to be operated directly on the extra high-voltage system of supply, or at some standard intermediate voltage determined by the actual circumstances and duty required.

(8) Mr. Corner's remarks upon the balancing of two-wire circuit loads on the three-wire distribution system is strictly theoretical; perfect balance rarely if ever existed in actual operating practice, and for that reason it was usual to provide three conductors of equal cross-section, or a neutral conductor never less than 50 per cent. of the area of the line conductors. For example, the failure of a distributor fuse on either of the outer lines of the system would result in a heavy out of balance, current flowing in the neutral conductor to the balancing point, with consequent wide disturbance of the voltages between line and neutral conductors. With the standard three-phase four-wire and single-phase three-wire systems it is the practice to have the sectional area of the neutral conductors equal to that of the phase conductors. It can be stated here that the purpose of "earthing" the neutral conductor of a "multi"-wire alternating or direct current system is to limit the potential of any line conductor above earth to a value not exceeding 250 volts in accordance with the regulations of the Electricity Commissioners for "the supply of energy at low voltage from a medium voltage system."

(9) In describing the three-phase system of supply, Mr. Corner states that single-phase motors, lighting and heating circuits are connected between different pairs of wires in order to effect balance. This is incorrect—the very purpose of the standard three-phase four-wire distribution system is to provide a potential of 415 volts between phases to supply. For example, standard three-phase three-wire induction motor circuits and a potential of 240 volts between any phase conductor and the neutral conductor for small single-phase industrial and domestic motors, heating and lighting circuits.—E. TIMLIN (Brampton).

Wood Block Flooring

SIR,—May I amplify the answer given in the November issue to Mr. J. Rowbotham (Heywood) with regard to a wood block floor.

As a floorlayer of 40 years' standing, I can clarify the matter a little better, I think.

First of all, floorlayers, usually sum up floors under three headings, namely, parquet, wood blocks, and secret nailed boards.

Many architects call all these floors parquet, but the floorlayer's description is the correct one.

Now, if Mr. Rowbotham talks of a hardwood block floor, we naturally infer that it is laid on concrete, with a perfectly level surface.

In that case a composition is used specially manufactured for the job. Years ago the usual job was to use coal-tar pitch diluted with creosote.

This was not successful, because after a while the oil soaks into concrete leaving only pitch, which, being very brittle, with the slightest knock broke loose, and the floor then became a nuisance and was dangerous.

Messrs. Hollis Bros. & Co., Ltd., Craven Hall, Hull, Yorks (flooring specialists), manufacture a substance called Corroid; this is excellent. It never really sets, but remains more or less pliable.

I have been to repair floors that have been laid 12 years, and the Corroid was still lively.

Should it be that your correspondent desires to fix material on top of an existing wood floor, we should call it parquet, and in that case rarely exceeds ⅜in. in thickness.

This flooring is glued and pinned. The best Scotch glue is used, and 1in. panel pins; a batten 9in. x 3in. x ⅜in. is usually pinned with six pins.—R. V. COOMBS (Eastleigh).

The Cinegram

SIR,—Having just received the October issue of PRACTICAL MECHANICS, I should like to submit some suggestions concerning Mr. Pamment's article, "The Cinegram."

In my opinion there is a way to circumvent Mr. Pamment's stumbling block. The same problem exists in ordinary film projection too, and Maltese cross, etc., movements were used to obtain the necessary intermittent movement. This, however, is detrimental to the film, causing fraying of the perforation, breaks, etc. Moreover, when sound was recorded, the same problem arose, as stated by Mr. Pamment, but I will not mention the solutions of this special problem. There were, however, already projectors in the late 'twenties on the Continent, which were *constant speed* machines with *uniform film movement*. These were the most famous "Mechau projectors" as built by the "A.E.G." in their factory at Berlin-Treptow, Germany. They were the most praised equipment of the leading cinemas in Germany, Austria, Switzerland, etc., and, as far as I am aware, got special reductions on leasing fees for the above-mentioned reason that they were really doing no harm to the film copies.

But Mr. Pamment will be interested in how they worked. Well, the (then) patented feature was not an oscillating mirror but a *mirror-wheel*. There were a number, I believe 16 or 32, of mirrors fixed on the rim, so that they followed the picture just in the same way as Mr. Pamment describes, but then the next frame was picked up by the following mirror and so on, reducing the problem to some very simple movements. Only, at that time, it was very costly to correct the mirrors, which had to be of the finest optical qualities, and so these marvellous machines, which were produced in small series of three to five each time, were very expensive, costing about twice as much as another good "normal" theatre projector.

To-day, as there are the illimitable plastics, and I know that plastic lenses and optical prisms are being manufactured on a mass production basis, I am convinced that there should be a possibility to produce a mirror-wheel for the "Cinegram" in plastic. I firmly believe that if a sufficient market outlet can be found the cost of the precision die required would be easily set-off by the cheap production costs.

I should be very interested to hear from Mr. Pamment about any further development of the "Cinegram."—G. I. SCHAFER (Beyrouth, Syria).

SIR,—Referring to the article in your October issue by F. Townsend Pamment, in the second column (page 20) he asks for suggestions *re* the oscillating mirror which he says is not quite satisfactory owing to the necessary speed.

I would like to suggest that instead of having the mirror to flick back, a drum travelling or rotating in one direction only and provided with 3 or more plane mirrors fixed on its periphery should answer his requirements. As one mirror finished its reflection of one picture, the following mirror would be in position to follow on with no loss of time.—W. SWAIN (Hipperholme).

Club Notes

Manchester Model Railway Society.

THE first public annual exhibition of the above society to be held since the war was staged at The Milton Hall, Deansgate, Manchester, on Thursday, Friday and Saturday, the 18th, 19th and 20th of December. The exhibition was open from noon on the first two dates and from 11 a.m. on the last date. Some hundreds of models, locomotives, rolling stock, signals, trackwork, buildings and accessories were on view in scales from 3½ m/m to one foot upwards.

Working demonstrations of "00" and "0" gauge layouts and a live-steam passenger-hauling track were in frequent operation and the exhibition was of great interest to all railway enthusiasts.

The Beverley Model Club.

ALTHOUGH only three months' old this club has just held its first annual exhibition. It was a great success and aroused much interest in model making in this ancient borough.

More than 100 exhibits were on show and ranged from model buses and lorries about 3in. long, and complete in every detail, to a 3½in. gauge model L.N.E.R. "Bantam Cock," which hauled visitors up and down the hall under its own steam.

Plans are now afoot for forming a model car section with a view to building a race track.

Club meetings are held on alternate Mondays at 7.30 p.m. in Armstrong's Recreation Club, Grovehill Road, Beverley. Further information may be had by writing to the hon. sec., F. H. Plaster, Virginia House, Cartwright Lane, Beverley, E. Yorks.

PORTABLE WATER SOFTENER—

(*Continued from page 134.*)

Regeneration

The length of time between regeneration periods will of course depend on the degree of water hardness, and the consumption of water. For water of the London area, and with average use, the softener should function between ten and fourteen days before regeneration becomes necessary.

To regenerate the softener, it is necessary to cleanse the softening material of lime and chalk with a concentrated brine solution. To prepare the solution, dissolve ½lb. of ordinary household salt—*not table salt*—in warm water. Remove the filler cap of the softener, and slowly pour the brine solution in. Replace the filler cap, and leave for an hour. Then slowly rinse the brine from the softener by turning on the water tap, and allowing the water to flow through same until every trace of salt is removed.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 32 (THE CYCLIST), must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Crystallisation Experiment

JUST before the last war there was a considerable vogue for a home chemical experiment in which a most fascinating growth of crystals was obtained, in any glass vessel, upon a piece of coal or Coalite. Amongst the requisites remembered were red and green ink; and the writer has a vague recollection of the smell of ammonia. Would you please inform me what materials are required for this experiment, and how one goes about it ?—A. Cassera (Hale).

THE chemical experiment to which you refer appears to have been a form of silicate crystallisation. You will best be able to repeat it in the following manner:

Take a large fish globe or a jam-jar and place on its base a thin layer of clean sand. On the sand place a few pieces of coke, Coalite or other porous material on which a few drops of coloured ink have been poured. Then cover the material carefully with ordinary "waterglass" or sodium silicate. Gradual crystal growths will take place from the Coalite or other material, which growths will be coloured by the absorbed ink.

Better crystal formations, however, are to be obtained by "sowing" "seed" crystals in the sand. These crystals must be of coloured salts, such as copper sulphate, copper nitrate, potassium dichromate, potassium chromate, chrome alum, iron sulphate, etc. Equal parts of waterglass and plain water are mixed and then very gently poured over the sand to a depth of 3ins. or 4ins. Within a short time crystal growths will begin to extend upwards, and since these will be of different colours, the effect can be made very interesting and entertaining.

If you sow seed crystals of lead acetate, lead nitrate, calcium chloride or magnesium sulphate, whitish growths will be obtained from such crystals.

Small amounts of any of the above materials should be available at your local druggist, whilst, of course, even nowadays, "waterglass" (sodium silicate) is a fairly common commodity.

Mounting Amœba Specimens: Power of Microscope

(1) I shall be very much obliged if you will inform me of the method by which a specimen such as an Amoeba may be fixed to a microscope slide.

(2) Also, is there any simple means by which the power of a microscope may be determined ? —J. Harper (Newport).

(1) THE microscope slide mounting of amœba is a difficult task unless the operator is possessed of skill and experience. In the first place, the organism should be killed by gradually injecting rectified spirit into the water containing it until as much spirit as water is present. The amœba are then washed in plain water and decanted into a 2 per cent. solution of chromic acid (2 parts chromic acid in 98 parts of water) for three minutes, followed by washing again in plain water. This chromic acid treatment is not essential, but it helps to "fix" the organism and to stain it.

The amœba are now transferred into rectified spirit overnight, after which they are placed on a microscope glass slide, covered with Canada balsam solution and a coverglass placed over the spot. In about a month the balsam will become hard. The coverglass should then be ringed with shellac or other cement, after which it will be ready for viewing.

If you are not experienced in the manipulation and mounting of microscope objects, you should refer to any textbook on this subject, which will be obtainable from your nearest reference library.

(2) If you had given us the focal length of your microscope objective, the length of the microscope tube and the magnifying power of your eyepiece we could have given you a precise estimation of the microscope's magnifying power when used under normal conditions. There are experimental methods of ascertaining the magnifying power of a microscope but these are anything but simple and they call for expensive apparatus.

A rough approximation of the magnifying power which, we think, will suit your needs can be gained by dividing 6ins. by the focal distance of the objective lens and then by multiplying the result by the magnifying power of the eyepiece.

Thus, for example, an objective lens of 1/10in. focus will magnify 60 times. This, when used with a 4 eyepiece, will produce an apparent magnification of 240 times.

Removing Mildew From Leather

CAN you please advise me how to remove mildew marks from a black leather coat ? The coat is quite old, and mildew marks have defied several attempts to remove them.—J. E. Barnett (Weston Beggard).

THERE are many varieties of mildew and some of them are notoriously difficult to eradicate. We should have liked to know whether the mildew marks on your black leather coat are white, pinkish, yellow, or greenish. Also, whether they can be attributed to dampness or to some other cause, such as the accidental spilling of a liquid on the garment.

In the circumstances we have to presume that the mildew stains are of the commonest variety, i.e., the thread-like whitish patches which form in circles. In this instance your best course of action is to paint over the stains with a fairly strong disinfectant, such as Milton. This will kill any active mildew which may still be present.

The unfortunate part of the matter is that the mildew is a thread-like plant which thrusts its roots deep into the actual fibres of the leather or other material, and which not only stains it but, also, often actually destroys it. Usually, however, its staining action is greater than its destructive effect. Let us hope this is the case in the instance of your black leather coat, for if the leather itself has been destroyed nothing at all can be done.

Obtain some pure castor oil. Heat a little of it in a teaspoon and dab it on to the garment with a wad of cotton wool. In many instances this treatment will entirely remove the whitish stain. You may, if you consider it advisable, mix a small amount of a black shoe-polish with the hot castor oil—sufficient to blacken it. This stain will be taken up by the mildewed leather, and a final application of a good wax polish to the whole of the garment will often be sufficient to brighten up the entire coat and to render the formerly mildewed area quite unnoticeable except on the most minute inspection.

You will appreciate that this is all the advice we can give from your very brief description of the trouble. Mildew damage varies so very much in degree and in consequences, that a visual inspection is usually necessary before any definite course of action can be decided on.

Removing Grease from Brass

CAN you supply me with a formula of a chemical solution for removing grease and dirt from brass without damaging the metal ?—R. D. Simmonds (Camberwell).

THE easiest way of removing grease from brass is to make up a medium-strength solution of caustic soda in water (say, about 1 part of caustic soda in 5 parts of water) and to gently simmer the brass articles in this solution for about half an hour. Use a vessel of iron, enamel, glass or earthenware for this boiling, but not a galvanized vessel, since the caustic soda will attack such a vessel.

If the articles are too big to be thus treated use a powerful degreasing agent, such as Teepol-X, which is a petroleum product sold by Shell Chemicals, Ltd., 112, Strand, W.C.2, price about 13s. per gallon. One part of Teepol-X mixed with 10 parts of water, plus a little soda (ordinary or caustic) makes a very good degreasing liquid when brushed on hot to parts which are too big for normal boiling.

The brass will be quite unaffected by the above treatments, always provided that it is properly rinsed afterwards.

Spirometer: Testing Petrol-engine Exhaust

(1) I HAVE a spirometer the dials of which are marked in cubic inches. What is this used for ?

(2) Is there any simple instrument or apparatus for testing the exhaust of a petrol engine to indicate if the mixture is lean, correct or too rich ?—F. E. Siggers (Hoshiapur, E. Punjab).

(1) A SPIROMETER is an instrument which is used for measuring the capacity of the lungs. It does this by measuring the volume of air which can be breathed out by a forced inspiration.

There are several different forms of this instrument. In general, however, the spirometer is merely a small gasometer having one or more graduated scales or dials. The subject under test takes a very deep breath and then breathes out into the instrument. The spirometer is calibrated either in cubic centimetres (c.c.) or in cubic inches.

(2) There exists no automatic exhaust-indicating instrument such as you visualise, although from time to time attempts have been made to design such instruments. An accurate indication of exhaust gas conditions can only be obtained by means of an analysis of the exhaust gas itself. This cannot be done effectively by any simple and automatic means. Added to this is the fact that the composition of a "normal" exhaust gas varies a good deal according to the composition of the fuel on which the engine is running.

Generally speaking, however, in a sweetly running engine the exhaust gas should be invisible, oil-free, and nearly odourless. The two most usual defects are (a) black smoke, which signifies imperfect carburation (usually from an excess of fuel), (b) blue smoke, which denotes excessive lubrication.

Making Imitation Pearls

CAN you please explain the process for making imitation pearl beads ?—J. H. Pearson (Worcester).

IMITATION pearl beads are made from special "pearl" glass, the glass being inherently opaque. This glass is sometimes (after having been made up into beads) given a coating of transparent lacquer to heighten the effect.

We are afraid that you will not find it possible to imitate this effect on a small scale. All you can hope to do is to coat clear glass beads with a semi-transparent synthetic lacquer which you might be able to obtain from a local paint store. Alternatively, you could make this yourself by dissolving clear scrap celluloid in a mixture of about equal parts of acetone and amyl-acetate and by stirring a little very fine cosmetic powder into the thick liquid resulting. But as acetone and amyl-acetate are becoming more and more difficult to obtain these days on account of priorities, restrictions, controls and exports, we are very much afraid that you will find it hard to purchase any unless, of course, you can claim the friendly assistance and goodwill of a local pharmacist or druggist. Failing that, you might try Messrs. Vicsons & Co., 148, Pinner Road, Harrow, Middlesex.

Dyeing Matting

I SHOULD be grateful if you could inform me of a way to dye natural coco-matting at home, and also the thick webbing-like material which is used as druggett ? I thought it might be possible to brush a hot dye into it.—E. Ginyko (Beckenham).

IT is not possible to dye satisfactorily matting and other similar thick material merely by brushing on a hot solution of the dye. If you attempt this method you will only get patchy results and, worse still, you will find that the colour will rub off badly and perhaps stain other fabrics which may happen to come into contact with it.

The only satisfactory method of dealing with these articles is a difficult one—so far as home dyeing is concerned. It consists in completely immersing the textile material in the dye solution and in slowly heating it therein.

The material should first of all be immersed for a day or two in water so that it becomes completely saturated with the liquid. If there is any suspicion of dirt or grease on the fabric it should then be washed with soap and finally rinsed with plenty of clean water. Surplus water should then be drained off. The dye bath should be made up in a tub (preferably a non-metallic one). The cleaned fabric should be immersed in the cold dye bath, but the latter should be heated to boiling-point during one hour, retained at that temperature for another quarter of an hour, after which the dye liquor may be run away and the material thoroughly well rinsed with water. It should then be hung up on lines after this treatment to dry out thoroughly.

Some degree of shrinkage and matting of thick fabric may be expected to result from the dyeing process, but this is unavoidable under the circumstances.

Colours which have been "keyed" on to a fabric in

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a hot solution will remain thereon, but any process of spraying, rubbing or brushing on dye solution will not be satisfactory, since such fabric will always be likely to shed its colour on the slightest provocation.

Cutting Triplex Glass

CAN you tell me if there is any method of cutting Triplex-toughened glass, as I have been told that it can be done with some kind of acid. If so, what is the acid, and the method of using it?—D. J. H. Evans (Newport).

THE only acid which will attack glass and ultimately dissolve it is hydrofluoric acid, particularly when it is used warm. This acid can be obtained from the usual chemical wholesalers such as Messrs. J. W. Towers & Co., Ltd., Victoria House, Widnes, Lancs, it being sold in special ceresin or gutta-percha bottles.

We do not, however, consider that you will be able to apply this acid successfully to the cutting of Triplex-hardened glass.

The only method available to you is, in our opinion, a carborundum saw which, in effect, is a thin steel disc revolving at a high speed, and the edge of which is tipped with a carborundum mixture, highly compressed. For such apparatus you might make inquiries of The Universal Grinding Wheel Co., Ltd., Stafford, although, like most other things, these cutting wheels are becoming increasingly scarce.

The usual method of glass-cutting with a diamond is, of course, hopeless with this type of glass.

Papering Plastic Surfaces

THE inside panelling of the roof of my caravan is of sheet plastic material.

After several attempts to paper it over, I cannot get the paste to hold for more than a few weeks, after which the paper falls clean away.

I have even given the plastic a coat of flat white paint which holds quite well, but it has not helped the paper to stick. Condensation is not the trouble, as the van has not been used yet. Could you please advise me on any special treatment?—F. Ghey (Eastleigh).

ALL synthetic plastic materials are more or less "hydrophobic," that is to say, water-repellant. Hence, an aqueous paste, glue or gum placed on such a surface does not "wet" it well and is, therefore, unable to obtain a good hold.

Our opinion is that you would best solve your problem by matting the surface of the plastic sheets with sand or emery paper and then by giving it a coating of a gelatine solution, used hot. Such a solution could be made up by dissolving 5 parts of ordinary cooking gelatine in 95 parts of hot water. Allow this to dry on the plastic sheets. Then stick your paper on, using exactly the same gelatine adhesive but of double strength, i.e., 10 parts of gelatine in 90 parts of water. This adhesive will, of course, have to be used hot, for it will set to a jelly when cold.

If the paper refuses to stick with this treatment, strip it off, and to the gelatined plastic sheet apply a thin coating of a washable matt distemper, *not* an oil paint. Give this three days to dry out completely, then use paste or gelatine solution to stick the paper over the distemper.

We think that the first process will be quite satisfactory, although we recommend that you try it out on a small area before applying it to the whole of the plastic sheets.

Gold-plating Process

COULD you please give me details for setting up a small gold-plating tank at home?

Also, could I run the electrical side from the mains? I would also like the name and address of a firm who could supply the necessary materials.

I plan to gild about six cameo surrounds or brooches at a time.—S. Garrard (Wood Green).

GOLD-PLATING or electro-gilding is quite an easy task if it is carefully carried out. The process, however, cannot be run off the electric mains. It requires a very small direct current only.

Since there is some risk in making up a gold-plating solution owing to the use of fulminating gold, by far your best (and cheapest) plan is to obtain your gold-plating salt ready made up from either Messrs. Johnson, Matthey and Co., Ltd., Hatton Garden, London, E.C.1, or Messrs. Wm. Canning and Co., Ltd., Great Hampton Street, Birmingham. You will only have to dissolve this salt in a stated amount of water and the plating bath will be ready for use.

As the anode of the bath, you can either use a piece of gold wire or a length of platinum wire. The gold wire will slowly dissolve in the bath, but the platinum will remain insoluble. In this latter case, the bath will need to be replenished from time to time by the addition of more gold salt.

The article to be plated is made the cathode (negative electrode) of the bath.

At ordinary temperatures the gold is deposited in a rather pale condition. As the bath is warmed up to 60 deg. C., the colour of the gold becomes warmer and more pleasing. Do not use a current of more than 1 volt. Excessive current will only produce a loose and powdery gold deposit.

Observe, also, the fact that the gold bath contains cyanide and is, therefore, very poisonous.

Gold salts are, of course, very expensive at the present time but, in order to conserve the amount of gold deposition, it is a good plan to paint a thick solution of shellac in methylated spirit over any portion of the article which is *not* required to be gold-plated. The gold will not be deposited on the shellac-treated area, and thus some saving in gold will be effected. Afterwards, the shellac can be dissolved off with methylated spirit.

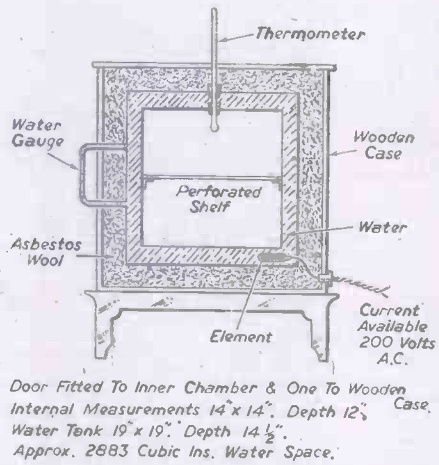
Bacteriological Culture Oven

I AM constructing a bacteriological culture oven (water heated) but the chief obstacle I have encountered is keeping the water and oven at constant temperatures between 30 and 50 deg. C.

I propose heating the water with an electrical element, as shown in the sketch.

Would you kindly instruct me on the wiring and type of thermostat I should require and the name of an electrical dealer that could supply me with one?—A. Stallwood (Stroud Green).

WE consider an immersion heater of about 250 watts rating would be sufficient to maintain the temperature under themostatic control. If, however, it is important that the temperature be raised from cold in a short time a larger element would be advisable. The immersion heater should be connected in series with the thermostat contacts and fed from the mains through a 15-amp. 250-volt double-pole combined switch and fuse box. We suggest you use a tubular type of thermostat fitted vertically at the side of a vertical heater. Messrs. Santon, Ltd., of Somerton Works, Newport, Mon, could probably supply what you require.



Section of an electrically heated bacteriological culture oven.—(A. Stallwood.)

Vitreous Enamel

WILL you please inform me as to the amount and type of materials to use, and the method of making, in the preparation of enamel, similar to the transparent material to be found on French clocks and snuff-boxes of the Louis XIV period?—B. Blakemore (Barnsley).

MANY of the old clock dials have "enamel" which is simply a white paint which has been applied to the underlying sheet iron and then cautiously baked in an oven. This material would not suit your purpose. You require a vitreous or a "porcelain" enamel, and this is only obtainable with very great difficulty and by means of a high-temperature pottery furnace.

The enamel itself consists of a mixture of various substances which at white heat fuse and combine into a sort of semi-opaque glass which runs uniformly over the metal surface. The composition of the enamel material varies enormously, and is, in many cases, a closely guarded secret. Here is a typical formula:

White Lead	20 parts (by weight)
Ground stone	9 „ „
Ground flint	9 „ „
Borax	4 „ „
Zinc oxide	2 „ „
Felspar	3 „ „

The above materials are ground to an extreme degree of fineness. They are then ground into a cream with water and poured over the metal. The object is then fired for about seven hours at white heat, after which it is allowed to cool slowly.

It is possible that you might be able to procure a vitreous enamel material for clock dials ready-made from Messrs. Wengers, Ltd., Etruria, Stoke-on-Trent, but a very great difficulty will be to gain access to a high-temperature furnace. Also, there is the question of skill, experience and practice, all of which are very important factors.

To be quite candid, you are up against a very difficult job and, unless you have a good knowledge of ceramics, we doubt whether you can hope to be successful in your project.

Yeast Production

WILL you please tell me how yeast is grown? I have heard that inorganic salts, e.g., phosphates, potassium salts, and nitrogen in the form of ammonium salts must be present in the medium on which it grows. I shall be glad of any information you can give me on the correct amount of the above chemicals to use, and the correct temperature at which yeast grows best.—J. McDonald (Dundalk).

COMMERCIAL yeast is not grown on synthetic solutions such as you suggest. It is the product of fermentation processes, chiefly in connection with the brewing of ales and the manufacture of spirits.

Brewer's yeast is merely a by-product of the brewing process, which is skimmed off the fermented liquor, drained and pressed.

What is sometimes known as "German" yeast is a similar product from the mash which is used for the distillation of whisky. The yeast is collected from the surface of the fermented mash by means of long wooden scrapers. It is then put through a filter-press which squeezes out the greater part of the liquid, leaving a stiff, pasty, yellowish mass which is then sewn up in canvas bags of 7, 14 and 28lb. capacity.

If you wish to grow yeast on a small scale, dissolve 20 parts (by weight) of sugar in 90 parts of water and to this solution add about one-half part of a mixture of equal parts of ammonium sulphate, magnesium sulphate, sodium phosphate and potassium phosphate. Keep the temperature at about 20 deg. F. during the fermentation process, and, after 30 hours, collect the scum of yeast which will float on the surface of the liquid.

Removing Ink Stains from Carpet

I WOULD appreciate your advice on the following matter:

Recently I had an accident involving a large carpet, which was badly splashed with ink. Could you please inform me if it is possible to remove the stains without damaging the carpet in any way.—G. Shaw (London, W.).

THE first thing to do is to raise the carpet from the floor and to saturate the stained area with hot water containing plenty of good soap suds plus sufficient ammonia to make it smell faintly alkaline. Run the water on to the back from the *back* so that the water runs away from the face of the carpet. In thus running away it will take some of the ink with it.

Next, gently scrub the face of the carpet with the same liquid as above. This will remove more ink. After this, run more of the soapy water through from the *back* of the carpet, and finally run plain water through. Now let the carpet dry out slowly (without heat). This will take several days.

You may, if you are lucky, find that this treatment has removed a considerable amount of the ink, for most modern inks are notoriously fugitive, but if the ink contains any iron or strong colouring matter it will require bleaching, and it is just here that the problem arises, since, very often, an ink-removing bleach will often injure the colour of the carpet.

All we can do in the circumstances is to advise you to proceed on extremely cautious lines, treating a little of the carpet at a time and exercising great patience.

For a bleach, use one of the proprietary preparations such as "Chloros," "Milton," etc., or else make such a preparation up yourself by grinding in cold water 1 part of chloride of lime with 7 or 8 parts of water. Allow the liquid to settle, pour off the clear liquid and add to it about 1 part of strong vinegar or acetic acid (preferably the latter). Dab this liquid on to the ink stains in small areas at a time. The ink stain will turn yellow and then bleach away altogether. When this happens, reverse the carpet and pour hot soapy water through it so as to remove every trace of the bleach. If this treatment is satisfactory proceed to another small area, and, by this means, gradually eliminate the whole of the stain.

It is almost certain that some of the colour of the carpet surface will be affected by the bleach, but this may be remedied after the carpet has been finally allowed to dry out by touching up the affected areas with a hot dye solution applied by means of a small brush.

The whole process, calls for great care and caution and patience, but if these are exercised intelligently, we see no reason why the task should not be accomplished quite satisfactorily, provided that neither printer's nor Indian ink has been spilled.

Fixative Medium for Water Colours

I HAVE some painting pencils (water colours) which I use for painting on materials. As I am unable to get the right fixative, could you please help me?

After painting with these pencils, the work is fixed so that the material can be washed.—E. Wicks (Southend-on-Sea).

WE presume that you refer to ordinary cloth fabrics, and not to paper.

Usually, when painting on fabric, the colours are ground up with a little gelatine solution (say, 1 part gelatine in 6 of water) and, after drying, the material is sponged over with a formalin liquid made by diluting commercial formalin (formaldehyde) with three times its bulk of water. The formalin renders the gelatine insoluble and since the gelatine "holds" the colour, the latter does not dissolve out on washing.

Other painting pencils are made up on a grease or wax basis. These resist water and do not require any fixing treatment.

Other fixing agents contain various solutions of synthetic resins which are deposited in the fibres of the material and so resist the action of water on the colour. Which of these would be best applicable in your case we cannot tell, since we have not any knowledge of the type of painting pencil which you are using. Possibly, however, you may now be able to obtain a ready-made fixative medium from either Messrs. Winsor and Newton, Ltd., 38, Rathbone Place, London, W.1, or Messrs. Reeves and Sons, Ltd., 18, Ashwin Street, London, E.8.

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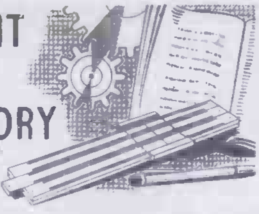

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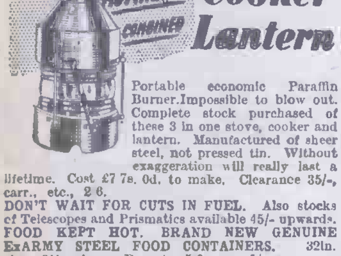

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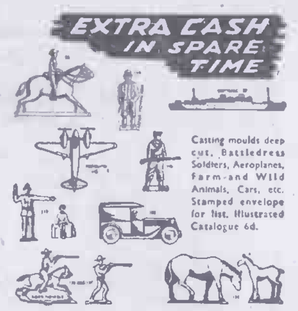

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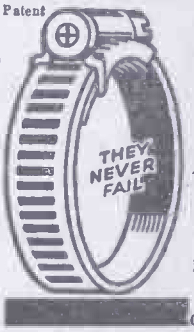

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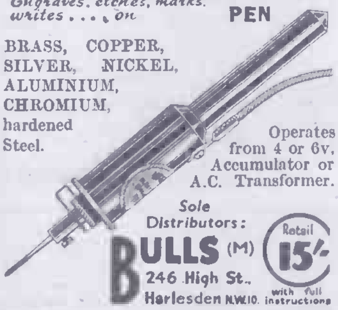

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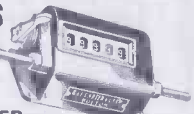

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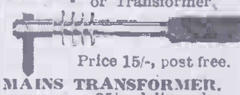

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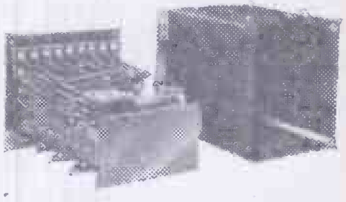

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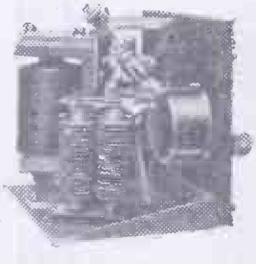

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THE Cyclist

Editor: F. J. CAMM

VOL. XVI JANUARY, 1948 No. 310

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

Phone: Temple Bar 4363

Telegrams: Newnes, Rand, London

Comments of the Month

By F. J. C.

Mr. G. R. Strauss on British Bicycles

IN opening the Raleigh Industries Fair, Mr. G. R. Strauss, Minister of Supply, said that British bicycles are acknowledged to be the finest in the world.

"It is gratifying to note that when Britain is trying to maintain her pre-war standards in industry, the British cycle manufacturers have expressed such determination to maintain and surpass their high reputation at home and overseas. The display I have seen to-day is undoubtedly typical of the fine workmanship incorporated in British bicycles."

The annual production of bicycles in 1938, said Mr. Strauss, was 1,980,000, of which 576,000 were exported. Britain then held third place in the world's cycle industry. In 1947, with production at the rate of well over 2,000,000 cycles, and 1,400,000 scheduled for export, "we hold first place and I am confident that with the energy, resource and skill I have witnessed in your products to-day we will remain the first."

Raleigh Industries, added Mr. Strauss, had always been export-minded, and in view of their already established world-wide connections, were in a particularly favourable position to help the export drive. "The world's demand for bicycles and bicycle components is still very considerable," Mr. Strauss said, "and we as the main producing country are striving to justify the faith placed in us by making every effort to satisfy all the demand." It was a tribute to Raleigh Industries, he added, that in a village in Burma the only word for cycle was "Raleighbike."

Progressive ideas in design, Mr. Strauss continued, were extremely important, for British bicycles were used under many varying conditions of climate and terrain. He was particularly interested in the new version of the dynamo lighting set operated by the hub and the child's tricycle.

Mr. Strauss pointed out that every bicycle sent overseas to a country such as Canada brought back its equivalent of some 800 lbs. of wheat. "Raleigh Industries, which include many of the world's best known cycle companies, might therefore be referred to as one of the most vital links in the chain which turns the wheel of our export drive," he added. "The coming months are to be regarded as the stepping-stones to future prosperity, and I know that the close cooperation and team spirit which I see in Raleigh's organisation is what is wanted to help us towards obtaining this very desirable result," Mr. Strauss concluded.

The total number of bicycles sent overseas during the first ten months of 1947 was 1,177,546, of a value of £8,100,657.

Reduction of Labour Force

WE support the attitude of that lively and energetic body the British Road Federation towards the Government's proposal to reduce the labour force employed on road maintenance by 20,000 men.

As a result of inquiries instituted by the Federation, a great deal of information has been received from Highway Authorities throughout the country confirming the opinion already held that any further reduction in road maintenance would be disastrous to the economic needs of the nation.

The evidence collected was placed before the Road Maintenance Committee of the Federation, and after consideration the following resolution was passed:

"This Committee, having carefully considered the evidence placed before the Federation by highway authorities throughout the country, believes that the Government has failed entirely to realise the implications of its present highway policy.

"The Federation urges that H.M. Government reconsiders its decision in the light of the evidence now submitted, which shows that the proposed cuts in labour and maintenance work will have disastrous effects on agriculture and industry.

"In view of the warnings given by Ministers of a possible railway transport crisis, the roads will have to bear exceptionally heavy traffic, and the evidence collected by the Federation on the state of the roads shows that expert opinion throughout the country is being ignored."

Rising wages and prices have themselves reduced the amount of money available for road repairs since the war, and it is only by the exercise of the utmost economy that it has been possible to make any inroads on the arrears of essential maintenance brought about by the war, and to reduce the staff employed at this juncture would be little short of disastrous.

We do not understand why local bodies should be pressed by the new Road Safety Committees to carry out all sorts of road improvements and road surfacing, whilst at the same time their estimates are cut in half. There is evidence to show that since the end of the war there has been a great increase in petty claims against corporations for compensation arising from minor accidents on carriage ways and footways.

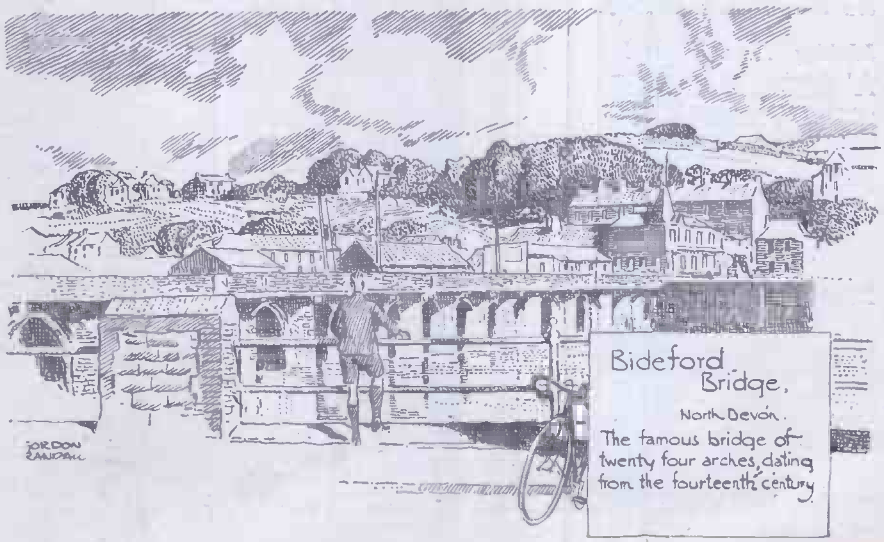
This is attributable to the fact that maintenance staffs have not even reached their pre-war level.

It would have assisted the County Councils very considerably if the Minister had stated that the total amount of grant that he was prepared to pay could be spent on either Class I, Class II or Class III roads at the discretion of the highway authority, who should, after all, be in the best position to know exactly what is needed on their own roads

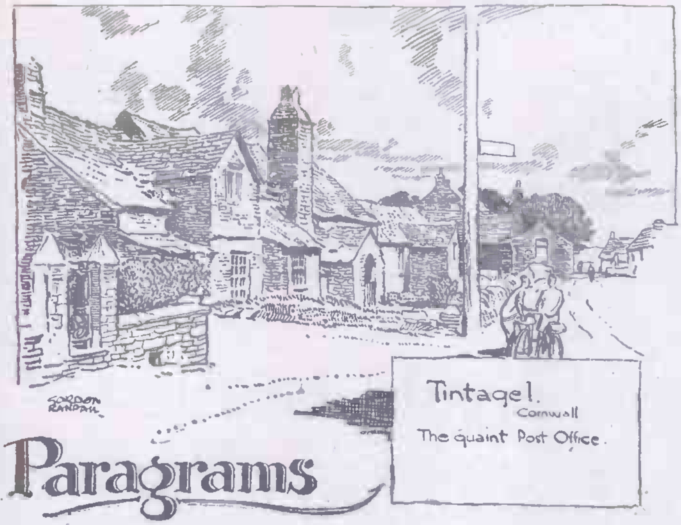
The Government could have requested every highway authority to reduce its highway labour force by a certain percentage, say, 25 per cent. or whatever is required, and at the same time left them with sufficient grants. This would have achieved a secondary object of compelling highway authorities to modernise their methods by using machinery as much as possible to save labour.

Many footpaths are not paved and in bad weather are pools of water or mud, being a menace to health as well as a danger to limb, and there seems little prospect of improving such conditions for many years.

The present condition of some footways is very bad and the absence of any maintenance treatment during the coming year will result in more expensive resurfacing works being carried out later.



Bideford Bridge, North Devon. The famous bridge of twenty four arches, dating from the fourteenth century



Paragrams

Whose Fault?

THE cancellation of the proposed Safety First Exhibition at Loughborough, Leics, has caused some controversy in the town, although no complete explanation has been given of the reason for the cancellation. A special cycling exhibit was arranged and various local organisations pledged their support of the proposed exhibition, and arrangements were made for a full-scale meeting to settle final plans. This meeting, however, did not materialise and delegates of the organisations were notified by the Town Clerk that the exhibition would not be held because it was impossible to obtain some of the exhibits needed. The mayor says he was "never even approached" about the scheme.

Both Wearing Well

MR. WILLIAM WHITE, of Argyle Avenue, Doncaster, who at the age of 70 is still taking part in the Doncaster Clarion Club's cycle races, hopes that he and his machine will be in action for some years yet. His cycle is not quite so old as its owner, but it was bought in 1919, and is keeping in good trim in spite of the hard work it puts in on the road and track. Mr. White is a veteran of both the Boer War and the 1914-18 war, in which latter spot of bother he was sergeant-major—so "Carry on, sarn't major!"

168,000-*Mile Ride*

MR. ARTHUR KILSBY, a Daventry postman for 46 years, who has just retired, calculates that during the 38 of those 46 years which he has spent as a cycling postman he has ridden altogether 168,000 miles. In spite of having had to cycle to earn his living, Mr. Kilsby hopes to spend many more hours on the road during his retirement. His grandfather, father and brother were all postmen also.

Riding to the End

MR. JAMES KEELING, 80-year-old cyclist, of Sprotborough, Yorks, who had faithfully observed his resolution, made when he first started cycling in 1888, to ride at least one mile every day, collapsed while cycling up a hill at Sprotborough and died later in Doncaster Infirmary. Mr. Keeling, who was one of the first tram-drivers in Rotherham, had travelled all over the world during his working career.

Making Them Careful

ALL the boys and girls who are pupils at Tynemouth High School, Northumberland, and own cycles, have had a test to see whether they are sufficiently good riders to be allowed to cycle to school. They rode through Tynemouth, following a special route, and were checked at various points by observers. Those children who were not sufficiently good riders or who showed lack of knowledge of elementary road safety precautions, will have to pass a further test before they are allowed to cycle to school. The school authorities cannot prevent them riding in their spare time, but they do intend to check careless cycling as far as possible.

Recipe for Happiness

"CYCLING has made me the happiest and healthiest old man in England," said 81-year-old Mr. George Jowitt, speaking at the twenty-first birthday celebrations of Doncaster Wheelers, held at the Mansion House, Doncaster. Mr. Jowitt started cycling 61 years ago, and is still a keen rider; his cycling reminiscences are innumerable. Doncaster's Mayor and Mayoress were guests of honour and an address was given by Mr. H. H. England, of London, president of the North Road C.C. The chairman of the club, Mr. T. R. Snowdon, told the club members that as well as having seen cycling history made, the Wheelers had helped in the making of it by turning out riders who gained national reputations.

Saving His Legs

AFTER thinking over for some time the possibility of converting a bicycle to electric drive, Mr. Stanley Brotherhood, a Melton Mowbray business man, tried out his ideas, using an old cycle frame, a low voltage electric motor and two car batteries. The scheme appeared to have no snags, so Mr. Brotherhood set to work and designed and built his own frame from steel tubing, fitted the electric motor and controls and two six-volt car batteries, after quite a bit of planning and scheming, and now he is the proud rider of his "Electro Glide." He was rather bashful about the looks of his new machine at first, so the first trial run was made after dark, but the machine is now a familiar sight in the streets of the town and is almost as quiet as the ordinary bicycle.

Non-dazzle!

MANY a cyclist has used rude words about approaching motorists who have dazzled him with their glaring headlights, but a motorist who appeared before the magistrates at Lutterworth, Leics, had gone to the other extreme. He had fitted up his car with three cycle lamps. He told the Bench he had been unable to get spare parts for his proper lamps, so had been forced to improvise, but the magistrates felt that cycle lamps were rather inadequate for a motorist and signified their disapproval in the way magistrates do.

Traffic Congestion!

AT a recent parish council meeting in a Midlands village a member complained about the traffic congestion in the main street of the village and suggested it should be made a one-way street. After some discussion it was agreed that a traffic census should be taken and a few days later several keen councillors took their stand in the street to check the traffic. But after an hour not a single motor vehicle had gone along the street, and, as they could hardly call an odd bicycle or two "traffic congestion," it was decided to call the whole thing off.

A Veteran Passes

THE first man to ride on pneumatic tyres in Birmingham, Mr. Frank Luckman, of Messrs. Latch and Batchelor, Birmingham, has just died in his 77th year. In collaboration with C. K. Welch, inventor of the wired-on tyre, Mr. Luckman carried out the initial experiments and manufactured for Dunlop the original wires for the first wired-on tyres, on two of which he appeared in the streets of the city.

Peterborough Club's New Secretary

AFTER nine years as secretary of the National Clarion Cycling Club, Peterborough, Mr. W. Airey has tendered his resignation at the club's annual meeting. He has been succeeded by Mr. P. W. Goodale, of 17, Hunting Avenue, Peterborough, who is also treasurer. In his last report, Mr. Airey gave details of increases in club membership and a better attendance of members on club runs. In spite of rather heavy expenditure on the social life of the club, it was reported that the general position was sound.

Cycle and Trailer

A YOUNG married couple, Mr. and Mrs. R. Loudon, of Middle Brighton, Australia, have solved the problem of what to do with Sonny on a cycling trip by taking him with them in a caravan trailer. Mr. Loudon designed and built an ultra-lightweight caravan mounted on two ordinary bicycle wheels, just large enough to carry a child in comfort. There is a large window on each side of the caravan for the child to look out and a smaller circular one in front. The caravan's towing-bar fastens behind Dad's saddle as, of course, he has to do all the work, while Mother rides by his side and has a look now and then to make sure Sonny and his caravan haven't come adrift on the road.

Wrong Track

THE railway authorities at Hinckley, Leics, have been complaining about cyclists who ride along the side of the track, either to find short-cuts or, as one rider said, to get home before lighting-up time. A railway policeman told the Bench during the hearing of one summons that a goods driver had to slow down his train on account of seeing a red light, which turned out to be a cyclist's rear light moving along by the side of the railway lines.

Nationally Important!

"I SHALL not be able to attend court as I have changed my occupation to work of national importance," wrote a 14-year-old Kettering boy to the Juvenile Court after he had been summoned for cycling without a light. The police superintendent said the boy was an errand-boy at the time of the offence. As he is now apparently one of the country's keymen, the Court thought he might manage to pay a 10s. fine.

Cycling Hunt Followers

THE abolition of the basic petrol ration will probably, according to a member of the Grafton Hunt, which hunts in Northamptonshire, mean that hunt followers will be seen following hunts on cycles instead of by car. If this is the case they will certainly be in a better position to do a spot of cross-country dashing than they would be in a car. The exercise, too, should be very welcome.

Another Mill Vanishes

KNOWN to many cyclists who are fond of the by-roads of Bedfordshire, the ancient post mill at Riseley has been destroyed during a freak thunderstorm on a November day after having survived the storms of at least two centuries. The solid centre post supporting the mill was struck by lightning and the supporting beams caught fire and collapsed, allowing the body of the mill to tilt at a dangerous angle. Villagers had to pull the mill down to extinguish the fire, and now all that is left is a heap of ancient timbers and rubbish. Millers have lived in Riseley and worked the mill since the early 18th century, and the last of them, Mr. B. Rootham, is still living in the village. With the destruction of the mill he feels he has lost a very old friend.

To America for Operation

A KEEN cyclist until he was taken ill, and an old member of the Peterborough Cycling Club, Mr. Harold Blake, of Kettering, has sailed to America on the *Queen Elizabeth* to undergo a special operation which, it is hoped, will result in his being cured of Parkinson's disease. This disease, which causes a form of paralysis, only attacked Mr. Blake a few years ago, during the war, but, in spite of the fact that for some time he has been unable to write or walk, he has continued his work in a Kettering newspaper office, where he is chief reporter. Mr. Blake first heard of the rare operation, which will take place in the Missouri Baptist Hospital, St. Louis, through reading an article in a magazine which suggested that this hitherto incurable disease might now be conquered.

Music While You Ride

ALTHOUGH not in the least envious of the motorist, Mr. C. N. Clarke, a keen rider, of Finkle Street, Thorne, Yorks, thought car-radio a good idea, so he has fitted his cycle with a set. The receiver is attached to supports over the rear wheel, with a telescopic aerial, and now as Mr. Clarke rides along he can keep well in touch with all the latest cuts and austerity measures. Now that the set is fitted and working, he is devising a flexible-shaft type of tuning control which he will attach to his handlebars.

Jet Cycle Now

THE Aeromarine Co., of Vandalia, Ohio, U.S.A., has adapted the jet propulsion idea to an ordinary standard bicycle. Three "Dyna-jet" units weighing one pound each were attached over the rear mudguard and during the experiments they propelled the cycle at speeds up to 35 m.p.h. Ordinary petrol is used as fuel and is contained in a tank under the saddle: a coil-ignition system provides the spark to start the jet motors. The pedal drive was retained in the experimental model. Although the experiments were successful, the Company does not recommend the jet cycle for everyday use, owing to cooling problems and high fuel consumption.

Hands Off!

AFTER a prolonged fight with the Ministry of Transport, the Rutland County Council has been told that it must remove its "This Is Rutland" signs which have been erected on each of the 32 roads leading into the county, on the county borders. The signs were erected to help to bring to the notice of road users Rutland's fierce fight to prevent itself being swallowed up by some neighbouring county as a result of the Boundary Commission's scheme to reorganise county boundaries. The Ministry have suggested that the notices might be mistaken for traffic signs, but the County Council do not propose to do anything further as they think that by the time the Ministry gets itself into action the need for the notices will have long passed.

Christmas Ghost Story

A "GHOST cyclist," stated to be "wearing a cloth cap and having the appearance of a labouring man," was blamed by a Derby motorist for causing him to swerve and collide with another car. He said, when charged at the police court with driving without due care and attention, that this lightless cyclist suddenly appeared from nowhere, caused him to swerve, and then vanished. The driver of the other car and the driver of a lorry told the magistrates that they saw no cyclist. The ghost-seeing motorist was fined £5 and ordered to pay a further £4 12s. costs and witness's expenses.

Too Attractive

THAT all posters near the road, particularly the more attractive ones, ought to be taken down on the grounds that they distracted the attention of road-users, was the suggestion made at the meeting of Holland Road Safety Council at Boston. One member mentioned a poster just outside the town of "a beautiful lady drinking a certain beverage" which he said was so striking that people looked at it instead of at road signs.

Around the Wheelworld

By ICARUS

Another B.L.R.C. Legal Victory

THE latest turn in the campaign against the B.L.R.C. took the form of a prosecution against 21 riders in a B.L.R.C. event. They were charged at Malling with riding pedal cycles so as to endanger the life or limb of any passengers on the highway known as Wrotham Hill, in the County of Kent. The charges were brought under Section 78 of the Highway Act of 1835. The riders were defended by Mr. John Bassett, instructed by the solicitors for the B.L.R.C., Messrs. William Charles Crocker. The case was heard on the 1st November, 1947, when the prosecuting counsel, after referring to the defendants as energetic, respectable young men, stated that they were competing in a cycle road race. They were observed to enter the London-Folkestone Road at a speed of from 30 to 40 miles an hour, and in the opinion of the police officers who apparently by design were on "duty" at the crossroads, the riders were driving furiously, and although the riders were not stopped at the time, the various numbers of the riders were taken down and after the race had finished the police patrol interviewed the riders concerned, taking their names and addresses.

The police did not shape up well under cross-examination. P.C. Maynard, when asked why he did not stop the accused riders at the time stated that he had had instructions not to interfere with the race, and he also stated that no one was actually involved in danger. The other police officers gave similar evidence that the roadway was clear at the time and, in fact, "the life and limb of no passenger on the highway was endangered through the passage of the cyclists." That being so, it is all the more surprising that the police brought the cases, and what is even more important wasted the time of 21 defendants and the time of the court.

After a hearing which lasted over 2 hours Mr. Bassett asked the magistrate to stop the case, as it was quite clear that the charge was not based on fact. The magistrates then retired, and returning within a few minutes, the chief magistrate announced that there was no case to answer.

The result of this case must be a severe shock to the N.C.U., the R.T.T.C., and those silly little clubs who think that the affairs of the world revolve around the world of cycle racing.

The police were not too comfortable about the case, as is apparent from the manner in which they gave their evidence. In my view this was an "inspired" case, and I am taking steps to see that the Ministry of Transport and the Home Office are made aware of the result. If the case has done anything at all, it is completely to vindicate the B.L.R.C. and to do great damage to those unsportsmanlike bodies and people who are losing no opportunity in attacking a body which has done more for the sport of cycling than any other. The gnawing pangs of jealousy have, no doubt, been responsible for this and other actions.

If there are any further cases I shall have to see what I can do *ex-parte* to put a period to the activities of these malicious and vindictive-minded people, who are known to me. Anyway, my congratulations to the public spirit in which the B.L.R.C. is defending itself against these oblique attacks from dying bodies.

Legislators

THERE seems to be an impression in cycling circles that if you come from Yorkshire you are a *great cycling authority*, or a *cycling legislator*, or *the greatest living authority on cycling*. I, for one, do not subscribe to these views, and object to the misuse of the term "Legislator," when the term critic or commentator is the correct one to use.

Cycle Maintenance Handbook

A VALUABLE handbook entitled "Cycle Maintenance Handbook," a guide on all matters relating to the maintenance of Raleigh, Rudge, Humber, and Robinhood cycles, Dynohub lighting sets, Sturmey-Archer, gears, etc., has just been published by Raleigh Industries, of Nottingham. It is lavishly illustrated and contains 10 road route maps, a page for recording expenditures on spares and repairs, a weekly mileage chart, gear tables, touring information, sections on the care of tyres and rims, etc.

Demon Cycling Club

THE Demon C.C., the Gen. Hon. Sec. of which is Mr. A. G. A. Wilkes, was originally founded in 1895. It was, however, forced to suspend its activities during the war, but it has now been re-formed. It has a large programme of events, both for road and track during the coming season. The club requires new members. Mr. Wilkes's address is: 88, St. Luke's Road, Holbrooks, Coventry.

B.L.R.C. Scottish Section

THE Scottish section has now formed the completely independent and separate Scottish Cyclists' Union. It will, of course, act in complete unison with the B.L.R.C. English League membership has already passed last year's record.

Readers are asked to note that in compliance with official regulations, the address of James Kain, hon. sec., to the B.L.R.C., has been altered to 39, Disraeli Road, Ealing, W.5; his address hitherto was 24. The change in number is due to road re-numbering.

A new league formation that promises to become one of the outstanding clubs in the Midlands area has just been formed, namely, the Birmingham Premier Road Club.

The club is already preparing a very active programme for 1948, and further information may be obtained from the hon. sec., Mr. R. C. Robathan, of 121, Villa Street, Lozells, Birmingham, 19.

G.P.O. Bicycles

THE G.P.O. had 10,500 bicycles on order, the majority of which were delivered by December 31st, 1947. They had 25,900 in use at the end of June, 1947. In addition to these, 220 postmen are riding tricycles, mostly in rural areas, and experiments have now begun with auto-cycles.

Raymond Blackburn, M.P., at Roadfarers' Lunch

THE guest speaker at the recent Roadfarers' club luncheon was Mr. Raymond Blackburn, M.P., who spoke on the atomic bomb and totalitarianism. He is a brilliant speaker. In spite of the strike at the Savoy, 100 members and guests sat down to lunch under the chairmanship of the club's president, Lord Brabazon of Tara. The Roadfarers' Club is now one of the most important national bodies in the country, and it is representative of all road interests. It breathes the spirit of true sportsmanship and good fellowship. It is free from the intrigues so common in the cycling world. It is unique in that you cannot *join* it: membership is by invitation only, and such invitation must be by unanimous vote of the Committee. Most of the people who count in the cycling world are members.

New Season's Raleigh Models

RALEIGH INDUSTRIES, LTD., recently staged at the Seymour Hall an exhibition of their new season's models The exhibition was opened by the Right Hon. G. R. Strauss, M.P.

There was the Clubman range of Raleigh, Rudge and Humber bicycles, which include the alloy handlebar bend, seat pillar, mudguards and rims, the Dyno-luxe range fitted with either car-type lighting having dry accumulators or with a dry-battery unit, and incorporating Sturmey-Archer three- or four-speed gear and Dynohub in one unit, and the front fork-lock. The new Dunlop "Sprite" tyres are fitted and stainless steel rims are supplied to order. The model which intrigued me most was the Raleigh R.R.A. weighing

The Guildhall
KING'S LYNN
Norfolk
This interesting brick and flint Hall dates from Tudor days. The old town contains many fine buildings, relics of its past importance.

20½lb. It is hand-built by craftsmen, individually produced, and is one of the finest examples of racing bicycles. I was particularly interested in it because I bought one of these machines some years ago and had it stolen before it was even unpacked! The specification includes the extensive use of alloy fittings. It is also supplied as a tourist model with Sturmey-Archer gear, kitbag, and other Raleigh refinements. The weight in this case without the kitbag is 27½lb.

They have reintroduced the Raleigh, Rudge and Humber loop-frame ladies' models.

The double top tube, gents model, is specially produced for certain markets abroad where the double top tube is extremely popular. The balloon tyre models are also produced specially for export markets where abnormal road conditions call for a bicycle with larger section tyres.

There was a complete range of Robinhood bicycles, which is a lower-priced range.

The exhibition included a stand devoted exclusively to service, showing the substantial efforts which have been made by the company to render the maximum service facilities to the public.

Sturmey-Archer Gears, Ltd., showed their products on a separate stand, including a full range of their variable-speed hub gears and hub brakes. The latest innovation is a four-speed wide-ratio hub gear. During the run of the exhibition there was a parade of new cycling fashions for women, the fashions being specially designed by leading fashion experts, sponsored by Raleigh, and presented by the International Wool Secretariat. Sir Harold Bowden introduced Mr. G. R. Strauss, whose speech is separately reported. Mr. George Wilson responded.

Critical B.L.R.C. Meeting

WHEN the British League of Racing Cyclists held their special general meeting towards the end of last year, much criticism was made concerning the League's affairs. As a result a special Emergency Committee consisting of five members was elected to take over from the former national executive committee of the League until such time as a new national committee can be formed.

The suggestion came from James Kain who proposed that the national executive committee of the League as then constituted was not competent to govern the activities of the League in the disinterested and unbiased manner demanded of executive officials. The proposal was carried by 48 votes to 32. Further arguments followed. A vote of confidence was passed in James Kain. The emergency committee of five are J. Kain, hon. sec., E. R. Hickman, W. C. Rains, G. Whittaker, and A. Holmes. A. H. Clark, the League's London section events organiser, A. Groves and M. Peers (winner of the 1946 Brighton-Glasgow race) were nominated but were not elected.

The B.L.R.C. is wise to purge its Augean stables during its formative years. If there is something cankerous in a body, cut it out before it contaminates the whole. There have not been many dissentient voices within the League since one of the founder members found it necessary to resign. Bearing in mind the great opposition to the League by the noisy minority, it has performed marvels and is here to stay.

I do not know full details of the causes which led up to the present change, but

In the lovely vale of Stiffkey. Norfolk
The approach to the little village.

whatever those causes were they have been nipped in the bud. It is a great pity that the N.C.U., which has languished all these years and promoted the myth that it governs cycle sport, did not adopt the same course when some dissident members caused it to abandon its control of road sport and road records. It should have "proclaimed" them. The N.C.U. is fond of legal claptrap.

Model of Sir Walter Raleigh

THE silver model of Sir Walter Raleigh shown at the Raleigh Industries Fair was historically correct in every detail, and is an apt and artistic symbol of the Company's famous products. An attractive touch at the Exhibition was the decorative scheme, which consisted of a colourful display of the flags of the countries to which Raleigh products are shipped, and shields bearing the coats of arms of the towns wherein their main depots are located.

I was interested, too, in the original Humber tricycle used constantly by King Edward VII, and which was shown on the tricycle stand. There was also an interesting etching showing the many contemporary royal and other distinguished cyclists who ride Humber machines.

Road Accidents: October, 1947

TOTAL road casualties in October were 499 killed and 14,155 injured, including 3,311 seriously. Compared with October last year, there was an increase of 27 in the number of deaths, and of 405 in non-fatal casualties. Records show that October is generally a worse month than September for road accidents. This year there were 24 fewer deaths than in September.

Fatal accidents were highest among pedestrians. The total of 244 for October included 78 child pedestrians, five fewer than in October last year.

Of the total of 91 children killed from all causes during the month, more than half were under seven years of age. Eleven were two-year-olds. Two children were killed while riding scooters. One of the child cyclists killed was only four-and-a-half years old.

The following is an analysis of the number of deaths according to the type of vehicle primarily involved, although not necessarily responsible:

Type of Vehicle	Number of Deaths
Service (U.K. and Allied)	5
Public Service and Hackney	85
Goods	102
Private cars	115
Motor-cycles	100
Pedal-cycles	76
Others	15
Total ..	499

Wayside Thoughts

By F. J. URRY

Chale
Isle of Wight
The weatherbeaten old church overlooking Chale Bay

Why Grouse?

PEOPLE are apt to be depressed because of the pressure of restriction, but surely that is the wrong way to meet a national—indeed a world—crisis, and overcome it. Nor do I think folk are helping to create in us the proper spirit by talking down the conditions, and suggesting the situation would have been better under other direction. The troubles can only be cured by work and the will to succeed, and thankfulness for our present blessings—and they are still many—and the full enjoyment of the leisure we have in simplicity. We have become spoilt during the last few decades by too many amenities, and if we are wise we shall learn again how to make our own fun, and get more enjoyment out of the process than having it made for us. How fortunate we cyclists are is being generally acknowledged; at least that is what I am told by a host of friends whose self-pity I am sometimes inclined to laugh at because I know it is the result of laziness, and that rather curious attitude towards cycling, suggestive of a mode of transport that "really, you know, is not done." Personally, I am very thankful to possess a bicycle, and so I imagine are millions of people, for it gives to them and me a freedom of movement within decent limits of distance that will keep us active, healthy and satisfied. What a chance to boom the bicycle! But, unfortunately, the limited quantity available even at present prices will not be able to greatly extend the pastime, for export will absorb most of the output, and the home trade will be short of machines and replacements. It is not a happy prospect, but at least we are warned, and if we are wise will see to it that our cycle property is put and kept in the best order possible, at once, while the going is as good as it will be in 1948.

Worthy of Notice

CYCLISTS as a rule are rather a careless tribe, nor do I consider myself outside that criticism. I suppose it naturally followed that when things were easily obtainable we slipped into careless habits and were neglectful of our property. During the war years and since, I have been cured of that failing to a very considerable extent, for not only did I find—like all the wheeling folk—that supplies were limited, the best of products extremely scarce and in many cases quite unobtainable, but the rise in costs made me understand how valuable a good bicycle had become. Because we are certainly in for another period of short supplies, and still greater difficulty in obtaining first-class machines, it is only the wisdom of the veriest novice to take greater care of his vehicle, that silent friend, to give him convenience of travel and the pleasures of carefree holiday roaming for thousands of miles, when so many other folk are tied to a time-table, stand in queues and travel expensively and often uncomfortably. I do not desire to exaggerate the value of cycling, but it is difficult not to express a conviction that to-day, it is the finest adjunct to active living. I have always thought so, and in carrying out my convictions have enjoyed life and largely escaped the many restrictions placed on other people, or self-imposed. Of this I am certain, that if the majority of people were cyclists, and would learn the fine arts of the pastime, they would be happier and more contented individuals; and on that proposition I speak from long experience, and with no little knowledge of the other great travel vehicle whose appeal to ease has always brought to me a sense of growing old and a definite loss of individuality. Cycling just for cycling's sake I have outgrown years ago; but cycling as an expression of individuality and freedom, of conscious, unhurtful activity and the means of establishing and preserving health, yes, every time, and I shall go on doing it as long as my muscles obey my mind.

A Good Lamp Needed

AND now I suppose we shall have to wait for a long while before some maker gives us battery lamps that won't rust up and corrode when, probably carelessly, we leave the batteries intact in them during the summer season to discover the containers are "gummed up" and useless when we need them to light us on our way. I am aware that we should not be so unwise, but most of us are, perhaps for the reason that we may want a glim to see us home after the summer twilight has faded. The cure, of course, is to fit a dynamo, but as I have said many a time I do not welcome working for my lights or carrying around unnecessary weight when I know it will not be needed. The battery lamp is popular because it is easy and fairly cheap; but how much easier and how little more expensive it would be if made sturdily from brass sheet instead of tin plate or thin aluminium. We had the brass lamp in the early days of the battery, and I believe if it were marketed again it would be popular with the regular night riding cyclist. For it lasted, as I know, having used one of the original Ever Ready lamps, through five winters. Now it seems to me I need a new head and tail lamp every year, due perhaps in some degree to personal neglect; but my point is that such human failing could very largely be overcome if we were given the opportunity of buying the better article.

Joe Millar, of the Angus Cycling Club, who recently won the Dundee Law Hill Climb for under 18-year-old members. He also won the 50-mile handicap and carried off the Championship Cup and Medal, the Clive Handicap Trophy First Handicap, and the Club Standard Medal.

The Long and Short Term Cures

IT has been truly said that the real cure for road accidents is not more controls but the making of proper roads to carry the ever-growing urgency of the traffic. Many of us have seen this necessity for years, but authority has jibbed at the capital expenditure the change would involve. Now we have all got to wait until we can afford the luxury of modern roads. While the ban on petrol remains that will not matter much, but immediately petrol supplies are released the overcrowding and, in consequence, the impatience which is the starting point of most accidents will begin again. To make a plea for great sums of money to be spent on the roads at a time when the country is passing through a difficult period is waste of breath, but as a road user on most days of the year I do seriously ask for the exercise of better and kindlier manners, particularly when the traffic is heavy at knocking-off times. This plea is to both drivers and riders to exercise a little patience and forbearance, and to avoid risks that so easily lead to disaster. For the sake of saving a few seconds on the home journey I have seen many a foolhardy happening and not a few accidents. A very little consideration would alter these risks and cut down the painful results of them, and since we cannot have the roads modern conditions need, we should exercise the manners that will make the present ways safer. We do not want further controls or restrictions, but they will inevitably be imposed unless manners improve. It is up to each of us to realise these things, and surely it is far better to be decent to one's fellow-travellers and reasonably safe than to practise an intolerance that can be controlled if the goodwill exists to be proper citizens.

Growing Consciousness

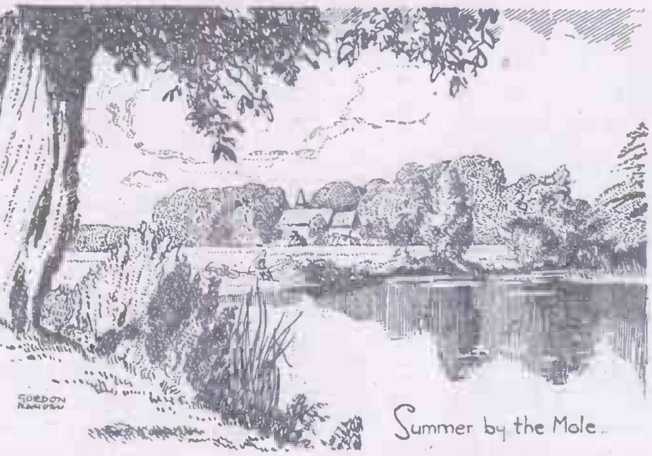
IT is a pleasant thing to get letters from numerous old cyclists asking advice on the type of machine I think would suit their years and activity, for it is proof that many folk are still wise enough to keep on riding, even when they are rich enough to use the other common means of locomotion. These inquiries came along before the cancellation of the basic ration, so it isn't a question of substituting the bicycle for the car in the cases under review. What will happen now I do not know, but if, as I suspect, my corresponding friends want to know where they can buy the best with a short description of my notion on a bicycle's constitution, I shall not know where to advise them to go, even if the latter part of the information is easy to give. Both small and big makers are finding it increasingly difficult to obtain the best materials from which to make the higher class of machines, and as far as I can see the situation will not improve for many months. Yet with all the supply troubles with which the manufacturing industry is faced, I am glad to know more and more people are becoming conscious that to enjoy the best of cycling the instrument for such enjoyment must fit the individual, be constructed with the highest craft and from the best possible material. Education in buying is certainly on the increase and I predict that when times become more normal the call for the good bicycle will be far greater than the industry generally supposes. People are beginning to ask themselves why so-and-so seems to ride so easily, and many of them are keen enough to write for the information, which construed into the shortest space is to buy the very best you can afford, gear moderately, and be sure that the whole ensemble fits.

The Best of It

I WAS riding across a busy city the other day, holding my place in the traffic stream and gaining a car's length occasionally when a head popped out of a window and said, "Do you ever stop cycling?" I did not know the speaker by sight or name, but evidently he had seen me knocking around for many years, and laughed at my prompt reply: "Not if I can help it." And thinking the incident over in tranquillity, those six words sincerely explain my mental and physical attitude to the pastime. I am happy on a bicycle even in the press of traffic, when I seem to feel individuality more than ever, a sense of separation that makes me self-contained, safe and satisfied. Out on the open road and in the lovely places this personal sensation of well-being is more absorbed amid the enchantments of the changing scene, for then you are first part of the mighty scheme of things and your own littleness is an invitation to enjoy the greater glory of creation.

My Point of View

By "WAYFARER"



Summer by the Mole.

Looking across the river to the little church of STOKE D'ABERNON. A treasure chest of monuments & brasses, including the brass of the first Sir John D'Abernon – the oldest in the country dated 1277.

Memory-provoking

ONE of the newspapers from which I draw my daily inspiration (!) proved to be very memory-provoking a week or two ago by its action in reprinting a hundred-year-old paragraph telling of the voyage of Queen Victoria and the Royal Family from Fort William to Crinan, en route for Fleetwood, where the London train was taken. Back went my ears and out came my Scottish maps, so that the places could be picked out and the route followed. That, of course, was not the end of the matter, because what I saw provoked me into exploring the adjacent maps until my den was littered with that delicious brown that represents the west of Scotland in the cartographer's mind. The ancient paragraph, in the case of a non-cyclist, was just a paragraph. In the eyes of a touring cyclist who adores "Caledonia, stern and wild" it was a lot more than that.

Scotland—and Ireland

THE foregoing mention of Scotland reminds me that I was disappointed this year in not being able to get across the Border, just as I was peeved because of my failure to visit Ireland. Both countries will wait, and nothing will be lost by their waiting, though I am very anxious to pay "welcome return visits" as soon as possible in order to see again all that I have previously seen and to find "fresh worlds to conquer." From the evidence in my possession everybody who has been lucky enough to go to Scotland or Ireland has had a thoroughly enjoyable time. Here are two selections from correspondence: "My friend and I had a wonderful time in Scotland, and really had our fill of hot, sunny weather. We cycled from Inverness along Loch Ness and through Glenmoriston to Skye, where we spent a week exploring. We received no end of kindness from crofters and others, who rowed us across lochs and gave us new-laid eggs, etc." "I am back from dear old Ireland and cannot say how much I enjoyed my holiday there. It was a wonderful trip, and I would certainly like to go again. The scenery was absolutely beautiful. The lanes were perfumed with honeysuckle, meadow-sweet, and new-mown hay. The fuchsia hedges and wild flowers were a picture. In fact, we were charmed with everything." Practically everybody who goes to Ireland for a holiday says the same.

Side-stepping the Facts

AN enterprising firm of retail traders in a provincial town ran an exhibition in the cause of road safety, with the aid of the Royal Society for the Prevention of Accidents, the police, etc. Superficially, it all sounded to me like a jolly good scheme, but some of the subsequent publicity raised doubts in my mind. This publicity, in rather clumsy English, made reference to the "appalling" accident figures and recorded the well-known fact, which is not always appreciated, that "railways were especially built to carry loads at speed." Then there came the strange statement that "our lovely highways . . . twisty, narrow, or broad . . . finding their ways through villages or towns built higgledy . . . have to carry burdens at speeds in fantastic numbers unimaginable to Mr. George Stephenson. . . ."

I do not think that the advertisement-writer intended to say precisely that, but anyhow, it may be pointed out that there is no "have to" about the use of our roads at unsuitable speeds. As is usual, the root-cause of the "appalling" accident toll is side-stepped. Speed in the wrong place is the cardinal fault, and it appears to me that speed is inexcusable when the existence of roads "twisty" and "narrow" and negotiating "villages and towns built higgledy" is recognised and admitted. All efforts to reduce the number of accidents are doomed to failure until fundamental truths are accepted.

Bad Start

I MADE a bad start in the current lamp-lighting season. When I switched on my rear lamp the brand new battery, bought a week before and not previously used, proved to be dead. Simultaneously, the front lamp battery, which was in a dying condition, decided to expire, leaving me with a three-mile walk home! Having thrown away the new battery, I retrieved it and, finding it bore the maker's name (an unknown one so far as I was concerned), I have written and told him where *he* gets off!

Holiday Methods

IT is right and proper that there should be varied ways of spending holidays. For one, the "life" of Blackpool; for another, the peaceful pursuit of fish in an Irish stream; for a third, the serene and constant movement of a cycling or walking holiday. Everybody to his taste, one man's meat being another man's poison. For my part, I have yet to find anything that so completely *makes* a holiday as cycle-touring. It is a thing complete in itself, and yet it may be mixed with walking, fishing, photography, boating, swimming and a dozen other pursuits—while there are actually people who include patronage of "the pictures" in a tour!

In the matter of holidays I am a purist, or it may be that I have a one-track mind. Anyhow, all I want is cycle-touring—the actual riding (and hill-walking, at which I am very good!) with its concomitant of leaning on gates and looking at views. That, to me—with suitable (and simple) night accommodation, and suitable (and simple) meals along the road—provides complete contentment. Nor can I imagine that there is any better form of holiday.

Apropos, I see that somebody has been writing to the newspapers to tell of the unsatisfactory holiday he had. "I walked along the sea-coast of Kent and Sussex, but do not advise anyone to follow my footsteps," because, except for one or two open spaces, he found that London is joined with Portsmouth by a system of ribbon buildings consisting of bungalows, caravans, old railway carriages, etc., with barbed wire and concrete blocks galore. So much for not "using your head"! To my mind, that holiday method is all wrong. How different is the case of the son of one of my neighbours who went off to Scotland for a month, armed with £5. He hitch-hiked there and hitch-hiked back (three lifts each way); he lived and slept rough; he lost a stone in weight and grew a beard. But what a holiday! What romance! What originality! What a sense of adventure! That's the holiday method I prefer!

Leading the Lads

ON the last Sunday in September I participated in the annual "social" run of one of the cycling clubs which claim my support and, after lunch, I was suddenly promoted to the status of leader, being requested to take the boys for a run which would fill in the afternoon, bringing them back to the lunch-place for tea. After a spot of quick thinking I decided on my plan of action, leading the party over a short quarter-mile of main road which could not be avoided. Then we took to our heels along secondary roads and lanes, which twisted and turned so frequently that the party was soon "guessing" as to their whereabouts. Then I opened a gate and led the gang through a succession of some eight fields, bringing them to a little river which was about 400 yards from another main road. Turning away, we stayed in the lanes, jerking hither and thither. As we began to run out of time, I said: "Just one more detour," and swung along a rough farm track through a farmyard and along some more rough track. Hitting a main road at right-angles, I cried out: "Straight across. One positively final detour," and this time I meant it. We climbed up to the highlands and then dropped back again, to meet our original main road exactly opposite the point at which we had left it two and a half hours before. We scampered along the remaining quarter-mile and found ourselves quite ready for tea, with 22 miles on the tally. Altogether, it was a most enjoyable afternoon, and the boys were unduly grateful to me for putting it across them and getting them so completely and thoroughly lost.

Real Progress

I WAS thinking the other morning about my early cycling days when, greatly daring, I decided that it would be pleasant to ride without any head-covering—thus setting a fashion which has spread far and wide, with (no doubt) mildly disastrous effects on the hat and cap trade. It was a revolutionary decision in those days, over fifty years ago, and it provoked many an inquiry as to whether I had lost my hat—or 'at! Nowadays this bareheaded appearance calls for no comment, and it is to be imagined that the men and women who dispense with headgear far outnumber those who prefer to remain "respectable." I still know two or three men who would not go out, even on a Bank Holiday, in anything but a bowler hat.

As I thought over these things I recalled that certain old photos of cycling clubs would reveal that at one time caps were looked upon as being as essential a part of one's wear as shoes and stockings. And then, by a coincidence which really is curious, I called at a cycle shop to have a tiny job done to my bicycle, and the man said: "Oh! I've got something to show you." He drew from his desk a faded photograph of a Sunday morning club group taken outside the Stonebridge Inn (as it was then called)—it has now been pushed into the hotel category—in 1890, 57 years ago. Apart from four of the company who were wearing bowler hats, every man-jack in that company had a cap on!

Sometimes I think that the world is "progressing" backwards. In respect of cyclists' headgear, however, we have gone forward.

Sad Tidings

IT is very sad for those of us who live in the Midlands to observe that the water-splashes, in Warwickshire, at any rate, are steadily disappearing. These wet places have always been a great feature of the county named, and I recall the joy which I experienced long years ago at the sight of little rivers wandering indiscriminately over the road. A flimsy wooden bridge was provided for foot passengers, while wheeled traffic took its chance in the tide. Woe betide the cyclist who was caught in the act of riding over the bridge!

One supposes that these water-splashes are being done away with in the interests of modern traffic developments. I wonder! Such action might be justified at Kenilworth, but how can the process of roofing-in be justified in the case of one particular ford which is in my mind? Remote from busy highways, access is secured by means of a steep, narrow and rough lane, which, it might almost be said, "leads nowhere." Periodically I delight to splash through that tiny river, but now, at long last, its secret has been revealed. The hand of "Progress" has fallen upon it, and the water has been provided with a concrete lid. Who benefits? Frankly, I do not know. The river was such a simple proposition that it never harmed anybody, even in the winter, but it has now been "made safe," and one more picturesque feature of the Warwickshire countryside has gone west. As I say, it is very sad.

Since writing the foregoing, I have visited Warwickshire's largest surviving water-splash, only to find that that, too, has been "attended to." Here, however, the flow of water has been interfered with only to the extent of laying down a concrete bed, which will certainly be advantageous to motor-car folk, while reducing the "fun" which motor-cyclists found in connection with their endurance trials.

Hope

RECENTLY, when retrieving two of my gas lamps from the factory where they had been re-conditioned, I casually inquired as to the possibility of new lamps of this type being made. Quite frankly, I felt that the position was hopeless, but the reply I received constituted a very pleasant surprise. I was told that, while no manufacture was going on at the moment, owing to conditions which hardly call for explanation, a definite demand for gas lamps was being experienced. Thus there are good prospects for those of us who cling to carbide.

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