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NEWNES

PRACTICAL MECHANICS

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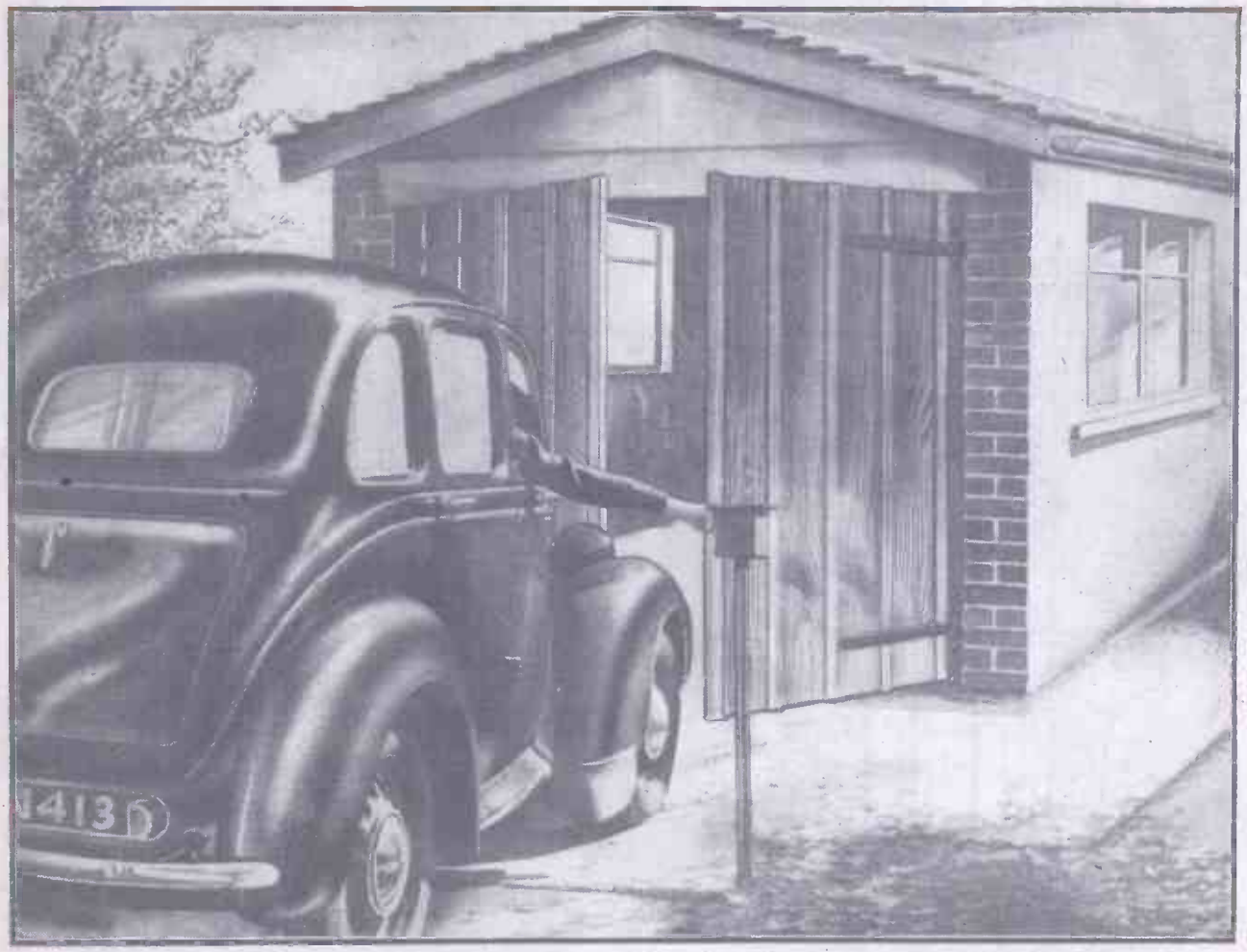
EDITOR : F. J. CAMM

JUNE 1948



ELECTRICALLY-OPERATED GARAGE DOORS. FOR CONSTRUCTIONAL DETAILS SEE PAGE 288

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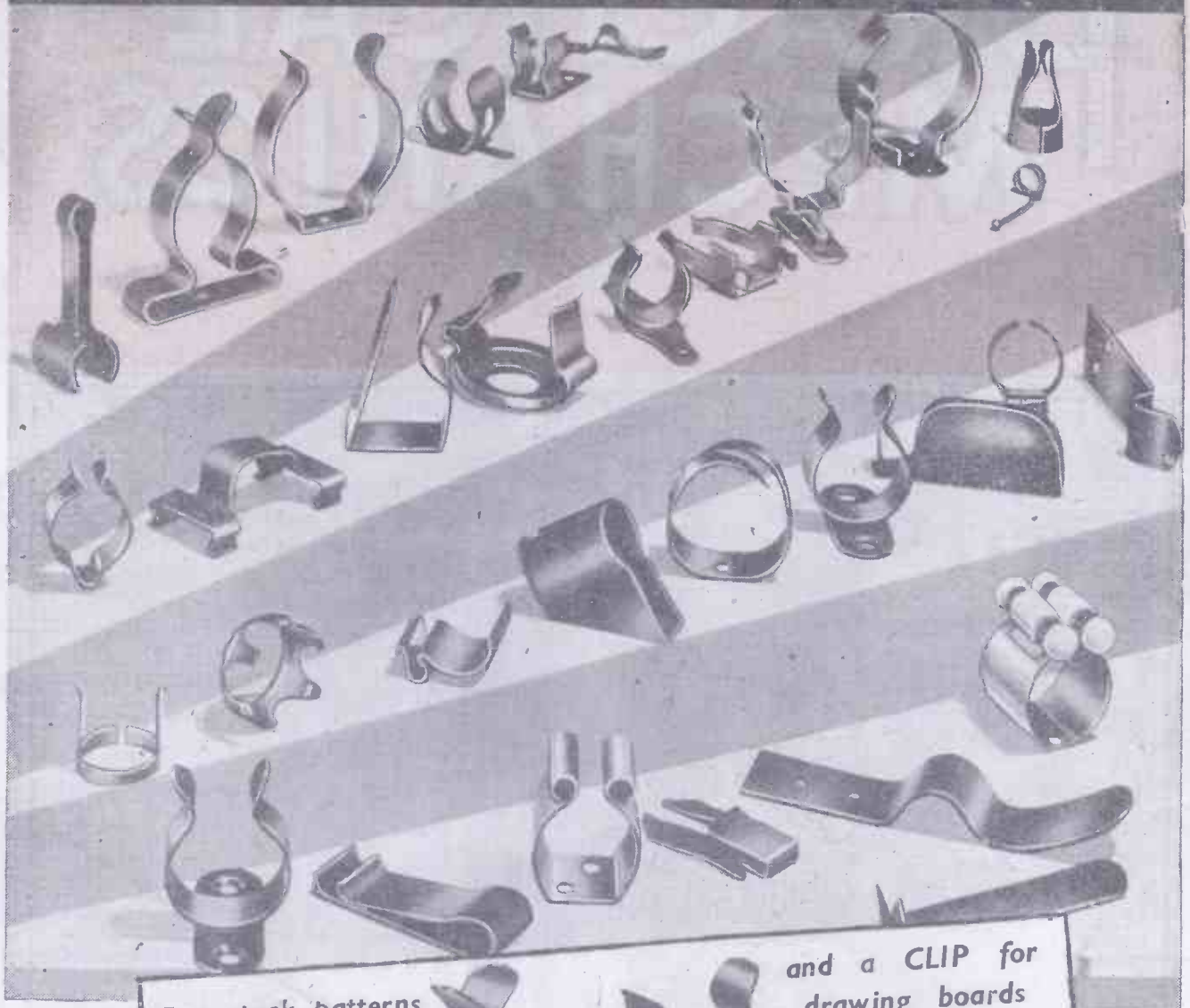

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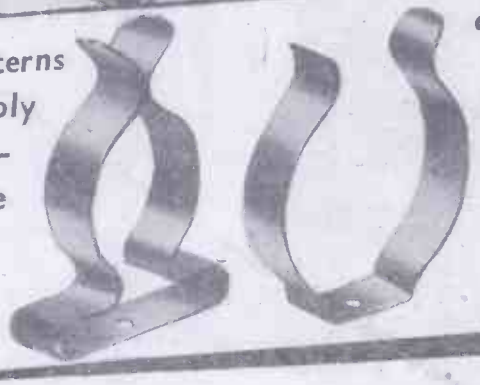

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XV JUNE, 1948 No. 176

FAIR COMMENT — BY THE EDITOR

The Development of Inventions Bill

THE Government has recently introduced the Development of Inventions Bill, and its object is to remove some of the obstacles to the development of inventions.

The matter was recently debated in the House of Lords, when several speakers stated that there were far too many cases of inventions being put into cold storage because they cut across the vested interests of powerful corporations.

The zip fastener was quoted as an example. Although this was invented in 1879 it was successfully suppressed by the button-making industry, and it was not until World War I that it came into general use, because it was needed for ammunition carriers.

The Lords entered a strong plea to free the genius of the British people and to allow the unrestricted development of inventions because this, more than anything else, will assist in placing Great Britain in the forefront of the world of commerce.

The inventor seldom makes anything more than a pittance out of his invention, and this applies to many inventions of world-wide use. An inventor may spend many years developing an idea and a considerable sum of money on patent fees. Unless he is successful in selling it, quite often the patent is allowed to lapse, when it becomes anyone's property.

To-day a successful inventor has to pay a considerable sum in taxation. If an inventor, or the owner of a patent, sells it for £5,000 the State receives £3,362, and the inventor £1,638; if it is sold for £10,000 the inventor gets £2,463 and the Government £7,557. If for £50,000 the Government takes no less than £46,262.

Something ought to be done to encourage the inventor. His ideas provide work and trade, and it may be only once in a lifetime that he strikes lucky by selling an invention. He may have spent considerable sums on unsuccessful inventions which cannot be offset against the successful one. This is manifestly unfair and a discouragement to those who could so considerably add to our invisible exports.

Foreign Manufacturing Rights

ATTENTION is frequently drawn in Parliament to the great benefits which result from the sale of inventions and of foreign manufacturing rights. If the inventor is to receive a sum of money on paper only he is unlikely to exert himself in promoting overseas interests.

New Orders made under the Trading with the Enemy Act, 1939, it is announced, carry a stage further the relaxation of the Trading with the Enemy Restrictions as they affect Germany.

Although these restrictions relating to Germany have already been relaxed to a limited extent by previous Orders, persons in Germany have hitherto been precluded from taking steps in the United Kingdom to apply for the grant of a patent or the registration of a trade mark or design. As from April 8th last, however, transactions are permitted with persons in Germany in connection with the submission by them of such applications. Transactions in consequence of any such patents granted or trade marks or designs registered will also be permitted; but moneys accruing from such transactions will not be subject to Board of Trade or Custodian Control.

As we are being generous with the Germans, surely the State can at least be equally generous with English inventors. Of course, these Orders do not affect the position of German-owned patents, designs or trade marks, granted or registered prior to the date of the Orders. These remain under Board of Trade and Custodian Control.

The Patent Office machinery needs to be overhauled and re-organised. At present it is altogether too slow. Its charges should be reduced because many good inventions lapse owing to the fact that the inventor cannot afford to pay renewal fees. Once a patent is granted the inventor should be entitled to full protection for the full period of 16 years, and it should not need to be kept alive by annual payments. One lump sum upon the grant should be sufficient. The Patent Office has no claim to a 16 years' interest in a patent.

Clearing House for Inventions

WE require in this country an organisation similar to the Mellon Institute in America. This acts as a clearing house for inventions. It decides whether an invention is patentable, whether there is likely to be a market for it, and it develops the idea, deducting a small percentage for its trouble. It should be possible to have a patent either granted or rejected within a month. At present it takes about two years.

The acceptance by the Patent Office of a Provisional Specification is not an assurance that a patent will be granted. Indeed, there is no assurance when the Complete Specification has been accepted by the Patent Office that the patent is good. It can be challenged in the Law Courts, and a judge has power to set it aside. An inventor may, therefore, find himself embroiled in costly litigation before he finally establishes his right to exploit the patent for the full period of its life, namely, 16 years.

The Late Percival Marshall

IT is with sincere regret that I have to record the death of my old friend, Percival Marshall, founder and editor of the *Model Engineer*. We had both for many years been connected, though independently, with the technical side of journalism, and although to some extent we were rivals we maintained a close and friendly association over a long period of years. Indeed, I was a frequent contributor to some of the early numbers of the *Model Engineer*. He was responsible for the successful organisation of a long series of exhibitions of the work of model makers, and he also wrote a number of technical handbooks.

He was known the world over, and technical journalism has suffered a great loss by his passing. He was, of course, the father of Howard Marshall, the well-known radio commentator.

Percival Marshall, Bassett-Lowke and I often lunched together and discussed model-making, mechanics, the latest scientific discoveries and journalism in general. I shall miss him.

The First Gas Turbine Engine

AT the B.I.F. in Birmingham was shown the first gas turbine engine for use in commercial vehicles and motor-cars. Within three years this will be developed to the point where it will replace the existing piston engine. It will radically alter motor body design. It was understandable that when live horses were replaced in carriages by mechanical horses, the engine should be placed where the horse was, namely, in the front of the vehicle.

This has meant a complicated transmission gear between the engine and the back axle, for most cars have rear drive. A few cars have been produced with the engine over the back axle, but they have never been popular. The present engine weighs 250lb. and develops 160 brake horsepower, equivalent to a normal 35 horsepower engine. It will run on any kind of fuel, and although primarily designed for diesel oil it will run on petrol, paraffin, coal dust or, in fact, anything which will burn with a continuous flame. It has no valves, pistons, crankshafts or connecting rods. There is, indeed, little to go wrong.

F. J. C.

Electrically-operated Garage Doors

How the Job Can be Successfully Carried Out by Using a Small Motor from Government Surplus

By A. R. TURPIN

Operating the switch without leaving the car.

OPENING garage doors mechanically is not new, and although the idea of sitting in one's car on a rainy night and watching the garage doors open by themselves so that one can run the car straight in is very attractive, it has usually been dismissed, at least by the writer, on account of the expense involved.

With the event of the flood of Government surplus upon the market, and the opportunity of obtaining expensive apparatus at scrap prices, one is apt to review many discarded ideas, and when the writer was offered a beautifully-made 24-volt electric motor, complete with a train of reduction gearing, overload clutch, electric brake, and automatic cut-out switches for less than a pound, he immediately clinched the bargain and the vision of self-opening garage doors came measurably nearer.

It was with some trepidation that the thrust was tested, as the motor seemed so small for the job, but when it is considered that the gear reduction is about one thousand to one, and that the apparatus was designed to open aircraft radiator shutters against an air velocity of 300 m.p.h., it is not surprising that it did stand up to the job.

The Motor Unit

In Fig. 1 two views of the unit are given, that on the left with the switch cover removed. The motor itself is of the small series-wound type, having two field coils wound in opposite directions, and both stator and rotar are built up from laminations. On A.C. it runs well on 30 volts and takes about 1½ amps. The armature windings are shunted by a coil of resistance wire housed in a metal capsule on the side of the motor housing; this is normally used as an inertia brake.

Cutting out this resistance greatly increases the power output, and this can easily be done by prising off the capsule cover and cutting through one of the turns of the coil. This load is replaced to some degree by a further piece of apparatus of which more is said later. The spindle runs on ball bearings, and has a single start worm cut directly on the end of it. This worm meshes with a fibre wheel mounted on a shaft which incorporates the overload clutch and a second gear which in turn meshes with a train of gears which terminate with a 90 degrees quadrant. On the shaft of this quadrant is mounted a contact arm (see Fig. 3) which can be made to operate two pairs of contacts, and also on the same shaft is a small arm which is used to connect up the operating levers of the doors.

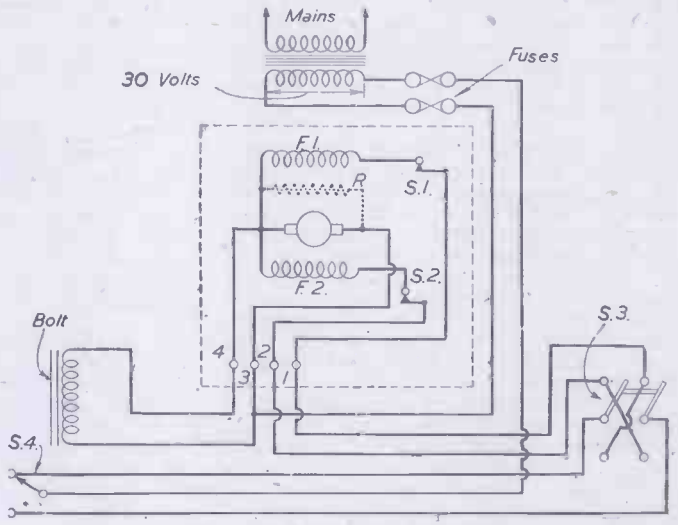


Fig. 2.—Diagram of connections.

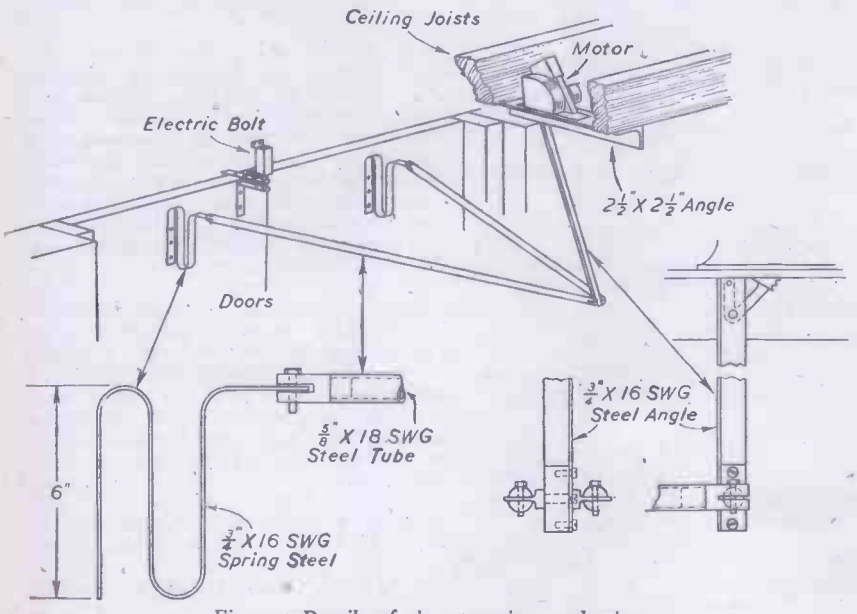


Fig. 1.—Details of the operating mechanism.

Electrical Connections

The electrical connections are made via a four-pin plug, the pins of which are numbered as follows: No. 1 goes to one field coil and No. 2 to the other. No. 3 is connected to one commutator brush and No. 4 goes to the other brush and the other ends of the two field coils. It should be mentioned here that the connections to the field coils from pins 1 and 2, do not go direct to the field coils, but via two pairs of contacts. In Fig. 2 that portion of the wiring diagram contained in the dotted square is contained in the apparatus itself.

It will be seen, therefore, that if a power supply is connected to, say, pins 1 and 3, the armature will rotate and will continue to do so until the contact arm opens the contacts at the end of its arc of travel, when the circuit will be broken. If the connection going to

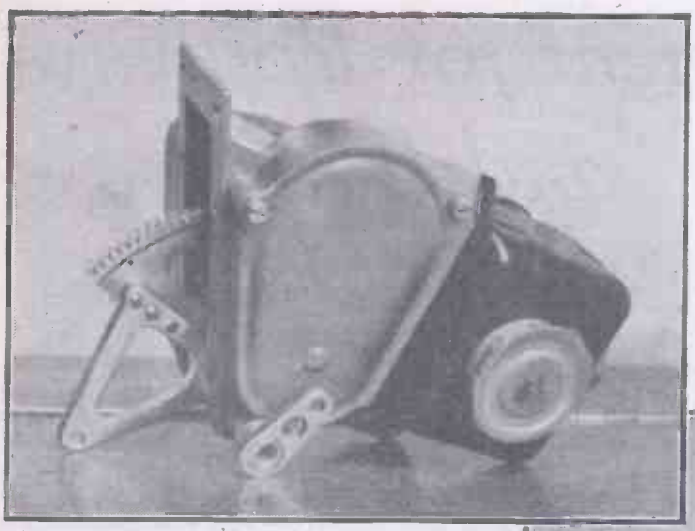


Fig. 3.—Two views of the motor unit, one with cover removed.

pin 1 is moved to pin 2, the motor will commence to rotate again, but this time in the opposite direction until the contact arm opens the contacts at the other end of its arc of travel.

It will be appreciated from the foregoing, that if one lead of the power supply is connected through a single-pole double-throw switch to pins 1 and 2, the motor can be made to rotate in either direction, and it will cut itself out when the quadrant reaches the end of its travel. If now we connect the quadrant via a series of levers to our garage doors we can open them at will by throwing over the S.P.D.T. switch and close them by reversing the process. If we add a second switch, which not only changes the connections to the field windings, but also reverses the connections to the first switch, we shall then be in a position to open the doors from either inside or outside the garage. This second switch will have to be of the double-pole double-throw type.

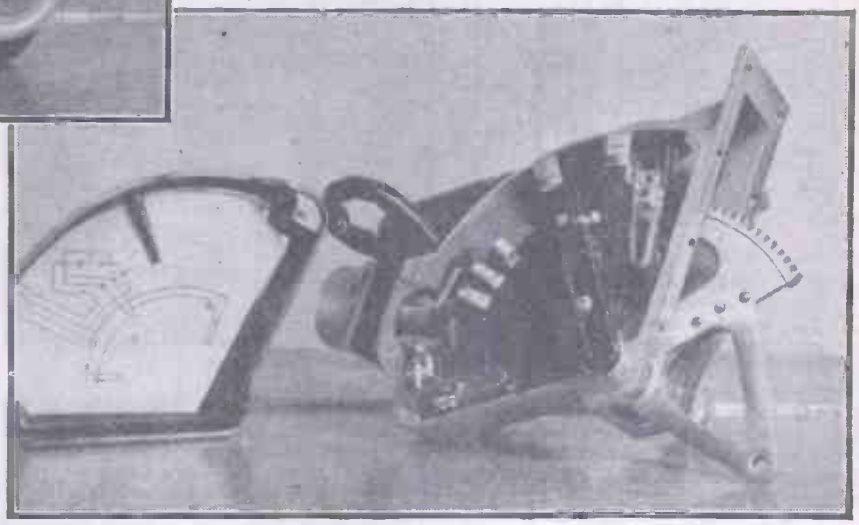
To prevent damage to the apparatus, which is extremely light, some kind of positive locking device is advisable, and this may comprise an electric bolt automatically operated by a solenoid wired-in shunt with the armature in place of the braking resistance that has been cut out. The complete wiring diagram is shown in Fig. 2.

The actual arrangement of levers to open the doors will depend to a great extent on the way the garage is constructed.

It is important that the doors should open freely and the hinges be kept well oiled. It is recommended that a scale drawing be made and the various promising arrangements tried out on paper first. The writer's own arrangement is shown in Fig. 1.

Mounting the Motor

As the joists of the flat roof were 2ft. above the top of the door the motor was mounted between them. A length of 2½in. steel angle iron from a Morrison shelter was used to mount the motor on. A slot was first cut in the required position by drilling and filing for the quadrant lever to pass through. The fixing holes in the motor baseplate were then carefully transferred to the angle, and drilled 4B.A. clear, other holes to take the necessary wood screws being drilled at either end for fixing to the joist.



A second hole was drilled and tapped 4B.A. in the quadrant lever about 1½in. above the existing hole and a 24in. length of 1in. × 16 S.W.G. dural. angle (steel will do) was bolted to it. Fixed to the other end of the dural. angle is a piece of mild steel, 2in. × ⅜in. × ⅜in., and passing through this is a double-ended shackle bolt (see right-hand details drawing, Fig. 1). The ends of this shackle bolt are connected to two rods about 4ft. 6in. long and these may be angle, or preferably ⅝in. diameter 18 S.W.G. steel tube; when connected to the doors these rods form a "V."

It is important that one door should always close first, this being the door with the rebate on it, and in order to do this one of the connecting rods is made about an inch shorter than the other. It is obvious that if the rods were connected directly to the doors as soon as the first door came up against the jamb the motor would slip its clutch, leaving the other door slightly open. To overcome this and to allow some flexing at the joints, the rods are connected to S-shaped springs made from ¾in. × 16 S.W.G. spring steel by means of a 2B.A. bolt. The holes are all clearance holes so that the bolt may be pulled out, and the doors opened manually if desired (see left-hand detail, Fig. 1).

Should there be insufficient head room to accommodate the motor above the door, as in Fig. 1, it may be fixed on its side with the actuating lever in the horizontal position, but if this is done some kind of horizontal support should be given to the lever, and this could be a rod attached to the ceiling at either end on which the shackle bolt end of the lever could slide.

Details of the electric bolt are given in Fig. 4, and as this is wired in shunt with the armature the impedance should be kept as high as possible so that too much power is not taken from the motor, and in order to do this it is advisable to counterbalance the moving core, and use pole pieces to increase the flux.

The solenoid bobbin consists of a 3in. length of brass tube, ½in. outside diameter, and 5/16in. inside diameter. To the ends of this tube are soldered two cheeks of ½in. brass, bent to form the fixing brackets as well. A saw cut is made through both the cheeks and the tube to prevent eddy currents. The number of turns required to give a positive lift will depend on the workmanship of the job; 700 turns of 26 S.W.G. enamelled wire should be about right.

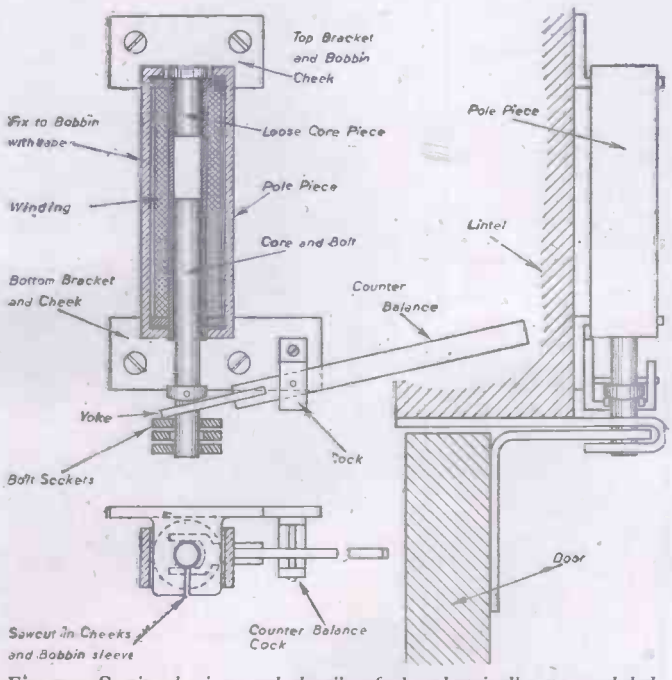


Fig. 4.—Sectional view and details of the electrically-operated bolt.

Transformer Details

As the motor is used intermittently, and on A.C. a higher voltage than that rated for D.C. can be used, and the writer wound his transformer to give about 36 volts. Now 36 volts can give a person quite a nasty kick if the recipient is standing on wet ground and with wet feet, so see that the insulation of the outside switch is of the best. It can be mounted on top of a steel post so that it is easily reached from the car window, and the metal tumbler of the switch earthed via the steel post.

To prevent unauthorized use of the switch it can be arranged so that the bolt of an

(*Continued on page* 304.)

Improved Equipment for Railways and Tramways

New Truck Units and Control Gear Developed by Crompton Parkinson, Ltd.

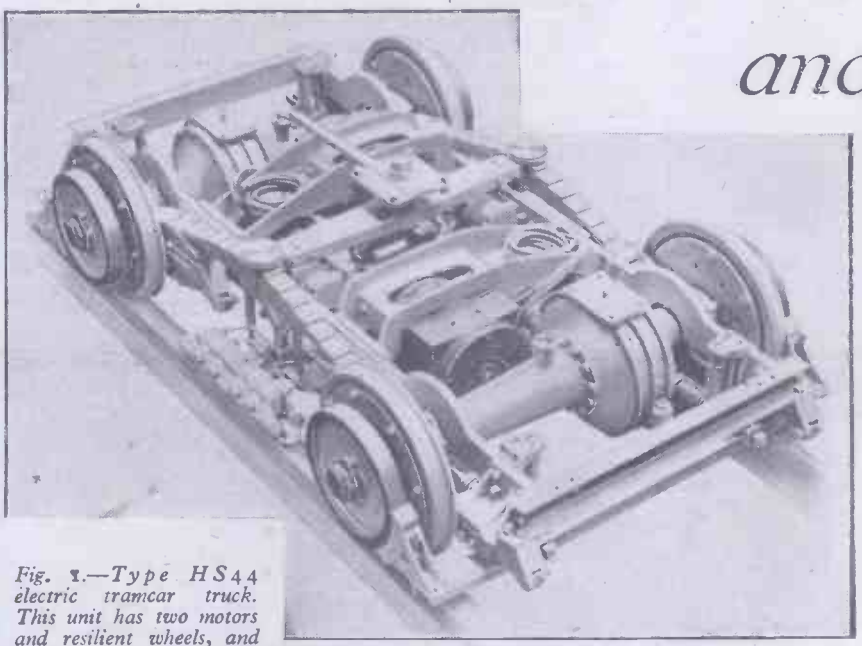


Fig. 1.—Type HS44 electric tramcar truck. This unit has two motors and resilient wheels, and brake drums mounted on the end of each axle.

TO meet the demand for railway and tramway vehicles with improved characteristics, such as higher schedule performance, quieter running, better riding, and greater passenger comfort, a new class of equipment is now available from the Traction Division of Messrs. Crompton Parkinson, Ltd.

The complete equipment comprises truck units of the American P.C.C. type (the exclusive British licence was acquired from the Transit Research Corporation, U.S.A.); and "Vambac" control gear, evolved by Crompton Parkinson, Ltd., as a further improvement on the P.C.C. developments in the United States.

Compared with standard types, the advantages claimed for the new equipment are: Higher accelerations, balancing speeds and braking rates; negligible noise and vibration; maximum permissible weight reduction; superior body and truck appearance; and lower first cost, due to standardised design and improved production methods.

The truck units and the electrical equipment are designed to be applicable, with a minimum of modification, for three basic types of car; single-deck bogie cars operating singly or in multiple unit; double-deck bogie cars; and single-deck cars hauling trailers.

Specification of Trucks

The type HS44 truck, shown in Fig. 1, manufactured by Maley and Taunton, Ltd., in collaboration with Crompton Parkinson, Ltd., is available in several models, distinguished by having either resilient or solid wheels, worm or spiral bevel gears, and by different brake arrangements. It is suitable for double bogie, single-deck or double-deck cars weighing approximately 20 tons full loaded, and for gauges of one metre, 3ft. 6in. or 4ft. 8½in.

The truck has been designed for long cars of from 45ft. to 60ft., operating at high speed. It has a springing system giving smooth and steady running, and the weight is the minimum consistent with adequate strength and rigidity. All truck members are machined and secured by turned bolts driven into reamered holes. No welding or riveting is employed, and the construction gives silent running and low maintenance costs. The truck is of the "side-bearing" type—the body rests on a self-lubricating bearing on each side. This minimises swaying and permits the construction of both truck and car body cross-members to be lighter than that of trucks carrying the load of the car body on the centre of the truck cross-members. The trucks have inside frames, connected by links to the axles, an arrangement which eliminates the noise due to the horn guides of hornway-type trucks. A two-part tubular cast steel housing encloses the axles.

In the ends of the housing adjacent to the truck side frame is the seating for the roller axle bearings. The inner end of one half-housing contains the gear unit, bolted to the other half-housing so that the whole forms a single dust-proof assembly. A steel sleeve, pressed on to the axle seating, carries the worm or bevel wheel. The relative lateral position of the axle and gear housing—which forms a single unit — is maintained by angular contact ball bearings on each side of the gear housing, which carry the journal load of the gear drive apart from preventing lateral movement between the axle and the housing unit.

The load of the car body is carried on a large roller bearing in each end of the axle housing. These bearings have the equivalent load - carrying capacity of the roller bearings used in orthodox axle boxes, but there is no end or thrust load on the bearings because it is taken by the ball bearings on each side of the gear unit. The gear drive is of standard design in which the load is carried on ball bearings. An advantage of the inside frame is that the load is carried on the full diameter of the axle, thereby increasing the safety factor considerably as compared with outside-frame trucks with the usual journals and axle boxes, where the diameter of the journal is less than the diameter of the axle.

The drive is by worm or alternatively spiral bevel gear driven by a short Hardy Spicer propeller shaft.

Motor Details

Each truck is fitted with two motors of the C90 type, each weighing 660lb. The main features of the motors are: Circular roll frame with four main and four interpoles; self-ventilation with protected inlets and outlets and special parallel flow fan; large roller-type armature bearings, grease lubricated, with effective seals. Class B insulation is used for the windings, and both armature coils and field coils are bakalised. Armature windings and overhangs are completely shrouded to avoid pockets where dust might accumulate. The armature is dynamically balanced to eliminate vibration and to ensure quiet operation.

The control system provides for the four motors on a car operating in two permanent series-parallel pairs connected across the 550-

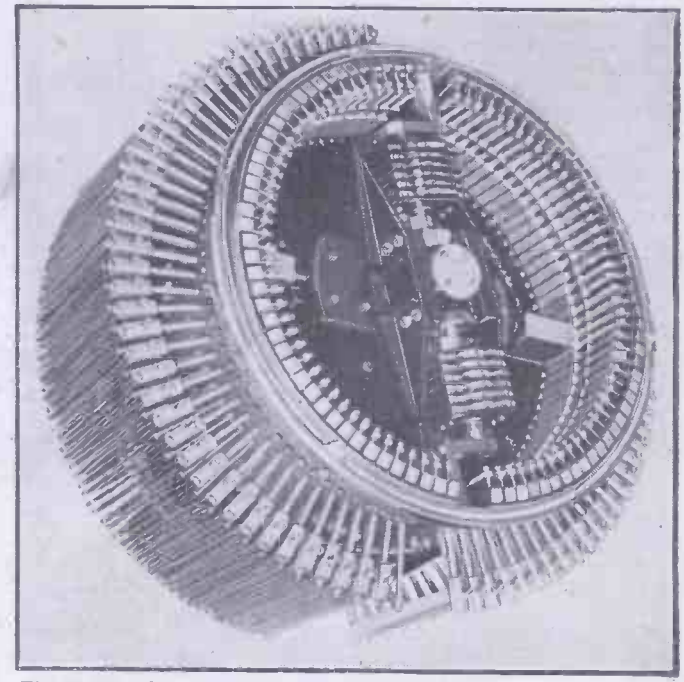


Fig. 2.—Accelerator unit showing construction of resistors and contact making arm.

volt supply. This arrangement limits the commutator voltage to 275 volts per motor, and permits a high rating. The low voltage ensures maximum stability under all conditions of over-voltage, particularly during braking. It also permits the use of single-turn armature windings, which allow for easier commutation, improved coil construction and increased output. The one-hour rating of the motor is 45 h.p. at 144 amps., 275 volts.

The control equipment is designed to attain a service performance carried to the limits of adhesion, speed and passenger comfort and safety. At the same time the control scheme is arranged for immediate variation of the operating characteristics by pre-selection of one of a range of acceleration-rate positions, to give a performance similar to that of older types of car running on the same route.

With the new car all axles are motored, and the number of control notches has been increased from 12 to 100. This provides for the mean accelerating effort to be sustained nearer to the adhesion limit, while individual variations from notch to notch are small and do not cause discomfort to the passengers. Acceleration is automatic, and the rate can be varied by a pre-selection dependent on the adjustment of a controller pedal or handle by the driver.

The electric braking provided is designed to operate at a very high value of retarding tractive effort, and it has therefore a large number of evenly graduated notches. Deceleration is automatic, at a rate which can be varied by pre-selection with the controller.

Control Equipment

The four traction motors are controlled in two permanent series-parallel pairs by a resistor used both for starting and for rheostatic braking. The amount of resistance in circuit is varied by the rotation of a reversible pilot motor governed indirectly by the driver. The resistor and pilot motor form a unit termed the "accelerator"—shown in Fig. 2. (It should be noted that this term is not applied to the driving pedal or control handle.)

The resistor sections are arranged around the periphery of a circular steel frame. From each section tappings are brought out, and contact with these is effected by 91 spring-load fingers actuated by permanent magnets on a rotating arm. This is driven through reduction gearing by the pilot motor, the whole forming a compact unit inside the circular frame. The rate of cut-out of resistance depends on the rate at which the arm revolves.

The accelerator carries a number of small interlock contacts, employed to control various contactors for particular operations.

The master controller, the reverser and the accelerating relay form one complete unit, shown in Fig. 3. The accelerating relay operates a reversing type double potentiometer against a spring to control the speed and direction of rotation of the pilot motor. A lever provides for emergency braking and reversing.

With single-ended drive, in addition to the main control unit a small drum type "back-up" controller is mounted at the rear end of the vehicle. This unit provides for a limited maximum speed only, at a minimum rate of acceleration. It is operated by the key of the main reverser, which must be set to the reverse position before the key can be withdrawn. This precaution makes it impossible for both controllers to be operated together. When double-ended drive is required the "back-up" controller is replaced by a second master controller.

The control equipment includes two circuit-breakers, contactor panels and the customary auxiliaries.

Method of Control

The control system operates on the principle of maintaining the motor current aproximately constant—within the limits of the apparatus—at a value determined by the pre-set position of the controller. For each position of the controller there is a corresponding value of current and therefore of acceleration or retardation.

Since the rate of acceleration depends on the rotational speed of the pilot motor, it is varied by adjusting the motor speed by means of a potentiometer regulating the voltage applied to the armature. The potentiometer is connected across the vehicle battery and the pilot motor field winding is permanently energised at a constant value from the battery. To reverse the direction of the pilot motor rotation, the connections of the potentiometer are reversible. The scheme is shown in Fig. 3.

The position of the potentiometer contacts, and, therefore, the speed of the pilot motor, is determined by the opposing actions of the operating coil of the accelerating relay and a spring which, in combination, control a link system. The force exerted by the relay coil is proportional to the main current, while that due to the spring depends on the setting of the controller.

With a given setting, the position of the potentiometer contacts is determined by the current through the accelerating relay coil, which adjusts the position of the connecting link, and the position of the controller, which regulates the opposition produced by the spring to the movement of the connecting link. Any adjustment of the setting changes the thrust of the spring and disturbs the equilibrium of the link system.

This adjustment changes the voltage on the armature of the pilot motor driving the arm of the accelerator, and thus varies the current in the main motors until it attains a value at which the equilibrium of the link system is restored.

The control scheme ensures that for a given position of the controller, constant current acceleration is maintained. External changes tending to vary the accelerating current, e.g., gradients, will alter the force exerted by the accelerating relay. This has the effect of varying the main resistance until the current is adjusted to the value corresponding to the setting of the controller.

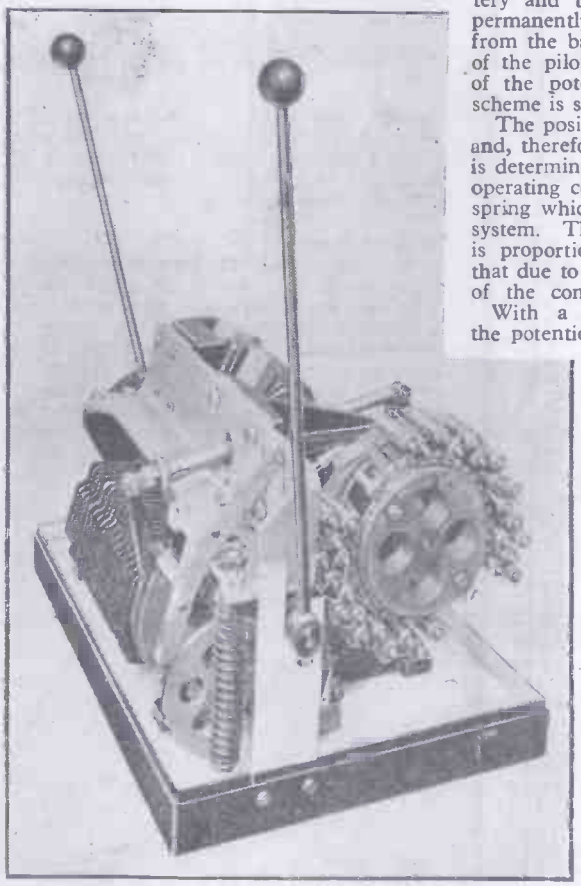
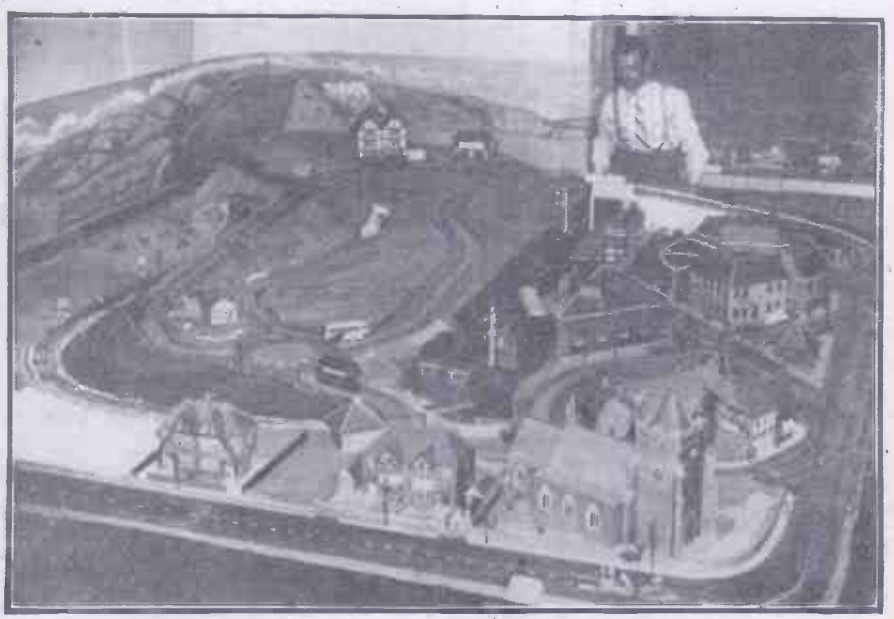


Fig. 3.—Complete unit comprising master controller and accelerating relay.



This working model roadway, which was exhibited at the Model Engineer Exhibition, includes the latest devices of traffic control. It is operated by a switch.

Making a Hall Lantern

The Construction of This Useful Lighting Fitting is Well Within the Scope of Any Handyman

By ROBERT L. HARDING

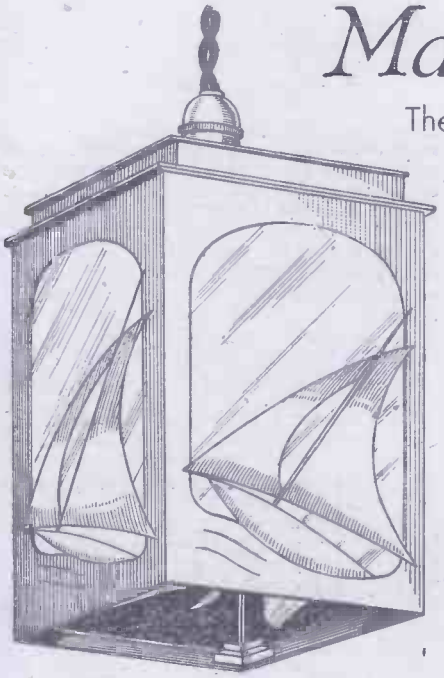


Fig. 1.—The completed lantern.

THE attractive lantern shown in Fig. 1 is easily made from sheet brass and copper and would form a useful addition to any home.

The main body of the lantern is commenced by marking out on 18 or 20 gauge brass, four adjoining rectangles, each 6in. by 4in., with an extra 1/16in. at each end for the joint (Fig. 2). The outline of the openings should be drawn out on paper and traced through with carbon paper on to each in turn. These openings are cut out by means of an abrafile, or by drilling a succession of small holes close to the outline. The lines representing the waves may be made with an engraving tool, but if this is not available, it will be found that deep scratches with a scriber are quite satisfactory.

The brass, having been cut to shape, is bent round and the two ends interlocked as shown in Fig. 3. If this joint is now silver soldered (from the inside), it should be practically invisible when the projecting

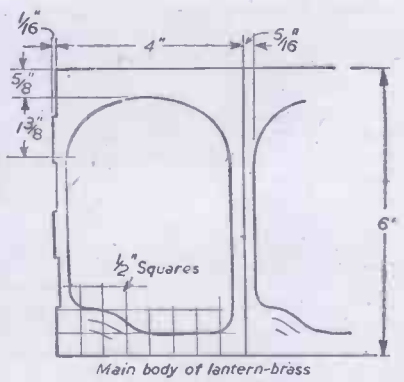


Fig. 2.—How to mark out the lantern sides.

pieces are filed off flush with the sides. The corner pieces shown in Fig. 4 should be silver soldered a little below the top at the same time. Apart from strengthening the framework they receive the screws which hold the top.

The Overlays

The ship overlays on the sides can be made next. The shapes of the boat and sail are outlined on ½in. squares in Fig. 4 and are cut out from 22 or 24 gauge copper. They should be annealed and then curved outwards slightly with the fingers. The mast is 4in. long and is made from ⅛in. copper rod, tapering towards the tip.

Top of Lantern

The top consists of three parts, all three being made from 18 or 20 gauge copper. The uppermost piece is a 3⅝in. square with a 1 1/16in. diameter hole in the centre for the lampholder. Below this is a 3½in. square of ½in. strip, this being bent round and joined in a similar way to the main body.

The third piece is a 4½in. square with a 3in. square hole cut in the centre. Clearance holes for 6 B.A. screws are drilled ½in. in

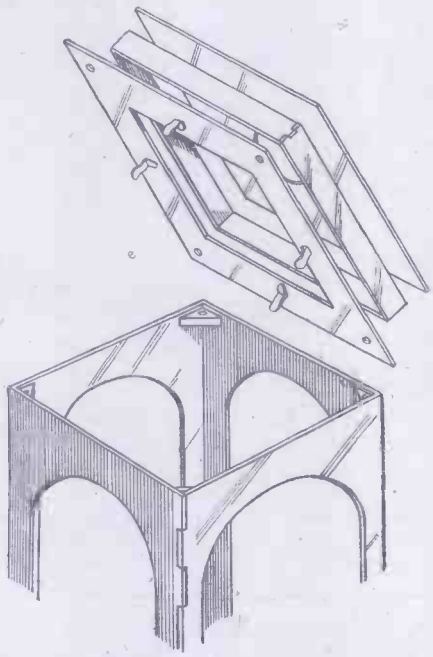


Fig. 3.—Constructional details of the lantern sides and top.

from each corner and countersunk on the top, corresponding holes being drilled and tapped 6 B.A. in the corner pieces on the main body.

All the component parts should now be cleaned up and polished. In the absence of a buffing wheel for polishing, the writer has had good results from a non-scratch cleaning powder and water followed by metal polish.

Assembly

The middle square of the top three pieces is soft-soldered to the lower one first and then to the upper one, both from the inside.

The boats, followed by the masts and then the sails are now soldered from the inside

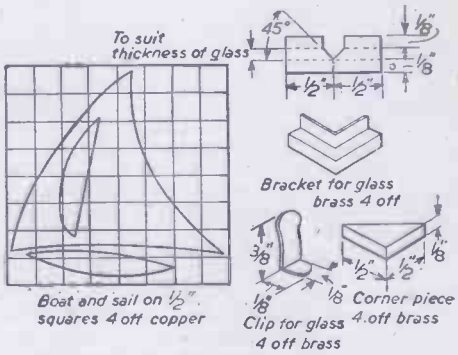


Fig. 4.—Details of the various parts.

in the positions shown in Fig. 1. This drawing also shows the position of the small brackets for the glass which are made up from oddments of thin brass as shown in Fig. 4 and soldered in the corners. Four small clips are also made from thin brass and soldered to the top where shown in Fig. 3.

The Glass

Pieces of ground glass, 5½in. by 3⅜in., are used for the windows, which may be left plain or tinted to a sunset effect. This can be done with special paint obtainable for glass, or even poster paint by applying yellow at the top and red at the bottom and running them together in the middle.

When dry the glass is put in ground side inwards and held against the sides with one hand while the other puts the top on, the brass clips holding the glass in position. The top is then fixed by four 6 B.A. countersunk screws which, being on top, are not visible when the lantern is in use. With the addition of a brass lampholder the lantern is now complete.

It is not necessary to lacquer the metal for if it is not touched by the fingers after hanging the lantern in place it will need cleaning only once every few months.

The Reality of Rain

Its Mechanism and Effects Outlined

By J. F. STIRLING, M.Sc.

From the left a lowering rain cloud blows over a sunny sky. Rising air currents compact the cloud droplets, thereby giving rise to rain, whose abundance is governed by the prevailing conditions of cloud masses and air currents.

RAIN is so common a phenomenon in our climate that we usually think little of it. We accept it, particularly if we are town dwellers, as an unmitigated nuisance, and, as, perhaps, a necessary evil.

Yet, quite apart from what might be termed the technical necessity of rainfall, there is much of scientific interest attached to the subject of rain. There is, also, still an aspect of mystery associated with it, for, even at the present time, the precise and detailed mechanism of rain precipitation is not very clearly understood.

It is, of course, quite easy to state that rain is a product of the condensation of atmospheric moisture; that moisture evaporates from the earth's surface, is formed into cloud systems and is then hurled back against the earth in the form of water drops. Such a statement is true enough, but it does not give us anything like a comprehensive picture of the precise means by which old Mother Nature, so effectively and beneficially (yet, often enough, so erratically), operates her age-old watering machine.

To get a better understanding of this natural earth-watering process, let us dwell for a moment on a few fundamental facts concerning water vapour and its propensities.

In the presence of water, air acts as if it were a sponge. Water particles (molecules) escape from the surface of liquid water and seek to pursue an independent career between the particles of the air. The hotter the water the more energy is imparted to the escaping water particles. Consequently, the quicker and the more abundantly do they escape into the "pores" of the air—if we may be permitted to use that term.

Now, the number of water particles which any given volume of air can contain in its "pores" is determined not by the exact composition of the air but mainly by its temperature, and, to some extent, on its pressure.

Warm air we know will accommodate much more water vapour than will cold air. Warm air, as we say, "dries." Cold air refuses to take up many water particles. Hence its drying properties are not good.

At normal pressure a pound of air can take up about a quarter of an ounce of water vapour at a temperature of 70 deg. Fahr., which is about the temperature of a warm day. At 50 deg. Fahr. the same volume of air will only accommodate a n eighth of an ounce of water vapour, whilst at freezing-point (32 deg. Fahr.) only a mere sixteenth of an ounce of water can be absorbed and retained by that volume of air.

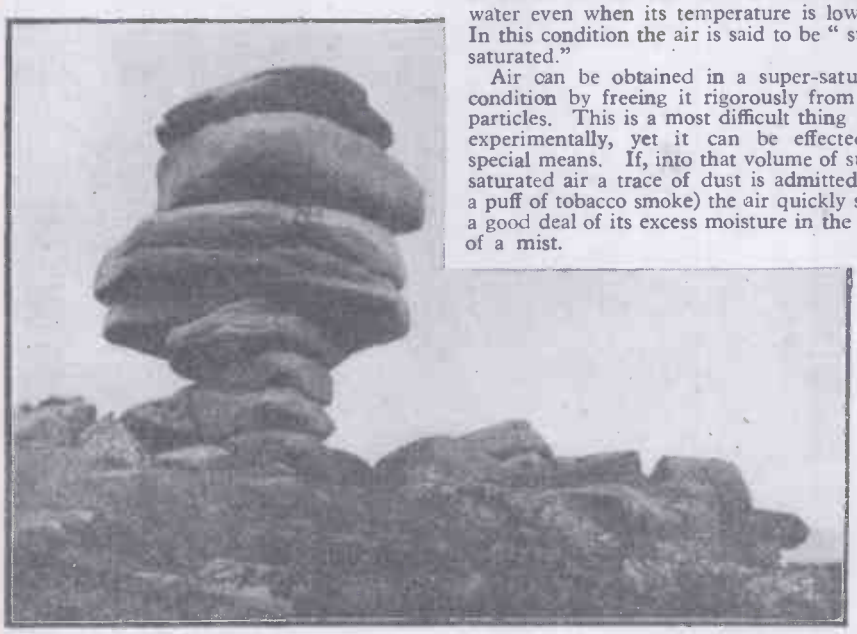
"Saturated" Air

Water is constantly evaporating into the air from the earth's surface. The process goes on continuously until the air holds its full amount of water vapour. When this point is reached the air is said to be "saturated."

If saturated air happens to lose some of its heat (as it usually does at night time) it can no longer hold all the water which it has absorbed. It has to get rid of some of it. This it does (usually) in the form of dew, thereby coating all objects exposed to it with a fine film of individual water droplets.

There are conditions, however, under which air can be made to retain its absorbed water even when its temperature is lowered. In this condition the air is said to be "super-saturated."

Air can be obtained in a super-saturated condition by freeing it rigorously from dust particles. This is a most difficult thing to do experimentally, yet it can be effected by special means. If, into that volume of super-saturated air a trace of dust is admitted (say a puff of tobacco smoke) the air quickly sheds a good deal of its excess moisture in the form of a mist.



A natural curiosity. The "Cheesewring," near Cullington, Cornwall. This strange rock formation which is perfectly balanced represents the remaining core of granite after a vast amount of surrounding rock has been removed by ages of rainfall.

It is almost certain, indeed, that before normally saturated air can shed its contained water it must have present a large number of nuclei to which it can hang its unwanted water particles.

And what is commoner in the earth's atmosphere than dust? Not merely the gross dust from our industrial cities, but the more natural dust particles such as the mineral dust from disintegrating rocks, vegetable dust from old leaves and other forms of decomposing vegetable matter, pollen from flowers, soot, bacteria and various spores, volcanic dust, salt particles from sea spray, and last, but by no means least, the residual dust of the millions of meteorites which enter the earth's atmosphere yearly. All these incredibly fine particles of matter constitute the "dust" of the atmosphere.

To these, also, as water-condensation nuclei we may add all those particles of water vapour which, by one means or another, have become ionised, that is to say, shorn of one or more of their electrons and thereby given a positive charge. These ionised particles behave in just the same way as atmospheric dust, serving as central specks of matter around which water droplets may be built up.

It has been estimated that ordinary air contains about 40,000 dust particles per cubic inch, this number not including any water particles which may have become ionised. Hence the moisture droplets which condense on them must be exceedingly small.

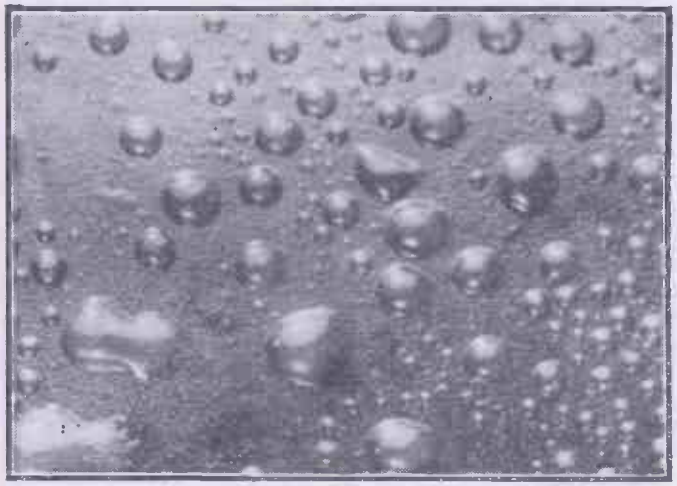
Water vapour, we have seen, is always escaping into the air until the air becomes saturated. As the air becomes heated by the direct rays of the sun or by other influences it becomes lighter. Consequently, it ascends to higher levels. It also expands in accordance with the general law of gaseous expansion.

Cloud Formation

But when a gas expands it automatically becomes cooler. This for the reason that it utilises some of its own heat-energy to do the work of expansion. Thus our expanding volume of air will eventually fall to a temperature at which it can no longer hold all its acquired content of water. There are plenty of dust material and particles in the air. Conveniently, the cooling air unloads its surplus water content on to these dust nuclei. A vast agglomeration of very fine water drop-

lets is formed, and when this becomes visible above the ground we call the assemblage a cloud.

The average water droplet in even a dense cloud is not more than a thousandth of an inch in diameter. Often it is considerably less.



Isolated water drops, similar in size to an average raindrop. In this instance they have formed on a greased plate in order to conserve their individuality and to prevent them from running together.

But a cloud is not rain. It takes several million cloud droplets to form a single raindrop, and clouds are often visible under conditions of the most settled and dry weather.

How, then, is the earth's evaporated water returned from the cloud systems to ground level in the well-known form of rain? What is the real mechanism of rain, the natural process by which the very fine cloud particles are agglomerated into the enormously larger raindrops which, in our country, are usually so abundantly showered down on to the surface of the land?

Well, let us look at the matter in this way.

No matter how small a cloud droplet may be, it will not remain suspended in the air. Being composed of water, it is about 800 times heavier than air. Consequently, a cloud droplet is ever tending to fall gradually to the earth. Its rate of fall depends on its size, an average cloud droplet, under conditions of still air, descending to earth at the rate of about eight feet per minute.

Now, a cloud droplet falling at this rate to the earth's surface would not grow in size as it neared the land. On the contrary, as it reached the warmer air of lower levels it would tend to be converted into vapour again and thus to become absorbed into the air.

It is quite clear, therefore, that the real mechanism of rain must be dependent on some process whereby a falling cloud droplet is increased enormously in size to form a raindrop heavy enough to fall more or less violently to earth.

The Mystery of the Raindrop

How, then, is this raindrop formation carried out? It is precisely here that the element of mystery still persists in this matter of rainfall.

Raindrops are not formed in still air. That fact is certain. They are always formed in rising air currents, the limit of whose speeds must be 18 miles per hour because no raindrops can penetrate air currents moving with a greater velocity than this. A raindrop must always be of such a size and weight that it is able to fall faster than the ascending air current. If it is not of this minimum size it will either remain suspended in the cool air or else it will be forced upwards by the ascending air current.

All factors considered, it seems pretty certain that raindrops are composed of exceedingly fine cloud droplets. These descending under the influence of gravity are, at varying distances from the ground, swept upwards by rising air currents, and in some way they are forcibly compacted together by the influence of wind, by electrical attraction and by other influences, some of which may yet be unknown.

In this connection, it is very interesting to note that molecular vibrations of air particles consequent on violent sound waves may possibly play a part in this compacting of upwards-borne water droplets into actual raindrops. There is, therefore, some probability in the oft-heard association that heavy gun-firing, bombings and explosions generally are productive of ultimate rainfall. In a similar manner, volcanic eruptions have been considered to increase rainfall over a wide area. In this instance, not only are sound waves generated but vast amounts of dust and debris of a mineral nature are hurled forcibly into the higher altitudes.

This is as far as present-day knowledge of rain mechanism will take us. As you see, the question is by no means a fully settled one. There is a missing link, it having yet to be proved exactly how the fine cloud droplets are compacted or agglomerated into raindrops of various sizes.

We all know, of course, that rainfall occurs most abundantly in those areas in which warm, moisture-laden wind hits hills which cool it down below its saturation point and so bring about the precipitation of its water content. Whenever we have a wind which has blown over a large expanse of sea or ocean, such a wind will have picked up all the water it can do. A wind of this nature may be guaranteed to deposit most of its absorbed water at the first opportunity.

Individual Winds

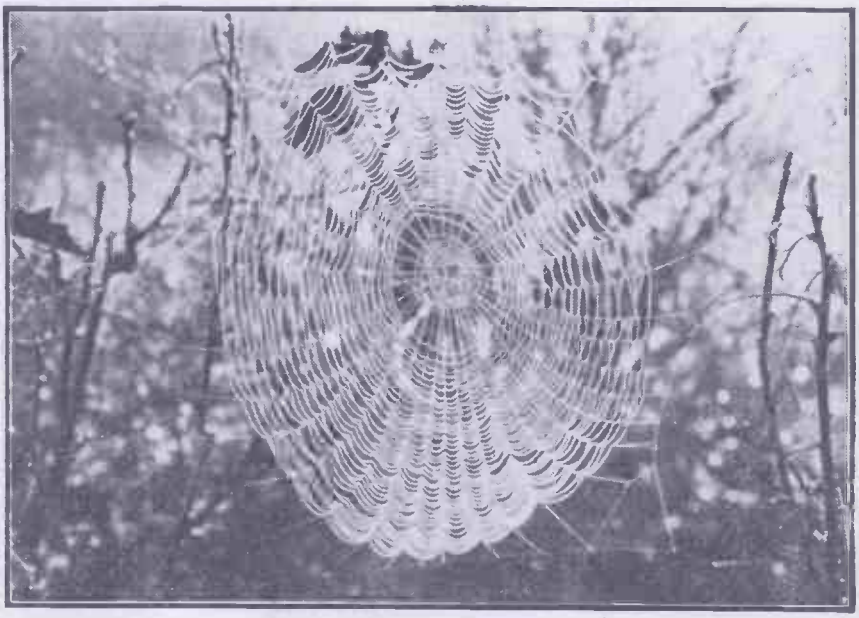
As long as a wind continues to blow horizontally and not vertically it will tend to retain its temperature. This will mean that it will not become cooler and that, because of this, it will not drop below saturation-point. Such a wind, therefore, will not give rise to rain.

But immediately the moisture-laden wind begins to veer upwards, it will expand, its temperature will drop and rain will be precipitated.

It is a curious fact that winds are very unsociable entities. They do not mingle together or mix in any way. A warm wind and a cold wind may move alongside each other for hundreds of miles just like trains on a parallel track. Such winds keep entirely their own individualities, neither being heated or cooled by its travelling neighbour. When such air currents happen to meet, there is no violent collision. The hotter air usually blows over the colder current. Mixing is not allowed in the etiquette of the winds. If it were, the rain precipitation in many parts of the earth's surface might well be overwhelming.

Raindrops vary in size according to the conditions of their formation. If the uprising air current is leisurely, we get one of the smallest possible raindrops, these constituting a mere drizzle. As the raindrop increases in size, its rate of fall becomes quicker and the prevailing weather is correspondingly stormier.

Mountain ranges act as directors of air currents. They cause the air currents to turn upwards. This is the reason why the mountainous districts in this country have rainy climates, for the moisture-laden up-turning air expands and cools, abundant rain being the result.



The revelation of dew. A spider's web is often hardly visible in good light, but when tiny droplets of water have condensed on it in the form of a thin dew film, the smallest details of this wonderful structure become visible, more particularly when the air temperature falls sufficiently to convert the dew film into a layer of frost. This phenomenon, common enough in the autumn, strikingly demonstrates the effect of atmospheric water condensation.

World's Wettest Place

Seathwaite, Cumberland, is England's rainiest district. An average of 130 inches falls there every year. Cherrapunji, in Assam, is easily the world's wettest place. Here between 400 and 500 inches of rain are registered every year, some 275 inches of this amount falling during the three summer months as a result of the moisture-laden monsoons blowing up the Indian Ocean and depositing their water on the slopes of the Himalayas.

Compared with this record, London, with its annual rainfall of about 25 inches, and even Manchester where it is erroneously supposed to be "always raining" appear almost as arid and parched areas!

Rainclouds sweeping in from the West over the inhospitable heights of Dartmoor, Devon. Being the highest land in the West of England, it receives the full impact of the Atlantic winds and is thereby noted for its rainfall.

Violent rainfall occurs in some tropical districts, but in this country it is rare. What we know in Britain as a "cloudburst" has nothing whatever to do with any bursting or rupturing effects. It is solely consequent on a rapidly rising air current which is laden with raindrops suddenly ceasing or suddenly diminishing in velocity. Under these circumstances, the heavy upwards swirl of water drops is brought more or less to a standstill. The water drops literally find themselves "in the air." They are entirely unsupported and instead of making their way gently downwards against a naturally balanced air-resistance, they simply drop earthwards of their own relatively excessive weight, which descent, in fact, often appears to us ground-dwellers almost as if a continuous sheet of water had been hurled downwards on us.

A one-inch depth of rain falling on the earth's surface represents a volume of water weighing about 100 tons per acre of surface. The average annual rainfall over England and Wales, on this basis, amounts to about 70,000,000,000 tons of water per year! Droughts and water-shortages in this country, therefore, are not the fault of natural processes. They result more from the short-sightedness of communities and their lack of engineering foresight.

What is the ultimate fate of rainfall? Here, an answer is not difficult to find. Some of the rainwater evaporates and is gathered up again into the air almost as soon as it has fallen. The remainder runs over the surface of the ground and sinks below the surface, replenishing rivers, filling wells—deep and shallow—and by various means, direct and indirect, making its way into the sea.

Remorseless Rain

Rain is a powerful transporting agent. It is able gradually to change the face of the land by washing out its soluble minerals and by dislodging and carrying away its insoluble parts. It has been estimated that the Thames carries away 550,000 tons of dissolved mineral matter yearly, to say nothing of the insoluble mineral debris which, like all rivers, it brings down from the higher reaches.

A simple experiment in vapour condensation. Steam from a kettle impinges against a suspended can of cold water. The tiny steam particles, being cooled, are immediately condensed into larger particles which collect on the colder surface of the can and which run off into the collecting dish below.

Even massive rocks succumb eventually to the mechanical and chemical eroding effects of rain. Continual rain will wear away hard mountain tops equally as remorselessly as it will dislodge the softer deposits of the valleys. And much rain, in descending, carries away traces of the nitric acid produced by lightning flashes. It is thereby given a chemical dissolving power, slight, it is true, but none the less certain.

The "weathering" of granite rocks is due to the chemical and mechanical power of rain. The mineral felspar, a constituent of granite, is dissolved away by the rain's chemical action, leaving the harder parts of the rock to be gradually worn away by the rain's mechanical action.

No tract of land can remain unchanged under the impact of recurring rain. In mountainous districts landslides are often the direct result of continual rainfall.

New Standard of Measurement

THE National Bureau of Standards, U.S.A., have found a new Standard Measure of Length.

Wavelengths radiated by mercury 198 are found by a hand spectroscope to be exactly $\frac{21}{1,000,000}$ inch apart.

In 1931, Dr. Meggers, of the Standards, U.S.A., proposed that a new and more accurate Standard of Length could be obtained if it were possible to separate one of the mercury isotopes from the others.

In 1942, the National Bureau of Standards, U.S.A., obtained 40 ounces of proof gold which was exposed to neutron bombardment in the Cyclotron at the University of California. In 1945, the proof gold was transferred from California to the atomic ovens of Oak Ridge, Tennessee, where it was subjected to intense neutron bombardment.

In 1946 the National Bureau of Standards distilled from the gold about 60 milligrams of pure mercury 198. The green light of mercury 198 was found to be 10 times as accurate when used as a Standard Measure of Length as the red light of cadmium accepted for so many years to calibrate the metre.

The wavelength radiated by mercury 198 was found to be exactly 21 millionths of an inch.

Such industries as petroleum chemicals, optics, automobile manufacturing, and airplane manufacturing already make use of certain wavelengths of light in determining tolerances, thicknesses of single molecular layers, and making lenses for fine optical instruments.

This new Standard for measuring lengths will be of practical value to those industries.

U.S. Standard of Length

In the U.S.A., some people patronise the Metric System, and some the British System of weighing and measuring. Legally the United States is on the Metric System.

The Standard of Length is a special platinum alloy bar one metre long, kept in a constant temperature vault at the National Bureau of Standards. It is a duplicate of the International Standard of Length kept at Paris.

Natural scientists, engineers and technicians, in the U.S.A. and Great Britain, make use of the metre, converting millimetres, centimetres and metres into inches, feet and yards, to conform to the "double standard."

Dynamo and Motor Problems—4

Armature "Cross-flux" : Back Magnetisation : Voltage Regulation : Third Brush Control

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

(*Continued from page 129, January issue*)

REACTIONS of the armature fields upon the main flux of a d.c. generator or motor are worth considering in detail.

The subject is vital to an understanding of car dynamos, which make use of the armature reactions to stabilise the output over a wide range of speeds.

Another modern application for control of the speed of large motors by a small amount of control power (such as from a valve amplifier) is the amplidyne generator. This actually makes use of the armature cross-magnetisation to provide the main output.

We saw, too, in the last article how an important function of interpoles—or "compensating poles"—is to annul armature reactions and thus enable brushes to be given a fixed position at all loads.

In this article we shall note briefly the part played by armature reaction in the special generators mentioned above.

The Armature "Cross-Flux."

On referring to Fig. 21a it will be seen that a coil carrying a current magnetises a straight piece of iron to the NS magnetic polarity shown.

Reversing the current will reverse the magnetic poles as in 21b. In each case, instead of showing complete "turns" of wire, we may represent the ends of "conductors" (Fig. 21c). Here a "+" sign is supposed to denote the *tail* end of an arrow, i.e., a *downward* current; the ⊙ are similarly arrow-points showing a current flowing *towards* the observer.

This method of showing single conductors is very useful in discussing dynamo armatures. Obviously, it would make things unnecessarily complicated to draw complete coils, so we simply imagine the armature cut in section, as in Fig. 22a.

We have a cylindrical core of iron wound with current-carrying wires—compare 22a with 21c. It matters not that one core is cylindrical and the other a straight bar.

The laws of electromagnetism indicate that both will become magnetised, to the NS polarity shown (with the given current direction).

Like the straight iron bar the armature core becomes a very strong magnet when the wires embedded in it are carrying (or supplying) appreciable current.

Many students find difficulty in picturing what we may call this *self*-magnetisation of an armature.

In Fig. 21 we have a very tangible "source" supplying current. A dynamo generates its own supply, and it is hard for some to realise that this self-generated current induces magnetism in the core exactly the same as if derived from an outside source.

No matter where derived, 10 or 100 amperes flowing in a number of turns has a definite magnetising effect proportional to the ampere-turns.

In a motor the armature current is supplied from outside; in a dynamo it is generated in the armature, but nevertheless has the same magnetic effects on the core as if supplied from an independent source.

The induced polarity N'S' in Fig. 22a is termed *cross-magnetisation* because the armature iron is magnetised at right-angles to the main N and S fixed poles.

The Cross "Ampere-Turns."

The conductors responsible for cross-magnetisation are those shown in Fig. 22a.

Remembering that these are really complete turns, we have a belt of wires on either side of the brushes (supposed fixed in the geometrical neutral plane PP), carrying upward and downward currents, the same as the parts of complete turns in Fig. 21c.

If we reckoned all the armature turns inducing the cross-magnetisation, i.e, if we regarded the armature as one big and rather complicated "coil," carrying a given current, we could estimate the *cross ampere-turns* instrumental in developing the armature magnetisation, and hence the interpole A.T. required to neutralise it.

This we shall not do now, because we are not considering machine-design problems. But note carefully what particular conductors are concerned in producing *cross*-magetisation—we shall have to refer again to another magnetic effect.

The Resultant Flux.

What effect is the cross-magnetisation going to have on the main flux the conductors are cutting?

Consider Fig. 22b. First, we have a strong "main field" developed by a magnet NS. At right angles there is a second magnet N'S'.

The *resultant flux* will be distorted, or "twisted," somewhat as shown. Lines of force will tend to "flow" along the iron path, since its magnetic reluctance is much less than that of the long air path between the two main poles.

But note that the iron path is another magnet having a polarity N'S'. Its own internal magnetic flux is in the same direction as the main field (N to S), in the direction S' to N' (internally), hence the main flux will be distorted as shown.

Is there any strengthening of the main flux? There seem two good reasons for thinking so: (a) provision of an iron path (which, however, is already present in a dynamo) and (b) the extra "cross" ampere-turns of the armature, which, when the flux is distorted as shown, give rise to additional flux in the same direction as the main flux.

I will leave this an open theoretical question some of you may care to discuss. Even if the resultant flux is strengthened, there remains the question whether this is going to have any substantial effect on the e.m.f. available at the brushes?

In Fig. 22c, I have again shown the "forward" distortion of the field in a dynamo.

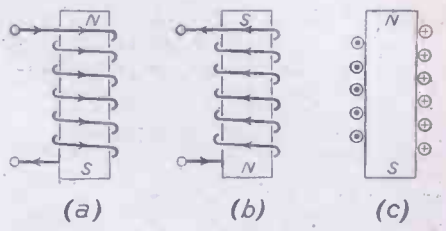


Fig. 21.—Fundamental "electromagnetics" to illustrate cross-magnetisation of an armature.

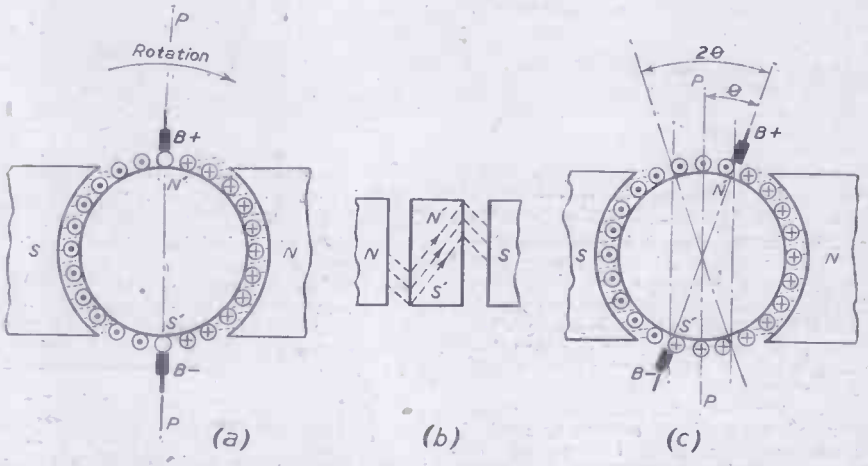


Fig. 22.—When conductors carry current, the armature iron will be magnetised NS (a) exactly like the iron in Fig. 21 (c). Diagram (b) shows, roughly, the way a few lines of force are "twisted" by the presence of a magnet giving "cross poles" N'S'. (c) shows the condition when the brushes are moved forward.

More Exact Meaning of "Neutral Position."

We have already outlined briefly in previous articles how the forward distortion must alter the potential distribution around the commutator segments—necessitating a forward lead of the brushes, both for sparkless commutation and getting the maximum available e.m.f.

So, in Fig. 22c, the brushes have been given a forward lead—moved forward by an angle θ from what we have called the "geometrical neutral" position.

Without interpoles the cross-magnetisation, and hence the distorting effect on the main field, will get stronger at increased armature currents, demanding still more forward lead as more electrical load comes on the machine. Usually, minimum sparking will be a sufficient criterion where the brush-gear should be set at a given load.

The axis along which cross-magnetisation

occurs will also move forward, as shown in Fig. 22c. Correct brush position will be directly opposite to the new position occupied by the "cross poles" N'S'—or the points where current is collected from the armature must be such as to give a current distribution that will induce cross poles at these exact points.

There are two sets of ampere-turns operating to give rise to resultant ampere-turns (and flux), as indicated in Fig. 23.

First we have ATm due to the main poles, and ATc due to the armature. ATm is always along the magnetic axis of the main poles, whilst ATc will make an angle θ with the geometrical neutral line, and should be along the line where the brushes are situated.

If drawn to suitable scales, the *resultant* AT is given by the triangle shown in Fig. 23. Unfortunately, in design, things are not quite so easy. The magnetic reluctances of the paths taken by the main and cross fluxes will not be the same, necessitating different scales for ATm and ATc.

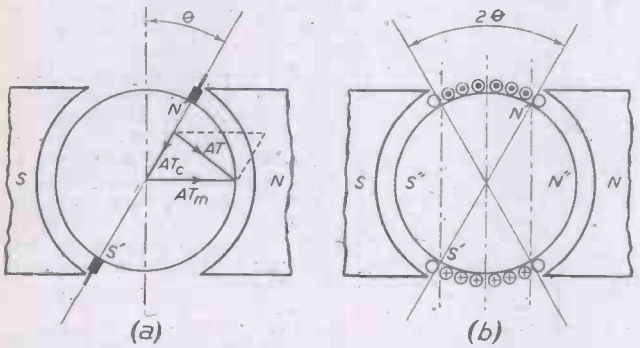


Fig. 23 (a).—Resultant of main A.T. (ATm) and cross-magnetising ampere-turns (ATc): the resultant being AT. (b) shows more clearly the belt of conductors causing "back" magnetisation.

"When the brushes are in such a position that the axis of the conductors under commutation is also the axis of the *resultant* field, they are said to be in the 'neutral position.'"

That is a definition given by one classical authority. It sounds a bit technical, e.g., what is "the *axis of the conductors* under commutation"? Obviously the axis through a belt of conductors right under the brushes.

The definition states this must coincide with the axis of the resultant field AT, Fig. 23. Or, a line joining the brushes must be at right-angles to AT.

Thus "neutral position" must be distinguished from the "geometrical neutral." Note, too, from Fig. 23, that the resultant AT is *less* than ATm; there is *weakening* besides forward distortion of the field when the brushes are given a forward lead.

Let us next inquire into this effect.

"Back" Magnetisation

When the brushes have been moved forward another belt of conductors is brought into existence, carrying current in such directions as to magnetise the armature core "along the axis" of this new "coil."

When set in the exact geometrical neutral (Fig. 22a) the few conductors on both sides of given brush are carrying equal but *opposite* currents, thus having zero magnetic effect along an axis at right angles to the neutral axis.

In Fig. 22c and Fig. 23b these conditions are changed. We now have a belt of conductors on top carrying upward current, and another belt at the bottom (actually the opposite "sides" of the armature coils) carrying downward current.

Looking again at the armature core as a mass of iron subject to magnetisation, and applying the rules of magnetism connecting field polarity with current-direction, you should find that this "coil" (spreading approximately within the limits of the two dotted lines in Fig. 23b) magnetises the iron to the polarity N"S", *along the axis of the main poles.*

Moreover, under a N main pole we get a N" induced pole in the core, and opposite S, an induced S" pole.

This is the equivalent of a magnet N"S" whose field *diametrically opposes the main field;* the effect is not distortion but definite *weakening* of the flux cut by the armature conductors—hence reduction of the e.m.f. generated.

The phenomenon is termed *back-magnetisation*—or opposing magnetisation—whilst turns (within the dotted lines) × current = the *back ampere-turns*.

Observe carefully that the demagnetising effect is non-existent as long as the brushes are set to exact geometrical neutral, as is the case in interpole machines. It is the forward lead (or backward lead in a motor) which brings about the "belt" of field-opposing ampere-turns covering a width on the armature of about 2θ degs. (Fig. 23b).

Cross-magnetisation by itself causes no appreciable field-weakening; nevertheless, if the brushes are left fixed, it will cause a reduction in voltage available at the brushes, because the true points of maximum available e.m.f. will have moved forward.

But the explanation of the fact that the resultant AT in Fig. 23a is less than ATm is found in back ampere-turns consequent upon moving the brushes forward, i.e., it is not a direct effect of cross-magnetisation, as the diagram might lead us to suppose.

Together, both effects come under the heading "Armature Reaction," as outlined briefly in previous articles. The foregoing detailed discussion should help to clear all difficulties and give better understanding of some important applications of the principles.

Car Dynamos

The problem in car dynamos was to devise some means—without having to use costly and troublesome vibrators, etc.—of keeping the output to the battery reasonably constant over engine speeds ranging from about 18-60 m.p.h.

Immense numbers of patents have been filed—some are mechanical, most electrical—making use of various methods of weakening the field when the current starts to rise with speed.

Thus we have made brief mention of the use of a differential compound field winding for this purpose. It may be interesting in later articles to review the principles in some detail, but at present I want to confine myself to the one that has come to stay—third-brush control.

First, it should be understood that a lead-acid battery has an extremely low internal resistance, being of the order of a few *hundredths* of an ohm, and thus comparable with the resistance of a short piece of wire.

Effect of Low Battery Resistance

If connected to an ordinary shunt-wound generator without additional resistance, charging conditions would be quite unstable.

Assuming that by means of a field regulator the generator voltage is first adjusted to exact equality with the back e.m.f. generated by the battery, no current should flow either way on closing the main charging switch or cut-out.

If now the generator voltage is slightly raised, a charging current will flow. But, without extra resistance, it will be a large current, exceedingly difficult to control. With a very low resistance circuit, a small difference between the applied and back e.m.f.s will cause a heavy current.

Consider a rather extreme case. Suppose the resistance were as low as 0.01 ohm. Then, if we adjusted the dynamo only 1 volt above the back e.m.f. from the battery, the current will tend to rise to 1/0.01=160 amperes; without stating any precise figure, let us take account of other factors by saying simply that it will be a "large current."

The real point, however, is, not only the excessive current but the fact that it is liable to be most unsteady, assuming we succeeded in setting the field rheostat to get some value around what is required.

Small changes in resistance, in the e.m.f. of the battery, in the dynamo speed and voltage output, will all give rise to large "ampere" changes (up or down), simply because the slightest voltage or resistance variation will cause a steep current-change.

It all reduces to the low resistance: Ohm's Law, I=V/R, where R is a small quantity. Try out a few figures, making R as low as say 0.05 ohm, and remembering that the effective voltage driving current through a battery is (V minus e), where e is the back e.m.f. Verify what happens to I with small changes in V, e or R.

Voltage Regulation of Dynamo

But if the dynamo is given a suitable *falling* voltage/current characteristic, the current can be stabilised at some required value, even over a wide range of generator speeds.

It boils down to a matter of maintaining a reasonably constant output voltage at all speeds, utilising the *output current* as the regulating device.

Thus an obvious method which suggests itself is a differential series winding carrying the main charging current. Any tendency for the current output to increase (with speed) will be counteracted by field-weakening and reduction of the e.m.f. generated.

Though difficult to accomplish with this simple system—over the wide range of engine speeds in cars—it is easy to understand how the e.m.f. may be made to fall inversely as the speed, thus counteracting its normal tendency to rise in direct proportion.

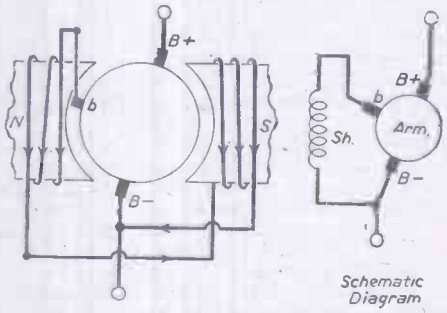


Fig. 24.—A car dynamo has a special "self-regulating" third-brush (b) to which one end of the shunt is connected. Hence separate-excitation (off the battery) could not be employed.

Actually, some current increase would have to take place to cause field-weakening, but with sufficient demagnetising ("differential") turns on the poles, the amount of increase can be kept quite small.

Stated otherwise: If the dynamo has a "steep" (falling) voltage/current characteristic, the voltage will fall rapidly, or the amount of current increase required to stabilise it at some fixed value will be comparatively small.

Third-brush Control

These are the principles of all systems of "current regulation," i.e., utilising the current in a circuit to stabilise the voltage, whatever the actual method used.

Almost all car dynamos to-day make use of the third-brush method, Fig. 24.

First, the main brushes B+ and B minus are given a forward lead, bringing into action the belt of conductors or back ampere-turns already described.

The brushes can be left in this forward position because, under regulating conditions, the load current supplied will be nearly constant. So, in the first place, there is a demagnetising action on the main field, which increases with any tendency for the charging current to increase.

Secondly, one end of the shunt field winding is taken to a third-brush b, set at a point on the commutator where the potential difference *tends* to undergo rapid change with current increase, due to forward field distortion.

The p.d. referred to is that between the third-brush and B minus, to which the opposite end of the shunt is connected. For example, forward field distortion is equivalent to shifting b nearer to B minus, hence reducing the voltage across the shunt.

The net result is that little forward distortion actually takes place. The current "tends to" rise with speed; it does so to some small extent, but the combined result of demagnetising and third-brush action is to reduce the generated e.m.f. by the right amount, so maintaining reasonable stability.

It is a case of using a "differential characteristic" in a very effective and ingenious way to compensate for a speed range of approximately 3:1 or more.

The "Amplidyne" Generator

In the space that remains we can only give a very brief outline of a modern generator which makes use of armature reaction.

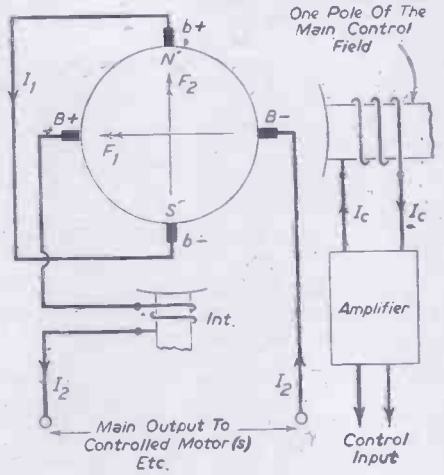


Fig 25.—An interesting modern application of cross-magnetisation: the Amplidyne Generator, by means of which a large d.c. motor can be speed-controlled by the power output from an amplifier.

It is used for giving a very fine degree of control of the speed of other motors, which it supplies. Its main advantage is that only a small amount of "control power" is essential for this purpose. Thus amplifiers may be employed to control the field of the amplidyne generator; in this way it is possible to control the speed of a large motor from such a low power source as a ray of light falling upon a photo-electric cell.

Fig. 25 illustrates the bare principle. The "control field" F1 develops an e.m.f. and current I1 across the "quadrature brushes," b+b minus. These are short-circuited, hence giving a very low resistance circuit where a small e.m.f. (and weak control field) will be sufficient to cause a large current.

Cross-magnetisation N'S' provides the field F2, at right-angles to F1, and *this is the "main field" used to develop the main output voltage across brushes B + B minus.* Further cross-magnetisation along this second brush axis is annulled by interpoles Int. Other special compensating windings are incorporated to give satisfactory commutation.

The motor to be controlled is connected to the main output of the amplidyne. The control field may be in two sections to facilitate reversal, etc., and requires such small control power that it may be energised from a valve amplifier as stated above.

A few watts can be made to control a large motor taking many kilowatts. The reason has already been indicated: The low resistance of the path between brushes b+b minus, where the circulating current I1 develops the field F2—the latter providing the main output across brushes B+B−.

(To be continued).

Fuel Mixture Indicators

Their Uses, and How They Operate

By D. W. G. ROSE

FUEL mixture indicators are used as a guide in setting the mixture controls on many types of engines not having automatic mixture controls.

These instruments work on the well-known thermal conductivity principle. The principle of thermal conductivity for the continuous analysis of industrial plant gases has been used throughout industry for many years.

The fuel mixture indicator (or exhaust gas indicator, as it is also called), indicates the ratio of air and fuel, by weight, of the fuel mixture entering the engine.

The scale is calibrated from 9 to 15 parts of weight by air to one part of fuel. The leaner the mixture the lower the reading; this indication is obtained by the analysis of the exhaust gases resulting from combustion of the fuel mixture.

From a "lean" mixture, the exhaust gases would contain approximately 12.6 per cent. CO_2, 0.3 per cent. H_2 and 1.1 per cent. CO. As the mixture becomes enriched the CO_2 content decreases, while the CO and H_2 content increases. A "rich" fuel mixture gives exhaust gases containing approximately 9.0 per cent. CO_2, 4.6 per cent. H_2 and 7.2 per cent. CO.

Since a fixed relation exists between thermal conductivity of exhaust gases and the fuel-air ratio of the pre-combustion mixture, measurement of the thermal conductivity of the exhaust gases will indicate the nature of the fuel mixture.

Electrically, this is accomplished by the fact that the resistance of the platinum spiral (also true of most conductors) increases as its temperature increases and decreases with a lowering of the temperature.

Wheatstone Bridge Principle

In the analyser, or measuring unit, as shown in the accompanying illustration, four platinum spirals form the four arms of a Wheatstone bridge circuit. The spirals are sealed in quartz cells and encased in a metal block. This assures that they are uniformly affected by the exterior temperature. Two of the spirals are exposed to the exhaust gas and two are exposed to water vapor saturated air, and a galvanometer is connected across the two pairs of spirals.

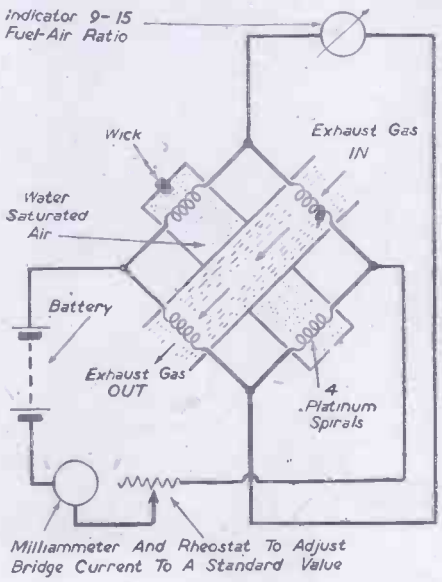


Diagram showing the platinum spirals in the analyser unit.

If a current of 240 m/A. is passed through the bridge, and the gas surrounding the wire in the "analysis" cell has the same thermal conductivity as the gas surrounding the wire in the "standard" cell, each wire will be heated to the same temperature. The temperature of the wires will rise until the energy received by the effect of the current through them is exactly equal to the energy dissipated through the heat conducting gases to the sides of the cells.

However, when the pair of test spirals is exposed to exhaust gases of different mixture their temperature will change and the Wheatstone bridge will be unbalanced; the amount of deflection will be a measure of the difference between the unknown and "reference gas" (water vapour saturated air). In this way it is possible to determine the air-fuel ratio directly.

Components Required

The components consist of the following:

(1) An analyser unit, to which is fitted stainless steel sampling tubing for conducting the exhaust gas sample from the engine exhaust to the analysis cell.

(2) Electric cable for connecting the indicator to the current supply (accumulator or mains unit) and the analysis cells.

(3) An inlet nipple is also provided for connecting to the inlet sampling tube, and a steel wool filter and chamber are incorporated to remove carbon from the exhaust gas.

If, however, the outfit is required for aircraft it is necessary to have an analysis cell for each engine, together with an indicator for each analysis cell.

In an average engine maximum power is indicated with a fuel-air ratio of 12.3 to 13.5. The desired aim is to ascertain the efficiency with which fuel is being burned in the engine, or the percentage of complete combustion.

Although this combustion efficiency can be determined by chemical analysis of exhaust gas, it does not, like the thermal conductivity method, give a continuous indication.

Standard instruments are calibrated for use on petrol engines, but correction scales are applied for use with benzol spirit.

The Elements of Mechanics and Mechanisms—8

Energy of the Sun : The Energy of Coal : Conduction

By F. J. CAMM

THE force used in raising the weight of a pendulum is stored in the weight as potential energy. When the pendulum is released the potential energy is gradually changed into kinetic energy which carries it downward to the lowest point, where it has no longer potential energy but kinetic energy only. However, the velocity which it now possesses will represent exactly the potential energy lost, and it will carry the pendulum onwards to a point as high on that side as on the other.

It is important to remember that the pendulum as it reverses its direction of swing stops for an infinitesimal period of time. The pendulum will continue to oscillate in this way whilst there is a driving power, although but for friction, air resistance, etc., a free-swinging pendulum should swing for ever. Friction and resistance will gradually bring it to rest, and these represent loss of energy.

The energy, however, is not completely lost. Friction causes *heat*, and the lost energy is revealed in that form.

Muscular force is exerted when a ball is thrown into the air and the force is expended in causing the ball to rise in opposition to the force of gravity. The amount of energy lost by the individual throwing the ball is exactly equal to the energy gained by the ball, but in rising the kinetic energy of it is gradually changed into potential energy, and at a certain point this change is complete. At this point for an infinitesimal space of time the ball is perfectly still, and the reverse action begins to take place. The potential energy is gradually changed into kinetic, and the ball begins to move in the opposite direction, that is, downwards.

When the ball touches the ground the change is again complete, and the kinetic energy at that moment is at its greatest. Upon striking the ground it is completely lost, apparently. Not in reality, however, for it is changed into heat and the heat developed is exactly equal to the kinetic energy lost by the ball.

If the heat so produced could be gathered and used in the right way it would raise the ball again to the height from which it fell. When a smith hammers a piece of cold iron it speedily becomes hot, but the heat is in reality only the muscular force of the blacksmith changed into another form.

Thus, in all cases where energy seems to be destroyed investigation will show that it has merely been changed in form. When a strip of zinc and a strip of copper are placed in a solution of sulphuric acid and water a chemical force begins to act, from which we can obtain an electric current.

This is an example where the chemical force is first changed into an electric force and then into the forces of light and heat. When a match is rubbed on the side of a box the kinetic energy of the moving match is changed into heat. The heat in its turn produces chemical energy, causing the phosphorus on the end of the match to combine with the oxygen in the air and igniting the match.

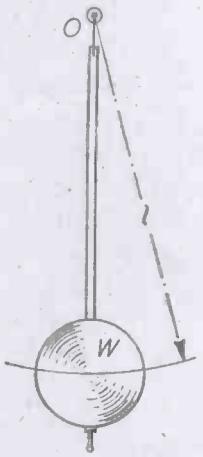
Energy of the Sun

The sun constantly supplies us with stores of force. Because of its light and heat, plants are able to take into their leaves carbonic acid gas from the atmosphere and to split up its gaseous substance into the carbon and oxygen of which it is composed. The carbon is retained by the plant to form its wood, but the oxygen is returned to the atmosphere. A plant cannot grow in a very cold place or in the dark; it needs the forces of light and heat to make it grow.

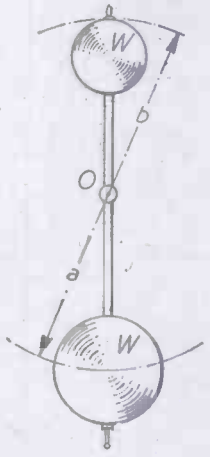
In decomposing the carbonic acid gas the plant is making use of the sun's energy in the form of light and heat to accumulate a store of potential energy.

The Energy of Coal

Countless ages ago enormous numbers of plants lived and died, and their wood has been buried deep within the earth for perhaps millions of years, becoming at last changed into coal, which consists mainly of carbon. The coal is dug up and burnt. The carbon of the coal unites with oxygen in the air and forms carbonic acid gas, producing light and heat. We are, as a fact, in such a case bringing together the atoms of carbon and of oxygen which the plant aided by sunlight separated so many years before. Thus, the potential energy is being changed into kinetic energy recognisable in the running steam engine and in the work it does.

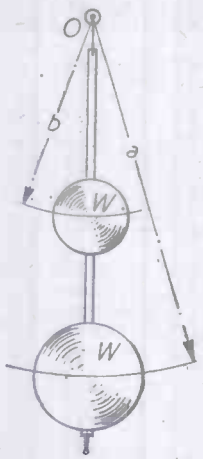


(*Left*) *The simple pendulum,* $t=\pi\sqrt{\frac{l}{g}}$ *l=length of pendulum in inches; t=time in seconds of one oscillation; g=32.097 ft. per sec. or 385.163in. per sec. Time for complete oscillation (two swings)* $=2\pi\sqrt{\frac{l}{g}}$



(*Centre*) *The compound pendulum, in which o=centre of suspension and l=equivalent length of simple pendulum to give same time of oscillation,*

$$l=\frac{a^2W+b^2w}{aW-bw}$$



(*Right*) *Another form of compound pendulum,*

$$l=\frac{a^2W-b^2w}{aW+bw}$$

Heat

The nature of heat was the subject of two theories. The material theory presumed that it was a thin fluid or gas and it was supposed that when a body contained a large quantity of this heat fluid, known as *Caloric*, the body felt hot, and when it contained little it became cold.

Heating a body was supposed to be putting more caloric into it, and the cooling of a body was assumed to be the result of taking caloric away. We know to-day that this theory is wrong, for a fluid or a gas must have weight and a body weighs just the same when hot as when cold. Thus the fact is established that heat is without weight, and, therefore, it must represent a condition. Also no body can contain more than a definite quantity of a substance, but it is possible to produce an unlimited quantity of heat out of any two bodies simply by rubbing them together.

The modern theory of heat is called the *mechanical theory*. It considers heat as a kind of motion. We know that bodies are composed of molecules, and heat is thought to be a motion of the molecules. When the motion is rapid heat is great, when cold the molecules are moving more slowly.

This conception of heating explains why bodies expand when they are heated.

The molecules of a body are held together by the force of cohesion, and heat causes them to move farther apart. The more the molecules are separated from one another the weaker their cohesion becomes, for the force of cohesion can act only over very small distances. It is obvious, therefore, that the greater the heat the less will be the cohesion, and if we continue heating the body above a certain point the force of cohesion will be completely overcome and the body will change from solid to the liquid state. If the heat is still further increased the molecules will be driven farther and farther apart, and they will fly off as a shower of sparks into the air. The heat has now changed the liquid into a form of gas.

Conduction

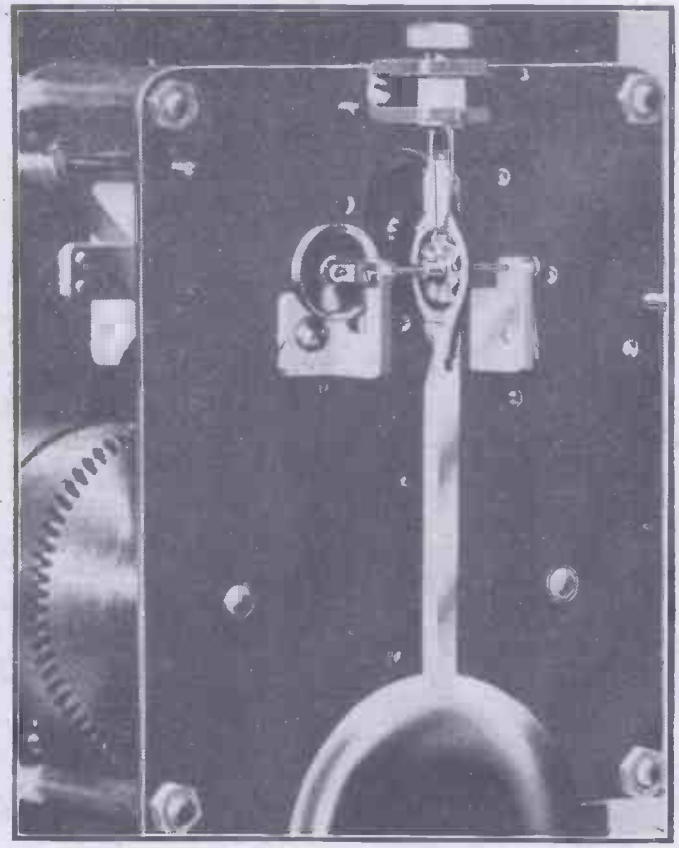
If a piece of iron be placed in the fire that part in the fire soon becomes hot, and the heat travels along the bar until the exposed end also becomes hot. The heat, therefore, must have been conveyed in some way along the bar. The heat of the part in the fire is transferred from molecule to molecule until it reaches the other extremity. This is known as the transmission of heat by *conduction*.

(*To be continued.*)

The Tickless Clock

Details of the New Magnetic Escapement

By THE MARQUIS OF DONEGALL



One form of magnetic-escapement fitted to a short pendulum clock.

RECENTLY I had the opportunity of going to Bath and meeting Mr. Cecil Clifford, who lately caused quite a sensation with the British Horological Institute in a lecture he gave to that body, in which he explained his Magnetic Escapement as applied to pendulum clocks.

He had four or five working models in the factory, which is in a large way of production of time-clocks for such purposes as switching-on gas street-lighting and switching it off again at the required time.

They also manufacture that gadget, known to every housewife, whereby you press a button, point the thing at the gas-stove and it lights.

It must have been the aim of designers of escapements in the past to keep friction and impact losses down to a minimum. In this design of escapement, Mr. Clifford has succeeded in eliminating them altogether. There is no mechanical contact between escape-wheel and oscillator, hence no friction, no impact, no wear and no noise.

Before going on to the various forms of escapement, magnetic or mechanical, we must have some basis for assessing their relative performances. If one judges by time-keeping properties, the results can be obscured by differences in pendulums, and it would take years to develop new designs by checking against lengthy time tests. I think that it is generally agreed that a pendulum oscillating at constant amplitude is an almost perfect time-keeper. If you apply uniform forces to keep the oscillations going at constant amplitude you must take care only to apply those uniform forces and not interfering forces. In other words, the escape-wheel must supply the impulsing forces, and no other force. Put another way, a hundred per cent. of the energy content of the escape-wheel should find its way into the pendulum because the pendulum should be the only control force applied to the escape-wheel. If you can achieve this figure, one hundred per cent. of the escape-wheel energy entering the pendulum, then it is submitted that you have as perfect a clock as a pendulum clock can ever be. The criterion of an escapement therefore is what percentage of the escape-wheel energy enters the pendulum.

This is easily and quickly measured. You find that the higher the efficiency of the escapement, the better the time-keeping, as one would expect. On this basis, the highest efficiency calculated for a mechanical escapement was 18 per cent. on a one-second pendulum clock made by Daniel Quare.

Most one-second hand-wound pendulum clocks have escapement efficiencies of approximately 10 per cent. This magnetic escapement on a one-second pendulum achieves 40 to 60 per cent. On very short pendulums, such as those of one-third second beat, four and a quarter inches long, the efficiencies of their mechanical escapement are very low—1 to 9 per cent.—whereas the magnetic escapements achieve 15 to 50 per cent. efficiency.

History of Magnetic Escapements

What have others attempted in the field of magnetic escapement? It should be mentioned that subsequent to the filing of Mr. Clifford's patent application, routine searches revealed two other patents for magnetic escapement.

In 1931, Baker in the U.S.A. took out a patent for a magnetic escapement. Clifford's provisional specification was filed after Baker's. Then, in 1942, a Swiss, Straumann, took out a patent in Germany for a form of magnetic escapement and followed up with the British and American patents.

Before describing this new magnetic escapement, I should perhaps mention first the names of the most powerful magnetic alloys; roughly, in order of power, there is Ticonal, Alcomax, Alnico, the 35 per cent. and 15 per cent. Cobalt alloys, and then Tungsten and Chrome. The soft magnetic materials which are magnetised by the magnet during operation are listed in order of softness, or smallness of loss. The best is Supermalloy, the Mumental, Radiometal, Silicon Iron, Swedish Iron, Mild Steel. Both permanent magnets and soft materials can be used in compressed powder form and, in the case of the permanent magnets, the powdered form is referred to as a Sintered magnet.

Sine-wave Principle

Imagine a pencil fastened to a heavy pendulum-bob. It it then set swinging (Fig. 1a). If we draw the paper at uniform speed past the swinging point of the pencil, the latter will draw a sine-wave on the paper. If for the pencil you now substitute a bar-magnet (Fig. 1b) and the paper is replaced by a sine-wave shape of magnetic material, e.g., mild-steel, not quite touching the magnet, then you only have to move the sine-wave at the same uniform speed and the magnet pole will traverse exactly over the sine-wave. If you try to move the sine-wave too quickly, the pendulum will tend to restrain it and at the same time draw energy from the sine-wave to maintain its own oscillations. In that case the magnetic sine-wave will be a little in advance of where the pendulum magnet wants it to be. Hence the sine-wave is always drawing or attracting the pendulum towards one end of its stroke, i.e., "impulsing" it.

The next stage is illustrated in Fig. 1c, where the sine-wave is wrapped round the cylinder with the shaft provided for rotation. If a torque of approximately the right magnitude is applied to the shaft it will try to rotate. But it will only be allowed to do so at the speed dictated by the pendulum and its magnet. Once again the sine-wave will stimulate the oscillations of the pendulum by being slightly in advance all the time of the position that the magnet would like it to occupy.

The next step to Fig. 1d, is only a small one to cheapen the magnetic sine-wave which, in this case, is only a disc with a crinkled edge. There will be a limit to the depth of the crinkles and as this has to coin-

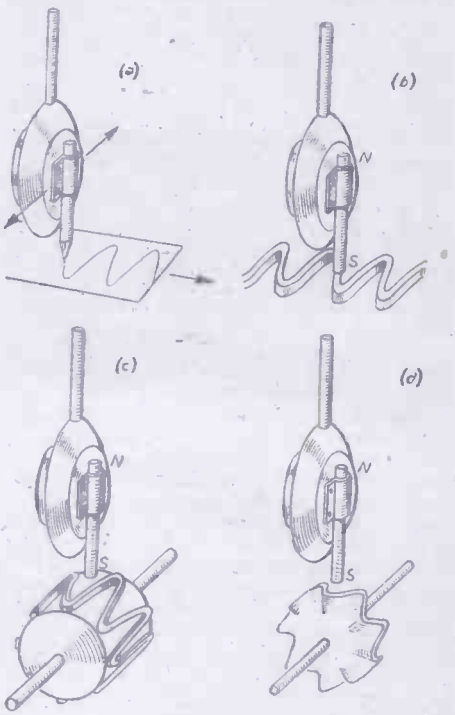


Fig. 1.—Diagrams illustrating the sine-wave principle of the magnetic escapement.

cide with the pendulum amplitude, the latter would be too small for practical applications.

So let's go forward to Fig. 2b, which allows a large pendulum amplitude and yet a small sine-wave amplitude. The design suffers a little from the fact that the return flux from sine-wave to magnet has to proceed via air.

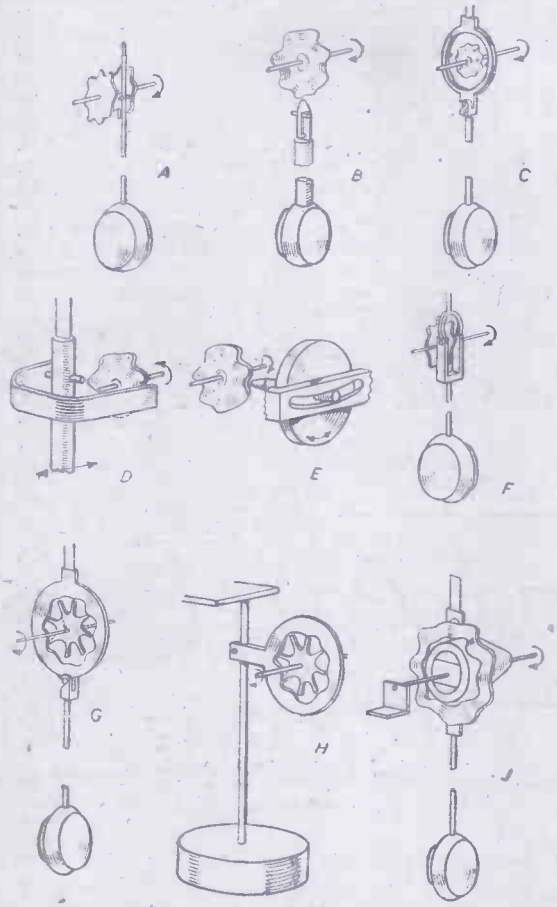


Fig. 2.—Various forms of magnetic escapement.

The design in Fig. 2c, I think, does not suffer from this disadvantage.

Various Designs

A glance at each of these designs may now be worth while: (A) has a very small, straight magnet, apt to be accidentally demagnetised if drawn too far from its escape-wheels, which are twice as heavy as in some of the other designs; (B) I have already touched upon; (C) is another design which even when made of 15 per cent. cobalt steel, it is said, the magnet can be taken from the escape-wheel without losing too much flux. (D) is a novelty. Up to now we have thought only of a crinkled or sine-wave escape-wheel and a co-acting magnet. Here we have the sine-wave and magnetic pin in the pendulum rod, and a magnet surrounding both, to induce the fluxes in the two inter-acting components. (E) shows an application to a rolling pendulum; but these require much power or much care in manufacture. (F) This is a somewhat similar design to (A), but the escape-wheel weight is halved. Note (A) and (F) oscillate in the same plane as the rotation, like the conventional escapements. The others illustrated give oscillations at right angles to the plane of the rotation of the wheels.

Up to now the sine-wave has been the rotating component. In (G) a spoked-magnet rotates inside an oscillating sine-wave and so does (H), which is applied to a semi-rotating pendulum. (J) is rather difficult to illustrate. A fixed magnet attached to the bracket magnetises pins in an escape-wheel connected to a shaft on the right. By reason of the magnetism the pins in the escape-wheel stay coincident with the oscillating sine-wave. There are models of both the rotating sine-wave type and the rotating magnet type; the rotating sine-wave because of its lower weight seems best for the one-third second pendulum. On the one-second pendulum it seems immaterial which you employ at the present stage of development; there are equal efficiencies on each.

It will be obvious that there will be an upper limit to the torque transmitted as impulse to the pendulum. Beyond this torque, the magnetic tooth-lock would break and the clock would "run away." Increase of torque above the working range can arise when setting the hands or during winding. This difficulty is overcome as shown in Fig. 3. The two phosphor-bronze, or beryllium copper springs lie in the troughs between the peaks of the waves when the pendulum is at rest. If I attempted to revolve the escape-wheel, the peaks of the waves would foul either or both springs and so prevent rotation. In normal action the springs never touch the sine-waves, but escape round it. If, say, the hand-setting torque is heavy, the wires act as a mechanical escapement tending to keep the pendulum in oscillation whichever way the hands are being set either forwards or backwards.

These wires and pins also serve their purpose in transit when the pendulum is detached. They set a limit to the forces which can be transmitted to the pendulum suspension and escape-wheel pivots.

Discontinuous Sine-wave

In diagram Fig. 4, it will be seen that a discontinuous sine-wave can be employed. In this illustration the poles of the magnet are opened out, more than would be done in practice to give a better view of the wave on the pole. To the same end the magnetic pins have been embedded in a transparent escape-wheel, both in the diagram and on the models. In this case the length of the track is of importance. It must be an exact multiple of the pole-pitch, e.g., one, two, three or more pole-pitches. This is to ensure that as one pin leaves the magnetic field associated with one end of the track another pin enters at the other end.

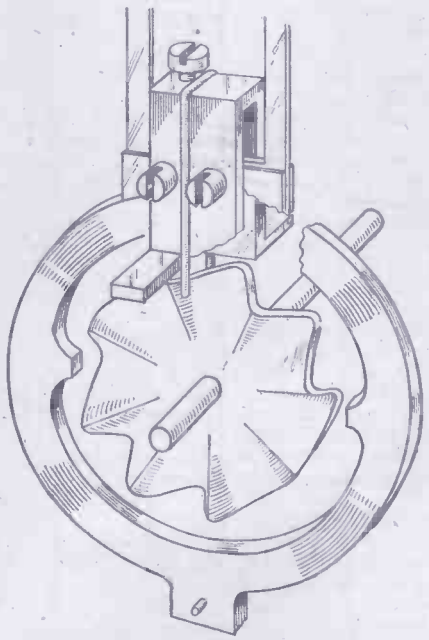
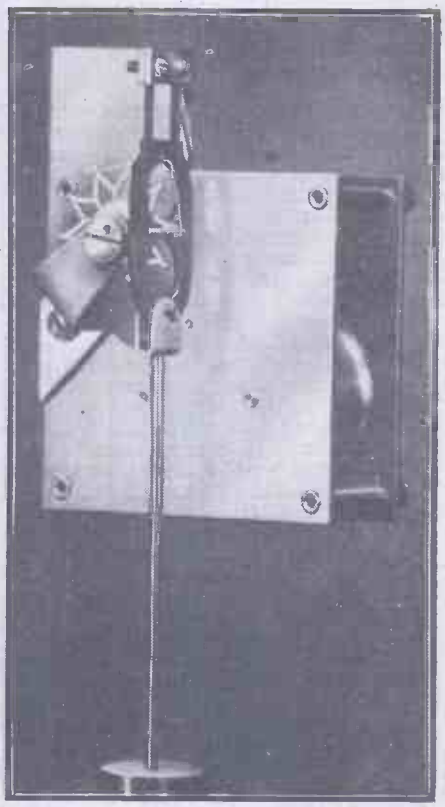


Fig. 3.—Enlarged detail of the rotating type of sine-wave escapement.



Another form of magnetic escapement in which the pendulum oscillates in the same plane as the rotating sine-wave escape-wheel.

It may be helpful to summarise the various forms of escapement in order of invention and development, as follows:—

There are two main forms of this magnetic escapement, firstly, an endless sine-wave; secondly, a sine-wave with ends. In both forms the sine-wave may be either on the escape-wheel or on the pendulum. In both forms the permanent magnet poles can act directly on the sine-wave or through an intermediary giving either a two-element or three-element escapement. At this stage you may say: "It works very well. Why should

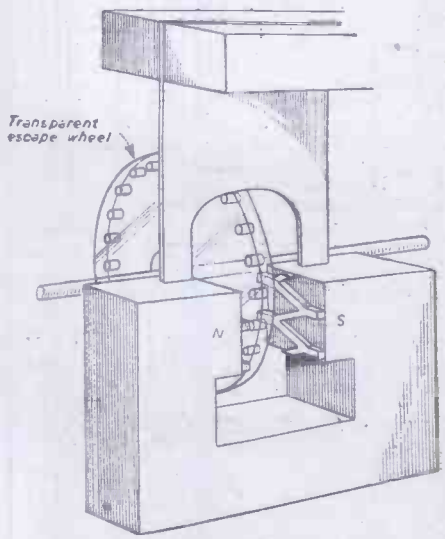


Fig. 4.—Details of the fixed discontinuous sine-wave and rotating escape wheel.

it replace the ordinary mechanical escapement? "

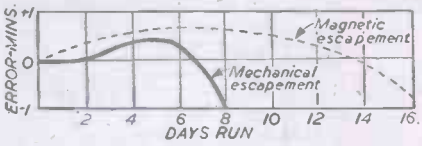
Advantages

Since only about a quarter of the mainspring energy has to be supplied, clocks can be made lighter and cheaper. Many people cannot tolerate a ticking clock, and this escapement is almost inaudible.

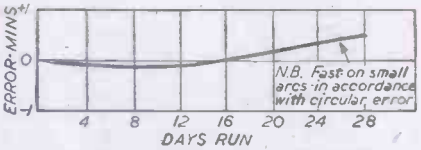
Synchronous clocks and the Ingersoll silent alarm have met such requirements up to now for these customers. But pendulum clocks may now be able to compete. Since there is no need for lubrication and no wear on the escapement, clocks should work longer between overhauls and hence give greater satisfaction to the user. Clocks fitted with a magnetic escapement have two to three times the tolerance for out of level than normal pendulum clocks, which again should give greater satisfaction to the user.

The time-keeping of a clock with a magnetic escapement should be much better than the same type of clock with a mechanical escapement.

I understand that the Central London Electricity Board could not obtain better than plus and minus ten seconds a week from the best British hand-wound clocks. Mr. Clifford's equivalent one-second pendulum model will keep time to plus and minus two seconds a week with a wooden pendulum rod, and with an invar-rod will follow the barometric error of 0.35 seconds per day per inch of mercury. Time-keeping of spring-wound pendulum clocks with magnetic escapements show circular error, i.e., they run faster as the mainspring unwinds and the pendulum amplitude increases. Every mechanical escapement clock is liable to run slow as the mainspring runs down. This surely indicates that escapement interference obscures circular error.



8-day spring-wound, one-third second pendulum clock with and without magnetic escapement.



8-day spring-wound, one-third second pendulum French clock with magnetic escapement (would not function with its mechanical escapement).

Fig. 5.—Diagrams showing comparative errors of magnetic and mechanical escapements.

According to Mr. Clifford, he first got the idea for this revolutionary clock while on "war" work in 1938, when the R.A.F. wanted a delayed-action fuse that was silent. The Germans made the mistake of fitting the ordinary escapements, and a stethoscope could tell whether they were duds or not. This scheme for a magnetic escapement was then devised. But by that time the chemical method and the loaded-wire method had made it unnecessary.

There is no doubt that Mr. Clifford has got something. I saw a letter from Dr. J. E. Richardson, Ph.D., B.Eng., M.I.E.E., A.M.I.MechE., Director of the National College of Horology, in which he visualises a great revival of British clock-making through this invention.

Electric Light and Power Installation—4

Converting a Light Control : Wiring an Electrolier : Metal-sheathed and Rubber-covered Cables.

By J. T. CORNER

CONVENIENCE and ease of control are the chief features of electric lighting that gave this form of illumination precedence over every other. When planning an installation, full use must be made of these advantages. All switches and control points should be placed where they are easily accessible when a room door is opened. It should never be necessary to search in the dark for a switch. Where a room has more than one door, a switch controlling the light is usually fitted at each door, these being interconnected, but independent in action. Intermediate switches are also fitted in long passages with doors leading off to various

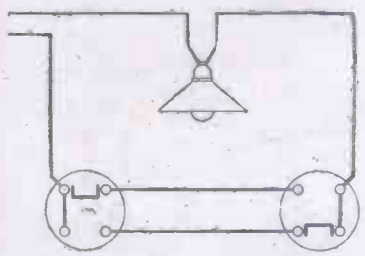


Fig. 15.—Two-way switch circuit.

rooms, and on staircases and landings. A convenient height for a switch is 3ft. 6in. from the floor.

Multiple-point Switching

Special switches with three terminals are used for two-way switching. These are diagrammatically illustrated in Fig. 15, with the method of wiring. It will be seen that the live feed wire is connected to the common terminal of one switch, but the common terminal of the other switch is connected to

(*Continued from page 154, February issue.*)

the lamp feed wire. The two switches are connected by intermediate wires. With this arrangement the light can be controlled by either switch irrespective of the position of the other.

In the same way a light can be controlled from any number of points by using intermediate switches wired as shown in Fig. 16. In this case the two outer switches are of the three terminal type, but the intermediate switches are of the four terminal type. These are of slightly different design and are provided with reversing connections which are wired as shown.

Where two-way or multiple-point switching is installed on staircases and landings, both the switch and light points should be taken from one power circuit, either that of the ground floor, or an upstair circuit. For the sake of economy there is often a temptation to use the power circuits of two different floors; but if a short-circuit occurs, the lighting of two floors will be out of action, instead of one.

A similar method of wiring is adopted for bedroom light circuits to facilitate control either from the door or by a person lying in bed. For the latter purpose a ceiling pull switch is preferable to the ordinary suspension switch; it is mechanically more durable and electrically safer. Bed reading lamps need have only a single switch control.

Converting a Light Control

A bed light controlled by one switch can easily be converted by two-way switching at very little expense. All that is required are two wooden blocks, two two-way switches and a length of triple cable to run from the original switch position to the new additional switch.

The old one-way switch and wood blocks are removed and discarded. The two new blocks are drilled for the two-way switches; these, of course, will have three holes in each to coincide with the three switch terminals. If the cable is run on the surface of the wall, a groove will be cut in the back edges of the blocks to allow for egress of the triple cable.

On removing the old switch, it will be seen that the two wires at the back are in a horizontal position. These must be altered to occupy a vertical position, i.e., one above the other, instead of side by side. One cable terminal

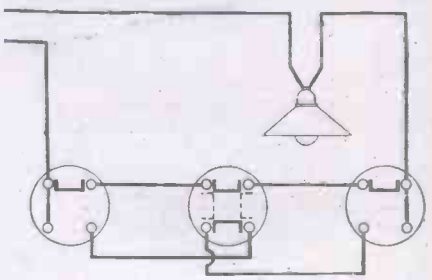


Fig. 16.—Two-way and intermediate switch circuit.

will probably consist of two wires twisted together; the two wires must not be parted.

The triple cable is first fixed, or sunk, into position, and the ends of its wires trimmed to connect to the switches, and the wood blocks screwed in position.

It will be seen that the three wires of the triple cable have insulated cases or cotton coverings of different colours, red, black and white, respectively. Place the red lead in the position previously occupied by the wire now in the vertical position (which was probably red). One end of the red lead of

the triple cable is connected to the common terminal of the new two-way switch, and its other end to the common terminal of the additional switch. The other leads, black and white, are connected, with the original switch wires, to the remaining switch terminals; and their other ends to the corresponding terminals of the additional switch, as shown in the diagram Fig. 17.

Instead of a wall switch the wiring can be run, and connected to a ceiling switch or a two-way drop switch over the bed. The former is preferable.

The foregoing arrangement is intended only as an expedient. If the point is being rewired the connections will be made as for an ordinary two-way circuit, as shown in Fig. 15.

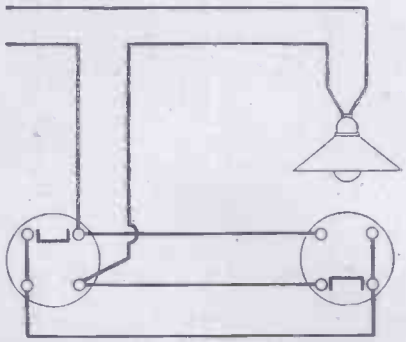


Fig. 17.—One-way converted to two-way switching.

Wiring an Electrolier

Sometimes it is necessary and desirable to fit an electrolier with a multiple-light control which permits independent switching of one or more lights. Assuming that an electrolier has three lights controlled by two switches, the feed wires will be run to the switches and lamp holders as in an ordinary circuit. The wiring is shown diagrammatically in Fig. 18. In this example the top switch controls one light, while the bottom switch controls the other two. It will be seen that the live switch wire is looped from one switch to the other, but each switch has a separate lead to the light fitting. Special three terminal ceiling roses are obtainable for this method of wiring, or the wires can be jointed and soldered together and a ceiling plate used. In the latter case the insulation must be soundly finished.

An electrolier can be converted to multiple control from the original single switch lighting. In most instances additional wires will be required, and, if possible, these should be drawn into the conduit, and two switches installed in the normal way. Unfortunately, tubing is usually skimped in size and no provision is made for wiring developments. To remedy such defects there is often an objection to pulling up flooring or making structural disturbances which add considerably to installation costs.

The simplest and quickest way of overcoming the difficulty is to fit a suspension switch from the ceiling rose and to rewire the fitting as shown diagrammatically in Fig. 19. It will be seen that the wall switch still controls one light, but the circuit of the other two lights is intercepted by a suspension switch. The live side of this switch is fed from the wall switch lead running to the single light, but the other side of the switch is connected to the return lead through the other two lamps, which are, of course, wired in parallel. By this method the suspension switch can be so fitted that it looks like a part of the electrolier. If preferred, a ceiling pull switch can be used.

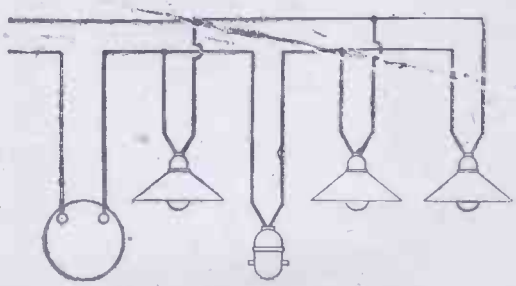


Fig. 19.—Three-light electrolier controlled by wall and suspension switches.

Metal-sheath Cables

Lead-covered cable is largely used for surface work, but there is nothing to preclude its being sunk in the plaster of dry internal walls. Even in wet positions, if the metallic sheath is sound, it is perfectly safe. There is a possibility of corrosion, caused by electrolytic action, in a fume laden atmosphere, or where chemicals are used.

There are several types of cable made by different well-known manufacturers, and each has a specific system of installation.

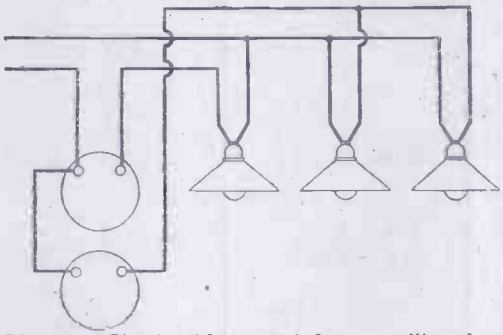


Fig. 18.—Circuit with two switches controlling three lights.

All fittings and accessories to the smallest detail should be those supplied by the maker of the cable being installed; no difficulty will then be experienced in matching the various parts.

Some makes of cable have an earthing wire incorporated within the metal sheath, and in contact with it. With this type, suitable provision is made on the junction boxes, switches, and other fittings for connecting the earthing wire. This usually takes the form of a small pin to which the wire is secured. Where necessary, for continuity purposes, the earth wires are joined together by a small thimble or a sleeve connector of light aluminium alloy. Another widely used system is earthed by bonding bars which clamp the metal sheathing where it enters the junction boxes and at other fittings with flat screw-down contact bars.

Lead-covered cable is supplied by all makers coiled on a wooden drum, from which it should not be removed until actually run into position and secured by metal clips. Cable of this type is somewhat delicate to handle; it is liable to "kink" if sharply bent or twisted, and the sheath is very difficult to straighten. The fact of being kinked is not functionally detrimental, but it looks ugly and unworkmanlike.

The run is first measured and marked out in as straight a line as possible, and the metal clips secured in position by suitable nails, or screws with small heads. The number of clips used depends on the size and weight of the cable, but economy in this respect is false. On an average, the spacing should not exceed eight or nine inches on horizontal runs, or twelve inches on vertical runs. Metal-sheathed cable, being comparatively heavy, is liable to sag and may pull away the clips.

To run this type of cable is a two-handed job; one man is needed to support the weight while the other manipulates the clips. The drum can be rigged up on a tripod so that it revolves freely on a spindle. A particularly long run can be temporarily supported in rope slings in line with the clips. By this method its length can be gauged before the cable is clipped in position.

Some straightening and bedding will probably be required. This can be done with a block of soft wood and a hammer or, preferably, a wooden mallet. If a hammer is directly applied to the metal sheath it will cause bruising and spoil the appearance of the work.

Concealed wiring of this type may be run from point to point by the shortest route, but surface wiring must be run in a rectangular form so that it conforms to the general lines of the room or building. Frequently this necessitates running by devious routes that require considerably more cable and makes looping-in complicated and cumbersome. To some extent this difficulty may be overcome by using junction boxes of the type shown in Fig. 14 in the previous article.

With the metal sheathed cable system most of the wiring is on the surface, and it is therefore more convenient and less costly to cut the wires and use junction boxes instead of looping by circuitous routes. Metal-covered cables must be bonded to provide a continuous earthed circuit and for this purpose metal junction boxes are to be preferred. These with suitable fittings, make electrical contact with the metal sheathing.

For surface work switches, plugs, and light fittings are invariably mounted on wooden blocks which are grooved and shaped at the back to fit neatly over the cable. This prevents dampness creeping through behind the fittings where it may cause trouble.

Rubber-covered Cables

In many factories and temporary buildings tough rubber, or cab-tyre cables are used fairly extensively. They are usually run on porcelain insulators that hold them clear of the wall.

The lead and return conductors are incorporated in the one rubber sheathing. Joint boxes are reduced to a minimum by looping-in, as shown in Fig. 20. Live feeds to the lights and switches are run from light to light, thus linking up all the light points in the circuit. A pair of wires is then run from the light to its controlling switch. By this method the ceiling rose or plate takes the place of a joint box, thus serving as an economical dual purpose fitting. In this case three terminal fittings are used instead of the normal two terminal ceiling rose.

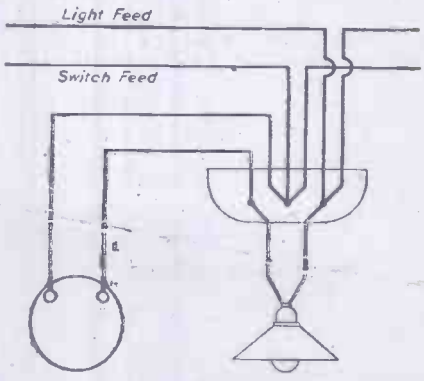


Fig. 20.—Looping-in twin conductors of lead- or rubber-sheathed cables.

Letters from Readers

Watch-repairing Bench

SIR,—May I suggest that M. M. E. Pearson's watch-repairing bench, described in the April issue, could be improved by the introduction of a sheet of medium or light green paper or paste-board beneath the glass. This will appreciably reduce any arising eye-strain.—R. BAXTER (Newtownards).

Indicator for Storage Tanks

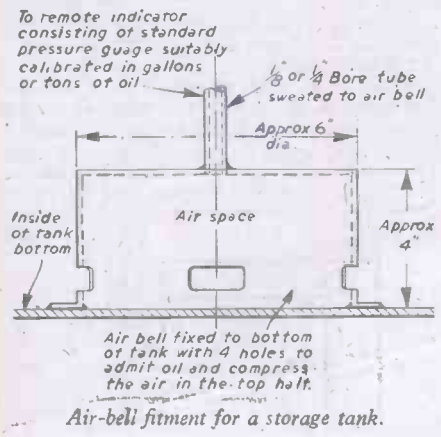
SIR,—Having read the note under the heading "Queries and Enquiries," in the April issue on "Electrical Indicator for Storage Tanks," I think that the better way of dealing with the problem is by using a pneumatic system of indication, as shown in the accompanying sketch.

With this sytem all that is required is a small air bell fitted to the bottom of the tank, with holes provided in the lower half in order to admit oil and thereby compress the air in the upper half and interconnecting pipe line, which is connected to a standard type of pressure gauge calibrated in either tons or gallons of oil; a "U" tube can, of course, be used if desired.

The interconnecting pipe line should be carried out with ⅛in. or ¼in. bore copper pipe, soft drawn, which can be obtained in long lengths, any joints being sweated to make certain of no leakage of air from the system. Provision can be made, if necessary, by a tee-piece and non-return valve, for using a small pump for charging the system with air.

I have found this system to be very satisfactory, and it has the advantage of having a low installation cost, and no electrical circuits and equipment to keep free from ingress of moisture in exposed positions, or the disadvantages of maintaining and charging of batteries. Furthermore, constant indication is available without operation of switches or the like.

A similar indicating system has since been developed employing a continuous capillary



Air-bell fitment for a storage tank.

tube of small bore (to any length), with a diaphram transmitter unit which can be lowered into the tank or bolted to a flange, the system being charged and sealed. This instrument is produced by Messrs. K. D. G. Instruments, Ltd., of Croydon.—R. SMITH (Gartmore).

Novel Wooden Chandelier

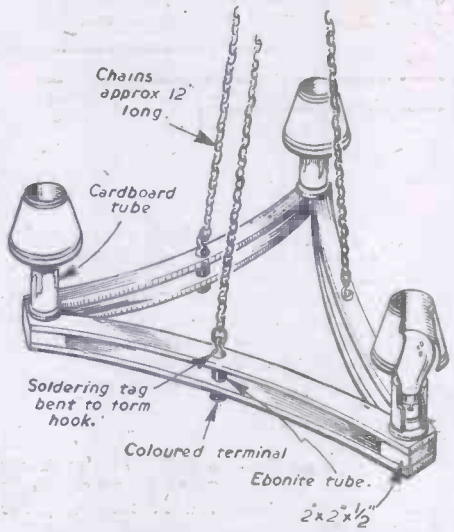
SIR,—The following brief outline of a novel chandelier of wood which I have recently made may be of interest to other readers of PRACTICAL MECHANICS.

The difficulty of obtaining timber prompted the following very simple method of building up a novel chandelier, using six coat-hangers. The sketch shows the idea clearly, and work should proceed as follows:

Remove the hooks from the hangers and fill the holes with plastic wood, and clean down with sandpaper. Cut three small pieces of wood roughly 2in. × 2in. × ½in.; these will be required for corner blocks.

It is then necessary to square the ends of the hangers, and in order to ensure that all are exactly the same length, clamp all six together and cut square about ½in. from each end.

For building up the frame, place three hangers on the table as per the sketch, then glue on the corner blocks; when the glue has set, fix the top three hangers in the same way. It is advisable to put a small cabinet pin through each hanger and make a solid joint. With a fretsaw, file and sandpaper, shape the blocks to the curve of the hangers, and the



An electric light chandelier made with coat-hangers.

whole frame should then be cleaned prior to staining or enamelling.

A small support will be required at the centre of each arm, and this is easily made by cutting a piece of ebonite tube, as used for aerial lead-in, into short ½in. lengths, and a short length of 3/16in. rod, with nut and terminal. It is a good idea to get a coloured terminal for the underside, as it adds to the appearance.

Before putting on the top nut, bend a large soldering tag into a hook in order to take the supporting chain.

To each corner fix a baseboard bulbholder, and wire up in parallel, leaving sufficient wire to reach the ceiling rose.

Pieces of cardboard tube cut to the height of the bulbholder and painted cream will give a realistic candle effect.—G. S. BEAVIN (Petts Wood).

Controlling Electric Light from Bed

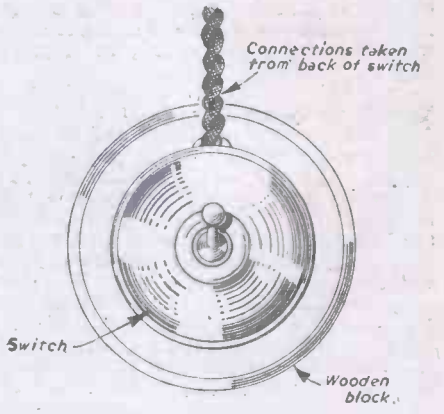
SIR,—I have read the article in the April issue by "W. R. Knapp" re "Controlling Electric Light from Bed." May I suggest one that is controlled electrically?

The parts required are a length of twin flex to reach from the wall switch up to the picture moulding and along top of same as far as the bed, and to hang down to the required length. The flex can be fastened on top of the moulding at switch and bed ends by an insulated wire clip.

At the bed end the flex is connected to an ordinary pear switch.

Next the mains are switched off and the wall switch unscrewed off the wooden wall board and the two remaining ends of the flex connected to the two switch wires so that when the switch is again screwed to the wooden wall block the flex comes out between the back of the switch and the wooden block. (See sketch.)

When entering the room one switches on in the ordinary way at the wall switch; when near the bed you also switch the pear switch



Making a flex connection to a switch for controlling electric light from a bed.

to the *on* position. If you are going to bed you need to put the wall switch to the *off* position. The light will remain "on" till switched off at the pear switch.

The light can be controlled at will from the pear switch.

When screwing the wall switch back on the block do not put too much pressure on the screws, as the flex protruding at the back of the switch might break the porcelain.—B. T. MILLER (Chesterfield).

Cutting "Triplex" Glass!

SIR,—In a recent issue of PRACTICAL MECHANICS you published a letter concerning the cutting of "Triplex" glass.

We would like to point out that, in our opinion, "Triplex" toughened glass cannot be cut by using a carborundum slitting saw. The moment that the outside skin of the glass (which is under compression) is pierced, whether by diamond, carborundum saw or by any other means, the forces of equilibrium are destroyed and the whole sheet of glass disintegrates into small particles. Whatever means are employed, the results will be the same and that is why we always specify that "Triplex" toughened glass cannot be cut or ground after manufacture.—"TRIPLEX" SAFETY GLASS CO., LTD. (London, W.1.).

ELECTRICALLY OPERATED GARAGE DOORS

(*Continued from page 289*)

ordinary lock actuates the switch, some secret device used, or a bell arranged to ring whilst the doors are opening. The writer uses the second device.

The leads should be run to the outside switch through galvanised waterproof conduit.

It is also very important that the insulation of the supply transformer should be above suspicion, and the secondary winding should be wound on a separate paxolin former. Details of a suitable transformer for intermittent use are as follows:

Core cross section, 1½ sq. in.; primary winding, 240 volts input, 1,200 turns; 30 S.W.G. enamelled wire; secondary, 190 turns 22 S.W.G. D.C.C. wire.

THE WORLD OF MODELS

Kodak Model Engineering Exhibition : Training in Precision Work

By "MOTILUS"

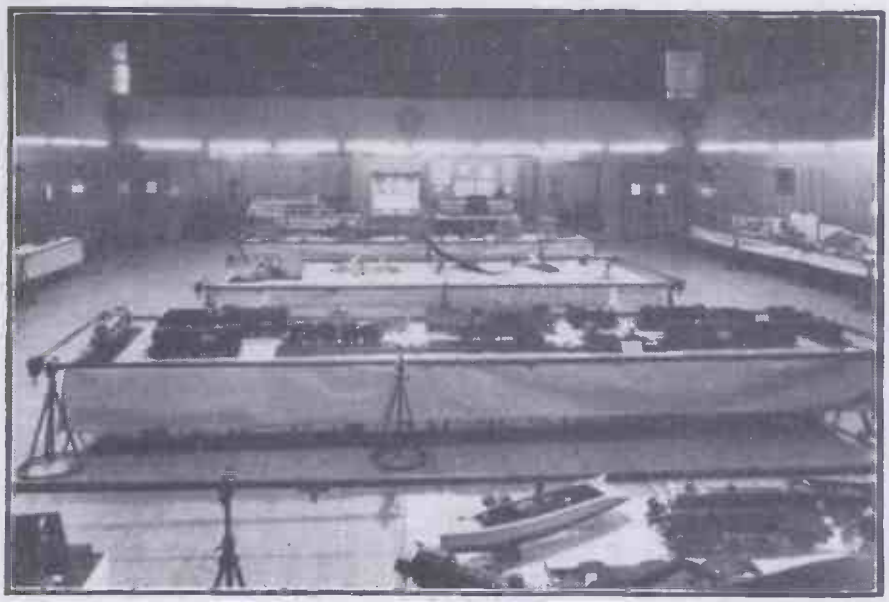


Fig. 1.—General view of the model engineering and handicraft exhibition held in Kodak Hall at Wealdstone.

THE name "Kodak, Ltd." being practically synonymous with "excellence" in the world of photography, I always look forward to a Kodak Exhibition in anticipation of seeing good work well presented. In March this year, Messrs. Kodak, Ltd. held another of their model engineering and handicraft exhibitions at Kodak Hall (Fig. 1), which is part of the well-equipped welfare facilities enjoyed by their employees. The exhibits did not appear to be as numerous as on previous occasions, but they all maintained the high standard that is always evident in the work of Kodak employees, and also the work of the Harrow Model Railway Society who co-operated with Messrs. Kodak on this exhibition. I had the privilege of a private view of the display in Kodak Hall, at the invitation of the chairman of the Kodak Society of Experimental Engineers, Mr. K. N. Harris, who was able to draw my attention to some of the most outstanding items.

Passenger-carrying Track

As usual, the outdoor railway running track proved a popular feature. The track had been specially built to accommodate six different gauges, from 1¼in. to 7¼in., and was 120ft. long. It was raised 18in. from ground level by reinforced cast concrete supports. The wooden sleepers were placed between two angle irons running the whole length of the track, and fixed to them were the steel sections to provide the various running gauges. A smart, 4-8-2, 3-cylinder locomotive was being used on the track, for passenger-carrying, for which purpose some excellent trucks were provided with footrests suspended on either side. There was a full load of passengers every trip! The locomotive had been built by Mr. Spinks of the Harrow Model Railway Society, who is seen in the illustration, (Fig. 2), with his model. Mr. Spinks also had a 6-coupled tank locomotive on view in the exhibition.

Among the model locomotives displayed, the Championship Cup was awarded for the unpainted, ⅜in. scale, 3½in. gauge, "Royal Scot," made by Mr. Dewhurst, an engineer and member of the Harrow Model Railway Society. This model (Fig. 3), was fitted with 3 cylinders, piston valves and mechanical lubricator and, except for the cylinders, was made entirely from the model builder's own drawings. It is interesting to note that Mr. Dewhurst's workshop is in his garage, where he uses a 3½in. centre Drummond lathe, a drilling machine of his own make, and the usual hand tools. Quite a new idea was the display, with each engineering exhibit, of a card giving particulars of the workshop facilities available for the construction of the model. This seems a very good way of indicating to would-be modelmakers the type of equipment and tools they would require for the building of a similar model.

Model "Pacific" Loco

The second prize in the locomotive section went to a Kodak sales manager for his semi-scale model of a 3½in. gauge L.N.E.R. (G.N.) "Pacific" locomotive, based on L.B.S.C.'s "Hielan' Lassie" design, and made in his small workshop with the aid of a 3⅜in. centre lathe and the usual hand tools. Another model I found worth studying carefully was Mr. Turpin's ⅜in. scale, unfinished, L.N.E.R. "Pacific" locomotive, for 3½in. gauge. Mr. Turpin's workshop is in a garden shed, where he has a small Myford bench lathe, a bench drill of ⅜in capacity and a vice. When this model is finished, it should be a very good example of model locomotive workmanship.

Fig. 2.—Scene on the outdoor, passenger-carrying railway. Mr. Spinks, of the Harrow Model Railway Society, and builder of the model locomotive, can be seen "getting ready for the run."

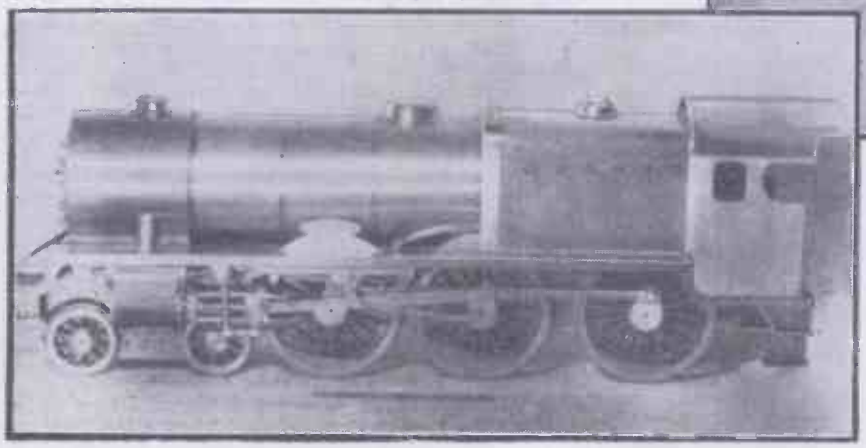


Fig. 3.—View of the partly-finished and unpainted model of the 3½in. gauge model of the "Royal Scot," made by Mr. Dewhurst.

The Harrow Model Railway Society devoted nearly all their space to an excellent display of gauge OO locomotives and rolling stock, with only one or two gauge O models. There was a particularly interesting model, made by Mr. R. E. Wilson, of an L.M.S. Diesel shunting engine with three vehicles and brake van, and also a very fine 7mm., 1¼in. gauge, G.W.R. locomotive of 1,000 class, in highly

polished brass with a G.W.R. refrigerator van and covered goods van.

Members of the Kodak Society of Experimental Engineers had made some excellent contributions to the exhibition. On their special display stand I found a model boat (Fig. 4) with a power plant embodying a "Scott" type water tube boiler, supplying steam to a uniflow engine of 11/16in. bore and ¾in. stroke, with a poppet valve inlet, 50 per cent. cut off. The underwater propeller unit is driven by bevel gears of equal ratio. Running light, the engine does 8,000 revs. per minute, with a pressure of 175lb. per square inch. This model was the work of Mr. K. Meyer of the Kodak Developments Department.

In the ship section there were not a great many exhibits, but I would mention the model of a naval schooner of circa 1780, which won the first prize for a ship model. I also liked Mr. Walliker's old-time model of the "Elizabeth Jones," a ship of 1570, and some of the attractive small sailing ship models. Another section with only a small display was that of the aircraft, where interest in this branch of modelmaking seems to be diminishing, although this is a tendency that I have not noticed at any other recent exhibitions, where aircraft models are usually well in evidence.

As might be expected, there were some fine examples of precision work among the model engines and the instruments on show. One was a small engine made by the chairman of the Kodak Society of Experimental Engineers, Mr. K. N. Harris. This was a model based on a small rolling mill engine (modernised) that was actually in use at the Kodak works some fifty years ago. Mr. Harris built the model during the war, taking some six months to complete it. The engine has a working pressure of 100 lb. per square inch and is to a scale of ¾in. to 1ft. No castings were used in the construction, only sheet and drawn metal being used, with brass cylinders of ⅝in. bore and 1¼in. stroke. The engine was mounted on a base that gave the impression of black and white tiles, and when I asked Mr. Harris how he had done this he explained that it was done entirely by a photographic process. Sensitised emulsion had been put directly on to the brass base, with very good effect.

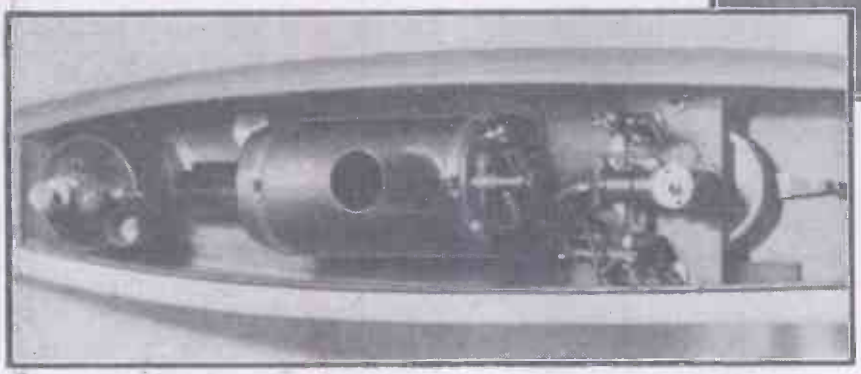


Fig. 4.—The power unit of the motor-boat designed and built by Mr. K. Meyer, of the Kodak Society of Experimental Engineers. The boiler is heated by a blow-lamp, and the engine is of the uniflow type.

Fig. 5.—Scene in the apprentices' workshop in the engineering section of the Kodak works.

handicrafts, and a display of work done by apprentices in the light engineering workshops of Messrs. Kodak, Ltd. No doubt this fine training of youths in precision work accounts for some of the excellent models to be seen among the exhibits from the Kodak Society of Experimental Engineers. These workshops are well equipped with the latest machinery, and every facility is provided to encourage apprentices to take a great interest in their work and to enable them to acquire the skill and accuracy required for the minute details in the construction of cameras and projectors. Among the handicrafts represented were leather work, wood carving, knitted goods and embroidery and many sketches and paintings. Mr. D. C. Simmons of Willesden Green had executed a very fine pair of pictures in wood, carved in perspective, both representing interior cottage scenes.

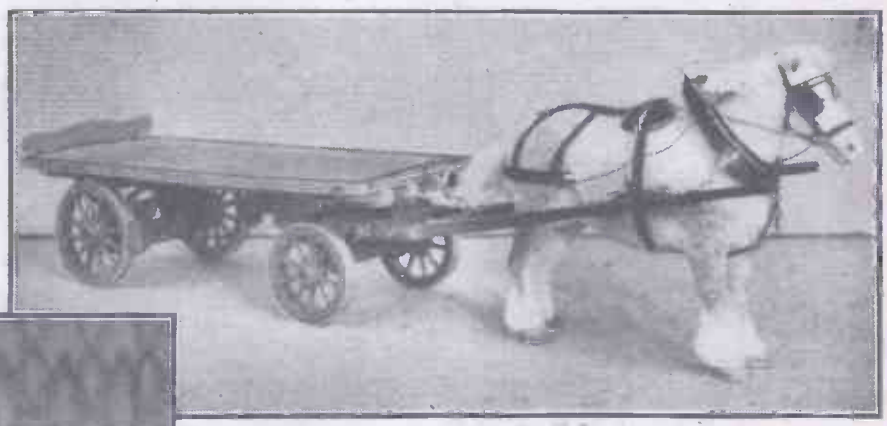


Fig. 6.—An unusual example of modelling: a horse and dray made to a scale of 1in. to 1ft. by Mr. E. Hasler, of Witney, Oxon.

A novel feature that attracted much attention was the work of Mr. R. W. Conway, a glassblower. Mr. Conway was there himself to give demonstrations of his craft, blowing shapely tubes and glass forms, some of them in fantastic curls and curves, and some of them in miniature. I saw a tiny teapot he had blown from a single piece of glass, and it was barely an inch high, yet perfectly shaped.

Fig. 7.—A fine, detailed model of the "Golden Hind," made by Mr. H. A. Harrison, of Colne, Lancs.

Training in Precision Work

The Exhibition was not entirely confined to models, but also included a large range of

The "Vortex Tube"

Those who are intrigued by scientific puzzles spent a long time near the "Vortex Tube" that was being demonstrated to visitors. The "Vortex Tube" consists of a stream of compressed air which is passed into

a chamber of helical cross section, so as to impart a vortex motion to the air in side tubes that are attached to the chamber. The air is then forced out of two tubes on either side, one air stream being hot and the other cold. The exact details and precise action of this is not properly understood, but the effect on the air is such that the fast moving air molecules are sent into one stream and slow moving ones into the other. This set many a young would-be scientist scratching his head!

There were not a great many trade stands in the Exhibition, but Messrs. Bassett-Lowke, Ltd., had a display in the central position at the end of the main hall. The stand was not serviced, but contained a representative display of some of the latest productions of this company, both for gauge O and OO model railways and locomotives and various fittings and castings for model engineers.

An Unusual Model

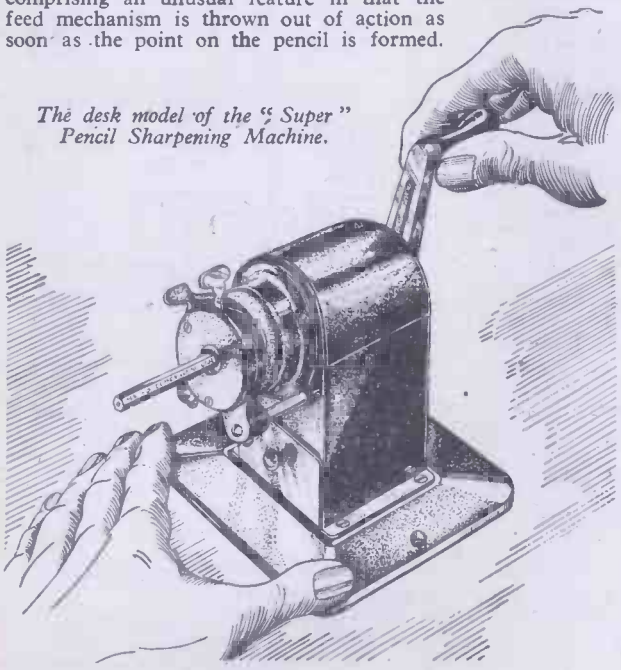
An unusual venture in modelmaking has been successfully attempted by Mr. E. Hasler of Witney, Oxon, who made the model horse and dray shown in Fig. 6. This very realistic model is to a scale of 1in. to 1ft. and was made specially for Mr. W. G. Harbinson of Belfast, who wanted a model of a "shire" or "Clydesdale" grey horse with a dray such as is used by brewery companies and the railways for heavy deliveries. As can be seen from the photograph, the model is detailed: the wheels are spoked and the front pair can swivel; there is a working brake, and the harness can be completely removed from the horse. Also, such small items as the metal tyres for the wheels and the horse's shoes, are clearly shown. This type of modelling calls for a larger measure of artistic temperament than does that of model engineering. Feeling for the atmosphere and nature of the model are of paramount importance and supersede the need for microscopic accuracy that is demanded for engineering, shipping and architectural models.

The old-time ship model illustrated in Fig. 7 is of the "Golden Hind," and was built by Mr. N. A. Harrison of Colne, Lancs. Having worked without drawings, taking his details from pictures, he tells me there are one or two structural differences between the pictures of the "Golden Hind" and his model, which might be spotted by observant readers, but they are only small divergencies. In making the model, the ribs were first built up from the keel and then covered with strips of wood, 1/16in. thick. The decks are laid in wood sheets, scored lines giving the effect of planking. It is interesting to note that when the decks are polished the scored lines absorb more polish than the flat wood, so heightening the effect of planking. For the running blocks lead shot were used, which were flattened and drilled. In making the sails, he found that cotton dipped in a thin solution of plaster of Paris was not very satisfactory, so he abandoned this and used a lampshade material instead. Mr. Harrison spent twelve months making this model, and made every part of it himself, with the exception of the barrels for the brass cannon, which were purchased from Messrs. Bassett-Lowke, Ltd. By each cannon is a small pile of cannon balls—lead shot once more, firmly glued together. It is a pity that the photograph cannot show the colouring, as the hull is cream, the triangular patterns round the sides are green, cream and red, and there is a considerable amount of gilt decoration.

Trade Notes

"Super" Pencil Sharpener

THE "Super" Pencil Sharpening Machine, marketed by Watkins and McCombie, Ltd., Charterhouse Works, Wandsworth, S.W.18, is a heavy desk model comprising an unusual feature in that the feed mechanism is thrown out of action as soon as the point on the pencil is formed.



The desk model of the "Super" Pencil Sharpening Machine.

The cutting cylinder is made of specially hardened steel, and should give good service for 12 to 18 months according to the amount of use: the cutting cylinder can be resharpened when necessary. Adjustable mechanism is provided to give fine, medium or coarse point as required, and the three-jaw chuck will take varying thicknesses of pencil. The shavings fall into a small metal box at the base of the machine, and may easily be withdrawn for emptying by the handle provided.

Phillips Newsreel

AN interesting booklet under the above title was recently issued by J. S. Phillips, Ltd., of Smethwick, the well-known manufacturers of bicycles and component parts. Published as a House Journal, number 1, dated Spring 1948, contains a foreword by the managing director, followed by a short history of the firm since its inception in 1892. There are also notes from various departments, a women's page, and recreation news and photographs.

Bassett-Lowke Ship Model Catalogue

THE first post-war catalogue of ship models has just been issued by the well known firm of Bassett-Lowke, Ltd., of Northampton. A fine selection of models, fittings and propelling machinery and parts are listed which should have a great appeal to all ship model enthusiasts. Of particular interest is the fine range of scale model ship fittings which are beautifully finished, silver plated and black oxidized. They are in two scales, $\frac{1}{8}$in. to the foot, and 3/16in. to some specially designed the foot. Also listed are permanent magnet boat motors which occupy but little space and consume only a small amount of current.

New "Burmos" Pressure Stove

AN entirely new and portable pressure stove is marketed by Messrs. Townson & Coxson, Ltd., of Alliance Works, Essington Street, Birmingham, manufacturers of the well-known "Burmos" products.

Known as the "Touring Outfit," the stove is fitted with an ingenious storm-proof shield and can be erected or removed in a few seconds. No tools are required other than the spanner provided for removing the burner, and the entire outfit packs into a box measuring only 3in. by 7$\frac{1}{2}$in. by 5$\frac{5}{8}$in. Capacity is 1 pint of paraffin or kerosene, with a boiling speed of 1 quart of water in 4 minutes. The complete outfit costs 28s. 6d.

The new "Burmos" pressure stove.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 72 (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.

Gelatine Moulds for Plaster Ornaments

I AM interested in making wall plaques and plaster models. Could you give me any information regarding the gelatine used for making the moulds? Also, are there any books on the subject?—F. Gartside (Guernsey, C.I.).

TO make a glue or a gelatine mould, the glue or gelatine should be placed into cold water and allowed to soften and to swell up overnight. The liquid is then heated in a surrounding water bath until the glue or gelatine has dissolved. If the resulting solution is too thin, the heating must continue until the solution has the consistency of thick syrup—until it is just capable of being poured freely into the model so that it can enter into the finest details of the latter. It is always advisable to dust the model heavily with French chalk to prevent the glue or gelatine solution from sticking. The solution should also contain a few drops of carbolic acid in order to prevent mould growths.

There are no books on the subject of gelatine moulds, apart from mould compositions, which are detailed in various books of formulæ. In our opinion, wooden moulds are the best for making plaster ornaments. Gelatine moulds tend to distort and shrink.

Removing Stains on Shoes

I HAVE several pairs of brown shoes which are in excellent condition, but are stained round the toecaps with dirty oil (from a motor cycle). I wish to renovate them by stripping and repolishing. Is there any way of removing these stains? I have tried most obvious things, such as petrol, methylated spirit and turps, but these don't seem to move the stains at all.—T. Neagle (Edgware).

IF you will be content with having the shoes a darker colour than they were originally, we think that you will make a success of the stain removal, but if you desire to restore the shoes exactly to their former colour, you will find the task next to impossible.

The procedure outlined below should be followed:—

Remove as much oil, grease or wax from the shoes by liberal rubbing with petrol-saturated cloths. If you can get any carbon-tetrachloride, use this powerful grease solvent, also. Benzene may also be used. When thoroughly degreased, the leather should have a dull surface appearance.

Dissolve an ounce of oxalic acid in about a small teacupful of hot water, and apply this liberally to the leather, particularly to the stained areas. You may be successful in effecting a partial bleaching action with this. If you cannot procure oxalic on account of it being a Schedule 1 poison, try a strong solution of citric acid instead. Do *not* use peroxide as a bleach—it attacks the leather.

Having now effected a bleach, partial or complete (but more likely the former), obtain some leather stain from your local bootshop and, using this cautiously, even up the appearance of the leather. Having done this, rub castor oil into the leather to restore its lost oil. Give the shoes thus treated a day or two to dry out. Then rub them up with ordinary brown shoe polish.

Black Ink for Celluloid Marking

COULD you please tell me what type of marking dye is used for white celluloid, when marking calibrations, such as on a slide rule? Could you also tell me how to make it, or where it can be purchased.—R. F. Roe (Derby).

A BLACK ink for celluloid is made according to the following formula:—

Tannic acid	..	5 grams.
Ferric chloride	..	5 grams.
Acetone	..	50 c.cs.

Dissolve the tannic acid and the ferric chloride separately in equal portions of the acetone. Then mix the two solutions. Write with an ordinary pen nib.

You will probably be able to obtain celluloid ink from either of the undermentioned firms:—

Messrs. P. & J. Arnold, Ltd., Algersgate Works, Benwall Road, London, N.7; Messrs. Alfred H. Atkins, Ltd., 27 & 28, Fetter Lane, Fleet Street, London, E.C.4.

Solvents for Varnish

COULD you assist me with the following problem?

What are the solvents used to dissolve the impregnated varnish on small electric motor armatures when same are being stripped down for rewinding? Also what is a suitable varnish to use for impregnating when new winding has been put on?—L. J. Lewis (Epsom).

SMALL motor armatures are usually varnished with shellac varnishes, although of recent years there has been a tendency to substitute synthetic resin varnishes.

A shellac varnish can be removed completely by soaking the armature in a bath of methylated spirit which will, after several hours, soften the varnish and eventually dissolve it. Some synthetic varnishes, however, will resist methylated spirit. Many of such varnishes are soluble in acetone.

A good varnish may be made simply by dissolving good grade shellac in methylated spirit until a strong solution results. It is then filtered through cloth.

Other electrical resinous varnishes are prepared by Bakelite, Ltd., 18, Grosvenor Gardens, London, S.W.1, to whom you should apply for particulars since these are exceedingly difficult to make for oneself.

Whitening Piano Keys

CAN you supply me with the formula for the solution to whiten ivory piano keys? Usually they are buffed with polishing key soap after scraping.

Recently I saw a french polisher take a piece of chamois leather, place some aqueous solution on it and then he rubbed a badly stained piano key over. In a few seconds the key came up equal to new. I think the solution contained sulphuric acid, but there was definitely no bleach, so perhaps the whitening came about with reduction rather than oxidation. The solution cleans woodwork too, so I would be very grateful if you can offer any suggestions.—J. Fidling (Wirral).

WE are afraid that merely from the information which you give us we cannot possibly identify the liquid which was used for the whitening of pianoforte keys. There are many liquids which have been suggested for this use, and we think it best if we enumerate some of them so that you will then be in a position to make your own experiments.

Solutions of salts of lemon, ammonium oxalate, ammonium oxalate and citric acid, sulphurous acid, sodium hypochlorite, dilute sulphuric acid, dilute nitric acid, strong hydrogen peroxide with or without addition of ammonia and, finally, sodium hydrosulphite, and, possibly, a strong solution of ordinary sodium sulphite or sodium metabisulphite.

You will, of course, realise that the use of any of these solutions is attended with some risk. If the pianoforte keys are of celluloid or plastic, on no account should acid be used on them. Ivory will stand up to acid treatment, but there is always a risk of the solution penetrating down the sides of the key and swelling the woodwork.

Indicating Liquid for Compass

I AM in possession of an aircraft compass in which the rubber sealing ring has perished, allowing some of the liquid to evaporate.

Could you please tell me what the solution consists of? Also, what could I substitute for the rubber ring?—F. Turner (Birmingham).

COMPASSES and other instruments employ various indicating liquids, hence it is quite impossible for us to express any definite and precise opinion on the nature of the liquid in your compass without our knowing the type of compass, date of manufacture and other particulars.

As a rule, however, these instruments use rectified spirit (alcohol), plain or coloured, and sometimes ethylene glycol mono ethyl ether. These are both anti-freeze liquids and can be obtained from any local chemical supply house, such as Messrs. W. and J. George and Becker, Ltd., 157, Great Charles Street, Birmingham, 3.

For the worn-out rubber ring you could substitute one of several layers of paper which have been impregnated with gold size and allowed to harden. A ring of Perspex would also resist the liquid.

Light-sensitive Cells

I WISH to make a self-generating light-sensitive cell, similar to those used in exposure meters. I am given to understand that selenium is formed upon an iron plate. I have fused selenium upon iron but have met with no success. I have a sensitive galvo and material for the job. Will you please inform me how this can be done successfully?—W. J. Sadd (Norwich).

THE light-sensitive cells which are used in photo exposure meters are not of the selenium type since selenium cells do not generate a current under light influence. They only change in electrical resistance under the impact of light. The photocells which you mention are of the copper oxide type, and we are afraid that you will find it beyond your technical means to construct one, since the sensitive surface is prepared by a secret heat treatment. If you wish, you can immerse a clean sheet of copper in a very dilute solution of copper sulphate (say, 1 part in 100 of water) for a few days. This will give the copper surface a light-sensitive character, but the sensitisation will not be in any way reliable, and it will be useless for your purpose. There is, unfortunately, no published information concerning the preparation of the commercial light-sensitive elements for photo exposure meter and similar purposes.

Crystal-growing Process

WILL you kindly describe the process of "growing" crystals. Recalling early experiments of suspending glass beads in jars of solution, what substance would be required, and quantity for, say, ½ pint of water? Would the colour be determined by the substance or can it be regulated?—B. Haley (Nottingham).

THE growing of extra-large crystals is a very delicate and intricate task. We presume, however, that you wish only to grow large single crystals, in which case the procedure is as follows:

Dissolve in warm water as much as possible of the salt-to be crystallised. Allow the resulting solution to cool. It will deposit small crystals. In the clear liquid above the small crystals suspend a single small crystal as perfect in form as possible. Suspend it in the liquid by means of a fine silk thread or a strand of human hair. The suspended crystal must be allowed to remain undisturbed for several days during which it will grow in size up to ½in. or more.

The jar containing the solution must remain covered and undisturbed. The temperature must be constant and even the prevailing barometric pressure of the atmosphere must be more or less constant. Without these essential factors the crystal will not grow regularly.

Please note also that the crystal growth must be started by means of a crystal of the same material which is dissolved in the solution. This is termed a "seed" crystal. A glass bead will not give good results. It will only tend to produce a crop of fine crystals instead of a single large crystal.

The solution must always be "saturated," that is to say, it must contain as much dissolved material as it will hold at that temperature.

You cannot change the colour of the crystals. It cannot be "dyed" in any way. Most crystals are colourless, but a few are coloured. Copper sulphate, for instance, is blue, nickel sulphate is green, chromic alum has a puce colouration, iron sulphate is green, potassium dichromate is orange, and so on. The colour is always determined by the nature of the crystallising substance. It cannot be regulated.

Rapid-drying Gum

CAN you please supply me with a formula for a rapid-drying gum such as that used in the manufacture of envelopes?

What is the method of application?—H. A. Wills (St. Peter-Port, Guernsey).

THE following is a good envelope and label adhesive:

A. Dextrin (white or yellow)		20 parts (by weight)
Water	.. .. ..	24 ,,

Dissolve by heat

B. Borax or boric acid	..	0.5 parts
Glycerine	..	0.5 „
Water	..	2.0 „

Add B to A. Then stir in a few drops of carbolic acid or Lysol to act as a preservative.

For use.—Brush the mixed solution lightly on to the envelope flap or back of the label and allow it to dry without heat.

Dissolving Rubber Dust

COULD you advise me as to what spirit I should use to dissolve rubber dust ? I wish to make up a form of plastic solution to put on cloth as an experiment.—J. Summerton (Dunstable).

THE exact solvent for your rubber dust depends entirely on the purity of the dust and on the state of vulcanisation of the rubber in the dust. If the dust is largely mineral "filler" and/or if the rubber is in a high state of vulcanisation there is no solvent which will dissolve it. On the other hand, if the degree of vulcanisation is only slight, ordinary naphtha will dissolve it.

Other rubber solvents are carbon disulphide, chloroform, trichlorethylene and carbon tetrachloride. None of these will dissolve scrap rubber really efficiently, but by allowing the scrap dust to soak for a few days in one or other of these solvents, you may be able to reduce it to a plastic, gelatinous mass, in which condition it may be applied to cloth.

Our experience with the reclaiming of these scrap rubber materials leads us to advise you not to be too hopeful of the results. The average scrap rubber material is only reconstituted on a works scale by being subjected to mechanical shredding and kneading, and even this is apt to be a very prolonged job.

Fountain Pen Ink : Small Steel Balls

I WISH to make up quantities of red and blue quick-drying dye, such as used in ball-point pens. Could you please give me the formula for same and tell me where the chemicals are obtainable ?

I have tried to purchase quantities of 1 mm. steel balls, but none of the ball-bearing manufacturers I wrote to can give a promise of delivery. I would be grateful for the names of firms who may be able to supply me.—H. Cademann (Leeds).

ANY aniline dye can be used for making the ink you desire. The dye should be dissolved in a 50 : 50 mixture of rectified spirit and water, and just a few drops of glycerine should be added to prevent the too rapid evaporation of the solution. The solution should be about 6 parts of aniline dye (of the desired colour) and 92 parts of water.

You should be able to obtain small amounts of dyes from Messrs. Reynolds & Branson, Wholesale Chemists, Leeds, or, alternatively, from Messrs. J. W. Towers, Ltd., Victoria House, Widnes, Lancs.

We do not know of any ball-bearing manufacturers who would be able to give you anything like an immediate delivery of small steel balls. Delivery periods of up to (and over) six months are "normal" nowadays ! However, for your information, the following are the names and addresses of reliable manufacturers of steel balls for various uses :

British Timken, Ltd., Cheston Road, Aston, Birmingham, 7.
Messrs. W. E. Cramp & Sons, Ltd., 8-12, Cheshire Street, Ashton, Birmingham.
Fischer Bearings Co., Ltd., Upper Villiers Street, Birmingham.
Denton Engineering Co., Ltd., Springfield Ironworks, Newton, Hyde, Cheshire.
Messrs. S. W. Lewis & Co., Ltd., Exmouth House, Pine Street, Clerkenwell, London, E.C.1.
Ransome & Marles Bearing Co., Ltd., Stanley Works, Newark-on-Trent.
Skefko Ball Bearing Co., Ltd., Luton, Beds.
Torme, Ltd., 57, Old Street, London, E.C.1.

Jointing Compounds : Powdered Asbestos

THERE are some non-hardening compounds on the market for jointing cylinder heads, etc. Could you tell me of what they are composed ? Also, where can I get powdered asbestos, which should be very fine for the purpose of making a paste ?—C. Beardmore (Newport, Mon).

THE jointing compounds to which you refer are mostly mixture of bitumen, resin and raw linseed oil. The proportions of these ingredients have never been published. Hence, you will have to make your own trials and experiments. Many of them have a mineral component or "filler," consisting of a mixture of sand and asbestos powder—say, about 20 per cent. of this filler.

Powdered asbestos is fairly cheap stuff. It can be obtained from Turner Brothers Asbestos Co., Ltd., Rochdale, Lancs. It is supplied in varying degrees of fineness, from a very coarse, fibrous material to an exceedingly fine powder.

Gut "Reviver"

COULD you give me some information on gut revivers for tennis racket strings ?

I would like to know if this is just a good quality clear spirit varnish or are there other properties included ? If so, will you kindly give me a formula for making same or names of firms who could supply ?—G. C. Young (Shanklin, I.O.W.).

THERE is really no such thing as a gut-reviver. Once a gut has lost its nature or has perished there is no substance or mixture of substances which can restore it to its former condition. The gut revivers which are used in the sports world merely give a varnish or other type of coating to the gut, thereby increasing its smoothness, improving its appearance, and rendering it waterproof or, at least, water-resistant.

As you surmise, many of these revivers are merely a solution of shellac and/or other gums in spirit. These dry with a hard, glossy surface. By dissolving shellac in methylated spirit, you can make your own reviver.

Another similar preparation which has been recommended has the following composition :

Gelatine	.. ..	3lb.
Water	.. ..	1 gallon
Glycerine	.. ..	5 ozs.
Turkey Red oil	..	1 oz.
Neatsfoot oil	.. ..	1 oz.

Mix the above ingredients together. Heat to near boiling-point until the gelatine dissolves. Then allow to cool. For use, soak the gut in this liquid for several hours, then allow it to dry slowly. For commercial use, the spirit varnish type of gut dressing is preferable.

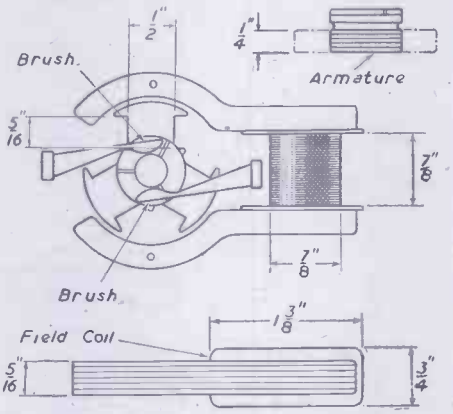
Possibly you may be able to obtain such dressings from one of the following firms of sports gut makers :

Messrs. L. Gathier & Co., Ltd., 2, Bow Lane, London, E.C.4.
Messrs. G. Tracet, 101-102, Turnmill Street, London, E.C.1, and
Messrs. J. Noonan, 61, Vinegarhill Street, Glasgow, C.1.

Re-winding a Small Electric Motor

I WOULD be obliged if you would supply me with the following information regarding the rewinding of a 6-coupled gauge "0" electric locomotive mechanism, which has an automatic reversing device fitted between the side frames. The dimensions of the armature and field magnet are given in the accompanying diagram.

The motor was originally wound for 20 volts D.C. I would like to rewind it to run on 8 to 10 volts D.C. Could you tell me the size of wire and number of turns required to give it plenty of torque and to run at the usual speed of a small motor ?



Armature and field magnet for a small electric motor (D. R. Lewis.)

The armature had 170 turns of 34 S.W.G. approx. on each pole and was series wound.—D. R. Lewis (Hale).

WE suggest you wind the armature with 68 turns of 29 S.W.G., and the field coil with 195 turns of 23 S.W.G. with centre tapping. As the motor will take an increased current when used on the lower voltage the resistance units of the speed controller will, no doubt, require winding with thicker wire.

Painting Aluminium : Plastic Paint

I HAVE constructed a trailer caravan similar to the "Practical Mechanics" blueprints, but I used aluminium sheet and dural angles for its sides and roof.

I desire to paint the caravan, so could you kindly give me the information on how to go about this operation, as I am inclined to believe that if not done correctly the paint will peel off the aluminium.

I had in mind using a spray-gun, the type used with a vacuum-cleaner and using cellulose ; the colours are to be cream and green.

Could you also tell me if it is possible to obtain a mixture of paint and cork granules for the interior of the caravan, since interior panelling at a reasonable price seems to be unobtainable at the present time.—J. C. Smith (Birmingham).

DISSOLVE 10 parts of caustic soda in 90 parts of water. Use this solution fairly hot or at least warm, and mop it over the aluminium surfaces to be treated. The caustic soda solution will not only effectively remove the slight grease film on the surface of the metal but it will also *attack* the metal surface, uniformly matting it and thereby giving a dull surface on which an applied paint will "key" much better than on a glossy surface. After the caustic soda treatment, the metal should be mopped over with plenty of hot water and then allowed to dry thoroughly. This will give you an excellent surface for painting on.

If you can get fine cork powder (a difficult task at present !) you can work it into any paint which you may wish to use. Alternatively, we believe that a material called "Watson's Plastic Paint" (for anti-condensation purposes) is manufactured by Chemical & Allied Products, Ltd., Midland Bank Buildings, 225b, Kensington High Street, London, W.8. Whether this would be suitable in colour, shade and character for your requirements we do not know, but it might, at least, be of sufficient interest for you to make an inquiry.

Another well-known firm from which you might be able to obtain a "corked" enamel is Messrs. Nobles & Hoare, Ltd., 3, Cromwell Road, London, S.E.1.

Composite Plastic Lettering

COULD you please tell me if there is a simple process for engraving a small number of plastic identification nameplates, as used on electrical switchboards, etc. ?

I am thinking of a sandwiched plastic (black, white, black).

Can you also tell me of a good book on the subject, and the name of a firm who could supply the sandwiched plastic ?—E. J. Lawrence (Fleetwood).

THE composite plastic lettering to which you refer is done by a hot-pressing process, which it would be impossible for any single individual to imitate, since the process necessitates the use of a hydraulic press. To make any imitation you would have to cut out (or stamp out) the letters in the plastic sheet and then to fill them in with plastic of another colour.

There are no books on this process, and there is no source known to us from which you can get detailed information of the process, since manufacturers keep such details very much to themselves. You might possibly, however, garner some information from The British Plastics Year Book, a copy of which may be in your local library.

Firms which may be able to supply the composite plastic material are to be found in the above book. Three other likely firms are :

Bakelite, Ltd., 18, Grosvenor Gardens, London, S.W.1.
Messrs. James Beadel & Co., Ltd., Beckacite House, Speke, Liverpool, 19, and
Erinoid, Ltd., Lightpill Mill, Stroud, Glos.

Plaster for Dolls' Heads

WILL you kindly inform me as to the method and ingredients which are used for the plaster which covers papier mâché dolls' heads ?

I do a good deal of repair work but am not satisfied with the plaster which I now use, as it cracks and does not leave a nice finish when painted.—J. Spreckley (Ilford).

YOU do not tell us what kind of plaster you are using for your dolls' head work. We presume, however, that it is some form of plaster of paris. This can be made very much less liable to crack by mixing with it about 10 per cent. of finely ground asbestos powder, which is obtainable from Turner Brothers Asbestos Co., Ltd., Rochdale, Lancs.

Keene's plaster might serve your purposes, but we understand that it is now hardly obtainable.

A plaster made by slaking finely powdered calcined magnesite with a 40 per cent. solution of magnesium chloride (i.e., 40 parts of magnesium chloride dissolved in 60 parts of water) takes 30 hours to set but it gives a smooth, dead-hard result which resists cracking to a high degree.

The smoothness of a plaster surface can be improved by painting over it a solution made by dissolving 10 parts of gelatine in 90 parts of water. To this add a few drops of carbolic acid to prevent it from becoming mouldy. This solution will set to a jelly when cold. Hence it must be used warm. Its action is to impregnate the surface pores of the plaster with gelatine and thus to provide a smooth resistant base for an overcoating of paint or enamel.

Non-inflammable Liquids

I SHALL be very much obliged if you will tell me of a few liquids, or pairs of liquids, which would comply with the following requirements.

When the two liquids are placed in a clear glass bottle a dividing line should be visible, one liquid floating on the other.

They should be non-inflammable.

The upper floating liquid should be clear like the glass or nearly so, and it would not matter if the lower liquid was coloured.

They should be obtainable without great difficulty or expense as I might require gallons.

Paraffin oil would be useful if it could be rendered uninflammable.—A. J. Bacon (Twickenham).

NON-INFLAMMABLE liquids suited to your purpose are the following : carbon tetrachloride trichlorethylene, aniline, butyl phthalate, tricresy phosphate, bromoform.

Of the above, bromoform is the heaviest and the most expensive. Carbon tetrachloride, we think, will be the best for your purpose, and it is not too expensive.

All the above liquids, except aniline, are water-white. They can be coloured with dyes. They are all heavier than water and the lighter petroleum oils, and will form a lower layer with a sharp dividing line when mixed with water and allowed to settle.

They can be obtained from various wholesale chemical houses. Also from Messrs. Boake, Roberts and Co., Ltd., Carpenters Road, Stratford, London, E.14, or Messrs. Vicsons and Coy.. 148, Pinner Road, Harrow, Middx.

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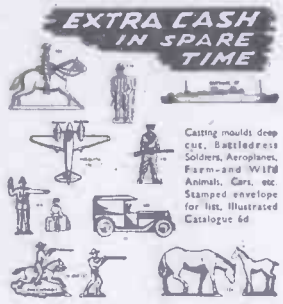

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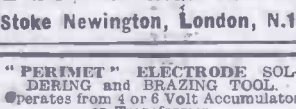

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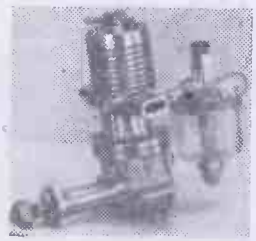

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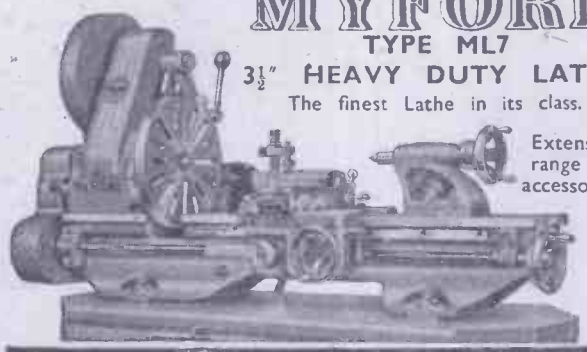

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THE Cyclist
Editor: F. J. CAMM

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Comments of the Month

By F. J. C.

Paris-London Race Cancelled

DUE to the impasse which has arisen between the autocratic N.C.U. and the R.T.T.C. the Paris to London Road Cycle Race between France, Belgium and England, which was to have been promoted by the *News Chronicle* over the Whitsun week-end, has been cancelled, in the following circumstances: The organisers, in accordance with the conditions prevailing in the cycling world, applied to the National Cyclists Union for a permit to promote the race under rules similar to those which prevailed last year, when George Fleming after a spectacular race was declared the winner. The N.C.U. under a mandate granted by a full general meeting of all cycling club delegates agreed to issue such a permit.

Under pressure by the Road Time Trials Council, which has no international status, no interest in international races, and, in fact, exists only to control club time trials in England, but which has a working agreement, so called, with the N.C.U., the N.C.U. subsequently informed the *News Chronicle* that a permit could only be granted subject to the British section of the race being run under conditions which they must have known were completely unworkable and unacceptable both to the promoters and to the French and Belgium cycling organisations.

Now, this Paris-London race was the major selection race for the British team to be entered for the Olympic Games Road Race. The *News Chronicle*, quite rightly, as we think, with great reluctance declined to accept these changed conditions and informed the N.C.U. that they would not proceed with the promotion of the 1948 events.

The Sport Suffers

THIS is a major tragedy for British cycling sport, and further evidence that the two cycling organisations concerned exist not to control cycling sport, but to promote internecine conflict and to prop up the proprietors of the cycling movement.

For the only point at issue between the two British cycling organisations, believe it or not, was the exact time of start of the British stage of the race from Folkestone. The Kent police, the promoters, and the N.C.U. all agreed on a start of 11 a.m. The R.T.T.C. on the other hand insisted on a start at dawn, all riders to finish under conditions of secrecy at a non-published point miles out of London. The two organisations were unable to come to terms and in face of this disagreement the promoters had no option but to withdraw.

The early morning start has become an old man of the woods with the R.T.T.C. It thinks that road racing is dangerous except when run in the early morning, notwithstanding all evidence to the contrary, and they are fortified in this stupid belief by the vapourings and the outpourings of the old men of the cycling movement who have a nostalgic desire to continue road racing on the lines of secrecy laid down in the latter part of the last century because of the attitude of the police.

They refuse to acknowledge what now is patent to most that the attitude of the police towards cyclists has entirely changed since motor-cars came on to the road. The police are far more concerned with standing for two hours watching a stationary motor-car with a view to bringing a charge for obstruction where the fine can be anything up to £20, than with prosecuting a cyclist where the fine may only be 5s.

The trouble, as we see it, is that all of the cycling organisations need to be purged of these old men who are not wise in their counsels, nor fair in their judgments. They pretend to speak on behalf of the cycling movement when they really are only speaking for themselves. They are entirely narrow-minded, and many of them are vindictive, adopting an attitude promoted by personal jealousies. As a result of all this our riders have lost a golden opportunity for partaking in a first-class race.

Apparently the Road Time Trials Council with its head in the sand and bolstered up by the biased attitude of a certain section of the cycling press, which ought to know better, still wishes to run road racing in this country on the hole-and-corner methods laid down by these stupid old-timers who become lashed into loquacity at the mere mention of the word publicity—the one thing which has been lacking from cycling sport for several decades and of which it and the industry is in so much need to-day. It is time that the clubs awakened to their responsibility and sent these old people, as well as the younger ones whose attitude is not sincere, about their business.

There should be a complete break with the N.C.U. and if those who direct the fortunes of the R.T.T.C. continue to run that organisation contrary to the views of the majority of sporting cyclists there is nothing left but for the clubs to get together and once again form another organisation, taking a little more care this time to get the rules right.

Cycle Prices Fixed

TAKING the lead from the Government's announced policy, the Bicycle and Motor Cycle Manufacturers have agreed to fix bicycle prices at the level extant in April, provided there are no increases in production or distribution costs outside their control. Major H. R. Watling, Director of the B.C. & M.C.M.T.U., suggests that future increases in prices could be avoided by an increase of working hours for all, a reduction in Government expenditure and in the Civil Service, thereby releasing workers, the reduction of loss from damage and elimination of theft, more efficient transport from the docks and on the railways and a more energetic policy to create and maintain and, when created, to keep open overseas markets.

It is also suggested that a special inquiry might be made into the costs of power, local rates and transport.

The Cycle Show

AS we go to press we learn that applications for space at the International Bicycle and Motor Cycle Show opening at Earl's Court on November 18th already exceeds those for the show abandoned at the outbreak of war. Inquiries have been received from manufacturers in Austria, Belgium, France, Hungary and Switzerland. Each of these countries wishes to exhibit motor cycles and accessories.

Cycle Boom

THE value of bicycles and motor cycles exported during the first quarter of the year was almost £1,500,000 more than in 1947; £4,540,370 as against £3,059,947. Of the 418,327 bicycles exported, the March figure (157,343) is a new all-time record. The money received from overseas for each British bicycle has risen from an average of £3 before the war to £7 10s., and for a motor cycle from £41 to £87. The number of motor cycles exported during the quarter was 17,452, compared with 12,534 last year and 4,943 before the war.

"There is a very real demand for British bicycles all over the world," says Mr. George Wilson, president of the Manufacturers' Union. "In foreign markets the Argentine, Mexico, Switzerland and Venezuela are all buying more of them, and there has been an increase in practically all the Dominions."

Road Accidents—March, 1948

ROAD fatalities in Great Britain during March totalled 322, compared with 302 in the corresponding month last year when severe weather conditions during the first fortnight tended to keep traffic off the roads in most parts of the country. There was also an increase in the number of injured, 9,981 compared with 9,849 in March, 1947, but the total casualties for the month compare favourably with those for March in past years, and are 7,000 fewer than in March, 1938.

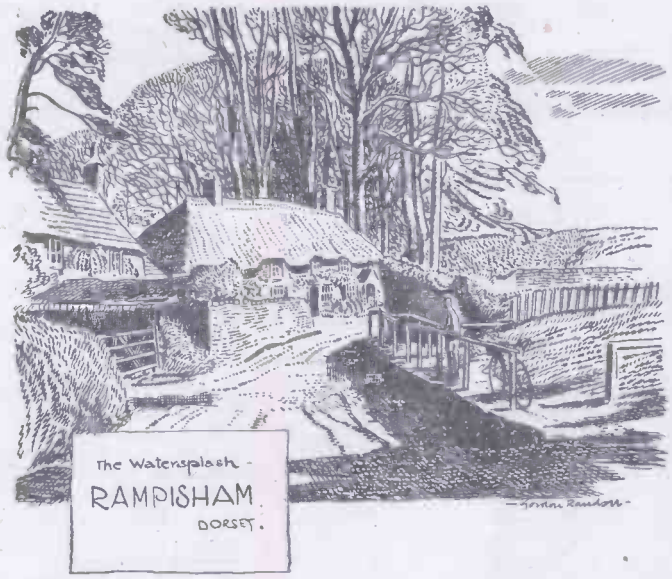
Child deaths during the month numbered 97, compared with 64 in March last year, and included 82 pedestrians and 11 cyclists.

"News Chronicle" Offer Prizes for Tourists

THE *News Chronicle* have offered £100 in prizes for a "Tourists' Competition," which will be organised by the Cyclists' Touring Club in conjunction with the great international rally at York in August.

The contest for the tourists will be open to all cyclists, and not confined to members of the C.T.C. Ten prizes of £10 will be awarded; there will be five classes of competitors in each of the two sections—camping and non-camping. The five classes will be men and women seniors, boys and girls under 18, and tandem pairs, and the winner of each class, in each section, will receive a *News Chronicle* prize, value £10. Further details will be given next month.

PARAGRAMS



Don't Write It

"IT would help the Court very much if people, instead of writing abstruse letters, would come and explain what they mean," commented the Chairman of Peterborough Bench during the hearing of a road offence summons. He suggested that a few words from a defendant would be of far more help to the magistrates than a long and involved letter. So those unfortunates, who one day get a little piece of paper from a policeman requesting their attendance in Court, would be well-advised to see what a winning smile and a few well-chosen words of apology will do, rather than trust to the pen.

Signal Early

CYCLISTS were reminded that they should give their signals to following traffic in plenty of time, and not turn directly after signalling, at the Scunthorpe inquest on a cyclist who was fatally injured in a collision with a car. The motorist told the coroner that he had passed a number of cyclists and was just about level with another rider when the man suddenly turned and ran into him.

Lever-pedal Cycle

A FRENCH inventor exhibited at a recent French show a modern version of an old idea—a cycle propelled by foot-operated levers instead of pedals. The levers are pivoted on either side of the rear axle and have slots for the toes to fit in. The levers drive, through cranks, a large sprocket wheel mounted just below the saddle and a chain from this wheel drives the usual free wheel. Ease in pedalling is claimed as one of the features of this system.

Back Answers!

"SOME of the remarks passed about it were not fit to repeat here," said a member of Grimsb Road Safety Committee during a discussion on the use of a loudspeaker van to warn road users to be careful. The van has been used for some time, cyclists being a particular target. Some of the people addressed did as they were told while others just did as they liked. Another member of the Committee suggested that the police were the people to be responsible for road safety, adding: "We've no right to go running around with a loudspeaker warning people that they are a danger on the roads." Another vehicle is to be bought by the Committee, if they can get one for not more than £100, but at that price it will probably be a greater danger on the road than the people who are to be warned.

Cycle Stealing "Wholesale Business"

ANNOUNCING the sentences on local men who were charged with the theft of cycles and accessories in Peterborough, the chairman of Peterborough Bench said the stealing appeared to have been conducted "as a wholesale business." He said this type of offence was on the increase and declared: "Stealing of this description cannot be allowed to continue. Anyone who is charged with similar offences must be taught a lesson that crime of this nature does not pay." One of the men was sentenced to three months' imprisonment and the other was bound over.

For a Good Cause

MEMBERS of the Hainton Cyclists' Club have organised concerts and other money-raising events for the benefit of the dependants of the Grimsby vessel, the steam trawler *Epine*, which was wrecked with loss of life in the North Sea. It is hoped that the fund will benefit considerably from these events.

Business Changes Hands

THE cycle business carried on for some time by Messrs. Munns and Sons, in West Park Street, Chatteris, Cambs, has been taken over by Mr. L. Barker. It will be continued on the same premises.

French Cycling Tour

A PARTY of about two dozen Leicester schoolboys, together with half a dozen masters and several of the boys' fathers, plan to spend 10 days on a cycling tour of France during the summer holidays. Those few boys who are without cycles of their own are borrowing machines from their friends, but the lenders insist that the machines come back all in one piece. Some 50 miles will be covered each day, if all goes according to plan, and Dieppe, Rouen and Paris will be among the places visited. From now until the end of July, when the trip is due to start, the boys will be putting in a good deal of overtime on their studies of the French language.

Another Fishy Tale!

HOW a Scottish gamekeeper sat on his cycle by the side of a river in Sutherlandshire and pedalled like mad without moving, so that a fisherman could land a 29lb. salmon, is one more story to add to the many that are told about fishing. At 11 o'clock in the morning the fisherman hooked his salmon and began to play it carefully. At dusk he was still playing the salmon, having been fed with sandwiches at intervals by his wife, but when it got really dark he thought he would have to lose the fish after all. Just as he was preparing to throw away his catch of the season, the gamekeeper appeared on his bicycle and, with true sporting instinct, propped it up on the bank and pedalled for another three hours, lighting the scene of battle with his dynamo headlamp until the monster salmon was safely on the bank.

Winner Pays!

OVER £3 was the cost to the member of a Midland cycling club of winning a race with another member. Two young riders were on their way to a cafe and decided to have a sprint, with the loser paying for tea, but the winner unfortunately got off course and crashed into a lorry, with unhappy results to his cycle. The rider was slightly injured, but his injuries were sufficient to keep him out of the senior event of the massed start contest in which the club was competing a few days later.

Cycle-powered Greyhound Track

SCHOOLCHILDREN at Ibstock, Leics, have built themselves a greyhound track in a field and have converted an old bicycle into the apparatus for providing the "electric" hare with motive power. Sufficient string is wound round the rear wheel, which is minus the tyre, to reach from one side of the field to the other and with a perspiring enthusiast in the saddle the hare careers across the field, pursued equally enthusiastically by a bevy of assorted greyhounds.

Recruiting Drive

AFTER a ride of nine miles to a neighbouring town to take part in an inter-club 25 mile event, members of Kettering Friendly Cycling Club cycled back to Kettering to collect 10 local girls and take them on a 20 mile ride to introduce them to the pleasures of club cycling. The club at the moment has only eight girl members and the recruiting drive has been started in an attempt to increase the number of girl members and also to encourage more lads to join.

Notorious Death Trap

THE cross-roads on the North Road at Brampton Hut, in Huntingdonshire, were described at a meeting of Hunts Road Safety Committee as "the most celebrated death trap in the country." During the past two years there have been 17 accidents, two being fatal, six resulting in serious personal injuries and the remainder causing minor casualties, while 39 vehicles were either completely smashed up or badly damaged. It was stated that the people usually involved in the accidents are long-distance travellers who do not realise the dangerous nature of the cross-roads and accidents have occurred there ever since the Great North Road was built. The matter is to be "considered" and meanwhile the accidents continue.

Really Light Weight

WHAT is claimed to be the lightest of all lightweight sporting or racing cycles has been produced by the Italian cycle firm of Legnato and Company. It looks just like any normal racing cycle but the metal used in its construction combines ultra-lightness of weight with considerable strength. The machine weighs only 9lb. and can easily be held and lifted by a crooked finger.

Cycle Dealer's Model Village

THE picturesque Yorkshire village of Thixendale, near Garrowby, which belonged to the late Mr. Brook Hardcastle, a cycle agent, who at one time had 45 branch shops in Yorkshire, Lincolnshire and Derbyshire and died in December, 1947, has been sold by auction to Mr. Wilfred Harrison, a Huddersfield accountant. When Mr. Hardcastle bought the village, which has four farms and a village population of about 300, he planned to convert it into a model village which would be up to date enough for comfort but would retain its old-world charm. He had installed electricity and was in the process of supplying a piped water supply when he died, but the war interfered with many of his schemes of improvement.

Cycle Dealers Amalgamate

THE two cycle and radio businesses carried on by Mr. F. Saywell and Mr. A. Briggs respectively at premises in the Market Place, and at 72, High Street, March, Cambs. have now been amalgamated. The two shops will in future be carried on under the name of Saywell & Briggs, Ltd., at the same addresses.

To Safety Signs—£5

DAVENTRY Road Safety Committee members have been protesting at having been charged £5 for two small wooden "Safety First" signs which they have just erected in Daventry. One member said that each board contained no more than half a crown's worth of timber and he suggested that a third sign should be made up from a spare piece of board or an old metal panel. The chairman, told that an estimate ought to have been obtained for the signs, retorted: "Generally speaking, you don't have to ask for estimates to-day. You have to beg for the work to be done and pay what you are asked."

Veteran Cyclist Dies

ONE of the best known figures in the Market Rasen district of North Lincolnshire, Mr. William Goulding Shaw, of Serpentine Street, Market Rasen, has died at the age of 86. He became a cyclist in the early days of the sport and remained keenly interested in cycling for the rest of his life.

Wind Against Him

DRIVING along a road in the Midlands the other day, a motorist saw a sprightly, but elderly, pedestrian walking in his direction and stopped to offer him a lift. The pedestrian got into the car and explained to the driver that, if it had not been for the high wind, he would have been cycling instead of walking. When asked his age, he replied, with a certain amount of pride: "I shall be 96 if I live until next September!"

Miracle Operation

MR. HAROLD BLAKE, chief reporter on a Northamptonshire newspaper and formerly a prominent member of Peterborough Cycling Club until he left Peterborough, has made good progress since he underwent a delicate brain operation in a hospital at St. Louis, Missouri, designed to cure him of Parkinson's disease, which had almost completely crippled him. The doctors say he is cured but he cannot get that extra bit of confidence to enable him to walk alone. He can walk with assistance and his condition is greatly improved. A girl reporter on the staff of Mr. Blake's paper has flown to America to visit him and to give him the good wishes of his colleagues for a complete and speedy recovery.

Spares Famine

CYCLISTS in Peterborough are having to do quite a bit of make-do and mend these days to keep their machines on the road, as for some time there has been a considerable shortage of spare parts locally. Tyres, inner tubes and saddles are fairly plentiful but items such as pedals and chains arrive in the shops in very small quantities and are extremely scarce. Sometimes a consignment of pedals consists of one or two pairs only and various other accessories arrive in similar minute quantities.

Sail, Ho!

A FORMER Loughborough College student, Mr. Ivan Wicksteed, makes other road-users stare when they see the way he travels from place to place. He had to give up his hobby of yachting when he went to live away from the sea so he has built himself a land yacht out of light steel tubing. It runs on three rubber tyred wheels, is controlled by a tiller steering device and is fitted with a steel mast carrying a sail from Mr. Wicksteed's dinghy. Mr. Wicksteed's best speed so far is close on 40 m.p.h., with perfect acceleration and control and absolutely no noise, but as he cannot tack on the open road he has to be certain that the wind is in the right direction before he sets off. He is now planning to have a number of these land yachts built and hopes to organise racing events on empty airfields.

Around the Wheelworld

By ICARUS

52 Miles—56 Hills

AS the *News Chronicle* has abandoned the Paris-London Race due to the stupid attitude of the N.C.U. and the R.T.T.C., the Nottingham Massed Start Race which took place in April increased in importance.

I understand that the pedestrians in the park utilised their right to cross and re-cross the road to a greater extent than they do on the open road. What has the N.C.U. to say about that? A major feature of the race, in fact, was the disorderly but continuous transmigration of men, women, children and dogs from one side of the 1⅛ miles of roadway to the other.

Ted Jones, of the Midland Olympic 18, was brought down by J. Walker and carried away in an ambulance. The race was 62½ miles and included 56 sharp quarter-mile-long hills. It certainly was a trial for the riders. Fortunately, the Olympic Road Race will take place on the flatter course of Windsor Park.

B.R.C. Annual Invitation Run

THE Bath Road Club is holding its annual invitation—Bath and back run—on the 19th-20th June. Those interested should communicate with R. Skinner, 149, Underhill Road, East Dulwich, S.E.22.

Some Errors Corrected

MRS. JEAN McCLINTOCK asks me to publish the following:

"For accurate future reference to the invention of the pneumatic tyre by my father, John Boyd Dunlop, may I, in no quarrelsome spirit, correct several errors made in one or two quarters during the recent diamond jubilee of that event?

"The statement that my father tested his first tyre by filling it with water is nonsense; anyone stupid enough to do that could never have invented a pneumatic tyre. Nor was the first tyre tried out in a Belfast 'backyard.' These first experiments were made in our long veterinary yard, the little wheels being rolled up to the large wooden gate, when it was closed for the night.

"I remember my father's gigs and many a long drive I had in them seated on a tiny 'boss' (or cushion) at his feet; there was room on the seat for him and the groom only. It has been said that my father had no knowledge of mechanics. No one, at any rate, will deny his resourcefulness, applying to the making of his first tyre the knowledge gained in making his own veterinary rubber gloves and securing the tyre to its wooden disc with a strip from an old linen dress of my mother's. I was with my mother in the grand stand at Belfast College Sports when William Hume won all four bicycle contests, and I shall never forget the excitement as the first pneumatic-tyred 'safety' crept up to the leading riders and eventually passed them.

"My father never thought of using a hosepipe. Here is his own comment on that story: 'The garden hosepipe story is childish—the material is so inelastic that it would be incomparably slower than a solid tyre. It could not be ridden on the road for 100 yards without being cut to pieces, and I should deem it impossible for an amateur to make an inner tube small enough to be drawn into the hosepipe—not to mention the inserting of a valve. The internal diameter of a hosepipe would be about equal to the diameter of one's little finger.'"

Warnings

THE Accident Prevention Committee of the Welfare Department at Fort Dunlop have just published a book of warnings in light verse. Here is a sample which I have adapted, with apologies:

Little Johnny head in air,
Never, never looking where
He was riding till one day,
Johnny rode into a dray!

Parcel-carrying Cyclists

IN a statement which accompanies the Northern Ireland Road Accident Returns for March, the Northern Ireland Ministry of Commerce points out that one fatal accident was caused by a pedal cyclist carrying a handsaw which came into contact with the front wheel of his bicycle. "There have been several accidents of this type during the past year," continues the statement, "resulting in death and injury. The carrying of a parcel, shopping-bag, bag of tools, overcoat or attaché case, etc., on the handlebar of a pedal cycle may lead to a serious accident and cyclists are asked not to carry parcels or other articles which may interfere with the proper control of their machines or may cause harm to others."

Nortec Road Club

THE Nortec Road Club was founded last November, mainly with the support of the students of the Norwich City College. The club held its first invitation run on May 30th. Mr. J. Robinson, the hon. sec., will be pleased to hear from those interested. His address is: 23, Mundesley Road, North Walsham, Norfolk.

An Amusing Bit

AT a meeting of the R.T.T.C. on the Paris-London Race, out of about 70 clubs entitled to attend, delegates from 15 only were present. Norwood Paragon proposed that the whole thing be a massed-start. That proposition being quashed, they were one of the 14 clubs out of the 15 who voted for a 7 a.m. start! The Fountain C.C. was the club which opposed this.

Nine Day Polo Tour of Britain

IN conjunction with the Central Council of Physical Recreation, the Bicycle Polo Association of Great Britain ran a grand match tour of Britain. Commencing on May 8th, a representative team visited Southampton; May 9th, Norwich; May 10th, Hull; May 11th, Newcastle; May 15th, Birmingham; and May 16th, Bath. The visitors defrayed their expenses, and the tour served the two-fold purpose of spreading the popularity of bicycle polo and aiding the Sports Development Fund.

On the following day two 'planes took the all England team to play Ireland in the first game for the Phoenix Trophy.

Pyramid Track Promotion

THE Pyramid R.C. is to promote its first track meeting on June 26th, when it is expected that a big international flavour will be in evidence. Already Coste and Faye of France, Kamber of Switzerland, McNulty and Proctor of Scotland have been approached together with Godwin, Pond and—if by then fit—Reg Harris of England. Two valuable trophies have been set aside for the main events as yet to be decided. The Ladies' National Sprint Championship will be included in the programme. Fallowfield, the venue, will not be the hoped-for cement surface, but will retain its red shale complexion so familiar to Manchester Track enthusiasts. The promoter is L. Stanton, 19, Amersham Close, Davyhulme, Manchester.

Reduction in Prices of Hercules Cycles

THE Hercules Cycle and Motor Company, Limited, of Birmingham, a subsidiary of Tube Investments, announces that the retail prices of all the eighteen models sold in the United Kingdom and Ireland will be reduced by three-and-three-quarters per cent. The reduction will mean that the Safety cycle at present costing the rider £11 3s. 4d. including purchase tax, will now be sold at £10 15s.—a reduction of 8s. 4d. The popular coloured racing cycles for both sexes will be reduced by 12s. 2d., and as much as 15s. in the higher price range.

Production being limited by allocation of materials, there cannot be any increase in the number of cycles available to the public.

Mr. Eric Brotherton, director of the company, emphasised the fact that the reduction is in line with the policy of Tube Investments. It is also in accord with the desire of the company over the last twenty-five years, namely to bring bicycles within reach of the multitude.

It is just six weeks ago since the Hercules Company announced lower prices for all overseas markets.

Vast Hordes at Fairlop

FAIRLOP AERODROME, disused wide open R.A.F. space, now being occupied by the N.C.U. as one of its Olympic road race trial grounds, was a menace to massed starters on Sunday, April 25th, when the E.C.C.A. promoted a 40-mile race for seniors and a 20-mile event for juniors. The menace arose from the fact that there were no fewer than 94 juniors and 112 seniors on the start card. Of this gallant 200, about 36 were fairly experienced bunched riders. A fair percentage of this number retired because of being brought down by unskilled wheels, or else in case they were.

Shake Earnshaw

SHAKE EARNSHAW has joined the B.L.R.C. He is holder of the following R.R.A. records:

50 miles in 1 hr. 39 mins. 42 secs.
12 hours (276½ miles).
London to York—8 hrs. 23 mins.
London to Portsmouth and back—6 hrs. 28 mins. 54 secs.
Liverpool to Edinburgh—9 hrs. 53 mins.

In applying for affiliation Earnshaw pointed out that he had tried several times to get back his amateur status, but apparently the N.C.U. do not like the idea, for they have continued to turn it down. The N.C.U. has no road programme to offer, and the R.T.T.C. refuse to recognise any other class of amateur. The only outlet, therefore, for Earnshaw is provided by the B.L.R.C.

He has been granted an independent licence, which requires that a rider must retain his normal occupation, but is allowed to take cash prizes within certain limits. He has been made a life member of his club, the Monckton C.C.

He is a miner by profession and resides on the outskirts of Wakefield.

Wayside Thoughts

By F. J. URRY

The Brönte Bridge
West Riding Yorks.

A spot on Haworth Moor well known to all Brönte lovers.

The Thought Ahead

THE year has started well for the people who ride bicycles for sport, pleasure or convenience, and if it proceeds with its early promise we shall enjoy a delightful season. I'm sorry about the restriction of petrol, because it means disappointment for many elderly folk who cannot now wait in long queues or ride bicycles; but it also means that those of us who can and do have an easier time along the road, certainly have a solution of the accommodation problem. Yes, we shall not need to worry over that matter so long as we are content to seek the more remote places and leave the seaside resorts until times become more settled; and for myself—and I think thousands of other people—this will suit admirably. In a long period of years I have found that the exploring cyclist with a map, a small spirit of adventure, and a meal of sorts tucked in the bag can and does discover more glorious places than the scenic gems so widely photographed, and the fact that he has them to himself gives him a real sense of discovery. The spirit and glory of 'cycle touring can be severely limited by too much haste; it is one of the pastimes that need time and the seeing eye, and always I am prepared to welcome the ardent photographer, for then I know there will be delectable halts, even though I am frequently handicapped by enrolment as carrier of part of his paraphernalia. When I was younger the collection of touring miles was a fault which time has cured. Now I can and do extract as much or more joy, real touring joy, out of a dozen miles than five times that distance of the old days. It is one of the reasons why so many of the old routes never tire; there is always something new and beautiful to find along the road, and often enough the complete change of vision along another if tougher way that is a delight and an expedition.

Getting Out of Practice

NOW that I have new sets of covers to all my little stock of bicycles, months have gone by without a roadside repair, or that tiresome exercise of a frantic inflation and a race for home before the ominous bump on the rim due to the slowly escaping air. I shall get out of the habit of puncture repair if this immunity persists; but, of course, it won't, for wear will supervene in due course, and there is always the risk of a dagger of glass or the quick turn over of a sharp flint by the front tyre to be caught by the rim and wall of the rear wheel before it has time to settle, and so pinch the slender fabric. That risk for me is less than it used to be because my progress is a trifle slower and much more circumspect, and as ever it is pace that kills. Lots of people I know have a real horror of punctures, which I suppose is one reason why they ride heavy and cumbersome tyres. Yet in my experience I find the light and lively cover almost as impervious to perforation as the more robust type, due no doubt to the better quality of fabric foundation. I don't like punctures on my work-a-day journeyings, they make me late; but when touring and my time is my own they are just another excuse for a rest and smoke and one which will not be denied. One of the returns to more normal things that have given me joy of possession and a very comfortable feeling of having been given a really square deal is the Sprite cover and the post-war price of it. In 1939 these covers were 7s. 6d. each; to-day—and they appear to be of similar tough and light quality—the figure is 8s 9d., and had they been priced at 12s. 6d. I should not have been surprised or disappointed. The Dunlop people have certainly paid a price compliment to the users of light tyres, and set a fashion in increases that is a credit to themselves and a help to the discerning cyclist.

The Careless Change

A WEEK or so ago I was out in the wind and rain, making a journey to see friends and for the purpose of comfortable exercise, which on such a day would have been impossible at any other game. I went into the gale with a constant lapful of water in the apron of my mack, and I should think a third of my fifteen miles of stormy riding the low gear of a derailleur saw me up the slopes with ease. Beyond the edges of my coat I did not get even damp, for the day was cool and I just sat still in the saddle and let the wind pass over without struggling. Tea at a farm I know, where hens lay numerous eggs, was a real refreshment followed by a smoke and a change of talk on country topics; then I started for home on a bicycle which had taken on a load of comfortable things. Now the wind was abaft and I could feel the liquid stair-rods of water plonk on the back of my ears, for I hate sou'-westers and an old cap does not cover those protuberances. I revelled in it; the swish of the tyres, the little fountains of dirty water from the fore-guard, and the sense of well-being with a road wholly one's own. Four miles from harbour is a long slope and at its foot I tried a change down, fumbled the trigger because of heavy gloves and a billowing mack, and off came the chain. In dismounting I forgot the weight of a couple of rabbits on the handlebar, which slewed round on me and the machine gently subsided on the road. Then I tried to put the chain back, and thrice succeeded, and thrice it slipped its moorings. It was now getting dark, there was no shelter, and I was getting annoyed. What I should have done in the first place I did now, glance at the jockey pulley which had been knocked out of alignment when the machine toppled over. A spanner soon put that right and away we went, but not before I had ruined a pair of good gloves and got my mack entangled with chain and sprockets. All of which is a lesson to glance at first things first, for it saves a lot of unnecessary trouble.

The Daily Ride

MY daily ride to work and home seems to get more interesting year by year. People imagine I would get tired of it, but nothing of the kind occurs. In the first place there is the weather, the most discussed subject between humans, and this element of our being is closely about you when you ride a bicycle; more closely, I think, than when you walk and hurry your steps to escape the driving rain, or stand for a moment and stare at the almond blossom, for aboard a bicycle you still see these things, and if you are wise do not rush to escape from them. And some of the mornings and evenings when spring is trembling in the air possess the quality of the supernal even on the busy approach to a great city, for they bring to mind the varied pictures of many places that have charmed the senses with the image of their present beauty under the mystic touch of the young year. And, of course, there is always the traffic, that ever-changing pattern of progress which demands your lively attention by a kind of sixth sense fully developed by constant practice. And what a changing pattern it is. When the petrol ban came it visibly lessened; there were gaps along the road, and the cheery pip of a friend's horn in passing was intermittent; but now it appears that anyone possessing a car and in need of a town journey can make the grade. So the stream seems to be as thick as ever, and as it nears the city centre becomes sluggish, for the fellow who passed me half a mile back is still awaiting an opening when I drop a foot by the side of him and change a mouthful of talk. It is only when you are well away from the city and suburbs that the petrol ban displays the full handicap imposed on the travelling public. There is, unfortunately, [still a good deal of bad driving, mostly by the younger people, whose display of impatience is often irritating to all other road users, although I must confess in the main this type of driver is pretty good at the job of escaping trouble even though he imposes temper. Finally, my young friends with whom I have a nodding acquaintance are a joy; they help to make the day merry with a wave of the hand and sometimes a cheerful salutation born of the sunshine. No, I would not miss my daily ride for anything except a longer one in the other direction, for it keeps me fit and, I think, very human.

The Grace of Them

IT is the little journeys that count. We cannot be going on tour for ever, we cannot always arrange the long week-end of our desire, but most of us can make the short journey during those odd hours of leisure sandwiched between work and duty, but—most of us don't. Sometimes I wonder why, and then remember I am favourably placed and can always extend my daily home journey up to 30 miles if the inclination is with me, as it frequently is, when I can almost hear the "horns of Elfland faintly blowing." There are so many local places of delight we miss in our scamper to the distant places, spots we should know intimately but don't, and just because they are local they are rather neglected. Late one afternoon I went to Sutton Park, a wooded heathland six miles north of Birmingham, dotted with little lakes where in summertime of many years ago I learned to row and swim. Now the scars of war camps have been partly removed this 20-odd square miles of orderly wilderness is as beautiful as ever, and on this quiet day was almost deserted. I spent a couple of hours riding quietly through the woods and over the heath paths, found a tea of sorts at one of the little chalets known of old, and saw the sunset across a placid pool where the waterfowl were calling from the reeds. Riding home an hour later, and as I turned on the glim of lamps, I blessed my fortune that a love of the country and a bicycle was part of my make-up, and within my capacity, for they have added to life, and especially the latter end of it, a simplicity and a pleasure nothing else could give. Hours of this degree make of cycling a blessing and a benediction.

No Answer

TALKING to an old friend on this subject, I discovered that he knew next to nothing of the lovely country within a dozen miles of his home. He was a motorist, and that form of travel lends itself to speed and distance and unconsciously ignores the beauty and delight of nearby places. To pick wild lilies-of-the-valley in a wood a dozen miles from the city centre, or picnic in a lovely vale within an hour's cycle ride where a stream meanders and the forest trees pattern the blue sky for you; yes, it needs a bicycle, or a pair of walking boots, to find such spots, and the former does not make me foot-weary. Apropos of this conversation, I was asked to give a verdict on the finest viewpoint in the U.K. A tall order, for priority in beauty is not always a matter of the land configuration or the verdure of it, for the elements and the seasons add their glory. I have seen Fingle Bridge in late autumn under the sun, a vision of gold and bronze; and Badenoch Moor in late August when it was a sea of mauve rolling in glorious waves to the long horizon. Inkpen Beacon on the right day, and Bredon summit and Cleeve Hill, from all three of which England can be seen in all its rural loveliness, and the cliffs of Pembroke and Cornwall when a breeze is driving the tide ashore, and Jack Sound is a maelstrom of wicked waters; Glen Ranza on Arran, and the splendour of the Hebrides from Gruinard Bay where the road climbs high. Such are a few that come to mind where there are no signposts to mark the way to the shrine of beauty; for I believe there are fairer visions to be found by the wanderer than ever were annotated in the guide books. You must take your choice of the best, for I could not decide that for myself among all the scattered splendour of this lovely land. And when you have seen all this, one day you will be roaming quietly into a loveliness you have known for years, and which has been bewitched by the trick of the weather and the season. That indeed is the great glory of cycling, it suddenly discovers, and makes you aware of a mystic loveliness that transcends all other things, and for a moment presents you with a new life, a new hope and a new sense of beauty that fills you with completeness.

CYCLORAMA

By H. W. ELEY

The picturesque wooden mill sketched from the long Weir. The little village of Hambleden lies a mile to the North, making a charming picture with its old houses clustered round the church, and the rising slopes of the Chilterns in the background.

Month of Roses

A SALUTE to June, traditionally the month of roses, and I do not doubt that, as the month progresses, I shall be called in to many a fair garden by my friends, and asked to admire their favourites . . . the yellows, the pinks, the deep reds, and those rarer whites which all go to make up the perfect rosery. Well, I do not think there is a better flower, and, after all, it is the flower of England. On some fine June morning I picture myself strolling along the lane which leads to my station, fragrant rose in my buttonhole, and a song in my heart because the summer has come . . . the summer of bird song, of hedgerows starred with flowers, of lazy days in the sun. . . .

I Meet Trevor Laker

"TREVOR" is, I should imagine, as well known—and as much liked—as any man connected with the cycle industry, and it was a joy to meet him again at a little function in London recently; I had not seen him for many months, and was glad to see him looking fit and well. It would seem that the air of Leicester suits him, and I gathered he had no hankering to return to the London he knows so well. But, all the same, I fancy that Trevor still enjoys a stroll down Fleet Street, and, when he does tread the street of ink, likes to meet some of those old friends of his journalistic days. One of these days I must slip up to Leicester, and see him at his office desk.

The "Roadfarers"

IT is rather a long time since the Roadfarers' Club met, and someone said to me recently that possibly the club was defunct! Heaven forbid! And actually it is very much alive, and I am looking forward keenly to a luncheon meeting early in May. This club, so widely representative of road interests, has done a good job in promoting knowledge of road legislation, of welding together into a happy family the various road interests, and, under the vigorous chairmanship of Lord Brabazon, has proved a big factor for good. F. J. Camm, to whom we owe the idea of the club, is still as active as ever in its interests, and its future is assured.

Unknown Essex

SO many tourists, with quite a wide knowledge of England, are strangely ignorant of some of its counties and some of its best touring grounds. Essex is a case in point; you will hear cascades of talk about the beauties of Surrey, the glories of Sussex, and the enchantment of Kent . . . but not so often do you hear, in tavern or tea-shop, a cyclist telling of the rich beauty of Essex—that county which to many seems to be just a place to avoid—flat and uninteresting. Now, at Easter, I did a little touring in Essex, and found myself in the area not far from Chelmsford, where one may find those pretty and unspoiled villages, the "Hanningfields." There is East Hanningfield, South Hanningfield and West Hanningfield—and it was at the last-named village where I spent many happy hours. A quaint, typical Essex church, with the wooden tower which is such a feature of the district. A good little inn, old and homely; rich, undulating agricultural land where some good crops are grown; and villagers who still retain all the fine characteristics of their forbears—tillers of the land, at one with the good earth—not a bit anxious to travel the few miles which would bring them to Mother London, with her noise and bustle and smoke and grime. I stayed in an old house where the rafters spoke of ancient days; where the owls haunted the old barns; and where good Essex pigs foraged in the stackyard. Yes, there is beauty and enchantment in Essex, and I commend this little-known county to all who would explore a new land, rich in tradition, and within such easy reach of London. . . .

A Price Cut

AS I write I learn that the Hercules Company are reducing their retail prices—good news for cyclists, and a typical example of Hercules progressive policy. I never see the name "Hercules" without recalling my very early Dunlop days, for is not the firm located in that factory in Rocky Lane, Aston, where, in 1912, I first commenced to work for the Dunlop Organisation? It seems a very long time ago—and how different was the tyre industry in those early days! Motoring really in its infancy—no garage full of employees' cars—only the "V.I.P.s" possessed cars in those far-away days! And I recall that we used to consider that a cover had done very well if it accomplished 5,000 miles. They were the days of the du Cros family—of pioneering work in connection with the cord construction of casings, of grand cycle runs on Saturday afternoons into the lanes of fair Warwickshire and Worcestershire. Looking back, very good days, with world wars unknown—and with bacon and eggs the normal breakfast dish for all of us!

Early in the Morning . . .

WISE is the cyclist who, on a Sunday morning, resists that pernicious doctrine that the Sabbath is the day on which to lie in bed . . . that "extra hour" of sleep is a fatal, insidious thing. I was reminded of the wisdom of getting up early and *out* early the other Sunday when some business took me out on the Great North Road. (And there is no road so rich in romance and history!) A nip in the air, and hardly a soul about . . . till a goodly company of cyclists appeared, all in modern sensible riding clothes—a happy band making, I fancy, for Barnet and beyond. Making a cracking pace were these wise boys and girls, and I thought how good it was—after a week's work in London—to be out on the open road breathing pure air and getting the best of all possible exercise. I love to see cycling clubs "in action," and I vowed that the very next Sunday I would follow the example of these riders. And I did. And in a Hertfordshire lane, what time many folks were snoring in bed, I was revelling in the delights of a spring morning, riding easily along an English lane . . . with bird song to cheer my way, and a gentle breeze to blow away the cobwebs and frets and fumes of the working week. . . .

In ancient York—"Lady Peckitt's Yard."

My Point of View

By "WAYFARER"

Satire

A SATIRICAL friend considers that all "Narrow Road" signs are redundant. He says that when you come to a road where the opposing hedges are close together you are obviously on a narrow road and don't need to have the fact proclaimed to you!

The Experienced Eye

I HAVE often expressed the view that the experienced eye can readily, by a glance at the map, size up the distance between two places. On that day which is usually looked upon as the first day of spring—a Sunday this year—three of us, having met at, and disposed of, lunch, were pondering the question as to how and where to put in the remainder of our hours of liberty. When the problem had been settled, and I had briefly outlined the route by which we would travel to our tea-place, one of my friends who happened to be carrying a map looked it over and said: "Why! that will be 20 miles." Nobody disputed the statement, and it turned out to be a good guess, for my cyclometer measured 21 miles at the moment we stopped for tea. Personally, I seldom use a map measurer or apply any other method of ascertaining the distance between two places. I am content with a glance at the map, and then, if the mileage looks "do-able" in the time at my disposal, I set forth and do it.

Division

IT will probably be accepted as a fact that there is no "best" way of dividing up a day's ride. The reverse was the case at one time, so far as I am concerned, for I was poor in the morning, not so bad in the afternoon, and a perfect lion in the evening. Nowadays I am poor all the time—and it is better for me to say that than leave it to somebody else! Actually, while I am still best in the evening, I am quite decent throughout the rest of the day, and I no longer suffer from the disadvantages which once afflicted me in the morning and the afternoon. So it appears to me that the division of the mileage on the very pleasant Sunday to which reference has been made may be of some little interest. In the morning I rode, solus, 29 miles; in the afternoon and evening, in company, I accounted for, respectively, 21 and 27 miles, making 77 in all—for a March Sunday. A late lunch (combined with a desire to have tea at the proper time) was responsible for the relative shortness of the afternoon ride, while the evening mileage arose from a desire to go home by anything but the shortest route. In point of fact, I had tea within some 15 miles of home.

Eternal Vigilance

ON the previous Sunday, while travelling with the same two companions, there befell a little incident which stresses once again the need for eternal vigilance. It was evening, and we were riding over unpeopled roads, and thus no external danger could threaten us. We had the world to ourselves. On turning a corner, I noticed lying on the road a lath of wood with two nails sticking through it, business-end upwards. I at once voiced a warning and pointed, meanwhile reducing my very mild pace so that I could dismount and remove the obstruction. That was instinctive. I did not know that one of my comrades was immediately behind me. My pointing action distracted his attention and he did not notice that I was slowing down. As he looked admiringly—or otherwise—at the two nails, he crashed into my rear, emptying me into the road (no personal damage) and putting "paid" to my back mudguard. There is nothing to be gained by trying to allocate blame for this incident, which, however, does serve to remind us, one and all, of the great need for unremitting care and watchfulness.

Queues Galore

ONE evening recently, at the rush-hour, I happened to be walking along the main street of a big city, and I was appalled at the sight of the hundreds of people who were herded into queues, waiting (patiently or otherwise) for the coming of the public transport which would take them to, or towards, their several homes. What waste of time, I thought, and what discomfort! Personally, I am as good at suffering fools gladly as I am at waiting, and the exercise of patience in such circumstances as those outlined was never pumped into me. And so my mind turned, naturally, to a much better way of getting home—or to what I consider is a much better way. Knowing nothing of the circumstances of the queue-fans, I can only assume that a considerable section of them might with advantage have had recourse to the bicycle as a mode of locomotion. I am naturally aware that traffic riding is not everybody's "cup of tea," and probably some of the folks swelling the queues to such gigantic proportions lived too far away to achieve the daily journey in comfort. But, making all allowances, I imagine that the crowd could be cut in half quite readily if the tremendous advantages of the bicycle as an instrument of travel were more fully recognised. I am sure that many of the waiters could have been home, or nearly home, by the time their particular bus came on the scene, and certainly the journey would have been much more enjoyable. At least, it would have been enjoyable—that characteristic being missing, in my view, from crowded public vehicles.

Somebody is sure to say, of course, that cycle travel has its disadvantages. For the sake of argument, let us admit that, and let us see where the balance of advantage lies. For the cycling way of travel, it may be said that the bicycle is always ready for you when you are ready for it. It is at hand in your home or office (or factory), and it provides door-to-door facilities. Self-propulsion is practically costless. Against the cycling way one must admit that there are occasional difficulties and discomforts. There may be excessive wear on trousers and skirts, while shoes and socks (or stockings) may catch a lot of dirt. On the other hand, if you rely on public transport you must walk from home or office (or factory) to the point where your vehicle will pick you up—for a consideration. You must wait in queues, probably in the morning and almost certainly in the evening, and you may then have to stand among a crowd in an ill-ventilated vehicle. Where lies the balance of advantage? To my mind, with the bicycle. The difficulties and discomforts are cancelled out. The convenience of the cycling way is of tremendous importance, in my view, and the exercise and fresh air which the bicycle provides are by no means negligible. On the question of clothing wear and tear, hardly anything need be said beyond stating that the financial saving effected by the bicycle provides a very ample margin for the purchase of an extra pair of trousers, or of an extra skirt, in a twelve-month. There is the larger question which does not concern us as cyclists: If more and more folks cycled to and from their work it would make for the comfort of the people who, for one reason or another, must rely on public transport. The queues which are a feature of our city streets at the evening rush-hour could be very considerably diminished if all in a position to do so would use the bicycle for their to-and-fro journeys. That is my point of view, anyhow.

Better Batteries

BY the way, I am inclined to agree with one of my colleagues who, in a recent issue, deprecated the eternal complaints of cyclists in relation to their batteries. During the war period we certainly could not say enough in brutal criticism of the muck which was palmed off on to us, but my experience shows that batteries are now much better. They *will* last a reasonable period. I forget whether this point has been previously mentioned, but it will bear repetition. For some months now I have been carrying my rear lamp in one of the pockets of my touring bag. It is out of the weather and away from vibration. Possibly these factors have contributed to my improved experience.

No Surprises For Me

FIRST thing on the morning after a ride I like to take a glance at "the bridge which carried me," just to make sure that it is in good order and condition. This precaution is especially good when one is away on tour, but it has its uses at all times, even when (as is the case with me at the present time) I do practically no cycling between Sunday night and the following Saturday afternoon. If a last-minute puncture should have occurred (as does happen on occasion), I have no wish to become aware of the fact when it is time to go out for a spin nearly a week later. So, on tour, I like to see the bicycle first thing every morning. Then, if there is a job to be done, a time allowance can be made for it—or the job tackled straight away. No surprises for me!

A Grievous Case

I HAVE stressed, and shall continue to stress, the constant need for care when using the road. I believe that, as the old tag has it, the price of safety is eternal vigilance. We must not allow ourselves to relax, even in these days when the country roads are almost clear of motor traffic. Take the grievous case of a schoolboy I know. He was cycling home from school against a strong wind. In front he saw a lorry which he thought was moving in the direction he was taking. He put his head down in order to reduce the resistance—and crashed into the lorry, which was stationary. The result was a fractured spine and, in all probability, a ruined life—even if the lad survives. To me, who has known the boy's parents for many years, this is a terribly sad case (he is an only child), constituting a quite unnecessary accident. The moral is obvious: Care, Care, Care—all the time.

Club Workers—and Others

IN conversation with a prominent clubman the other day, I was surprised at the warmth engendered when he came to speak of the workers—and especially of "the others." He assured me that the majority of cycling clubs are carried on by a handful of workers, the others retaining the right to grumble and to criticise—and to make promises which they do not intend to implement. It so happens that, for the time being, I am rather out of touch with club life, but there is no reason why my friend's picture should not be accepted as being quite accurate in detail. I know, of course, that there is always a kind of competition as to who shall be the last to pay the annual dues, thus throwing lots of unnecessary work on the shoulders of the honorary treasurer, who has to send out reminder after reminder. When the matter comes before the committee there is no dearth of volunteers who will undertake to call on the wayward ones living in their home district, but I gather that such promises are of the piecrust variety—made to be broken—and that nothing is done. Clubs can confer considerable benefits on their members, and it appears to me that the least one can do is to give something in return. When we reach the stage at which more and more folks see how much (particularly in the way of service) they can put into a club, and do not trouble about what they can get out of it, club-life will be on safer ground.

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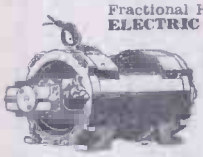

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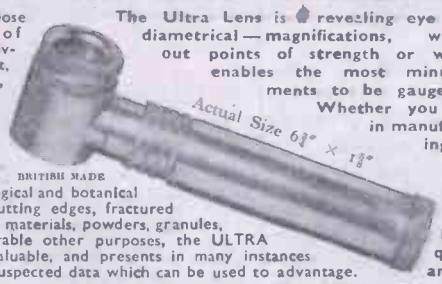

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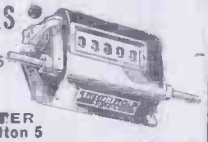

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