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EDITOR: F. J. CAMM

MAY 1952

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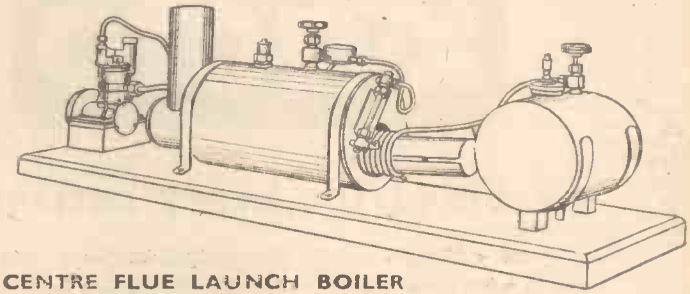

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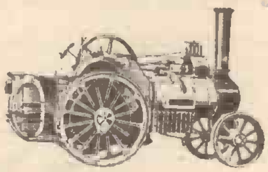

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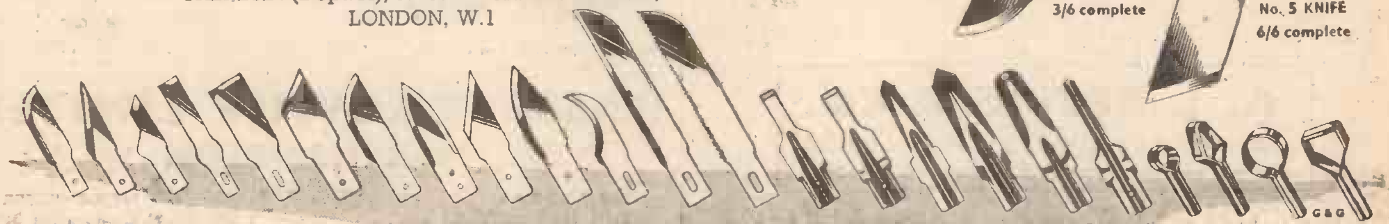

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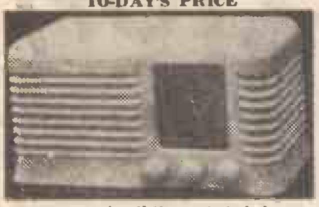

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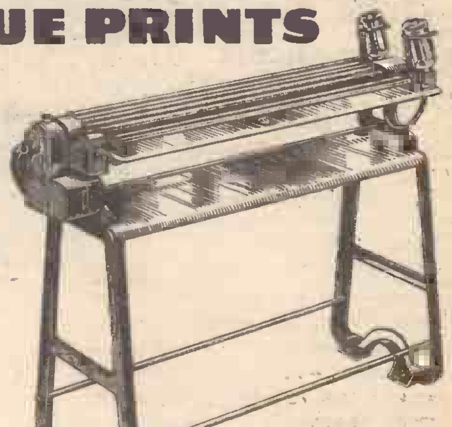

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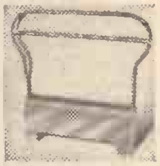

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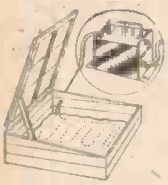

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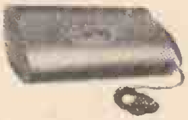

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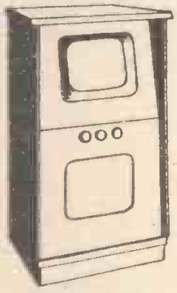

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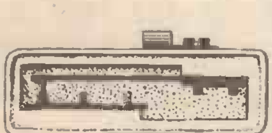

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MAY, 1952
VOL. XIX
No. 221

PRACTICAL MECHANICS

EDITOR
F. J. CAMM

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

FAIR COMMENT By The Editor

Nuclear Propulsion for Aircraft

AN official of the Aircraft Nuclear Propulsion project of The General Electric Company of America says that nuclear energy is ideal for the propulsion of aircraft. It will, I think, be many years, however, before we have an aircraft propelled by atomic energy. Aircraft design at present is veering towards jet and turbine propulsion, the planes themselves somewhat resembling the darts of our school days. Of course, the advantages of a highly concentrated source of heat as is possible with fission are great. The consumption of rare elements such as uranium 235 or plutonium 239 could only be justified in an emergency such as war, for it is unlikely that in peace time the considerable sums necessary for development would be made available. The development of the atom bomb and other devices dependent upon nuclear energy in conformity with our rearmament programme make the possibility of atomic propelled vehicles a problem for future development. It is interesting, however, to think about those possibilities. A nuclear aircraft could encircle the earth many times without stopping, travel around the world at local midnight with the lower vulnerability which night flying confers. The careful husbanding of fuel and the detailed planning of flight speed and altitude would be unnecessary. Such a plane could fly at maximum speed at any altitude and be sure of having sufficient fuel to return to its base. The general design of the aeroplane, which under present systems is limited by fuel storage space, such as large tanks which may have to be built into the wings, thus preventing the use of the most ideal form of aerofoil, would undergo radical change. The performance possibilities of a nuclear plane would be limited only by the freedom of the aircraft and power plant from breakdown, and by the ability of the crew to endure long hours of flight and exposure to nuclear radiation.

One pound of uranium 235 on undergoing fission will liberate heat equivalent to the energy contained in 1,700,000 pounds of petrol and the superiority of nuclear fuel over chemical fuel is thus 1,700,000 : 1. There have been many proposals for an atomic power plant including the use of turbine-driven propellers, a turbojet in which the reactor takes the place of combustion chambers and a ramjet engine also substituting a reactor for the combustion chamber. In all cases, except that of the ramjet, and other direct air cycles, it is necessary that heat be transferred in a coolant from the reactor to the propelling machinery. The reactor would take the form of a cylindrical body throughout which a fissionable material, such as uranium or plutonium, is distributed. The reactor would also contain passages for the flow of coolant through it, necessary for removal of heat. It would contain a material called a moderator such as graphite, ordinary water, heavy water, beryllium or beryllium oxide.

Reaction commences with the capture of a neutron by a nucleus of, say, uranium 235, and since neutrons are present in small concentrations everywhere in the atmosphere, this serves to start the reaction. Immediately after the capture of the neutron, the nucleus disintegrates with the liberation of two to three neutrons and two atomic nuclei, both smaller than the original nucleus.

Recently the American Government announced that the nuclear aircraft programme is entering a new phase. The aircraft gas-turbine department of a large American company is producing the propulsion system and an American aircraft company is producing the air frame. As I have said, we are at present committed so far ahead to our current production and design of planes that nuclear aircraft will not appear for some years, except perhaps as experimental prototypes. But that they will come is beyond all doubt.

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OUR £200 COMPETITION

THE free-for-all competition announced last month has already aroused considerable interest. The competition closes on June 1st, so there is still time for every reader who has not already done so, to get to work. The rules of the competition are repeated on page 270 of this issue.

"TELEVISION PRINCIPLES AND PRACTICE"

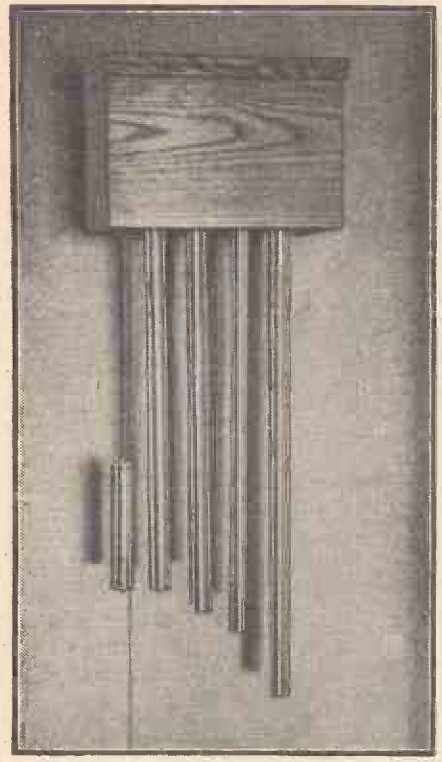
WE have just published an important new handbook entitled "Television Principles and Practice." It costs 25s., or 25s. 8d. by post, and contains 215 pages. The chapters are: The BBC Television System; The Television Camera; From Transmitter to Receiver; Projection Time Bases; D.C. Receivers; Aerials; A London-Birmingham Converter; Servicing; Interference; A Pattern Generator; Choosing a Receiver; The Beveridge Report; Dictionary of Television Terms; Index. The edition is necessarily limited by the paper position, so copies should be ordered without delay.

"SUCCESSFUL CONJURING FOR AMATEURS"

READERS will remember that some years ago Norman Hunter, a former colleague of Maskelyne, contributed a long series of articles on the secrets of conjuring. This material has now been collected into book form and has just been published by C. Arthur Pearson, Ltd., at 18s., or 18s. 6d. from the offices of this journal. It is the most comprehensive book on the subject of conjuring ever published. Issued under the title of "Successful Conjuring for Amateurs" it covers such subjects as: Conjurors' Equipment; Tricks with Flowers; Magic Wands; Card Tricks; Coin Tricks; Tricks with Billiard Balls; Chemical Magic; Cookery Tricks; Levitation; Lamp and Candle Tricks; Tricks with Ropes. The text is illustrated by 400 diagrams and half-tones, and it contains everything the modern conjuror needs to know.—F.J.C.

Making Westminster

Constructional Details of an Interesting



The completed Chimes.

THE task was undertaken from first principles and so entailed some entertaining experimentation, which eventually led to the satisfactory result which is here described. When the door bell-push is pushed the Westminster chimes are played on four notes, G, C, D, E, in the following order:

1	2	3	4	5	6	7	8
E	C	D	G	G	D	E	C

It is therefore necessary to have four gongs and to strike each gong twice in the cycle. This can, of course, be arranged in many ways, but for simplicity it was decided to use a camshaft fitted with four double cams, and to rotate the shaft by means of a clock weight so that, on release by a relay-operated trigger, the shaft makes one complete revolution before coming back to its stop, resetting the trigger in the process. A uniform speed of rotation is achieved by making the shaft drive a clock mechanism from which the spring and escapement have been removed, and to which an air-paddle on the fastest spindle has been fitted. The gongs consist of brass tubes, as in the usual two-gong type. A feature of this design is that the operation of the chimes is not affected by the duration of the contact at the bell-push. As soon as the button is depressed the apparatus commences its cycle, and will complete it whether the circuit continues to be closed or not. If the visitor continues to press the bell the cycle will simply repeat.

This article was first published in the July, 1949, issue of PRACTICAL MECHANICS, *which is now out of print. It is now reprinted in response to many requests from readers.*

The Gongs

Reference to a book on physics revealed that the frequency of a musical note doubles in every octave, i.e., the frequencies of two notes an octave apart are in the ratio 1:2, the higher note naturally having the higher frequency; that an octave consists of 12 equal semi-tone intervals; and that the natural frequency of vibration of a tube varies inversely as the square of its length. It was therefore possible to construct the table (see opposite page), giving the relative frequencies and lengths for a full octave.

The "relative frequency" column is constructed by inserting 11 geometric means between 1 and 2, and the "relative length" column is obtained by dividing 1 by the square root of the corresponding relative frequency.

In the present case we are only concerned with the notes G, C, D and E, but the full octave is given for the benefit of those who may wish to construct chimes giving other tunes.

The actual lengths, diameters and thicknesses of the tubes are immaterial, provided that the lengths are in the proportions 1.000: 0.866: 0.817: 0.773, and that the diameters and thicknesses of all the tubes are equal. In the present case

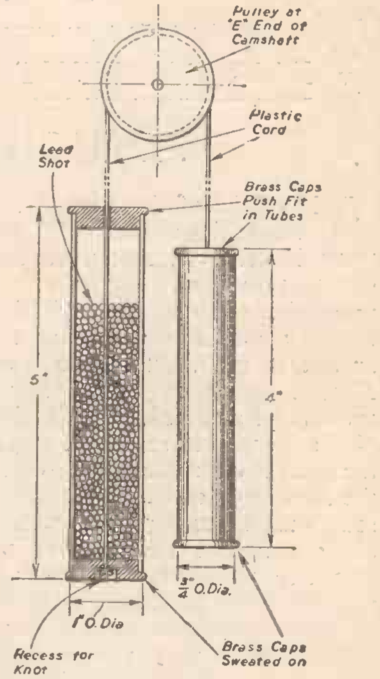


Fig. 4.—Details of weight assembly.

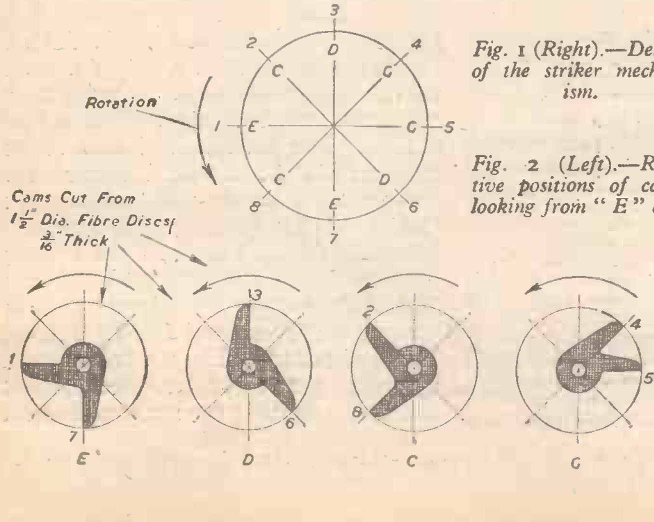
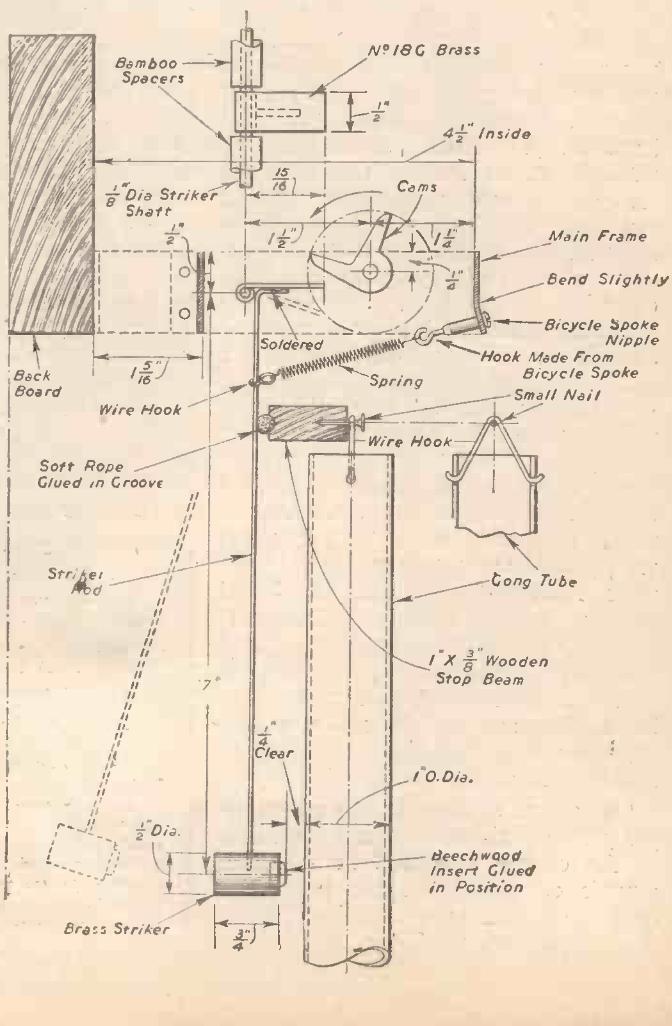
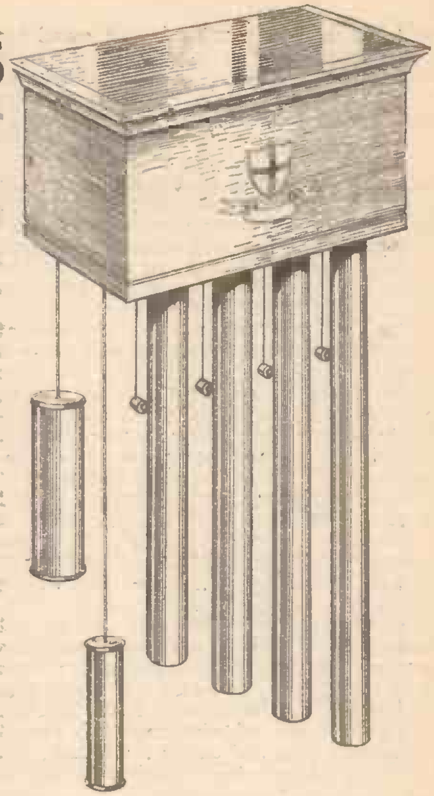


Fig. 1 (Right).—Details of the striker mechanism.

Fig. 2 (Left).—Relative positions of cams, looking from "E" end.



Tubular Door Chimes



This sketch of the completed chimes shows the decorated box and position of the strikers.

Mechanically-operated Unit

By G. MURRAY

tubes 1in. o.d. by No. 16 SWG were selected, having the following lengths:

- G 20.000in.
- C 17.32in. (or, say, 17 5/16in.)
- D 16.34in. (or, say, 16 11/32in.)
- E 15.46in. (or, say, 15 15/32in.)

It is probable, however, that larger and longer tubes, say, 1¼in. o.d. No. 16 SWG, with "G" 30in. long, would give a better tone. The suspension was done with wire loops, as shown in Fig. 1, with satisfactory results, but other means, such as nylon threads, might be slightly better.

Strikers

The principle of the strikers is illustrated in Fig 1, from which it will be noted that when at rest the striker should be well clear of the tube. The inertia, or momentum, of the blow carries the head beyond its rest position to strike the gong, and the elasticity of the striker rod withdraws the head so that the blow is sharp. The rope facing on the stop beam "deadens" the vibration of the striker rod and so prevents repetition. The tension of the springs is a somewhat critical factor and the correct tension was arrived at after some experimenting and adjustment. The springs used were the light type used in some armlets (for holding up shirt sleeves) and the adjustment provided consists of a bicycle-spoke nut on a threaded hook, as shown in Fig. 1.

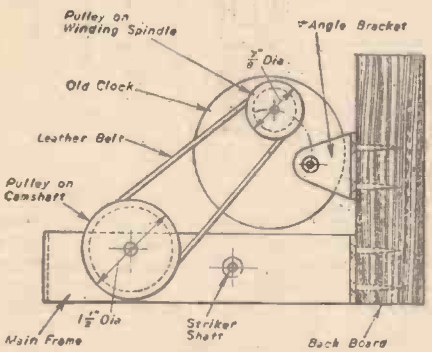


Fig. 5.—Side view of speed regulator drive.

Table of of Relative Frequencies

No. of note	Notation	Relative frequency	Relative length
1	G	1.000	1.000
2	G♯	1.059	.974
3	A	1.122	.945
4	A♯	1.189	.919
5	B	1.260	.892
6	C	1.334	.866
7	C♯	1.414	.843
8	D	1.496	.817
9	D♯	1.586	.795
10	E	1.680	.773
11	F	1.782	.750
12	F♯	1.888	.729
13	G1	2.000	.707

Cams

The cams were made of ¼in.-thick laminated bakelite (a similar tough material would do equally as well) forced on to the 3/16in. diameter silver steel camshaft. Each cam is different from the other three, as indicated in Fig. 2, in which the relative positions on the shaft looking from the "E" end are shown. The method for working out the cam position is also shown in Fig. 2. A circle is divided into eight equi-angular sectors, the eight radii being numbered 1 to 8 in a direction contary to that of the rotation, and the appropriate note letters are set against each. The cam shapes are easily derived from the resulting diagram.

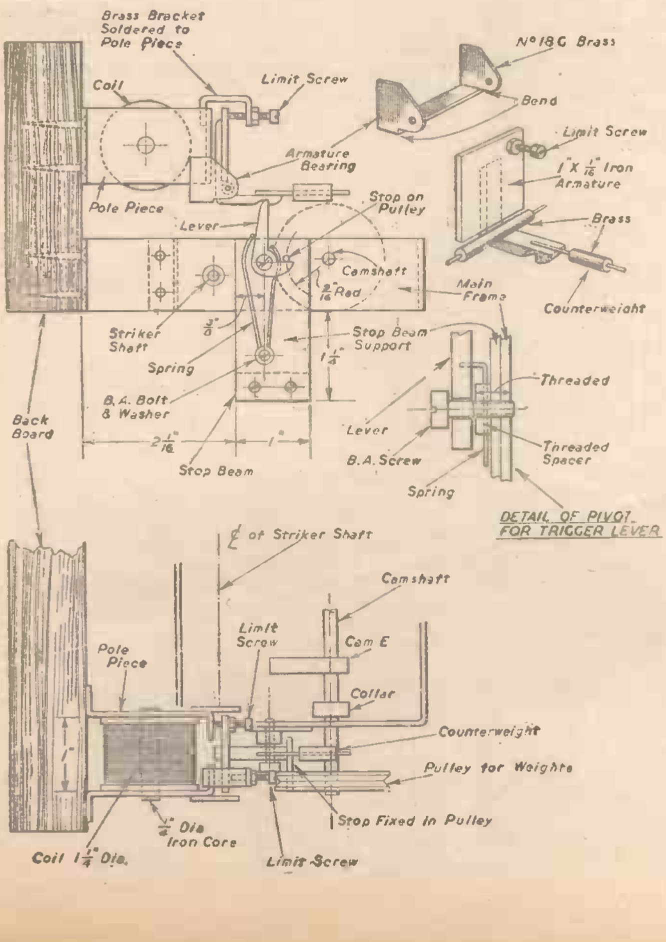


Fig. 3 (Left).—Details of trigger mechanism and relay, and section showing pivot for trigger lever.

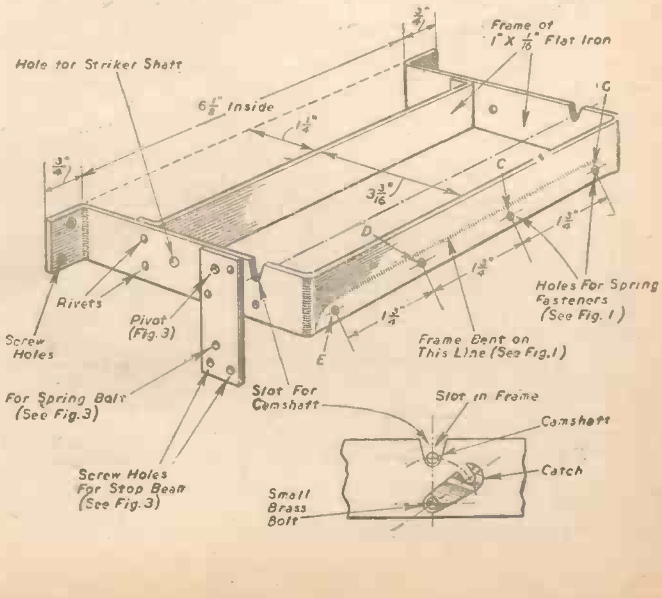
Fig. 6 (Below).—Details of main frame, camshaft bearings, and catch.

Trigger Mechanism

On the "E" end of the camshaft, outside the frame, a fibre pulley to carry the weights is fitted, with a projecting stop to engage the trigger mechanism, which is shown in Fig. 3. The lever turns freely on a spindle firmly attached to the frame and is retained in a "neutral" position by a light wire spring of the shape shown. The trigger is sweated to its spindle, which turns freely in sheet brass bearings sweated to the pole-pieces of the relay.

Relay

The pole-pieces, which form the frame of the relay, are made of 1in. by 1/16 in. strip



iron and the core is made from a round bar $\frac{1}{4}$in. diameter. The ends of the core are slightly shouldered and riveted into holes in the pole-pieces after the coil is in position. The armature is a piece of iron 1in. by 1/16in. by 1in. sweated to the vertical arm of the trigger. Adjusting screws with lock-nuts are provided to limit the travel of the armature. It is important that the armature should not come too close to the poles (about 1/16in. minimum) as otherwise residual magnetism may prevent proper operation, and the travel should be kept to the minimum necessary to operate the trigger.

The coil contains about 1,000 turns of No. 26 gauge enamelled copper wire and was wound on a lathe. The coil former was made by wrapping several turns of stout writing paper around $\frac{1}{4}$in. diameter rod and smearing Durofix on the paper as it was wrapped. The flanges of the former are of 1/16in. fibre-board, glued to the paper tube.

It is important to grease the $\frac{1}{4}$in. rod so that it can be withdrawn after serving as a mandrel for winding the coil. It is also advisable to support the flanges of the former with metal washers to prevent splaying during winding. Electrically-minded readers may criticise and improve on this. The coil actually used, however, is compact and gives excellent results when operated on 15 volts A.C. from a bell transformer. It would probably work equally as well from batteries. The ends of the coil wire are simply carried to terminals mounted on the back-board, and connected into the door-bell circuit.

Weights

Considerable thought and some experimentation were devoted to devising a simple weight system which could be regulated and be easy to rewind, since the weights control the speed of operation. The arrangement finally adopted is shown in Fig. 4. This consists of two weights of different size connected by a cord of "plastic string," which is readily obtainable. The weights are made of brass tubes containing lead shot, the quantity of which can be adjusted until the proper conditions are obtained. It is obvious that the difference between the weights provides the operating torque, while the small, or counter-weight, determines the tension necessary for the driving friction. The cord should be as long as possible, consistent with the space available, so as to give as many chimes as possible between winds. Rewinding is done simply by lifting the larger weight and, therefore, the height at which the apparatus is fixed should not be more than about six feet, and it should be placed on a conveniently accessible position. The diameter of the cord and the shape of the groove in the driving pulley should be combined in such a way that the cord bears on the sides of the groove, not on the bottom of it.

Speed Control

A small clock which had been discarded as beyond repair was dismantled, the spring and escapement were removed and a copper-foil air-paddle of the largest size that could be accommodated in the available space was soldered to the fastest spindle. A small fibre pulley was forced on to the winding spindle. The clock was then mounted on the back-board so that the small pulley was in line with the pulley at the "G" end of the camshaft and the two pulleys were connected by a belt made from a leather bootlace. The tension in the belt can be adjusted by rotating the clock on its mounting bracket, which is secured by a nut to one of the columns of the clock-frame. (See Fig. 5.)

Main Frame

This is made from 1in. by 1/16in. strip iron, bent to shape and riveted together as shown in Fig. 6, in which it will be noted that the camshaft is held in slots by means of bolted catches. This arrangement permits the camshaft, with its cams and pulleys, to be assembled complete before placing in position. The camshaft assembly is shown in Fig. 6. This shaft should run freely in the bearings but with a minimum slack and end-play, the latter being prevented by the collars which bear on the inside faces of the frame.

The striker shaft is fixed and is held in position by collars placed on the outside of the frame. The strikers turn freely on the striker shaft and are held at the proper spacing by sleeves made of bamboo cane to avoid chatter noises, slipped over the shaft as shown in Fig. 8.

Back-board and Cover

The back-board was made from 1in. thick pine and an oak cover box was fitted as shown in Fig. 9. A decorative design in brass may be fixed to the front of the box. If the box is waxed light oak and the brass work highly polished the general appearance is quite pleasing, but other, perhaps, more modernistic designs may appeal to other readers. The brasswork might be chrome-plated and the cover could be worked in aluminium or coloured Perspex.

The iron parts should be protected by enamelling or lacquer applied before final assembly, care being taken to remove all paint or lacquer from the bearings and other working surfaces, which should be lubricated with a good light oil applied very sparingly.

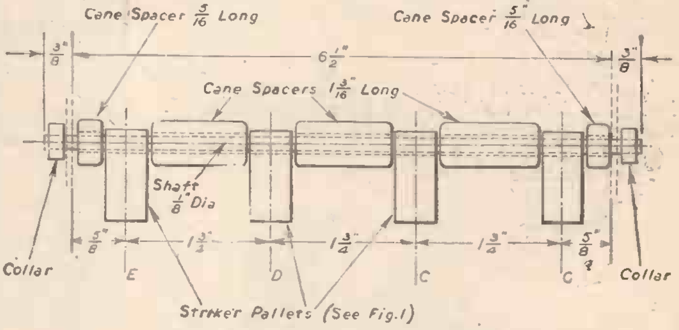


Fig. 8.—Striker shaft and spacers.

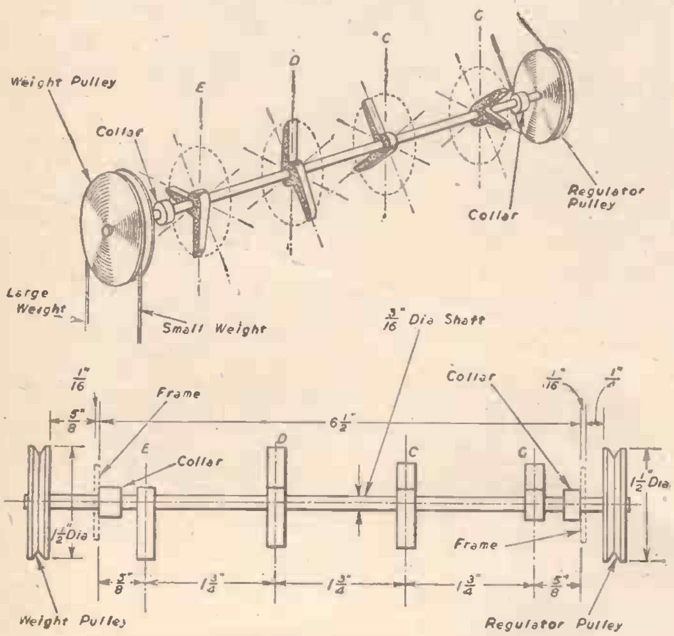


Fig. 7 (Above).—Perspective view and plan of camshaft.

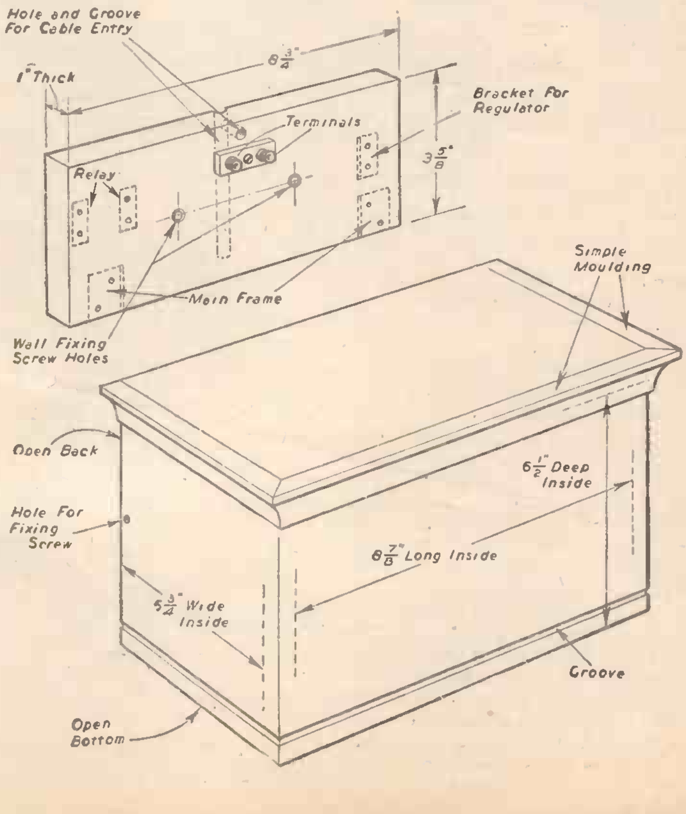
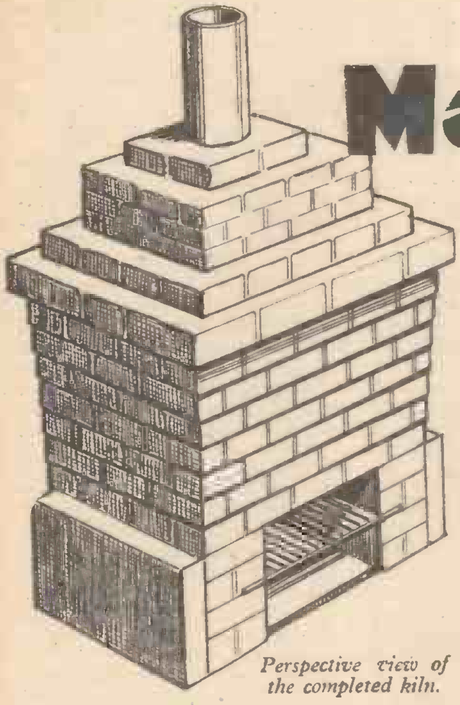
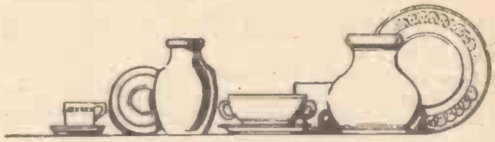


Fig. 9 (Right).—Details of backboard and cover box.





Making a POTTERY KILN

Details of a Practical Coke-fired Kiln for Craft-pottery Firing

By J. F. STIRLING

Perspective view of the completed kiln.

CRAFT workers who have made experiments in clay modelling, and particularly those who have already constructed and made use of the simple potter's wheel which was described in this journal in December last, will, doubtless, have cast around for some workable means of adequately firing their clayware in order to convert the soft, plastic material into the hard, unglazed "biscuit" pottery proper.

At first thought it might appear to be a very simple matter to construct a really practical furnace or kiln capable of turning out pottery articles of small size on a home scale. In fact, however, this is far from being the case. In the first place there are many different types of kilns to choose from—electric, or coke-fired, up-draught, down-draught, direct firing, muffle fired, large, small, firebrick, asbestos, etc.—the various types and modifications of constructional materials used being fairly numerous. Secondly, the kiln must be of small dimensions so that it becomes "easy" in fuel, and so that all work may be conducted on a necessarily small experimental scale. The kiln must be capable of attaining a temperature of at least 1,100 deg. C., which is a true white heat, for although the mere surface glazing of pottery articles can be effected as low as 800 deg. C., a kiln which is intended to be used for the serious purpose of adequately firing the various hard pottery clays becomes more or less useless unless it is able to reach up on occasion beyond a round thousand degrees of well-maintained Centigrade temperature.

The kiln described in this article is primarily of the coke-fired, "up-draught" type. It would, of course, burn coal, wood, or, indeed, any other variety of solid fuel. It can be made to any required size or altered in size when desired. Possibly, too, it might be converted into a kiln of the gas or electric-heating type, although it is not very likely that this modification will be required in view of the present costs of gas or electricity supplies. Therefore, interested readers building this kiln are well advised to stick to solid-fuel firing which, after all, is the oldest known heating principle in the pottery world.

The kiln may be constructed in various positions. It may be built standing directly on the ground, as shown in the illustration, or it may be incorporated into an existing old cellar fireplace, provided that the latter has a good flue and is adequately lined with firebrick or other high insulating material. Usually, the best site for a kiln of this type is out-of-doors in a sheltered position so that all danger of fire is well minimised.

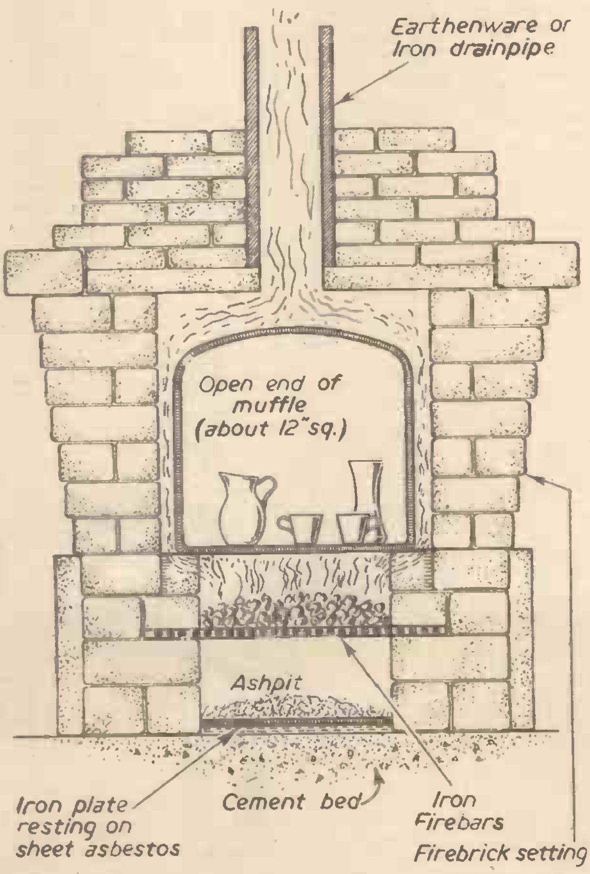
Heat Conservation Essential

Maximum conservation of interior heat must be the aim of the constructor of any type of pottery kiln, since valuable heat is wasted and the attainment of high temperature absolutely precluded if the generated heat is allowed to leak away and escape by radiation. That is why the entire set-up must be effected in firebrick or in some other type of heat-insulated brickware.

Let us begin with the actual oven or inner compartment in which the clay articles are to be baked. It is, of course, possible to do without this enclosing muffle or compartment, but, in this event, the clay articles have to be enclosed in some type of protective cases, or "saggers," of refractory material, for otherwise they would be directly exposed to the flames and to the hot gases of the furnace, which influences would be to their constant detriment.

Muffles of various sizes and patterns can be obtained from dealers in potters' requisites, such as Wengers, Ltd., of Etruria, Staffs, but it is well to remember that an ordinary fireclay crucible of sufficient size can be used as a pottery muffle. So, too, can even a common flower pot laid on its side, provided that it is perfectly dry to begin with, although such an article, even when quite dry, is liable to crack and to spall or flake a good deal as the higher firing temperatures are reached.

Another type of improvised muffle may consist of a fairly substantial sheet of true asbestos (not the asbestos-cement composition used for roofing and similar purposes) fitted together into the shape of a cube and held in this position by means of adjacent firebricks, the joints of the asbestos wall so formed being carefully luted-up with ordinary clay or fireclay cement.



Sectional diagram showing the inner and outer construction of a simple pottery kiln.

Small Kiln is Economical

The size of the enclosed muffle should be about 1ft. cube. Although it will not provide for any large-size articles to be baked therein, we must remember that the smaller the model the less the fuel used, which fact, in these days of high fuel cost, is of primary importance. Bear in mind, also, that this is merely an experimental kiln, designed mainly with the aim of allowing the homecraft pottery worker to attain some practical experience and facility in pottery firing and general kiln working at the lowest capital and maintenance costs. Having derived reasonable success with a kiln of this type, the individual worker may always consider going on to better things.

A study of the accompanying illustration of the kiln in section will show that the inner muffle rests directly on a brickwork ledge by means of its own weight. The entire muffle is closely surrounded with brickwork, a space of about three or four inches being provided all round the muffle for the passage of the hot gases from the coke fire which rests on firebars set into the supporting brickwork about a foot or ten inches below the muffle.

The firebars are raised about six inches above the ground in order to form a suitable ashpit from which the ashes may be raked from time to time. The best floor for the ashpit consists of a two-inch layer of cement (preferably refractory cement) laid on a bed of rubble. Over the upper surface of the cement is laid one or two sheets of asbestos and, finally, a half-inch sheet or plate of iron or steel.

The flue of the kiln consists of an ordinary drainpipe. If this is not sufficiently long to give a good draught, it may be extended by means of another length of earthenware or iron pipe inserted into or constructed over it.

Firebrick Surround

The whole of the inner brickwork of the furnace or kiln must be constructed throughout of firebrick material, or of refractory brickwork of some other kind. For a really good job, refractory brickwork or firebrick should be used exclusively for the making of the entire furnace set-up, but if expense is a primary consideration, the outer brickwork may be effected in common brick material, or even in old or secondhand building bricks, and one or two extra brick courses may be added to make up for the lack of thickness of firebrick. The rear and sides of the brickwork surround of the kiln should be well mortared with any good refractory cement or mortar. A serviceable mixture for such material consists of about equal parts of crushed, baked fireclay and ordinary unbaked fireclay made into a plastic paste with water, and a little raw clay.

In order to insert the pottery articles into the muffle and the withdraw them after firing, one end of the muffle must be left open. After the insertion of the articles, this open end is closed by means of a sheet of asbestos, or a thin stone slab, which is placed close against it, the joints being luted-up with a fireclay plastic paste. The whole of this side of the kiln will then have to be bricked-up in the usual manner, but ordinary clay should be used for the mortaring because this side of the kiln will be required to be pulled down in order to reach the muffle again after the firing and to extract the contents therefrom. The mortaring of the brickwork on this side should, naturally, be of the lightest description possible. Despite this, it is of the highest importance to ensure that every chink and crevice in the brickwork of the furnace is properly plugged and mortared up with clay or some other suitable refractory material, for, in a furnace of this type, every scrap of heat is precious.

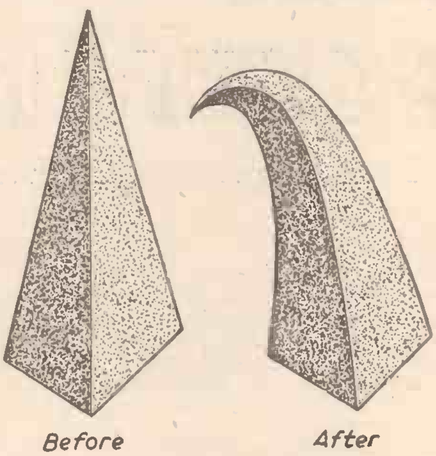
The Spy Hole

A very desirable refinement for the working of the kiln can be provided by setting an iron tube of about 1in. internal diameter into the brickwork of the "removable" side of the kiln, so as to provide a "spy hole," the inner end of the tube proceeding an inch or two into the muffle itself, and the outer end of the tube being plugged with a lump of hard clay. After removing this plug, the condition of the muffle interior can be viewed directly during the heating process.

If a kiln of this type is erected out of doors in a very exposed position, it will be as well to plaster a clay paste over the sides and top of the whole of the exterior brickwork in order to lessen the escape of heat by radiation and, also, to protect the kiln during its working from heavy or continuous rain and from other inclement weather conditions.

Firing the Kiln

After placing the clay articles in the muffle and building-up the open side of the kiln, a slow fire is started in the grate by means of paper, wood and coal. This fuel, once ignited, then requires a small addition of coke in order to keep it gently burning. If the kiln has been freshly erected, it is best to maintain a slow fire for as long as possible in order to dry out the walls of the furnace. A complete day's preliminary slow firing is not too long. Indeed, the slower the



A potter's cone before and after firing to 1,000 deg. C.

firing of this kiln, the better the pottery, for imperfectly fashioned clay articles can very frequently be cracked, spalled or distorted by over-rapid firing.

When it is desired to increase the kiln temperature the fire in the grate is gradually built up into a roasting, roaring mass by means of small coke. In this matter the length of the kiln chimney or flue pipe will determine the draught and the ease with which a fire can be maintained under good burning conditions. Suffice it to say that the average kiln firing lasts from 8 to 12 hours and sometimes longer, according to the type of pottery which is being fired. It is here that actual visual inspection of the muffle interior through the "spy hole" is of the greatest assistance in determining how long to continue the firing.

Incidentally, from dealers in potters' requisites may be obtained various cones and miniature pyramids composed of special claylike materials which soften and thus cause the cone or pyramid to bend over at predetermined temperatures. The experienced potter usually places one or two of these cones in such a position in the muffle that they are able to be observed directly through the spy hole during the firing of the kiln.

Ample Cooling Time Important

After the contents of the muffle are adjudged to be well and properly fired, the fire in the grate is damped down by raking it out or by covering it with ashes. Ample time should be allowed for the kiln to cool down thoroughly before the removable side is pulled down in order to get at the muffle and its contents. A kiln may appear to be perfectly cold outside, yet it may hold much interior heat. So much, indeed, that the sudden inrush of cold air on to the still very hot pots within the muffle may cause them to crack. As a rule, it is safest, on the first operation of the kiln, to allow it a good three days in order to remove its pottery contents without risk of such thermal mishap.

Operation

In the operation of a kiln of this type nothing of the general cleanliness, convenience and ease of working characteristics of the electric and gas-fired kilns must be expected. But then, of course, the coke-fired kiln can be set up and operated at a mere fraction of the working cost of its more efficient and aristocratic relatives.

Given a properly built coke-fired kiln, the success of its firing depends mainly on the regulation of its furnace draught and the adequate conservation of its internal heat. There is always a merely small up-draught at first and, to the inexperienced user of the kiln, this may give rise to some trouble in the starting of the fire. However, as the kiln structure gradually warms up the draught becomes better and better in consequence. If, by chance, the draught is too free at first, it is probable that, subsequently, the extra heat obtained from the fire in the later stages of the heating will merely go up the chimney and be wasted completely. Do not, therefore, ever attempt to "force" a kiln fire during its initial and early stages.

As a final and important hint, do not try to design and build up any kiln of this type on too large a scale until you have at least obtained adequate experience and familiarity with the details of working a small-sized kiln, and of economically managing its fire. An interior muffle of about 1ft. cubic capacity is sufficient for any inexperienced pottery-minded individual to start with. Such a muffle capacity will accommodate about a dozen average small-sized pots.

"Tell the chief that, apart from a navigational error, the new rocket is a complete success."

Making a TAP RE-SEATING TOOL

Readers owning, or having access to a small Screwcutting Lathe should have no trouble in making this indispensable Tool.

Constructional Details of a Useful Appliance for Home Use

By A. D. STUBBS

THIS tool came into being after I had re-washered one particular tap about four times, knowing all along that the seating was in an unseatable condition, but winter and the probability of frosts brought things to a head.

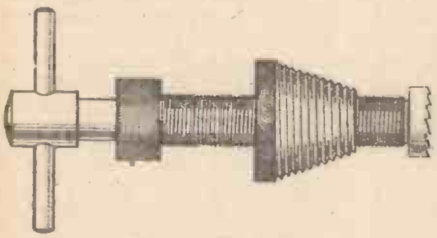


Fig. 1.—The completed re-seating tool.

The cutters themselves I did not make. They can be purchased in four sizes from 11/16in. to ⅞in. diameter, and though mild steel, case hardened, would easily do the job, the time involved in cutting the teeth seems hardly worth while, unless you are really looking for work. Incidentally, in my perigrinations I found two manufactures, one with ¼in. the other with 5/16in. screwing, so if you also buy your cutters ready-made, check up on the threads before screwing your own spindle.

Fig. 1 illustrates the completed re-seating tool. In use, the tap is dismantled as for

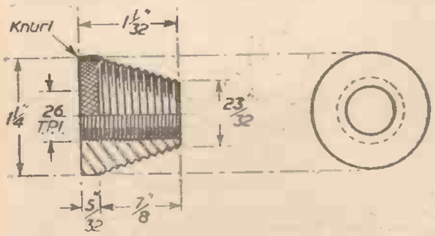


Fig. 3.—Part section and end view of the taper-screwed body.

re-washering (perhaps it is superfluous to mention the advisability of closing the main valve) and the taper threaded body of the tool is screwed into the body of the tap. This assumes that the taper body is near enough to the cutter to allow the taper to seat well into the tap. Now screw down the internal sleeve, Fig. 2, until the cutter face contacts the tap seating, and operate the cutter by rotating the tommy-barred end.

If the tap seating is only just below par, it can be brought into good condition by advancing the knurled head of the internal sleeve a sixth of a turn, but if corrosion has really got to work on the seating, you may have to advance the sleeve, in easy stages, for half a turn or more. The finished job leaves nothing to be desired.

Constructional Details

The whole of the tool is made from mild steel. Fig. 2 gives the internal sleeve in half section. The bore size is not arbitrary, since the spindle can be machined to suit, so the 29/64in. dimension can be reduced if you wish.

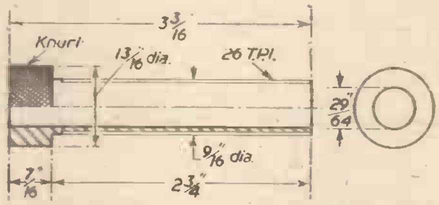


Fig. 2.—Section and end view of the internal sleeve.

If you have no knurling tool the sleeve could be machined from hexagon mild steel for use with a spanner, but only a very light pressure is needed when the cutter is in action.

My screwing is 26 threads per inch. You need a fine thread, but here again there is no reason to keep to the 26 if your change wheels do not come just right.

The taper screwed body is shown in Fig. 3, also in half section, and it is assumed that your lathe can be set over for taper screwing. Alternatively, two or more bodies could be machined, with parallel threads to suit the taps fitted in your home, in which case I suggest that the total length of the body should remain at 1-1/32in. The knurled portion could be set amidships, with one size thread to the right and another to the left then, with luck, two sizes will see you successfully round the house. By keeping to 1-1/32in. or somewhere near it, you retain a long internal thread, so lengthening the life of the tool.

Knurling is not essential, but if you resort either to hexagon or to the use of a footprint wrench on a turned diameter, be very light handed when screwing the body into the tap. Aluminium taps in particular do not take kindly to rough usage.

Main Spindle

Fig. 4 shows the main portion of the spindle, 7/16in. diameter, but it should be a sliding fit in the sleeve. Remember that the cutter threads may not be 5/16in. Whitworth, but otherwise the job is straight forward. The tommy bar is 2⅜in. long overall and is a drive fit in the spindle.

Having reseated the only bad tap which I possess, of course I had to go all round the house, so now I do not anticipate requiring the tool for another twenty years or so, but if I had either purchased one or employed a plumber I should have been out of pocket, as all the steel used came from that untidy heap of raw material on the floor of my workshop.

Incidentally, I am going to find the set of cutters very useful as end mills, and with that in mind an arbor has already been produced.

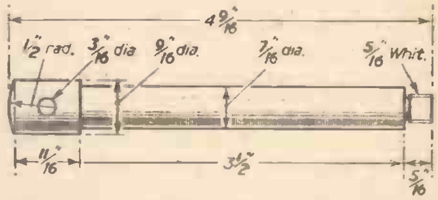


Fig. 4.—The main spindle, showing the hole for tommy bar, and threaded end for cutter.

This fine free-lance model luxury cruising liner, m.s. "Patria," was built by boys at the "Barnes Model Shipyard," at Wilmslow, Cheshire. The model is 5ft. 8in. long, and is powered by a 15 c.c. diesel engine, driving a three-bladed propeller of 2¼in. diameter.

Fluorescent Lighting

Its Operation and Advantages Briefly Explained

By E. GODLEY

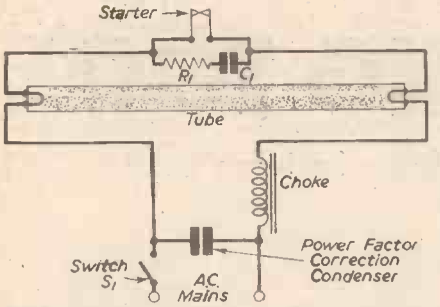


Fig. 1.—Circuit diagram for a single fluorescent tube.

FLUORESCENT lighting although not now used a great deal in homes, seems to have great prospects in the near future.

The first thing to consider if contemplating installation of fluorescent lighting is the life and cost of components. There are four main parts, viz.: chokes; tube; starter switch and power factor correction condenser. There is, of course, the tube holder and other fixing devices.

The Tube

This is the part which does the work and provides the light. The rest of the equipment required is for starting purposes only.

The various sizes of tubes, and wattage, are given in the accompanying table.

Nominal length	Dia. of tube	Wattage
5ft.	1½in.	80
4ft.	1½in.	40
3ft.	1in.	30
2ft.(2)	1½in.(1)	20(20)
1½ft.	1in.	15

The tube may have bipin ends or may be bayonet cap, depending on the make. The life of a tube is about 3 times that of a filament bulb, that is, an average of 2,500 to 3,000 hours. After 3,000 hours the tube should be replaced even if it still works as its efficiency begins to drop rapidly. With regard to the prices of tubes: they vary from £1 to 25s. for an 80 watt straight tube, and other prices in proportion according to the size of the tubes.

The Choke

This is a special component and not one as used for radio. It has to carry first a heating current of 1.3 amps (for 80 watt) and a continuous current of approximately .85 amp. (again 80 watt A.C. tube); so it has to be designed to stand these currents, yet still have an inductance to do its job properly. The price varies from 25s. to £3 and it has a long life if treated properly.

The Starter

This may be of two main types:—(1) The gas or glow type which consists of a bulb with helium at a reduced pressure. It is a small gas discharged tube of the negative glow type, the electrodes of which form the switch contacts. One or both electrodes are of bimetal strip operation, described later. The price is about 5s. Type 2. Instead of the bimetal strips being heated by the passage of current through the helium gas, they are heated by a small heater, which is run in series with the lamp. The contacts are closed when cold, while in the first type the contacts are open when not in use. The starter will last for up to 15,000 hours, if used under proper conditions.

In Fig. 1, R1 and C1 are to cut down

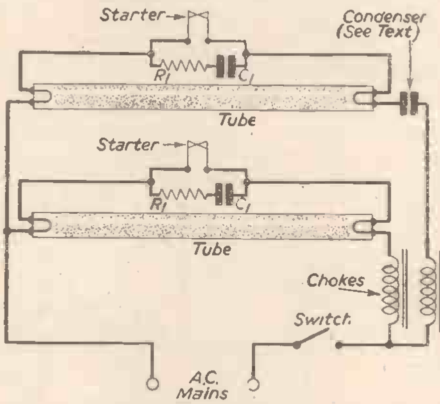


Fig. 2.—Circuit arrangement for twin tubes.

interference with radio and television. Values are R1 about 100 ohms ± 20 per cent.; C1 .005 μf. ± 20 per cent.

Operation

In Fig. 1, switch S1 is closed and the current flows through the heaters, the starting switch and choke. The starting switch, if of the glow type, when first switched on allows a current of about 100 milliamps to flow through the helium gas, so heating up the bimetal strips, the contacts close and allow a current of 1.3 amps. (80 watt tube) to flow through the heaters. When the contacts close they short out the voltage across the helium gas so that the starter cools down and the bimetal strip contacts open suddenly. The magnetic field round the choke quickly collapses causing a high voltage to be induced across the choke (approx. 750 volts) and this fires the tube, which has been ionised near the ends by the heaters. Once ionised the gas in the tube will then continue to carry a current. This short circuits the starting equipment. The voltage developed across the tube when running is about 106 volts.

Stroboscopic Effect

One of the chief disadvantages of fluorescent lighting is the stroboscopic effect, i.e., where things such as moving machinery appear to stand still or even move backward. These are, of course, optical illusions. Sometimes it is desirable to lessen or cut out this effect. It is done by having two tubes wired as in Fig. 2, with condenser C2 in the circuit of one of the tubes. This not only makes the tubes flash out of synchronism but makes the power factor near unity. The value of condenser to use is 7.5 μf. (8 μf. may be used with success, and 275 volt A.C. working is advised). This arrangement cannot be used on direct current supplies.

Other disadvantages are if the tube is to be used below 10°C it is more difficult to make it strike. Below 5°C it is impossible to use ordinary fluorescent tubes.

Operating on D.C.

If fluorescent tubes are used on D.C. a resistance must be used to limit the current as the choke's D.C. resistance is too small to do this. Also, mercury tends to collect at one end of the tube on D.C., but this can be overcome by reversing the polarity of the mains at intervals, say, every day of use. Below 220 volts D.C. starting may be difficult and is not recommended.

Advantages

The advantages of fluorescent lighting are the efficiency is greater than other types of lighting. Efficiency is about 35 lumens per watt after 100 hours of tube life. About 20 per cent. of energy consumed is given out as useful light. (See Fig. 3.) In a filament lamp only 5 per cent. or less is useful light. Fluorescent lighting can be used where heat is not wanted because running temperature of tube is only 20°C above ambient temperature. Colour and absence of glare are further advantages of fluorescent lighting. Colour can be varied by the powder used in the tube during manufacture. Also, it is not a point source of light so no hard shadows are formed. By having two lamps very little shadow is formed so parts of the room which are normally in semi-darkness can be used, and so less space is wasted.

From the foregoing notes it will be seen

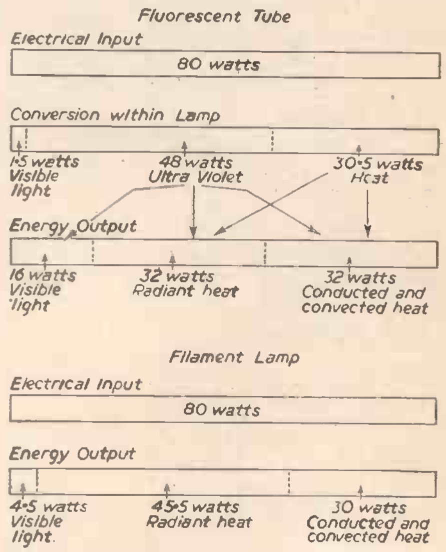


Fig. 3.—The relative efficiency of a fluorescent tube and a filament lamp.

that the initial cost of installation of fluorescent. lighting is higher than that now used, viz., filament lighting, but after installation fluorescent lighting has so many advantages it is well worth the cost and with its greater efficiency running costs are much lower.

Making a Vertical Enlarger

Constructional Details of Apparatus for Enlarging "120" Films

By D. H. INGHAM

(*Concluded from page 239 April issue*)

TWO blocks of metal measuring approximately 2½in. x 2in. x ¾in. were cast in a suitable tin and, after marking out, as much surplus metal as possible was cut away. Then the brackets were worked into shape with a half-round file. The slots in the end may vary in size according to the type of camera used. (See Fig. 6.)

Lamphouse

Constructional details are found in Fig. 7. Little comment is necessary, except to mention that the hole in the top allows for horizontal as well as the vertical adjustment of the lamp. The bracket at the rear serves as a holder for the camera back whilst in position on the enlarger. The lamp stem is a 9in. length of ½in. brass tube, with a thread at one end for a ½in. brass lampholder.

Gallery

Here again we resort to the use of 1/32in. sheet copper and curtain rail. The rail is cut to a length of 11¾in. and bent round till the ends meet to form a circle 3¾in. dia.

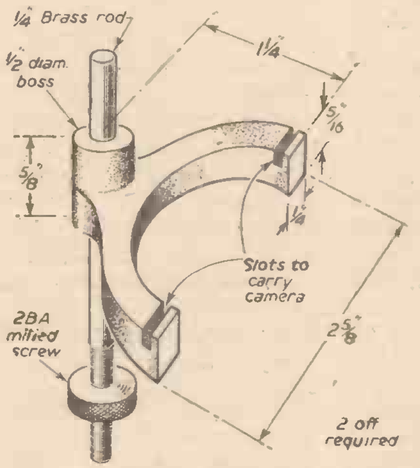


Fig. 6.—Perspective view of camera mount.

After bending, bind a length of wire round the perimeter to hold the ends together, tin the narrower flange and sweat on to a piece of copper 3¾in. dia., and solder up the ends. Finally, cut a hole in the centre of the copper 1¾in. dia.

Next cut out a piece of copper to the dimensions given in Fig 8 and drill a ½in.

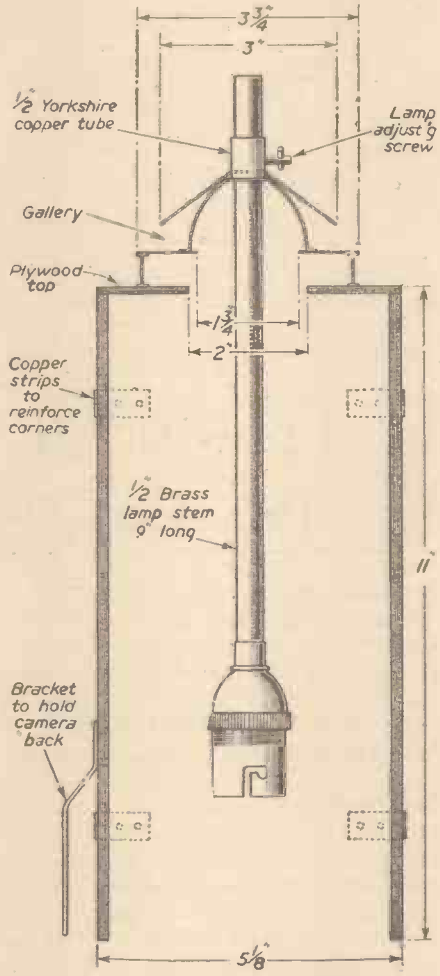


Fig. 7.—Sectional view of lamphouse and gallery.

hole in the centre. Solder a 1in. piece of ½in. Yorkshire copper to the perimeter of the hole, and drill and tap the side of this to admit a ⅛in. thumbscrew. Bend legs A and B down till bases are 2in. apart and likewise with C and D. Make a ⅛in. lip on each leg as shown, and solder centrally to gallery.

Gallery Cone or Cowl

Details of the cone, which is cut from sheet copper, are shown in Fig. 8, and when finished it is soldered to the top of the gallery.

Pulley Assembly

Details of this are found in Fig. 9. The shaft is a 4¼in. piece of ½in. mild steel and the bearings can be cut from ½in. Yorkshire

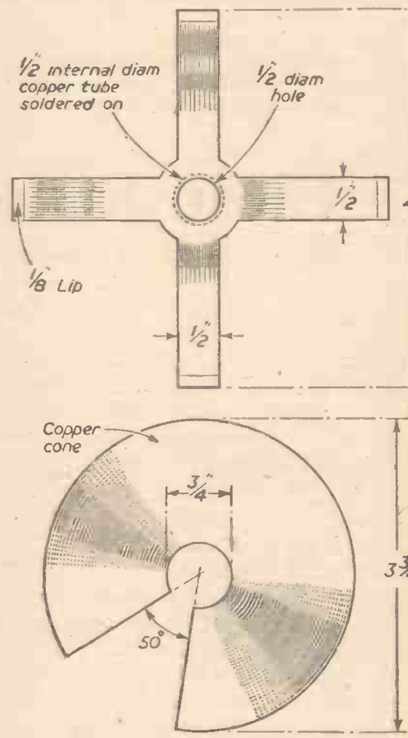


Fig. 8.—Details of gallery parts.

copper tube, the ends being stopped.

The 1¾in. pulley was originally a V-pulley. One flange was cut away and a 1¾in. dia. brass washer bolted to the end, and this allows a wider surface for the elevating rope to wind on to.

The stay wire rope is anchored to the pulleys through the holes shown with nipples

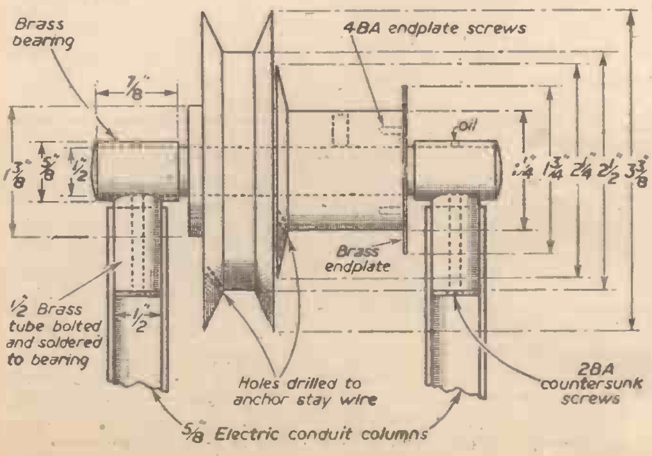
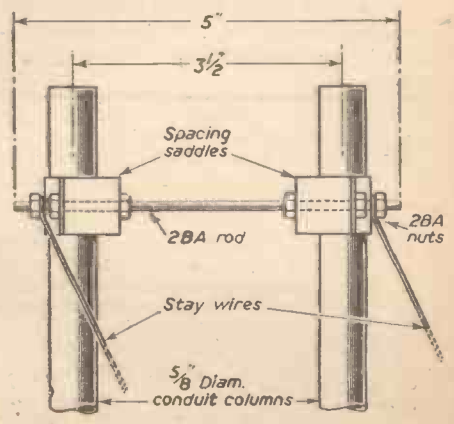


Fig. 9. (Left).—Part sectional view showing details of pulley assembly.

Fig. 10. (Right).—Details of spacing saddles, and method of fixing stay wires.



from cycle spokes. Care being taken to splay out the wire ends before soldering.

The method of fixing the stay wires to the saddles at the top of the upright columns is shown in Fig. 10.

Elevating Ropes

The elevating ropes are cut from 3/32in. wire rope and measure 2ft. 1in. and 2ft. 6in. respectively. The counterweight is suspended from the large pulley on the 2ft. 6in. piece, whilst the enlarger is suspended on the 1¼in. pulley by the 2ft. 1in. piece, and attached to the enlarger by means of a small " S " hook, affixed to the loop of stay wire on the bracket as shown in Fig. 2.

The counterweight is a piece of 2in. brass tube filled with lead, the weight first being determined by experiment.

Extension Box

In the case of a camera which possesses extending bellows, this part may not be necessary as the distance required between lens and negative may be covered by the range of the bellows. This being the case, the legs for the camera mount will be shorter.

The distance between lens and negative can be determined by experiment, prior to the construction of the box, details of which are given in Fig. 11. The depth of the box will vary according to the focal length of the camera used. As the boxes are a sliding fit, it may be found advantageous to construct more than one—each of different depths; by this means a much wider range of enlargement than formerly stated may be permitted.

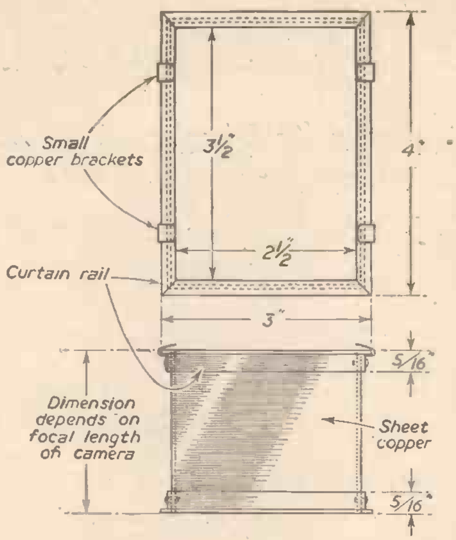


Fig. 11.—Plan and side elevation of extension box.

For finishing the enlarger the whole of the interior, including the gallery, is painted with photographic or drop black paint. The exterior of the lamphouse and the base likewise. The copper and brass parts may be polished with steel wool and lacquered with water white cellulose lacquer.

The gallery, lamphouse and condenser assembly are all separate sections, fitting loosely together. The whole assembly rests firmly on the bracket arms, thus allowing easy access to all parts, and allowing the body to be simply lifted off for storing purposes.

The flex is bound to the stay wire to keep it out of harm's way.

To ensure that no light would escape from the condenser assembly a piece of thick blotting paper was sandwiched between each joint, the paper then being trimmed off to form an efficient gasket.

Great National Free-for-all Competition

£200 IN PRIZES!

WE invite all our readers to enter our latest competition, details of which first appeared last month. Readers will see that the competition is divided into four sections with prizes of £25, £15, and £10 in each section.

There is no entrance fee !

The competition is only open to regular readers of this journal and entries must be accompanied by the coupon on page 64 (Cyclist supplement).

Here is a chance for inventive readers to put their talents to good account, for apart from the prizes we shall pay at our standard rates for all ideas published but which are unsuccessful in gaining a prize.

Almost every reader has either thought of or actually made some gadget, some improvement to an existing piece of apparatus, or some device which he has not been able to obtain because it is not on the market.

There are hundreds of things about the home which are in need of improvement, even in the most modern and up-to-date households. A great deal of the housewife's work can be drudgery. Perhaps you can suggest a device for making such work less irksome. A simple washing machine that will fit into the sink; an ash and cinder disposer; a hand-operated clothes washing machine; new uses for the vacuum cleaner; improvements to the lawnmower; garage accessories; lighting devices. These are but a few of the directions to which you can turn your inventive ability. There are hundreds of others. Spend a little time working them out and putting the details down on to paper. It is not necessary, of course, to make working models; drawings and descriptions will suffice. We do not, however, bar models. They may be submitted as well if they are necessary to explain the idea.

Flat owners particularly, because of their limited space, will welcome suggestions for small labour-saving devices which they can accommodate in their small homes. A fan-operated clothes drier and airer, a small refrigerator, a tap-operated food cooler, a carpet sponger, an upholstery cleaner, a mechanical pot scourer—there is plenty of scope.

Readers should note that the closing date is June 1st, and where drawings or models are required to be returned, stamps should be enclosed.

See that your name and address is written on every drawing and document.

See that the descriptions and drawings are sufficiently detailed to enable the judges to clearly visualise your idea.

All entries, of course, must be the original work of the competitor and they must not have been published before. They must not be copies of existing devices, fixtures or apparatus.

You may submit entries in each of the four sections listed below :

1. Kitchen appliances (cooking, washing).
2. Cleaning items.
3. Leisure aids.
4. General household fitments.

Readers may submit any number of entries in each and all of the sections.

RULES

1. All entries must be original and the unaided work of the competitor. They must not be copies or infringements of existing apparatus.
2. Each entry must consist of drawings and a written description explaining the device. Drawings need not be to scale, although scale drawings are preferred. They may be made in pencil or in ink. Models as well as drawings may be submitted if desired. The coupon on page 64 must be enclosed.
3. We reserve the right to publish any of the entries, but competitors will be advised beforehand in case they wish to apply for a patent.
4. Each entry must clearly indicate the size, shape, conception and operation of the idea and describe the materials to be used in the making. The availability of such materials, cheapness of manufacture and total cost will be taken into consideration by the judges who will be presided over by the Editor of this journal.
5. Stamps to cover the return of the drawings and/or models must be enclosed with each entry.
6. All entries must be submitted not later than June 1st, 1952, when judging will commence. The result will appear in our August issue.
7. Entries should be addressed to The Editor, PRACTICAL MECHANICS, Tower House, Southampton Street, Strand, W.C.2, and envelopes or packages should be marked " Competition " in the top left-hand corner.

Earthing Circuits and Trips

The Efficient Earthing of Electrical Apparatus in Accordance with I.E.E. Regulations

By J. L. WATTS

In order to avoid the risk of electric shock and fire in the event of failure of the insulation of electrical apparatus, it is common practice to connect the metallic framework of the apparatus and the metallic sheathing of the cable conductors to the general mass of earth. Earthing is required, under certain specified conditions, by the Regulations for the Electrical Equipment of Buildings (the I.E.E. Regulations) issued by the Institution of Electrical Engineers; the Electrical Regulations of the

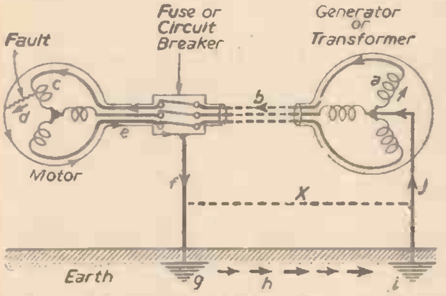


Fig. 1.—Path of earth fault current in a three-phase circuit.

Factory and Workshops Act; the Coal Mines Act; and the Quarry General Regulations (Electricity), 1938.

Components of the Earth Loop

Every effort should be made to keep the earthing resistance low enough to pass sufficient current to operate the fuses or the excess current protective trips, in the event of an earth fault resulting from the failure of insulation between the conductors and metallic sheathing. In order to ensure this, the impedance of the earth loop should not exceed the value given by

$$\frac{\text{Voltage to earth of the system.}}{\text{Operating value of the excess-current protective device.}}$$

As indicated in Fig. 1, the path of the earth-fault current on a motor or other circuit may include the following items:

(a) The windings of the generating plant or transformer.

(b) Cables between the supply plant and the faulty apparatus.

(c) Possibly the windings of the consuming plant.

(d) Resistance of the faulty insulation.

(e) The impedance of the consumer's earth continuity conductor.

(f) The impedance of the consumer's earthing lead.

(g) The resistance of the consumer's earth electrode.

(h) The resistance of the earth between the electrodes.

(i) The resistance of the supply plant earth electrode.

(j) The impedance of the supply plant earthing lead.

Item (h) is so low that it can be neglected. In many cases item (g) is fairly high, whilst item (i) may not be very low in the case of an isolated consumer fed from a transformer on the consumer's premises. However, if the supply plant is accessible to the consumer these three items can be eliminated from the earthing circuit by connecting the framework of the plant to the earthed neutral point of the system by means of a low-resistance conductor, as shown at X in Fig. 1. If, however, the supply plant consists of a step-down transformer which also supplies other consumers, the supply authority may not favour the metalwork being earthed to this point on account of the risk that an earth fault on the plant of another consumer may raise the voltage of the neutral, and thus make the framework of the connected plant dangerously "alive."

Since one cannot predict at which point an earth fault will occur, or the severity of the fault, the items (c) and (d) will be unknown. In fact, an earth fault may occur at a point on the winding which is connected to the earthed neutral conductor, as shown in Fig. 2. In this case no excess current will flow in the circuit, and the voltage V_1 between the framework of the plant and earth would merely be equal to the line-to-neutral voltage V_N less the volt drop V_2 on the live line and the consumer's apparatus. The volt drop V_1 on the neutral line is normally less than 5 per cent. of the line-to-neutral voltage V_N, and would not introduce

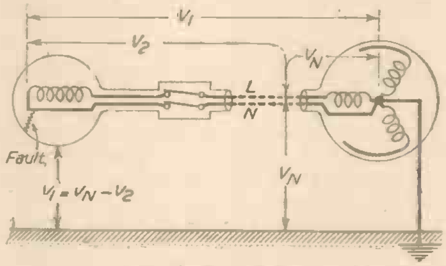


Fig. 2.—Conditions with earth fault on neutral of single-phase apparatus with unearthed metallic sheathing.

any serious risk of shock. Fig. 3 shows that if the fault occurred on a conductor directly connected to the live main the metallic sheathing would become alive at the voltage V_4, which is actually equal to the line-to-neutral voltage V_N of the system less the volt drop V_3 on the line cable. V_4 is likely to be more than 95 per cent. of V_N. In this case also, if the metallic sheathing is not earthed, no excess current will flow, and excess-current devices will not cause the faulty circuit to be isolated from the supply.

Earth Fault Current, Heating and Voltage

Fig. 4 shows a more usual type of fault at some intermediate point on the windings of earthed plant. An excess current will flow because there is a path for the fault current through the earthing circuit consisting of the

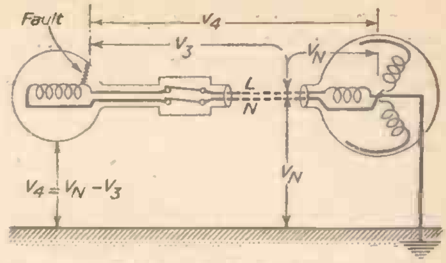


Fig. 3.—Conditions with earth fault on live side of single-phase apparatus with unearthed metallic sheathing.

earth continuity conductor (e), the earthing lead (f), and the earth electrode (g). The value of the earth fault current will largely depend on the impedance of the earthing circuit, whilst the voltage V_8 between the metallic sheathing and earth will be equal to the sum of the volt drops V_5, V_6 and V_7 across these parts. This volt drop V_8 will be equal to the product of the earth-fault current I and the impedance of items (e), (f) and (g) of the earthing circuit. Provided that the earthing conductors are fairly straight and do not pass through iron and steel tube (so that little or no magnetic field will be produced by fault-current through the earthing conductor), the impedance of the earthing circuit will be practically the same as its resistance. This should be low in order to allow maximum earth-fault current to flow so as to operate the excess-current trips, and in order to limit the voltage of the metallic sheathing.

As in any other conductor, current through the earth wire will create heat, the rate of heating being proportional to I^2R, where I is the fault current, and R the resistance of the earthing circuit. It is essential that the earthing conductor be large enough to carry the fault current without dangerous overheating; that there should be no high resistance connection in the earthing circuit at which sufficient heat might be generated to start a fire; and that the resistance of the earthing circuit and the operating values of the fuses, or trips, be low enough to cause a faulty circuit to be disconnected before its temperature has risen to a dangerously high value.

In view of the many variable quantities in the earthing circuit, it is probably best to regard the earth protection as unsafe if it would allow the metallic sheathing of the apparatus or cables to remain alive at more than 40 volts to earth. In this case the resistance (R_E) composed of items (e) (f) and (g) of Fig. 4 through the earthing circuit from the metallic sheathing to the general mass of earth should not be more than the value given by the formula

$$R_E = \frac{40}{\text{Operating value of fuses or excess current trips.}}$$

Thus for a circuit which is protected by a fuse rated at 5 amps, and melting at about 10 amps, the maximum earthing resistance (R_E) should not exceed 4 ohms. For a cir-

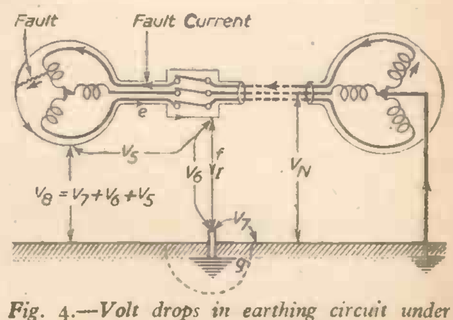


Fig. 4.—Volt drops in earthing circuit under fault conditions.

cuit protected by a fuse rated at 15 amps, and melting at about 30 amps, the earthing resistance should not exceed 1.33 ohms.

It should be noted that the volt drop or difference which may exist between any two points of the earthing circuit under fault conditions will be equal to the product of fault current and the resistance (ohms) between the two points. It is of interest to note that the I.E.E. Regulations specify a maximum resistance for items (e) and (f)

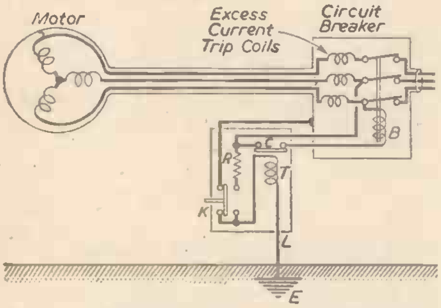


Fig. 5.—Connections of a voltage-operated trip in a three-phase motor circuit.

of Fig. 4 of 1 ohm, measured from any point on the metallic sheathing of any apparatus to the connection to earth. With a 1-ohm resistance the voltage difference between the metallic sheathing and the earth electrode under fault conditions could be equal to the operating value of the fuse or excess current trip, expressed in volts. Thus, with a trip operating at 30 amps this value of resistance could allow 30 volts to exist between the sheathing and the earth electrode, with possibly a much higher value between the sheathing and the general mass of earth, or any material, such as piping or structural steelwork, which is in contact with earth.

A Practical Example

The difficulties of providing efficient protection against earth faults is seen by considering a fairly large motor, such as a 60-h.p. 400-volt three-phase motor. Such a machine may have a full load current of about 83 amps, and is unlikely to be protected by excess-current trips which are set at less than 100 amps. With such a setting, however, the maximum resistance of items (e) (f) and (g) should not exceed $\frac{40}{100}=0.4$ ohm if the voltage between the metallic sheathing and earth is, at all times, to be limited to 40 volts. Such low values of earth circuit may be practicable if the metallic framework is connected to the earthed neutral point of the system and if the earthing circuit is regularly tested and maintained. If, however, earth-fault current has to pass down an earth electrode and into the general mass of earth, it may be very difficult to maintain such a low earthing-circuit resistance. It will be appreciated that the resistance of many earth electrodes varies from time to time due to variation in the dampness of the soil, and may also increase due to chemicals in the soil being dissolved away.

It may be noted that the value of earthing resistance specified for items (e) (f) and (g) of the 60-h.p. motor is lower than the maximum value specified for items (e) and (f) by the I.E.E. Regulations. Another point which may be noted is that the maximum amount of heat which would be allowed by an earthing-circuit resistance of 0.4 ohm and excess-current trips set at 100 amps is, by the formula: rate of heating= I^2R, 4,000 watts or 4 kW. In the event of there being a resistance of 0.1 ohm at one point of the earthing circuit the heat generated at that point might be as much as 1 kW, the same as given by a small electric fire. The risk of fire, if the circuit is not quickly disconnected, will be obvious, as will also the need for the avoidance of high resistance connections in the earthing circuit.

So far no standard earthing system appears to have been agreed upon for various conditions. It is interesting to note that the Quarries General Regulations (Electricity), 1938, require that where the earth plate for the metallic sheathing is not connected to the earth electrode for the system neutral, the resistance between them through the earth (items (g) (h) and (i) of Fig. 1) shall not be more than 2 ohms, or else the resistance of the consumer's earth electrode (g) shall not exceed 2 ohms. Such low values are often very difficult to obtain on a quarry, and it will be appreciated that, even with earth electrode resistances limited to those values, dangerous conditions may exist under some fault conditions.

Voltage-operated Leakage Trips

The difficulty of providing efficient protection against earth faults by direct connection of the framework and metallic sheathing to earth is recognised in most regulations, which, in certain circumstances, require other methods of protection against earth faults. For example, the I.E.E. regulations require the provision of earth leakage trips to disconnect all live conductors of the faulty circuit from the supply on the occurrence of an earth fault, with the exception of the following cases: (1) where the maximum possible fault current can be proved to be more than the operating current of the fuse or excess current trips protecting the circuit;

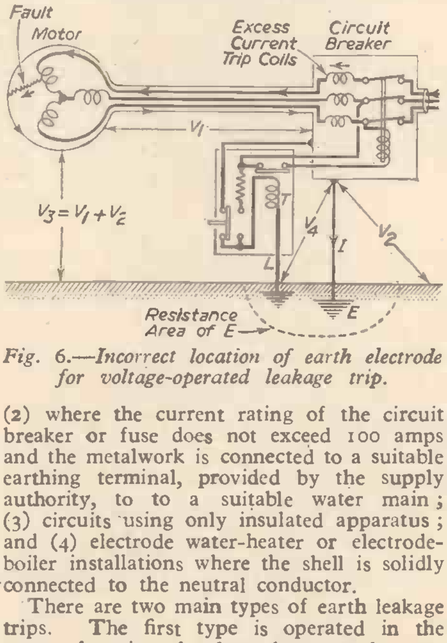


Fig. 6.—Incorrect location of earth electrode for voltage-operated leakage trip.

(2) where the current rating of the circuit breaker or fuse does not exceed 100 amps and the metalwork is connected to a suitable earthing terminal, provided by the supply authority, to a suitable water main; (3) circuits using only insulated apparatus; and (4) electrode water-heater or electrode-boiler installations where the shell is solidly connected to the neutral conductor.

There are two main types of earth leakage trips. The first type is operated in the event of a rise of voltage between the protected metal and earth; such voltage should not exceed about 40 volts. The second type of trips operates when the leakage current to earth reaches 15 per cent. of the rated current, or 5 amps, whichever is the greater. The latter type, current-operated trips, are required by the quarries regulations for apparatus exceeding 650 volts A.C. and for portable and transportable apparatus operating on more than 125 volts A.C.

The connections of the former type of trip, voltage-operated, in which a leakage trip coil T is connected between the metallic sheathing of the plant and the earth electrode E, is shown in Fig. 5. Should the metallic sheathing become alive at about 40 volts the resultant current through the coil T will create sufficient electro-magnetic effect to attract the armature; the movement of the armature then opens the contacts C to de-energise the trip coil B of the circuit breaker. The voltage-operated trip has the advantage that a small fraction of an amp. leakage current will cause the circuit to be isolated from the supply; in consequence the earth electrode provided for the trip coil T need not be of very low resistance. Other systems need a low resistance earth electrode, and do not operate until an appreciable leakage current flows. The voltage-operated trip has the further advantage that the device can be tested quite simply by pressing the test key K to connect one pole of the supply to earth through the high resistance R, thus creating an artificial leakage current.

Whilst the directly earthed protective system can function with either fuses or circuit breakers with excess-current trips, the voltage and current-operated trips can only be used with circuits controlled by circuit breakers with voltage trips. Either type of trip may be used on individual circuits, in which case the earthing systems used with voltage-operated trips must be separate. On the other hand, one trip may be provided for the whole of an installation, in which case the whole installation will be switched off automatically in the event of a leakage in one item.

Voltage-operated trips may, however, be rather troublesome in damp situations, due to frequent tripping resulting from slight leakage which may not be serious. The lead L, from a voltage-operated trip coil T to earth, should be insulated in order to avoid the possibility of the coil being short-circuited by the lead making contact with the protected metalwork in any way. Voltage-operated trips can also be used in addition to direct earthing, as shown in Fig. 6. In this case the earth electrode for the trip coil T must be placed outside the resistance area of the electrode E provided for direct earthing, say, more than 10 yards away. Otherwise, as in Fig. 6, the voltage V_4 across the trip coil T may be less than the voltage V_2 across the direct earth electrode E. In any case, with the connections shown in Fig. 6, the volt drop V_2 due to an earth fault at the motor will be less than the voltage V_3 between the motor frame and earth by the amount of the volt drop V_1 across the earth continuity conductor. From the point of view of safety it is an advantage to connect the trip coil T to the metalwork at the opposite end of the circuit to the direct earthing connection. In any case, the continuity resistance must be kept as low as possible, especially if direct earthing is used as well as voltage-operated trips. It must be remembered that such direct earthing may unintentionally exist due to contact between metallic framework or sheathing and earthed piping or structural steelwork.

Current-operated Leakage Trips

Provided that the insulation of a circuit is sound, the current which passes in one direc-

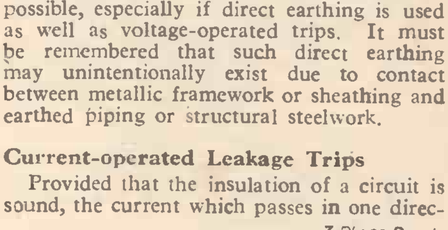


Fig. 7.—Connections of two types of current-operated earth leakage trips.

tion through one or two lines of an alternating current system at any instant will return through the other line or lines; thus the algebraic sum of the currents in a sound A.C. circuit will be zero. This is the principle of current-operated trips which are shown in Fig. 7. At A all the lines of a circuit pass through a ring type current transformer with a secondary winding which is connected to a trip coil T. Alternatively, as at B, each line may have a separate current transformer with the secondary windings connected to the trip coil T_1 in such a way that the resultant current of the secondary windings will flow through the trip-coil. If the circuit is sound there will be no resultant current and the electromagnet effect of the current in the lines will be cancelled out.

In the event of an earth fault, as indicated in Fig. 7, some of the current flowing to the apparatus through one line or lines will return to the supply plant through the other line or lines; there will then be a resultant current and resultant magnetic effect in the ring type transformer, or resultant current in the separate transformers, which will cause current through the trip coil to trip out the circuit breaker. With this system it is essential that the earthing circuit be maintained at low resistance in order to allow the passage of appreciable fault current.

It will be noted that current-operated trips directly control the fire risk, since they directly control the possible fault current which may be maintained. They only indirectly control the possible shock risk, however, because this depends on the resistance of the earthing circuit. Volt drop is equal to the product of current and resistance (or impedance). Voltage-operated trips directly control the shock risk, but only indirectly control the fire risk, because the heating effect and current depend on the resistance of the earthing circuit through which fault current flows. Heating is proportional to I^2R.

Conclusions

We may conclude that, in general, direct earthing is a reasonably good method of protection against earth fault risks for small apparatus and low current circuits. It may also be suitable for a high current circuit where the metalwork and metallic sheathings can be connected to the earthed neutral point of the system. Assuming low continuity, resistance of the earthing conductors current-operated trips should be quite satisfactory where a low resistance earthing connection can be provided or the metallic sheathing can be connected to the earthed neutral point of the system. It would, however, appear that voltage-operated trips have definite advantages for circuits, especially of high rating, where a low resistance earth connection is impracticable. Low resistance earthing continuity conductors are, however, essential if the plant is also earthed directly, whether intentionally or unintentionally.

The resistance of the earth continuity conductors should be tested periodically, together with the resistance of any earth electrode which is also provided for direct or solid earthing. Such testing is called for by all regulations which are concerned with this problem.

Making a Control Box

By E. W. DEAN

SINCE the end of the recent war I have acquired from various sources a number of fractional h.p. electric motors both AC/DC and DC only for operation on 6, 12 and 24 volts, and these have been adapted for an electric drill, a grinder, a polisher, and on occasions a coil-winder.

In order to run these machines it was necessary to wind a suitable transformer with a series of tappings, and as this entailed connections to switches and rectifiers, it was decided to construct a complete control-box containing all these parts, and with a fully switched and metered output.

A suitable transformer was obtained having a large core area of about 5 sq. in., and this had marked primary tappings of 10, 0, 200, 220 and 240. The secondary tappings were unmarked and these windings were removed without disturbing the primary section.

It was decided that a ratio of 8 turns per volt per sq. in. would be suitable for winding the new secondary, and a quantity of 16 gauge enamelled copper wire was obtained and wound with the following tappings: 0, 5, 5, 5, 10, 10, 10, 10, 15 volts, each layer being interleaved with brown paper varnished with shellac. After completing this work I found among my stock a length of enamelled copper strip of 3/16 by ¼ section, and this was wound on as well with the idea of using a spot-welding or a low voltage soldering bit.

The transformer was then fastened in a box with a hinged lid which originally contained a bomb-sight azimuth bracket, and a piece of tufnol sheet cut to size and fitted into the top for the panel above the transformer.

The components shown in Fig. 1 were fitted into the panel and wired as shown in Fig. 2, the rectifiers are 10-12-volt ½ amp. selenium rectifiers wired in parallel and bolted to the side of the case, the sides of which were drilled in order to assist the cooling of the rectifiers.

The terminals ABC are connected as follows: A to one end of the secondary windings, and each of the tappings are connected to a switch contact in the form of a knife switch socket taken from an old fuse-board. B is connected to the knife switch, and is made to swivel through an arc over the contacts, and C is connected to the other end of the secondary tappings, so that as the knife switch is moved in a clockwise direction the voltage (AC) between A and B is increased, and at BC decreased, and vice versa, so that either the large tappings at one end may be used or the small tappings at the other end. By moving the meter switch the voltage across AB or BC may be checked on the 70-volt meter.

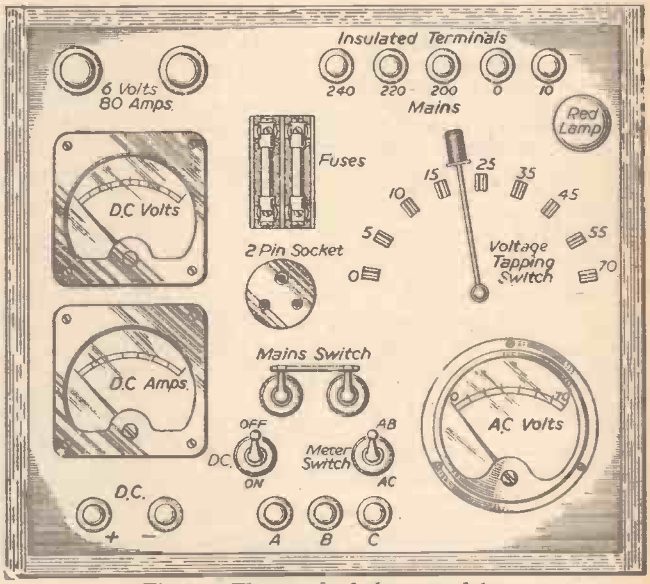


Fig. 1.—The panel of the control box.

A DC-only machine is connected across the DC terminals and switched by the DC switch, the voltage being varied by altering the voltage across the terminals AB.

Similarly the two-pin socket is connected across the AB terminals so that the electric drill may be plugged straight into it.

The high-voltage tappings of the primary were brought out on to insulated terminals in order to use a 240-volt soldering iron when required.

The high-current tappings are brought out to two large terminals at the top left-hand of the board.

The whole box is closed and locked and a series of different plugs are available.

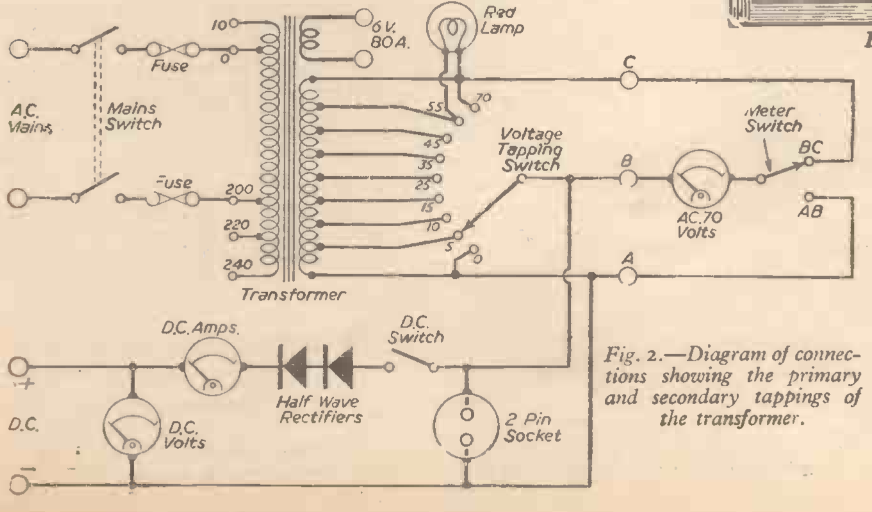


Fig. 2.—Diagram of connections showing the primary and secondary tappings of the transformer.

GENERATING MICRO-

The Scientific Principles Simply Treated

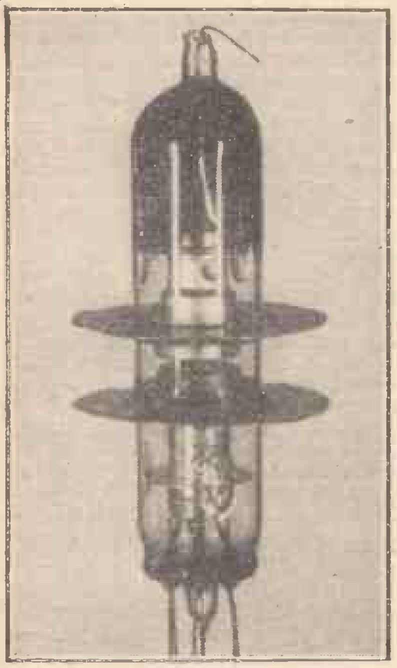


Fig. 18a.—Reflex Klystron CV116.
(By courtesy of E.M.I. Research Laboratories, Ltd.)

THE development of radar during the late war and the increasing demand for further channels of communication have resulted in extensive researches being made into what is termed the micro-wave band of the electro-magnetic spectrum.

It is the object of this short article to familiarise the non-technical reader with the uses of electro-magnetic waves in the ultra-high frequency range and to explain in simple fashion, by analogy and definition, the manner in which energy of this nature is produced and radiated into space.

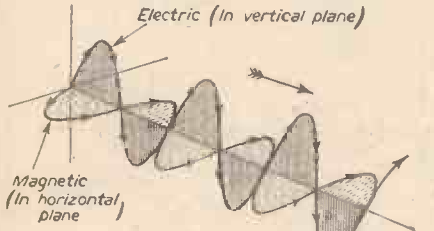


Fig. 2.—Graphical representation of an electro-magnetic wave.

It is desirable at an early stage in such an endeavour to confess that without recourse to mathematics much of the phenomena referred to may not be capable of a rigorous treatment. To offset this and—it is hoped—to increase the value of the article to the more serious reader an extensive bibliography is given, in conclusion, and many of the finest books and articles on the subject tabulated as suggested works of reference.

Radio Waves

Radio waves are electro-magnetic waves fundamentally similar to light waves, and for this reason they appear in the electro-magnetic spectrum along with the other energy carriers of free space. The electro-magnetic spectrum is represented diagrammatically in Fig. 1, and from this it will be seen that the characteristics which distinguish any one class of wave from another class are frequency and wavelength; frequency is defined as the number of vibrations, or waves, or cycles of any periodic phenomena per second; and wavelength as the distance between two similar and successive points on an alternating wave, e.g., between successive maxima or minima. The relationship between frequency and wavelength is given by the expression—

$$\lambda = \frac{c}{f}$$

Where λ is the wavelength
c is the velocity of propagation
f is the frequency.

The velocity of propagation is a universal constant equal, according to Michelson, to $(2.99796 \pm 0.00004) \times 10^{10}$ cm. per sec. *in vacuo*; this is generally accepted as 300,000,000 metres/sec. (i.e., 3×10^8 metres/sec.).

$$\text{Thus } \lambda = \frac{3 \times 10^8}{f} \text{ metres.}$$

A graphical representation of an electro-magnetic wave is shown in Fig. 2, and the wave must be considered as a travelling disturbance in space produced by the accelera-

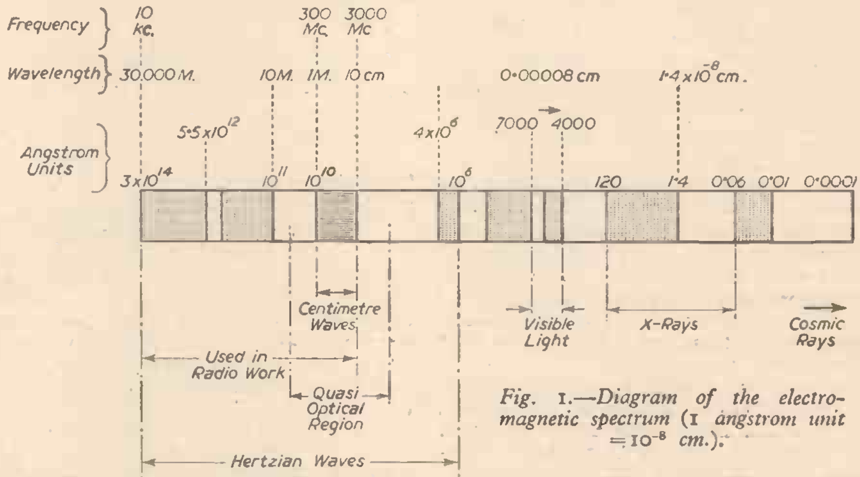


Fig. 1.—Diagram of the electro-magnetic spectrum (1 angstrom unit $= 10^{-8}$ cm.).

tion of an electric charge, and comprising an electric field at right angles to a magnetic field, both of which are moving at the same velocity (i.e., c) in a direction normal to the plane containing the two fields.

Now, radio waves are sub-divided into specific groups according to frequency and wavelength: there are long waves (low frequency); medium waves (medium frequency); short waves (high frequency); and ultra-short waves (ultra-high frequency). The last-mentioned group may have wavelengths of such a low order that they are most easily expressible in centimetres, and such waves are termed centimetre waves or micro-waves; they are generally considered to lie between the wavelength of 3 m. (100 Mc/s) and 1 cm. (30,000 Mc/s).

It is a property of centimetre waves that they have substantially straight-line propagation, analagous to that of light waves, and they are unaffected by the ionosphere.* For this reason they are ideally suited for short-distance communication and radio navigational aids, such as radar. It is a feature of an electrical circuit carrying current which is alternating that electrical energy is radiated therefrom as electro-magnetic waves. This, however, is very small and insignificant, unless the dimensions of the circuit approximate the order of magnitude of a wavelength of the current therein. It is for this reason that a power carrying lead and return cable having, say, a spacing of 15ft. and a current of frequency 50 cycles/second radiates practically no energy; since the wavelength at 50 cycles/sec. is $\frac{3 \times 10^8}{50} = 6 \times 10^6$ metres, a distance approximating to a 1/6th part of the meridian of the earth. Even when we consider a radio wave having 3,000 kilocycle frequency the wavelength is 100 metres long and the "radiator" needs to possess dimensions approaching this value. With centimetre waves, however, the problem is very much changed; the wavelength may be 10cm. or lower, and this facilitates the construction of radiating devices large in comparison with the wavelength yet reasonable in overall dimensions. This is shown comparatively in Fig. 3[1], the reflectors being parabolic in shape as these have found much favour, for propagation of centimetre waves, in that if the distance to the focal point is a number of wavelengths, optical conditions are approached and the wave across the mouth of the reflector is a plane wave.

The Generation of Radio Waves

It has been explained in earlier references

* Ionosphere—the region above the earth's surface in which ionisation occurs.

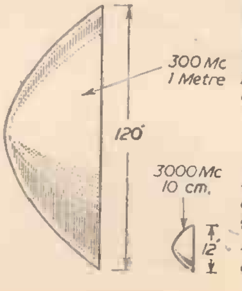


Fig. 3 (Left).—Relative size of parabolic reflectors required to produce identical beams at various frequencies.

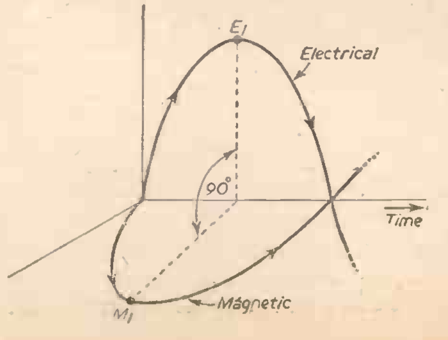


Fig. 4 (Right).—In an electro-magnetic wave, points E1 and M1 are in time phase and space quadrature.

WAVES FOR RADAR

By F. W. COUSINS, A.M.I.E.E.

that radio waves are electro-magnetic and consist of two fields—an electric field and a magnetic field in time phase and space quadrature, that is to say, points such as maxima and minima on the respective waves are coincident in time but at 90 deg. to each other in space (Fig. 4). Such waves are produced in the ether* by oscillatory electrical circuits, a portion of the energy in the circuit becoming detached and radiated into space.

To fully appreciate this phenomenon and the principles involved it is profitable to digress a little and consider the genealogy of the oscillatory circuit, thereby to prepare the way, smoothly, for a study of high frequency

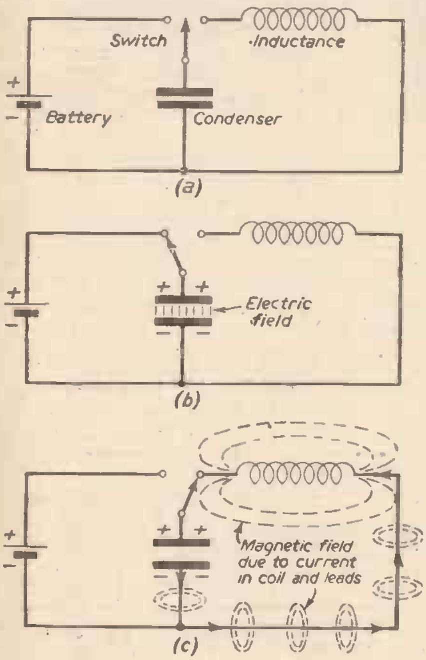


Fig. 5.—Simple oscillatory circuits.

oscillators specifically designed to produce the centimetre waves.

One of the most homely mechanical devices using an oscillatory "circuit" is the pendulum clock, the oscillatory mass being used to "feed back" a portion of its energy to maintain the pendulum action and drive itself. All oscillatory devices depend upon a state of resonance which is characterised by a "see-sawing" of energy to and fro from potential energy to kinetic energy, at a rate depending on the mass and stiffness of the mass suspension member or analogous properties. It can be shown that the period of oscillation T for a mass M supported by a spring of stiffness S is given by the expression:

$$T=2\pi\sqrt{M/S}$$

Similarly for a pendulum of length "l" the period T is expressed

$$T=2\pi\sqrt{l/g}$$

where g is the gravitational constant.

Now in the electrical oscillatory circuit M and S are equivalent to the electrical properties L (inductance) and C (capacitance), and once again the period T of the oscillatory phenomena is expressed as:

$$T=2\pi\sqrt{L.C.}$$

and since frequency $=\frac{1}{T}$

$$\text{frequency}=\frac{1}{2\pi\sqrt{L.C.}}$$

Consider the simple electrical circuits shown in Figs. 5(a), (b) and (c). In the first case, Fig. 5(a), the switch is open and the condenser is uncharged; now close the switch, Fig. 5(b), and the condenser becomes charged due to the plates of the condenser being in electrical contact with the poles of the battery.

If now the switch is moved to the position shown in Fig. 5(c) the condenser is able to discharge and a current flows through the inductance L. When the condenser is charged an electric field exists between the plates thereof, and when the condenser is discharging the current flow through L causes a magnetic field to appear. It can be shown that the magnetic field is at a maximum when the electric field is zero.

Naturally an automatic switch must be employed, and in early oscillatory circuits this took the form of a spark gap. The spark gap behaves as a switch "closing," or breaking down as it is called, when the condenser reaches a finite voltage; such a circuit is shown in Fig. 6. If an alternating voltage is applied as portrayed, then as the voltage builds up so the condenser becomes more charged, and as the voltage falls to zero so the condenser will be able to discharge via the spark gap. With such a circuit the electric and magnetic fields are oscillatory and in time and space quadrature.

If the condenser plates are separated, then a greater volume of space is made available for carrying both the electric and magnetic fields—the circuit is then termed an open oscillator and the electric and magnetic fields produce an electro-magnetic wave in time phase and space quadrature.

If the condenser is separated to a marked extent, then the plates may be considered to form an aerial wire and earth; if these are joined by a wire having a certain amount of self inductance a simple aerial circuit is formed (Fig. 7).

If a source of alternating E.M.F. is included the operation will be similar to that described, it being desirable to emphasise that the radiated wave consists of electric and magnetic fields in time phase—it not being possible

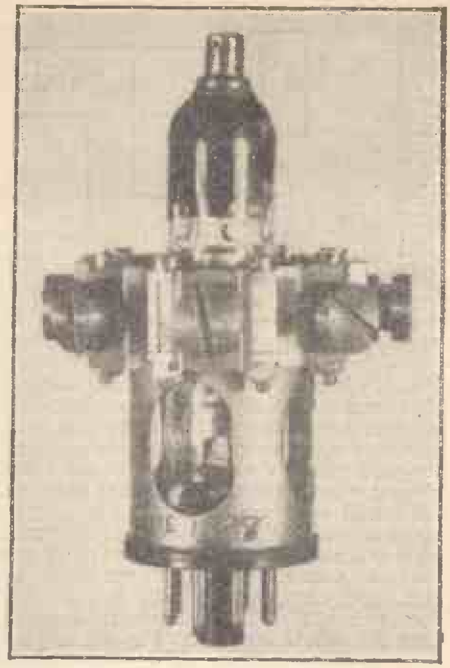


Fig. 18b.—Another reflex Klystron CV116.
(By courtesy of E.M.I. Research Laboratories, Ltd.)

for them to exist out of time phase on their journey through space, even though the fields induced in the circuit proper are 90° out of time phase.

Spark gap circuits are now rarely used since the spark transmitter generates damped waves which have several undesirable qualities. The most important oscillators of recent years have been valve oscillators using the triode valve, which is fundamentally an amplifying valve. It is the ability of the triode to amplify which permits the oscillatory phenomena to occur in the attendant electrical resonant circuit; since the input power required is less than the amplified output,

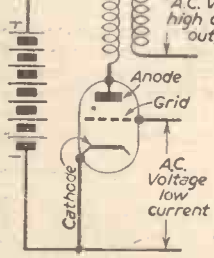


Fig. 8.—Simple triode amplifier.

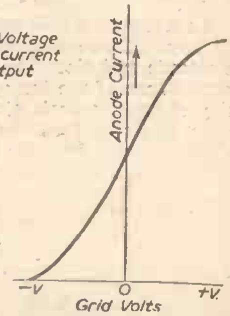


Fig. 9.—Curve showing how grid volts control anode current.

the output may be used to feed back a certain proportion of energy and supply its own input, thereby sustaining the oscillations. It is usual for such a valve oscillator to take power from a D.C. source and convert it into an A.C. output.

A simple triode amplifier is shown in

* The ether is a hypothetical non-material entity supposed to fill all space, and capable of transmitting electro-magnetic waves.

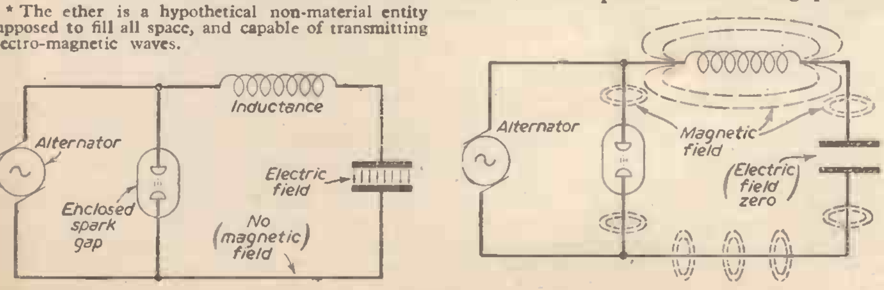


Fig. 6.—Two diagrams showing automatic switching in oscillatory circuits.

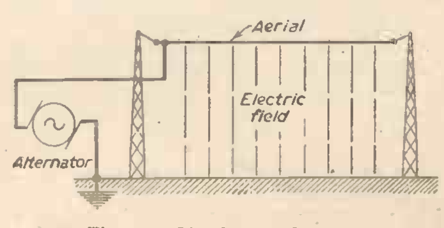


Fig. 7.—Simple aerial circuit.

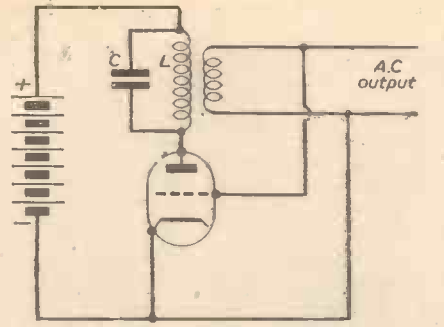


Fig. 10.—A simple valve oscillator circuit.

Fig. 8. It must be appreciated that electron flow from the cathode to the anode is strictly dependent upon the grid voltage; and since electron flow to the anode is the anode current, the grid volts are able to control the anode current over a considerable range (Fig. 9). Now grid volts are constantly changing in harmony with the A.C. supply and the anode current is made to rise from zero to maximum positive values, and this produces an alternating voltage in the inductively coupled output circuit. If the grid volts are supplied from the alternating output, Fig. 10, and the resonant circuit L.C. provided, then a simple valve oscillator is obtained. The grid supply is termed "feed back" and the oscillatory circuit is generally referred to as the "tank circuit," since a storage of energy is effected therein, not dissimilar to the flywheel of an internal combustion engine or the like.

In a reasonably well-designed circuit the oscillator may permit anode current to flow for approximately one-fifth of each cycle, the tank circuit using its "flywheel" action to sustain the oscillatory phenomena while the triode valve is resting.

A large number of valve oscillator circuits have been designed, and three of the most widely used are shown in Figs. 11(a), (b) and (c).

Limitations of Triode for High Frequency Operation

There are very definite limitations to the maximum frequency which may be obtained from a triode oscillator of the conventional pattern. These limitations arise from the electrode and electrode lead inductances, the capacitance of the inter-electrode spaces, and the electron transit time. Electron transit time is defined as the time taken for an electron to go from the cathode to the anode of a thermionic valve, and to give some idea of this value it can be shown[2] that in a triode the time required for electrons to move from the cathode to the grid plane is given by the relationship:

$$t = \frac{5\times10^{-8}}{\left(Eg+\frac{Eb}{\mu}\right)^{\frac{1}{2}}}s \text{ where}$$

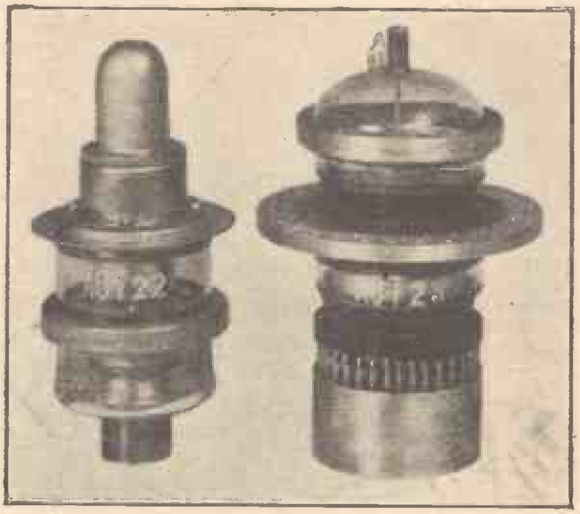


Fig. 12.—Forced air cooled ultra-high frequency triodes (1,000 Mc./sec.).

s is the cathode to grid distance in cms.

Eg is the control grid voltage.

Eb is the anode voltage—and

μ is the amplification factor.

In the normal operation of triodes it has been usual to arrange the phase difference between the grid and the anode potentials to be π radians, and it is therefore necessary to keep the transit time of the electrons at a small fraction of the oscillation period.

At a frequency of operation producing waves of about 10 metres wavelength the period of oscillation approaches the electron transit time, and this seriously upsets the phase relationship necessary for the maintenance of the oscillations.

The most obvious remedy was to make the physical spacing between the electrodes as small as possible, so that although the electron velocities were still comparatively low, the short distances traversed made the actual transit time more suitable for the high frequency operation. The result of this scaling down of the physical dimensions produced the "acorn" and door-knob" valves, names now well accepted and originally coined because they were so highly descriptive of their appearance.

Another technique consisted in making the valves with grid, anode and cathode in planar form, and these were termed "lighthouse valves." Difficulties due to transit time phenomena were still in attendance, however, and speaking generally operation was restricted to a frequency of 1,000 Mc/sec.

Representative of the ultra-high frequency triodes embodying the very latest techniques, such as forced air cooling, are the ACT22 and ACT23 made by The General Electric Co., and shown in Fig. 12.

(*To be continued*)

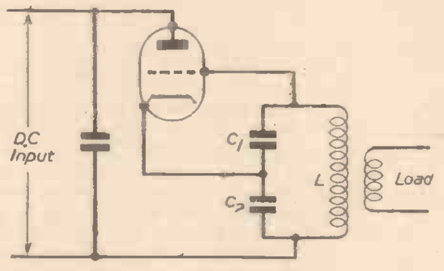


Fig. 11a.—Colpitts feedback oscillator circuit.

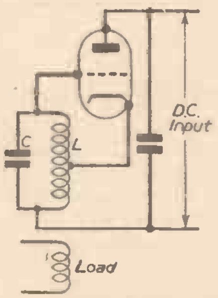


Fig. 11b.—Hartley feedback oscillator circuit.

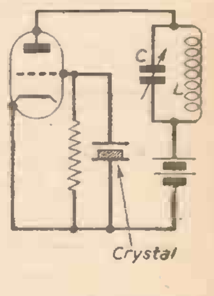


Fig. 11c.—Tuned grid-tuned plate crystal oscillator.

Books Reviewed

Racing Through the Century. By G. S. Davison. Published by The T.T. Special. Price 9s. 6d. net.

THE author realising that, because of the immensity of the subject, he would not be able to cover every event and incident in the world of motor-cycling since 1900, has stressed those occasions which he remembers personally. Into the 176 pages of this book is packed a wealth of personal recollection of machines and events and, perhaps more important, riders. At the commencement of the book, motor-cycling was in its infancy and the reader is taken through the sport's colourful history step by step, from the days when there was a 20 m.p.h. speed limit on English roads, to 1951, when Geoff Duke was the first man to become "Double Champion" in 350 c.c. and 500 c.c. classes. The bulk of the illustrations in the book are in cartoon form and portray many famous riders of the past. The foreword is written by Geoff Duke, who says that "Racing Through the Century" has given him his first insight into the difficulties which were faced and overcome by the early riders.

The Past Presented. By Professor A. M. Low. Published by Peter Davies, Ltd. Price 12s. 6d. net.

THE author's purpose is to present in easy-to-read form the salient facts about how the English people lived in the different periods of history from 1066 to the present day. He aims to prove that history is exciting when viewed from the point of view of the ordinary person of the time's activities and beliefs and the conditions in which he lived. History is boring, says Professor Low, only when the reader has to wade through masses of dates and uninteresting details of the uneventful reigns of various monarchs. The chapters of "The Past Presented" are formed by the reigns of various kings and queens, but only for the convenience of using the name to define the period. The authentic sketches with which the book is profusely illustrated were specially drawn and are of such things as houses, clothing, weapons, transport, etc. A special index enables the reader to look up historical phrases and names encountered in plays and books in their proper setting.

Make and Do the Woodcraft Way. By J. G. Cone. Published by C. Arthur Pearson, Ltd. Price 7s. 6d. net.

WRITING under the nom-de-plume "Eagleye," J. G. Cone was a regular contributor to the official organ of the Boy Scouts, "The Scout," and it is in response to many requests from readers of his articles on gadgets for the patrol room and camp, that this book was produced. The very many illustrations are all by the author and each of the articles dealt with has first been made and tried out by "Eagleye" before being described. Each different branch of the fascinating subject of woodcraft has a chapter devoted to it and several more are concerned with camping in all its phases. This volume should appeal, not only to scouts, but to all those who enjoy camping and particularly those who prefer to make their own gadgets.

LOCOMOTIVE VALVE GEARS

Constructional Details of Models of Valve Gears in Wood and Metal

By E. W. TWINING

(Concluded from page 234, April issue)

THE table referring to scale reduction for models is given at the foot of this page. If the model is to be used for lecture purposes, the 2½in. by 4in. size will not be sufficiently large to be seen by the whole class, for it must be noted that the important thing for students to observe is the position of the edges of the valves in relation to the edges of the ports and the position of the piston indicator on the percentage scale. In such a case it would be advisable to double the size of the model and this doubling would, of course, double all the scale fractions given in the table below. No. 1 becoming $\frac{2}{1}$, No. 2 $\frac{1}{1}$, and so on to No. 8 which would become ¼.

A list of all the parts of the model, with their references on the drawing, and, in most cases, the names by which they are known, is as follows: BP, the backplate, representing the engine frame. W, the driving wheel. CPI, crank position indicator. CP, the crank pin. DA, the driving axle. CR, the connecting rod. RC, the return crank. RCP, return crank pin. EC, eccentric rod. CH, crosshead. CT, crosshead thickness pieces. GP, gudgeon pin. CL, crosshead extension lug. PR, piston rod. P, the piston. PL, piston lower half. PB, piston back. CYB, cylinder back plate. CYM, cylinder middle plate. CYT, cylinder thickness plate. CYF, cylinder front plate. PV, piston valves. VR, valve rod. VS, valve spindle. VA, valve adjustment. UL, union link. CL, combination lever. RR, radius rod. EL, expansion link. LT, link trunnions. DB, expansion link die-block. LG, link girder. RA, reversing arm. RS, reversing shaft. RVR, reversing rod. QS, quadrant sector.

The last item, as shown in the drawing, is not really a quadrant, nor yet a sector but the single calibrated line made on the back-plate and the pointer on the reversing rod, together with the knurled clamping nut, serves exactly the same purpose as a correctly modelled sector with a reversing lever. The reader must recognise the obvious fact that there is not sufficient space available at the driving wheel end of the model to accommodate the usual form of screw, or lever, driver's reversing gear, and, after all, it is quite unnecessary; the arrangement shown provides all that is needed for "notching up" the cut-off and expansion periods by the valve.

Fig. 6 is a drawing of the four plates which make up the "cylinder"; the differences between them should be carefully noted; particularly the dimensions "X" and "Z." The first is the normal cylinder diameter whilst "Z" in CYM, the third plate from the front, has a larger opening in order to provide a rebate in which PB, the piston backplate, slides. Fig. 7 shows the shapes of the four plates which make up the piston. One of these, "P," is continuous with the piston rod and with the middle plate of the crosshead, all the plates of which latter are drawn in Fig. 8.

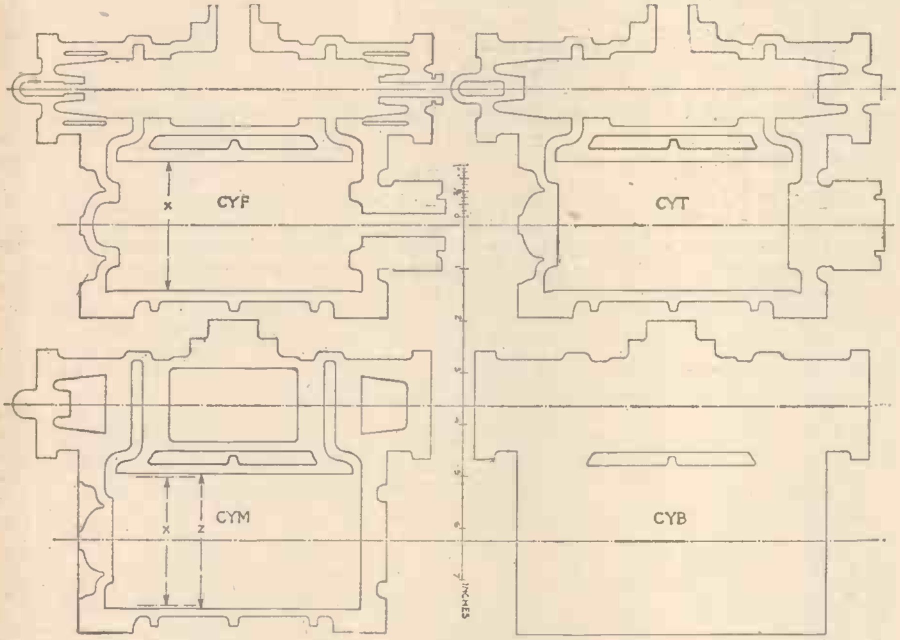


Fig. 6.—The four plates which make up the cylinder.

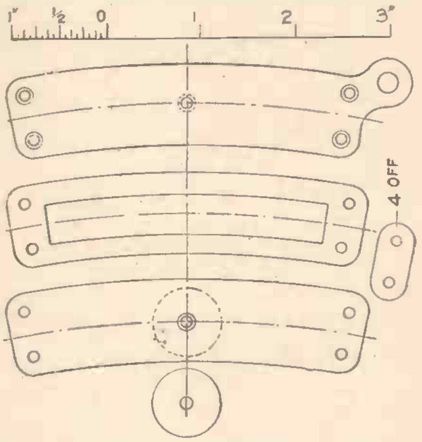


Fig. 9.—The plates for forming the expansion link.

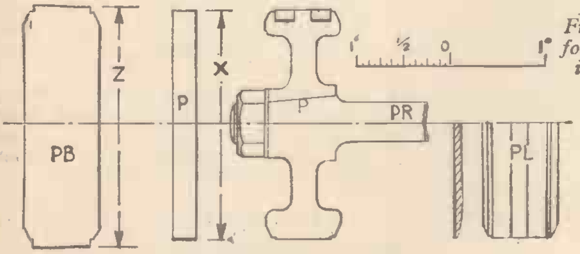


Fig. 7 (Left)—The four plates forming the piston.

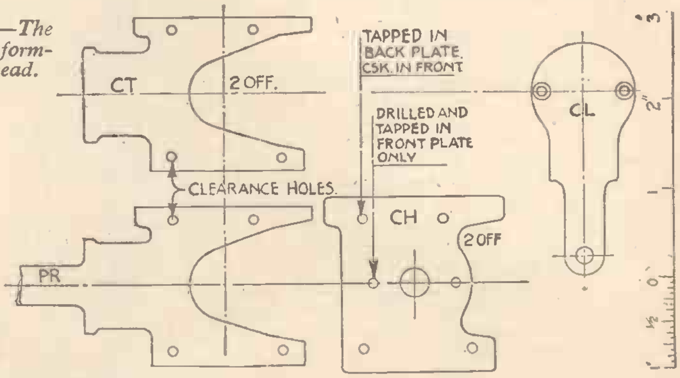


Fig. 8. (Right)—The four parts for forming the crosshead.

The last detail drawing which it is thought necessary to give is Fig. 9. This represents the parts of the expansion link, composed of three main plates, four distance pieces, all alike, and which must be cut from a little thicker plate than that used for the two parts of the radius rod, and a washer to separate the link from the backplate. The curvature of the middle, slotted plate of the link must exactly equal the radius swept out by the die block in the radius rod. The remaining parts of the model will, it is hoped, be obvious

TABLE OF SCALE REDUCTION

×1	Cylinder	2½in. × 4in.	Scale	1/1	A model only of about 10½in. gauge.
×2	,,	5 in. × 8in.	,,	½	15in. gauge pleasure railway.
×3	,,	7½in. × 12in.	,,	⅓	Light, narrow gauge railway (24in.).
×4	,,	10 in × 16in.	,,	¼	Industrial narrow gauge railway.
×5	,,	12½in. × 20in.	,,	⅕	Industrial narrow gauge railway.
×6	,,	15 in. × 24in.	,,	⅙	Light railway, 3ft. to 3ft. 6in. gauge.
×7	,,	17½in. × 28in.	,,	1/7	Normal weight, standard gauge.
×8	,,	20 in. × 32in.	,,	⅛	Heavy 2 cylinder, 8 coupled std. gauge.

from the general arrangement, Fig. 5.

All pins, trunnions and working parts should be turned from brass rod and all screws, of brass, should have B.A. threads.

The models of the Walschaerts gear shown in the photographs and drawings (see April issue) are all designed for inside admission, which is, of course, now almost universal practice, and in putting a finish to a model when it is made, the inside of the valve chest, between the ports, may well be enamel-painted vermilion and the exhaust spaces, at the ends, blue; these colours suggesting the hotter and cooler steam respectively. The cavities of the ports and the cylinder can very well be of some neutral colour, such as grey. In all the large models made by the writer's firm, the backplate or frame was lacquered black and the mahogany-plywood panel french polished.

The reader may be interested to know that the valve gear and motion, shown in Fig. 5, was designed by the writer for, and was built into, two narrow gauge locomotives and that the full cut-off percentages worked out, in actual practice, at approximately the figures given for the subject of Figs. 1 and 2.

Reference has been made to the use of these models for lecturing purposes. Such lectures can, of course, be delivered not only to men actually employed in handling locomotives, but before engineering students in technical schools and engineering colleges.

Earth-satellite Vehicles

With Notes on How to Calculate Their Orbital Speed

By P. BOWN

A SATELLITE vehicle—a space-depôt—is circling the Earth at a height of 3,200 miles.

How long does it take to get around, and what is its speed? If it were describing this orbit around Mars instead of Earth, what now would be the figures for time and speed?

The average reader who is unable, through lack of time and other circumstances, to go profoundly into these matters will assert—and rightly—that it is a subject which is tied up with a good deal of high-flying mathematics; though the spirit may be willing, the exacting conditions of everyday life make it difficult for some to plan a protracted study of space mechanics.

However, as in many other cases, a large part of its more onerous demands can be by-passed, and when the amateur discovers that he can work out for himself simple problems by easy arithmetic, it not only deepens his initial interest but enlarges his vision, giving an added urge to pursue the theme more extensively. Interplanetary matters are coming in for an ever-increasing amount of attention in magazines and the press. At the moment, a lot of factors militate against the actual projection of a spaceship right away from the Earth's pull, but attention is now being focused on the possibility of launching a space-depôt to act as a stepping-stone to outer space, where it would serve as a re-fuelling and repair station. Moreover, it would be equipped in such a way as to act in the capacity of a "roadhouse" or place of rest—a veritable space-port. We must also think of it as a centre of activity for radio, radar and TV exploitation and research, to say nothing of its obvious service to astronomy.

Tangential Send-off

If a space-station is taken out into the void and brought to rest it immediately begins to fall in the rational way, but, if given a proper tangential send-off, the centrifugal force set up will balance the inward pull of gravity and continuous orbiting takes place as with the Moon. Anything that continuously slows the vehicle will cause it to spiral inwards and ultimately crash, so it must be well outside our atmosphere. There are actually two celestial loops or orbits, the ellipse and the circle; our calculations apply *exclusively to the latter*. The true circle is an immensely rare figure in space, so much so, that it may be wondered of what use it is to examine it arithmetically.

Changing the Orbit

The following is one instance:

A satellite vehicle is running in an elliptical orbit; it is on an astronomical commission and the pilot receives a request from the astronomer on board to put the vehicle into a circular path for observational purposes; the arithmetic of such an orbit now has an immediate value.

Again, although the path of planet and moon is elliptical, the astronomers themselves set up a sort of average path, treating it as a circle and quoting widely upon it in the mathematical sense. Consequently, the tyro is on perfectly safe ground and his efforts will not be wasted.

"Free Fall"

When any object whatever is tracking round a central orb in an elliptical or a circular path under the influence of its own momentum and the pull from the orb (when it is floating freely, or "free-wheeling"), it is said to be in free fall. A space-station will certainly possess a limited amount of accelerative machinery. This must be shut down, likewise the engines of a spaceship if this is the vehicle in question. All thrust must be absent; if we saw a rocket out in the void and observed that it was "blasting," it cannot be in free fall.

Fig. 1. Diagram illustrating circular orbits; true and false.

Circular Orbits

In Fig. 1 are four circular tracks around a planet. Two are seen edgewise, and therefore appear as straight lines. Three of these orbits are concrete and stable for they satisfy an indispensable ruling which is, that centre of circuit and orb-centre shall *coincide*. The track x does not fulfil this condition, and it is important to appreciate that this orbit, and any such orbit, is entirely fictitious; it just cannot exist, in spite of any symmetry it may otherwise possess. The mass or weight of any kind of vehicle does not count in the least. The time it takes to make a round is called the Period, T, and for our purpose is carried to three decimal places. π is 3.1416. We obtain the diameter D of the orbit and extract the square root, then:

$T = D \times \sqrt{D} \div$ (a number from the accompanying table). As the space-depôt is 3,200 miles up, it must be 7,200 miles from centre, so D will be 14,400 miles, with square root 120, thus:

$$T = \frac{14{,}400}{1} \times \frac{120}{1} \times \frac{1}{504{,}360} = 3.426 \text{ hrs.}$$

The speed $S = D \times \pi \div T$, or

$S = 14{,}400 \times 3.1416 \div 3.426$. This is:

$$\frac{14{,}400}{1} \times \frac{3.1416}{10{,}000} \times \frac{1{,}000}{3{,}426} = 13{,}204 \text{ m.p.h.}$$

So our satellite vehicle rushes around Earth at 13,204 m.p.h., completing a round trip in 3 hrs. 25½ min. If it described this orbit around Venus instead of Earth, what now would be the figures?

$$T = \frac{14{,}400 \times 120}{454{,}750} = 3.799 \text{ hrs.}$$

$$S = \frac{14{,}400}{1} \times \frac{3.1416}{10{,}000} \times \frac{1{,}000}{3{,}799} = 11{,}908 \text{ m.p.h.}$$

The reader can deduce the figures for Mars, taking care to use the Martian number in the table.

Earth-satellite Vehicle!

The first Earth-satellite vehicle will probably be about 500 miles up—which means an orbit of diameter 9,000 miles, having for square root 94.868. We require its time and speed.

$$T = \frac{9{,}000}{1} \times \frac{94{,}868}{1{,}000} \times \frac{1}{504{,}360}$$

or 1.693 hrs.

Its speed S is $9{,}000 \times 3.1416 \div 1.693$ or 16,701 m.p.h.

In the distant future, space-depôts will be established around other orbs as well as Earth. If the last-named was tracking around the Moon instead of Earth,

$$T = \frac{9{,}000}{1} \times \frac{94{,}868}{1{,}000} \times \frac{1}{54{,}480}$$

$= 15.672$ hrs.

and S comes out at 1,804 m.p.h.

Doubtless, the reader requires to be satisfied as to the accuracy of his results. It happens that there are time-keepers in space which serve to check them. Circling the planet Jupiter at an average height of 373,431 miles above its surface is satellite Europa, making her round in 85.22 hrs.

Central Globe	Radius (Mls.)	Working Number
Earth	4,000	504,360
Moon	1,080	54,480
Venus	3,840	454,750
Mars	2,100	164,150
Jupiter.. ..	43,280	8,927,000
Saturn ..	35,750	4,884,000

Table of working numbers.

Let us take our space-station far afield and launch it around Jupiter in an equivalent orbit.

Distance to centre will be 416,711 miles, giving D, 833,422 miles, with square root 912.92.

$$\frac{833{,}422 \times 912.92}{\text{(Jupiter Working Number)}} = 85.22 \text{ hrs.}$$

The concordance fully attests the reliability of our arithmetic.

$D \times \pi \div T$ gives 30,724 m.p.h. as the speed; an average figure for Europa, but, in the case of our satellite vehicle, uniform.

The "Propeloar"

Details of a New Foot-driven Outboard Unit

The " Propeloar " leaves the hands free for fishing, etc.

A NOVEL unit for propelling small boats is being marketed in the United States of America. Known as the " Propeloar," it dispenses with rowing and allows both hands to be free for fishing, shooting and other purposes.

Easy Fixing

The device is very compact and when in use is simply clamped on to the transom of the boat, as shown in Fig. 3. It will be seen, with reference to Fig. 1, that the Propeloar consists of two chief parts, the pedalling unit and the propeller unit, the two parts engaging at the drive housing when assembled on the boat. The drive is by means of rope and chain, the pedals being given a to-and-fro movement.

A boat fitted with this unit can reverse, stop or turn quickly, and with little effort on the part of the occupant. Steering is effected by turning a small crank on the end of an inclined shaft, as seen in Fig. 1.

Fitting the "Propeloar"

The unit will fit any small row-boat without any alterations, providing that (1) the distance from the transom to the farthest edge of the rear seat is less than 19in., as at A, Fig. 2; (2) the distance from the transom to the nearest edge of the centre seat is more than 44in., but less than 61in. (dimension B, Fig. 2); (3) the depth of the transom is 15¼in., or less (dimensions C and D, Fig. 2).

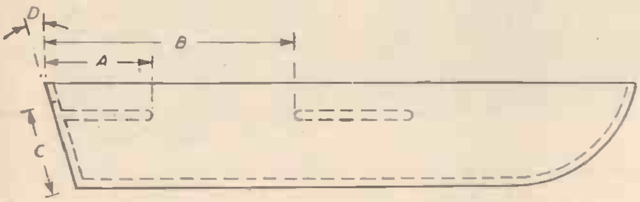


Fig. 2.—Measurements to note when fitting the unit.

Adjustments

If any adjustment is necessary, the rear seat can usually be moved back or reduced in width without any inconvenience. Should the nearest edge of the centre seat be less than 44in. from the transom the seat can be moved back. If the nearest edge is farther than 61in., the seat can be moved forward, or the Propeloar seat could rest on a box or other support If the transom of the boat has a greater depth than 15in. it should be reduced to that dimension, otherwise the propeller may strike the bottom of the boat while in the reversing position.

Lubrication

In order to ensure easy operation of the unit the bearings should be lubricated with a suitable motor oil occasionally. The gears in the underwater housing are topped with oil to the top of the gears. If the propeller unit is not turned upside down very much the oil should last for many months.

Light Construction

Made chiefly of aluminium, the complete unit weighs only 25lb. and can be quickly folded for easy carrying. The price in the United States is about 49 dollars. Further particulars can be obtained from Skinner Supply Coy., 774, Folsom Street, San Francisco, 7, California, U.S.A.

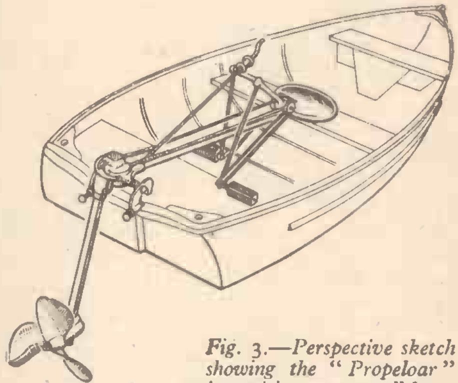


Fig. 3.—Perspective sketch showing the " Propeloar " in position on a small boat.

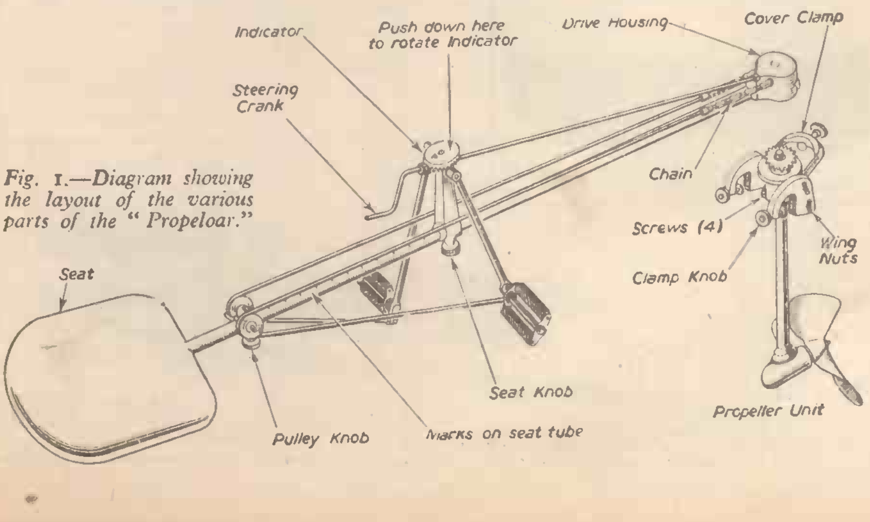
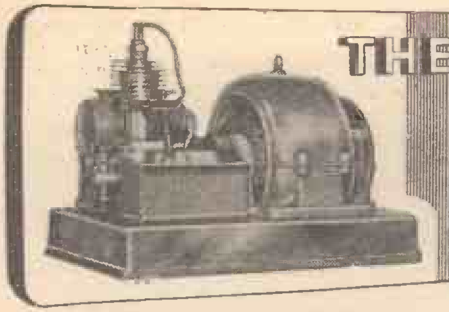


Fig. 1.—Diagram showing the layout of the various parts of the " Propeloar."



THE WORLD OF MODELS

By "MOTILUS"

Trans-mountain Model Railway : Models at a South African Exhibition

MANY readers will be interested in the accompanying plan (Fig. 1) of Mr. Arthur Oswald's trans-mountain model railway on the Dietschiberg, Lucerne, Switzerland: also the snapshot (Fig. 2) taken during the completion of the new south-west spiral tunnel that was added to this delightful outdoor model railway during 1951.

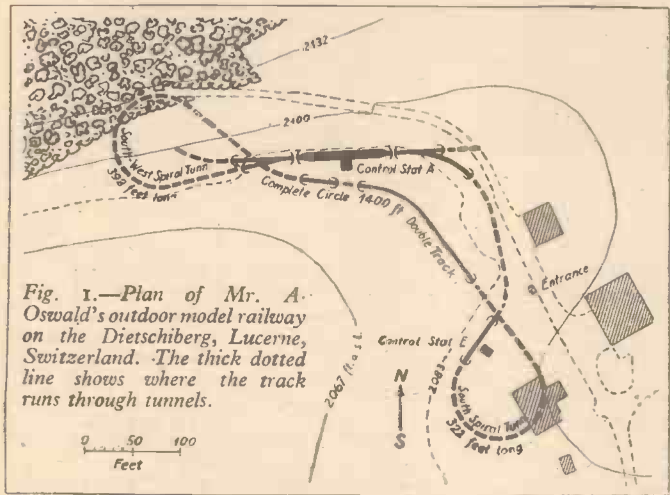


Fig. 1.—Plan of Mr. A. Oswald's outdoor model railway on the Dietschiberg, Lucerne, Switzerland. The thick dotted line shows where the track runs through tunnels.

I have visited this railway many times and hope to do so again this spring or summer. It is all to a scale of one-tenth full size, and is wholly electrically controlled. Two or three years ago I commented on the building of the south spiral tunnel excavated by Mr. Oswald and part of which runs underneath his own home at the summit of the Dietschiberg, a small mountain near Lucerne.

Spiral Tunnels

Mr. Oswald has built up the whole of this railway himself, over a number of years and with the help of various assistants. The building of the two spiral tunnels has certainly been a most ambitious project and this Swiss enthusiast must feel it is a great achievement now they are completed. The latest, south-west tunnel is 398ft. long which means that the railway now comprises 1,400 ft. of double track in its complete circuit.

As Mr. Oswald is a civil engineer by profession, he is able to carry out his tunnelling expertly, from the initial digging and blasting through the earth and mountain rock to the final stages of concreting and the laying of the railway track through the tunnel. The tunnel is shored up by means of a wooden basis with iron struts at intervals, the whole covered with the concrete.

So now Mr. Oswald has attained his ambition to run his trains round a complete circuit: previously they had to run so far and then reverse but now they can continue right round and back to the starting point, having travelled through two spiral tunnels en route. All the rolling stock is, of course, to Continental pattern, and the locomotives are of the electric types that are now almost universal in Switzerland.

Fig. 2.—One of Mr. Oswald's assistants is seen here in the south-west spiral tunnel on the model railway during the concreting of the floor. The floor has already hardened where he is standing.

Models at S.A. Exhibition

South Africa this year is celebrating the tercentenary of the landing of the first white settlers at the Cape under the leadership of Jan van Riebeeck. A Van Riebeeck Festival is being held, culminating in the unveiling of a National monument.

Celebrations extend all over the Union. At Cape Town a large area of reclaimed land on the foreshore has been devoted to an important Festival Exhibition, which opened in March. Among many interesting exhibits is a series of models that have been constructed to show the progress of transport in the Union over the three hundred years. It is interesting to note that all these models were made in Great Britain. The contract was placed, on behalf of the High Commissioner for the Union of South Africa, with the Model Engineering Trade Association, the model-making being carried out by member firms of the Association.

Models such as these require the skill of several kinds of model craftsmen: workers

(Continued on page 282.)

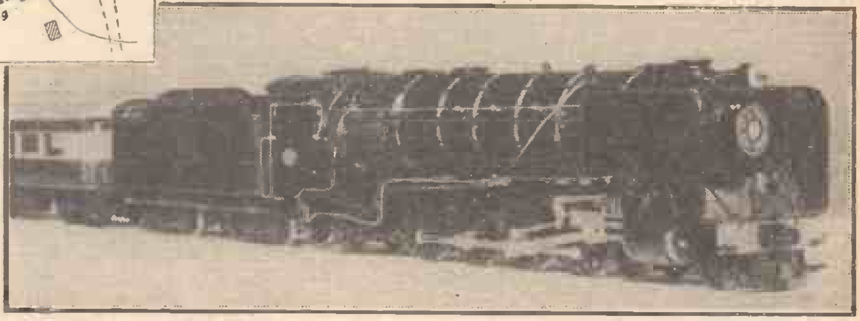


Fig. 5.—Model of the "Blue Train" steam loco to a scale of 7 mm. to 1ft.

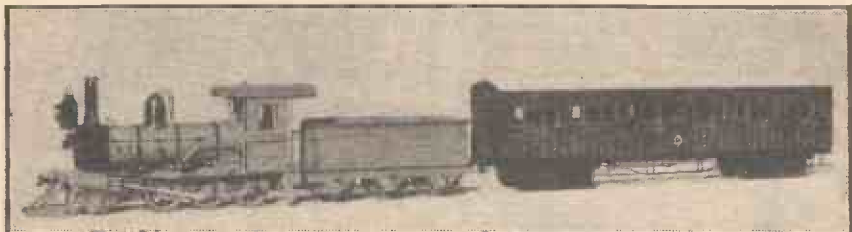


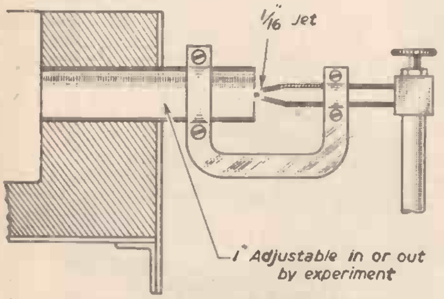
Fig. 4 (Above).—Model loco and coaches of the 3ft. 6in. Cape Railways. Scale 7 mm. to 1ft. Fig. 3 (Right).—Model of a stage coach. Scale 7 mm. to 1ft.

Making a Light Forge

SIR,—I was interested in the small forge described by Mr. Ilston, but it seems to me that it requires a great deal of footwork, as the only air available is that supplied by the tyre inflator, which will have a capacity of about 1 cu. ft. of free air only at, say, 70 strokes per minute.

As the whole idea of a blower is to increase the oxygen supply, I would suggest that an induction blower, as shown by the accompanying sketch, would supply a much greater volume of air.

The air receiver must be capable of supporting a pressure of about 20lb. per sq. in. to supply the blast air and should be fitted with a safety valve.



An induction blower for a light forge.

The writer once had to adapt a large hearth to be blown by a 90 cu. ft. free air per minute compressor which was quite inadequate coupled as in Mr. Ilston's forge, but when fitted with a ¼in. diameter jet blowing into a 3in. induction pipe the result was most pronounced, and the demand on the compressor reduced to about one-third.—J. E. DRINKWATER (Wallasey).

Stereoscopic Photography

SIR,—The revolutionary letter from G. W. E. Hicks printed in your January number has much good sense in it—except that a stereoscopic camera is not absolutely essential to the practice of stereoscopy.

There are people, doubtless, who find it tedious to have to use a stereoscope for viewing stereograms, as compared with viewing prints held in the hand, or in an album. Now, every photographic dealer's window offers in grand variety viewers for colour transparencies made with one-lens cameras. There is no more trouble in viewing a stereoscopic slide in a stereoscope than the other sort in a one-eyed viewer. Why are not all miniature cameras that are specially designed for transparencies made stereoscopic? It cannot be because of the added weight and expense, which are not as great as might be imagined.

G. W. E. Hicks may be surprised to know that there is newly come to the market a stereoscopic camera of his specification—"fitted with a pair of single achromatic lenses, with apertures no larger than *f*/16"—or approaching it. It is the "Robin Hood" made by Standard Cameras of 66, Villa Road, Birmingham, 19, and it costs only twelve shillings and sixpence.—S. H. S. MOXLY (Lymington).

Interplanetary Space Travel

SIR,—Your correspondent W. E. Hadfield raises an important point in connection with space travel. Theoretical science advances so rapidly, and we become so familiar with its more popular fringes, that we tend to forget the colossal distances which separate us from the other stars. How can we mortals hope to visit stars which take rays of light many years to reach?

However, when in doubt, or requiring a sensational theory, turn to "Einstein and Relativity." First, if Mr. Hadfield is prepared to even suppose a rocket speed of 18,600 m.p.sec. (X 2,657 escape velocity, and at the moment, remotely foreseeable rocket speeds), why not go the whole hog? Once in space a small thrust from rocket motors would gradually build up *any desired speed*, the limiting factors being time and the amount of fuel available. (The latter being the crippling proviso with present-day propellants.) So let us add a further zero to the speed to be really dazzled by speculation.

According to relativity, time slows down when approaching the speed of light. A space ship accelerating to 98 per cent. of the speed of light would, from the point of view of the occupants, take a certain period of time to do so—say, two years. From the point of view of the Earth, however, it would have been 11 years. The nearer the speed of light is approached the more fantastic becomes the divergence. Thirty-three years on a space ship attaining 99.9999 (to 18 places of decimals) per cent. of the speed of light would be 10,000 million years on earth! If the occupant could look back, he would see a man be born, live his life, and die, all in the space of five seconds—provided that his eyes were quick enough to follow the rapid movements. What price time and distance now?

As regards meteoric bombardment, apparently 750,000 million million missiles hit the atmosphere every day, which, very approximately, is one every square yard, 50 miles above the earth. Taking this and the minute size of the majority of the particles into account, it is estimated that only minor precautions need be taken.

For anyone interested in space travel I thoroughly recommend that easily read book by the chairman of the B.I.S., Arthur C. Clarke, called "The Exploration of Space."—H. H. PORRITT (Newcastle-on-Tyne).

SIR,—With reference to W. E. Hadfield's letter in the March issue, headed "Interplanetary Travel," may I point out that Professor Einstein's "Relativity Theory" may provide part of the answer to interstellar travel.

With its usual fickleness, nature seems to have provided a means by which man may eventually reach the distant nebulæ.

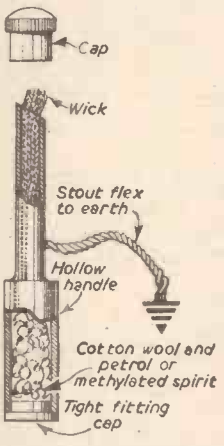
Relativity theory states that time slows down as speed increases, until the speed of light is arrived at, and then time stops. This theory led to what is known as the "twins paradox," which is that if twins were born and the one child were shipped off in a rocket at the speed of light and the other stayed on Earth, then if after 80 years (Earth time) the prodigal son returned, he would still be a babe in arms while his brother would be an old man of 80. Though ludicrous at first sight, many eminent scientists and mathematicians believe implicitly that if the experiment could be carried out the theory would be proved.

So, perhaps, travel into the light years may be practicable one day when man's ingenuity has devised the machine.—DENNIS URCH (Newport, Mon).

An Electric Lighter

SIR,—Replying to the criticisms of my electric lighter, which was published in the March issue of PRACTICAL MECHANICS, my intention was to offer something simple, handy, and which could be made with few tools, such as are to be found in the average household. As described, the lighter is exactly how I and many others use it, but it is up to readers to improve it and make it safer if they wish. I am aware that part B is "live," but the chances of getting a shock cannot be accurately estimated.

With regard to the question of fire risk owing to the close proximity of the inflammable liquid, as shown in Fig. 2 (March issue), this, of course, need not be kept near the lighter. Also, there is nothing to prevent any reader from unplugging the unit directly after use, or to make a hinged door in front of the serrated terminal plates. The insulated handle of part C can be used safely, provided, of course, that the user does not put his fingers on the terminal plates.



An earthed striker handle for an electric lighter.

The improved type of striker handle shown in the accompanying sketch may be preferred. The hollow handle, of wood or plastic, is filled with cotton wool saturated with petrol or methylated spirit, the end of the handle being plugged with a tight-fitting cap. The tube containing the wick can be earthed, as shown.—E. D. MISRAHI (Kfar Hanasi, Israel).

[*The device is contrary to I.E.E. regulations.*—ED.]

Electrically-operated Film Screen Curtain

SIR,—I wish to fit up an electrical device for opening and closing a film screen curtain. The curtain is in two halves and moves to and from the centre. I wish to incorporate limit switches at the end of both directions. The size of the screen is 6ft. I shall be greatly obliged if you can help me with this device.—S. B. BAGLEY (Woodsetton).

[*Readers' suggestions are invited.*—ED.]

Trade Notes

A Review of the Latest Appliances, Tools and Accessories

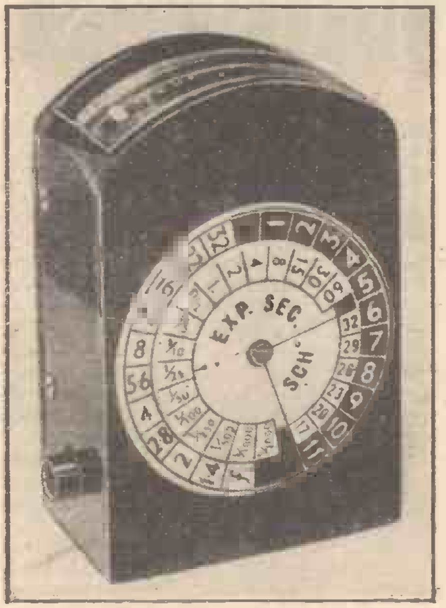
G.R. High Light Exposure Meter

A COMPLETE kit of parts for constructing a high light exposure meter is being marketed by Messrs. G. R. Products, Ltd., 22, Runnymeade Avenue, Bristol, 4. The meter measures the incidental light reaching the subject and operates in both natural and artificial light. A high sensitivity meter movement is operated by a solenium cell and

The G. R. high light exposure meter in use.

a reading is obtained in "light units." When this is applied to a conversion dial the correct exposure may be calculated. The "light unit" readings are in two ranges—0-6 for low light intensity and 6-11 for high light intensity and the change over is made by means of a push-button switch, disconnecting a 12 ohms resistor for range operation.

The kit is accompanied by a sheet of full scale diagrams and comprehensive constructional details. The information is easy to follow and the few tools necessary will be



Rear view of the meter, showing the conversion dial.

possessed by most people in their home-workshop.

The case is cut from opaque black Perspex sheet and the component parts are joined with Perspex cement. This is a material which is easy to work and one which may be highly polished.

One of these meters was made up, from the kit of parts supplied, in the PRACTICAL MECHANICS workshop and, when tested, was found to be an accurate guide, comparing favourable with a commercial meter which was known to be reliable.

The price of the High Light Meter kit is 42s. 6d., and G. R. Products also market a kit for a Reflected Light Model, priced at 37s. 6d.

Lucas Accessories

THE new Lucas Cycle Accessories current retail price list has been sent us by Joseph Lucas, Ltd., Great King Street, Birmingham, 19, together with brochures on the new King range cycle dynamo sets, large range of cycle bells and many varieties which were exhibited at last year's cycle show. The profusely illustrated price list includes a range of cycle bells and many varieties of battery lamps, both front and tail, approved reflectors, and the famous King of the Road cyclometer for 26in. or 28in. wheels. The chief features of the new "King" range of dynamo lighting sets is modern streamlining and a central conical formation in the lens which has the effect of projecting an intense spot beam.

The new Lucas Minor headlamp.

THE WORLD OF MODELS

(Continued from page 280.)

in metal, wood and cloth, etc. The series begins with models of primitive forms of transport such as basket carriers, (men with baskets slung on a simple yoke carried across the shoulders) and the earliest forms of passenger travel, sedan chairs. These are followed by ox-wagons of various kinds, with their long teams of oxen yoked in pairs and the coloured drivers with their fantastically long whips. As the country developed the stage coach also appeared, and so is included in the series (Fig. 3): also individual types of transport such as the Cape Cart and the Spider, the latter deriving its nickname from its small body and high, delicate wheels.

Then follow railway models, showing clearly the development of locomotives through the early part of this century (Fig. 4). The series finishes with a fine model of the "Blue Train," which is entirely air-conditioned and is hauled by an all-electric locomotive for part of the journey and then taken up by the powerful 15F steam locomotive (Fig. 5). Both these locomotives are of British design and build.

As a unified display these models will be most impressive and an interesting illustration of progress in transport. The realism imparted to these models by the British craftsmen who built them is remarkable. They are also unique in that they are all made to the same scale and with a uniform degree of accuracy and finish.

Club Reports

Aylesbury & District Society of Model Engineers

THE February meeting was devoted to a model night. Among the models on view, all of which were locos, was a Great Northern tender built by Mr. E. D. Hasberry, and a "Pamela" class chassis. This loco has progressed considerably since we last saw it, and its builder, Mr. C. Gill, has continued his excellent standard of workmanship.

On the "O" gauge side, Mr. Stevens brought along the first stage of his "fine scale" layout, which promises to be most interesting when it is completed.—Hon. Sec.: E. H. SMITH, Mulberry Tree Cottage, Devonshire Avenue, Amersham, Bucks.

Ilford & West Essex Model Railway Club

ALTHOUGH we have not issued a report recently, activities have been continuing unabated, the club generally and its various sections having met regularly.

As a result of the exhibition at Ilford at the end of September in connection with the Festival of Britain, we have welcomed several new members.

Speakers have included Mr. P. J. Dupen upon the construction of his model contractors' locomotive, "Lord Mayor"; Mr. Fleetwood Shaw upon his own model railway, and Mr. F. H. White upon turning small boiler fittings.

The recent film night provided a further selection of films kindly lent by British Railways and was much enjoyed.

The annual general meeting takes place on May 7th.—Hon. Sec.: E. W. CORNELL, 42, Lincoln Road, Forest Gate.

Birmingham Society of Model Engineers

THE above society held its annual general meeting at the White Horse, Congreave Street, on Wednesday, March 19th. Mr. H. Wright, the treasurer, gave a very healthy report on our finance in spite of the increased cost of running the society.

Mr. W. H. Heaton, the chairman, gave a report on our activities with special reference to the West Midland Loco Rally.

Social and loco trials were held, including a day for the public. The climax was reached on the annual National Rally, when Sunderland Society received our medal for the greatest distance travelled to our track, also a cup for the finest loco.

The last event, a social, finished with a grand firework display which completed our summer programme at Campbell Green, Sheldon.

Our winter season was filled with lectures by members, and the place of honour must be given to Mr. J. N. Maskelyne for his fine lecture on loco design and models.

Hon. Sec.: R. PHILLIPS, 98, Filberstone Avenue, South Yardley, 26.

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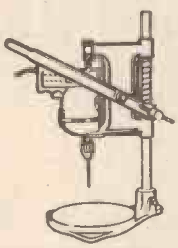

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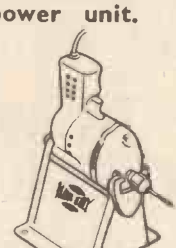

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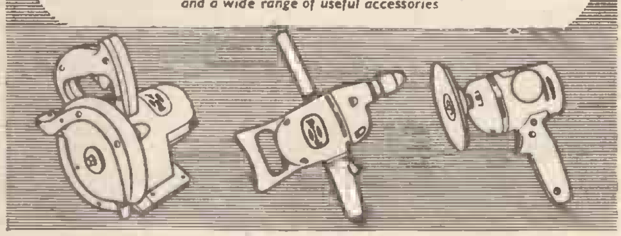

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EARLY CLOSING DAY THURSDAY

EX-R.A.F. ROTARY CONVERTERS. 24 volts D.C., input 50 volts, 50 cycles, 1 phase at 450 watts output, complete with step-up transformer 50 to 230 volts, £9/10/- each, carriage 10/-.

MAINS TRANSFORMERS (NEW), input 200/250 volts in steps of 10 volts output 350/0/350 volts 300 m/amps. 6.3 volts 8 amps twice, 4 volts 4 amps, 5 volts 4 amps, 65/- each, carriage 3/6, ditto, 450/0/450 volts 250 m/amps 6.3 volts 8 amps twice 4 volts 4 amps, 5 volts 4 amps, 65/- each, carriage 3/6; another, input as above, output, 500/0/500 volts 250 m/amps 6.3 volts 8 amps twice 6.3 volts 4 amps, 4 volts 4 amps, 5 volts 4 amps, 70/-, carriage 3/6. Another, wound to (electronic) specifications, 350/0/350 volts 250 m/amps 4 volts 8 amps, 4 volts 4 amps, 6.3 volts 8 amps, 0/2/6.3 volts 2 amps, 63/6 each, carriage paid; another, input as above, output 500/350/0/350/500 volts 250 m/amps, 6.3 volts 6 amps, 0/2/6.3 volts 2 amps, 0/4/5 volts 4 amps twice, 67/6 each, carriage 3/6.

SWITCHBOARD METERS, 4 inch scale moving coil (D.C.) only 0 to 14 amps, 17/6 each, post 1/6. Ditto, A.C./D.C., 22/6 each, post 16.

EX-RADAR MAINS TRANSFORMERS 230 volts input 50 cycles 1 phase, output 4,500/5,500 volts approx. 80 m/amps 6.3 volts 2 amps, 4 volts 1¾ amps 2 volts 2 amps, these transformers are new immersed in oil, can be taken out of the oil and used as television transformers giving output of 10 m/amps, overall size of transformers separately 5½in. x 4½in. x 4in. and 3in. x 3in. x 2½in., price £3/10/- each, carriage paid.

ROTARY CONVERTERS, 24-28 volts D.C. input, 1,200 volts 70 m/amps D.C. output, 10/- each, P.F.

MAINS TRANSFORMERS (NEW), suitable for spot welding, input 200/250 volts, in steps of 10 volts, output suitably tapped for a combination of either 2/4/6/8/10 or 12 volts 50/70 amps, 87/6 each, carriage 7/6.

AUTO WOUND VOLTAGE CHANGER TRANSFORMERS, tapped 0/110/200/230 volts 350 watts, 48/6 each, post 1/6, as above but 500 watts 62/6 each, carriage 3/6; as above 200 watts, 35/- each, post 1/6.

RECTIFIERS (NEW), D.C. output 37 volts 50 amps, complete with mains transformer 230 volts A.C. input 50 cycles 1 phase output to match the required voltage for the rectifier, £15 per set, carriage 10/-.

EX-NAVAL ROTARY CONVERTERS, 110 volts D.C input, output 230 volts A.C. 50 cycles, 1 phase, 250 watts capable of 50% overload, weight 10 lbs., price £10/10/- each, carriage forward.

ELECTRIC LIGHT QUARTERLY TYPE CHECK METERS, all for 200/250 volts A.C. 50 cycles 1 phase, 5 amp load, 17/6 each, post 1/6, 10 amp 21/- each, post 1/6, 20 amp load, 25/- each, post 1/6.

MAINS TRANSFORMERS (NEW), 200/250 volts input, in steps of 10 volts, outputs, 0, 6, 12, 24 volts 6 amps, 37/6 each, post 1/6. Another as above but 10-12 amps, 48/6 each, post 1/6; another, as above but 25/30 amps, 70/- each, carriage 3/6; another, input as above, output 0/18/30/36 volts, 6 amps, 42/6 each, post 1/6.

EX-U.S.A. W.D. ROTARY TRANSFORMERS, 12 volts D.C., input 500 volts, 50 m/amps. 275 volts 100 m/amps D.C. output. Complete with smoothing switches, fuses, etc., as new, 17/6 each, carriage 2/6, can be run on 6 volts giving half the stated output.

VARIABLE RESISTANCES, 9 ohms, 4 to 12 amps, 30/- each.

SYNCHRONOUS F.H.P. MOTORS, complete with a large selection of gear wheels 200/250 v., A.C. mains, 14/6 each.

MAINS TRANSFORMERS, 230 v. input, 150/0/150 v., 200 m/a., 6.3 v. 8 amps. 5 v. 2 amps output, 21/- each.

PRE-PAYMENT 1/- SLOT METERS, 200/250 volts A.C., calibrated at ¾d. or 1d. per unit, 5 amp load, 45/- each, 10 amp load, 57/6 each.

HAND-DRIVEN GENERATORS, output 6 volts 5 amps, 17/6 each.

MAINS TRANSFORMERS (NEW). Input 200/250 volts in steps of 10 volts, outputs, 350/0/350 volts 180 m/amps 4 volts 4 amps 5 volts 3 amps, 6.3 volts 4 amps, 39/6 each, post 1/6; another 350/0/350 volts 180 m/amps 6.3 volts 8 amps, 0/4/5 volts 4 amps, 39/6 each, post 1/6; another 500/0/500 volts 150 m/a. 4 volts 4 amps C.T., 6.3 volts 4 amps, C.T., 5 volts 3 amps, 42/6 each, post 1/6; another 425/0/425 volts 160 m/amps 6.3 volts 4 amps, C.T. twice 5 volts 3 amps, 42/6 each, post 1/6.

QUERIES and ENQUIRIES

A stamped, addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 64 (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.

Underglaze Pottery Decoration

I HAVE a plain white, bone china tea service and am desirous of edging each piece with gold.

Can you inform me of the method employed and materials used, and whether it is within the scope of the handyman? I believe each piece has to be subjected to heat after painting, and if so, how can a high enough temperature be attained in the home?—D. G. Jarman (Ipswich).

WE presume that you are referring to the usual process of underglaze pottery decoration, using genuine gold. We are afraid that you will not be able to undertake such a process, because it necessitates the possession of a pottery kiln capable of attaining a temperature of at least 840 deg. C. Such a process is definitely not within the scope of any average handyman. You would have to obtain a quantity of "potters' gold" from Messrs. Johnson, Matthey & Co., Ltd., Hatton Garden, London, E.C.1. This is a very expensive material. It is painted on to the surface of the cup with an ordinary fine brush, after which the cup is then placed into a "glost" pottery furnace in which it is slowly raised to about 840 deg. C. for several hours, being allowed to cool slowly afterwards. This is the only process which will give the true underglaze permanent decoration in colour on any ceramic surface. You can, of course, surface-paint the pottery ware with an imitation gold ceramic paint obtainable from various firms of handicraft dealers such as Dryad, Ltd., St. Nicholas Street, Leicester, but all such paints are, naturally, very impermanent and wear off, more or less rapidly, afterwards.

If it is your desire to go in for the complicated subject of ceramic decorations, you should obtain, and carefully study, various books on the subject from your local reference library or county library. There are various modern books which deal with the subject in a comprehensive manner.

Casting Garden Ornaments

Recently I designed a figure, about 36in. high, which I would like to cast as a garden ornament. What is the most lasting and weatherproof material to use? I had in mind something like a magnesite composition, or a suitable cement, but am not sure of how they react in extremes of temperature. Please advise me of any special preparation for moulds and possible suppliers.—T. Fisher (St. Ives).

AN outdoor casting material as good as any for your use would be a mixture of Portland cement, 2 parts; fine sand (not sea sand), 1 part; asbestos powder, 1 part; stone dust or other fine, light-coloured filler, 1 part. This is merely slaked with water to mortar consistency and then charged into the mould. Magnesite compositions are quite effective and they have the advantage of expanding very slightly on casting, so that essentially sharp castings are obtainable from them. A good magnesite composition has the following ingredients:

Calcined magnesite	1 part
Fine filler	2 parts

This mixture is slaked to mortar consistency with a solution prepared by dissolving 40 parts of magnesium chloride in 60 parts of water. The mixture takes about 30 hours to set.

The ingredients mentioned above are obtainable as follows:

Asbestos powder: Messrs. Turner Bros., Asbestos Co., Ltd., Rochdale, Lancs; Messrs. J. Milne Cooper & Co., Ltd., Kobar Works, Bradford, Yorks.

Magnesite: Messrs. Everitt & Co., Ltd., 40, Chapel Street, Liverpool, 3.

Magnesium chloride: Messrs. S. Pitt & Co., Ltd., 95, Bath Street, Glasgow.

"Vinamould": A special moulding composition suitable for all kinds of ornamental casting. This is supplied by Vinyl Products, Ltd., Butter Hill, Carshalton, Surrey. For your type of work it is, we think, superior to the more ordinary types of gelatines and glue moulds.

Plating Wooden Articles

I WISH to develop a bright metallic finish on small wooden ornaments. Is it possible to electro-plate on a graphite coating previously applied? The finish desired should be as near to bright nickel or brass as possible.—A. Taylor (Birkenhead).

ARTICLES of wood can be plated quite satisfactorily. The wooden article, after careful surface sandpapering, is immersed for a time in a solution of 10 parts of gelatine in 90 parts of warm water. It is then dried, without washing, and brushed over with the finest graphite or plumbago, which latter would then adhere well to the surface. After this it is immersed in a copper-plating bath of the following approximate composition:

Copper sulphate	1½lb.
Sulphuric acid	2oz.
Water	1 gallon

Plating of the copper should proceed for about five minutes, merely a thin coating of copper being required. If a bright nickel finish is required, the copper-coated article is quickly rinsed and then plated in the following bath:

Nickel ammonium sulphate	4oz.
Nickel sulphate	8oz.
Water	1 gallon

Here, of course, a nickel anode must be used. The current should be about 4 amps./sq. ft. of surface to be plated and the plating may be continued for about half an hour, or until a plating of the required thickness has been obtained. The nickel plating is then rinsed in cold water and allowed to dry. The plating thus obtained will be a matt one, but it can be polished up by any of the usual polishing methods.

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

Making Red Lead or White Lead

CAN you give me any information on how to make a small quantity of white lead or red lead? I remember reading once that scrap lead is cut up and put into an earthenware vessel, acetic acid poured over it and left for some time to dissolve. Is this idea correct, and can you develop it further?—W. A. Farquhar (I.o.M).

WHITE lead is manufactured along the lines which you mention, although more modern processes are now coming into use. The method which you outline is known as the *Dutch process*. It is about the oldest of all methods and one of the best. The scrap lead is melted and cast into thin grids or bars, which are then stacked one on top of the other in an earthenware vessel, care being taken to expose as much of the lead surface as possible. A small quantity of acetic acid diluted with an equal volume of water is then poured over them. The pot is then placed in warm surroundings. In the older processes the pots were placed on beds of manure or spent tannage. The acid is gradually vapourised by the heat, and its fumes attack the metallic lead, converting it into lead carbonate, or white lead. The process takes about three months.

An inferior form of white lead can be made quickly by adding a solution of ammonium carbonate to a solution of lead acetate or lead nitrate, whereby the white lead is precipitated at once. The solution-strengths are immaterial, but it is better to have them fairly strong.

Red lead is lead oxide, Pb_3O_4, or *minum*, and is best obtained by subjecting white lead in shallow layers to a prolonged heating in contact with air. The white lead will slowly become coloured as the red lead is formed. The temperature to which the white lead is heated must not exceed 450 deg. C., otherwise the read lead will begin to evolve some of its oxygen. The process is one which is quite straightforward, but which calls for accurate temperature determination and control.

Cleaning Chromium-plated Fittings

Please suggest a chemical means of cleaning chromium-plated fittings such as are used in bathrooms and on doors.

The problem is to remove (a) Hard water deposits; (b) Accumulations of paint without damage to the surface of the plating.—P. Ward (Gosport).

ALTHOUGH chromium is plated in an extremely hard form, it is better not to use abrasive cleaners on its lustrous surface. To remove hard-water deposits from chromium plate, merely rub the surface over with a cloth charged with dilute acetic acid (50 : 50). The acid will quickly dissolve the deposit, after which the area should be swabbed over with warm water and carefully dried.

For removing hardened paint deposits, merely dissolve a little candle wax in acetone, and then brush the solution on to the deposits. Allow it to remain thereon for five minutes, then gently scrape the softened paint deposits away with a blunt edge. Finally, wipe over the entire area with a soft cloth moistened with the pure acetone.

Neither of these treatments will affect the chromium-plating in any way.

Ordinary benzene, or a 50 : 50 mixture of benzene and methylated spirit, may often be used for the purpose in place of acetone.

Identifying Mineral and Vegetable Oils

I HAVE a lot to do with different types of oil for lubricating and hydraulic purposes, and for various reasons would like to know how to be able to tell a mineral oil from a vegetable one.

Is there any simple test method or must I use a microscope?—S.A.C. Reay (R.A.F., Rugby).

THE main distinguishing tests for mineral and vegetable oils are chemical in nature, such as the ready saponification of vegetable oils by boiling with caustic soda solutions, the tendency of most vegetable oils to rancidity on standing, and the behaviour of such oils on treatment with strong sulphuric acid. Obviously, these are not tests which can be done "at sight."

The mineral oils are derived from petroleum. The most convenient distinguishing test for them is to observe their appearance when sunlight is allowed to fall on them obliquely. Almost invariably a mineral oil will show its characteristic fluorescence, which will be green, blue, yellow-green or yellow-blue according to the nature and type of oil. An oil which is thus fluorescent in sunlight (or in ultra-violet light artificially produced) is always of mineral origin. An oil which does not fluoresce under these conditions is always of vegetable origin. This applies independently of the colour or viscosity of the oil.

When, as is sometimes the case, a mineral oil is mixed with a vegetable oil, the product acquires the fluorescence of the mineral oil. In such an instance, the presence of the admixed vegetable oil cannot be detected by such a quick, rough and ready means, and laboratory chemical tests would have to be applied to determine the amount and extent (if any) of the admixture.

The use of a microscope will not provide any reliable method of distinguishing between vegetable and mineral oils.

Heat-resisting Varnish

I REQUIRE a heat-proof, or at least heat-resisting, varnish for table mats made from plywood. Very small bottles of this are available from art shops but are rather expensive. Have you any suggestion or advice to offer, please?—R. V. Wallis (Norwich).

THE various bakelite resin varnishes will usually resist table heat fairly well. Spirit-soluble bakelite powder for making your own varnish can be obtained from Bakelite, Ltd., 18, Grosvenor Gardens, London, S.W.1, or from one of the subsidiaries of this company, but a much better ready-made varnish based on bakelite can be had in 1 lb. tins from Messrs. Smith and Walton, Ltd., Haltwhistle, Northumberland.

For resisting temperatures up to about 200 deg. C. a synthetic resin of the "Melamine" type is necessary, but, unfortunately, you will not be able to obtain this resin in small amounts.

In our experience, any ordinary cellulose lacquer, coated thickly, gives a good heat-resisting clear varnish. This can be made by dissolving to syrup consistency in a mixture of equal amounts of amyl acetate and acetone clear scrap celluloid, the resulting varnish then being brush- or spray-applied.

Another type of heat-resisting, quick-drying varnish is polymethyl-methacrylate dissolved in toluene or xylene. This varnish can be obtained from Vinyl Products, Ltd., Butter Hill, Carshalton, Surrey.

Atlantic Crossing Details

COULD you please tell me the names of the ships which first crossed the Atlantic with :
1. Sail and steam together.
2. Steam and paddles.
3. Steam and screw.
4. Motor engines ?
—H. Eames (Redditch).

1. The first steamship to cross the Atlantic was the "Savannah." It was a vessel which was owned by Mr. Scarborough, of Savannah, in the American State of Georgia, and was named by him after his home-town. The "Savannah" left New York on May 20th, 1819, and arrived at Liverpool some 26 days later. It was, of course, a paddle vessel and it was fully masted as a sailing ship. Its Atlantic passage was made partly under steam and partly under wind. In fact, its full steaming time during the voyage was only 80 hours. Nevertheless, it arrived with its coal fully consumed.

2. The first Atlantic crossing in a paddle vessel purely under steam (i.e. without wind assistance) was made by the "Great Western." This vessel sailed from Bristol on June 17th, 1838, and arrived at New York 18 days later.

3. Captain John Ericsson, a Swedish engineer, designed a steamship, the "Francis Boyden," which was screw-propelled, had a speed of about 10 knots and which made the Atlantic voyage in 1837. It was, however, wind assisted. The first big attempt to use a screw-propelled vessel was made in 1845, when the "Great Britain" sailed from Liverpool on July 26th, 1845, and arrived at New York on August 10th.

4. Your query concerning the first Atlantic motor-ship is not a very straightforward one, since the term "motorship" may be given a number of different meanings. However, taking the term to designate a vessel burning fuel oil, the first of the Atlantic vessels of this type was the "Saturnia," which first made the crossing in 1920. It was designed and owned by Italia Anonmina di Navigazione.

Eel Grass Board : Rendering Gloss Paint Absorbent : Radiant Heat

1. Where can "Eel Grass Board" be obtained, and what thickness would be required to have a sound-proofing effect equivalent to a 14in. brick wall ? What is the approximate cost ?

2. Can anything be added to an ordinary gloss paint to render it absorbent ? I wish to use it for a kitchen.

3. What is the difference between the rays emitted by the "radiant heat" element and "infra-red" element in "health lamps," and those emitted by an electric fire ?—F. W. Hewlett (Birmingham).

1. We doubt whether "Eel Grass Board" is now obtainable in this country. It is merely a sort of straw-board impregnated with plaster. We do not think that you will be able to obtain it locally from any builders' merchants but you might try Messrs. Baxendale and Co., Ltd., Manchester. Since this material is not ordinarily called for nowadays, we cannot give you a figure for its cost. Straw and grass boards of this description have a sound-deadening effect of roughly one-half that of solid brick or stone-work, but much depends on the precise way in which the board or sheet is fixed and anchored in or to its surroundings and/or supports.

We suggest that you would get a much better, cleaner, lighter and more efficient product by using glass wool sheets specially prepared for sound-deadening purposes. For particulars apply to Fibreglass, Ltd., Ravenhead, St. Helens, Lancs.

2. There is nothing which can satisfactorily be added to a gloss paint or, indeed, to any other type of paint, to render it absorbent. If the gloss oil paint is thinned down sufficiently with white spirit, it will dry out with a dull, "flat" surface which will absorb small amounts of moisture from the atmosphere. If this flat surface is given one or two coats of distemper, its absorbency will be increased. For a good absorbent flat oil paint you might well try "Murac" wall paint, which is manufactured by Messrs. John Hall and Co., Ltd., Hensgrove, Bristol, 4. No matter how highly pigmented a true oil paint may be, it can never be greatly absorbent owing to the oil which it contains and which, especially after drying to a hard, resinous film, militates directly against the attraction and absorption of moisture.

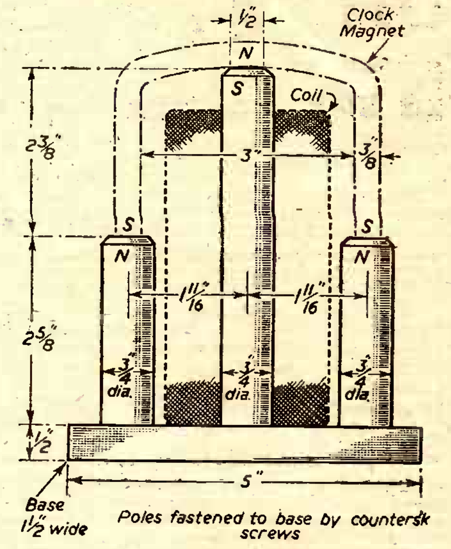
3. There is no difference between the nature of the "radiant heat" emitted by "radiant heat" and "infra-red" elements of health lamps. Nor is there any difference between these heat radiations and those derived from ordinary red coal, coke, gas or electric fires. All these radiations are composed of relatively long-wave heat rays and they are all equally beneficial in rheumatic and other bodily conditions. The great advantage of the special heat-ray "health" lamps is that their radiations can be controlled and directed or focused more accurately.

Re-magnetising Bulle Clock Magnets

I WISH to make a pair of solenoids for re-magnetising the magnets of Bulle battery clocks. This magnet is unusual in that it has the north pole in the middle and south poles at both ends.

I have had several of these clocks for repair, with the magnetism almost or completely gone.

Can you give me data for winding a pair of coils for this purpose to work off 240-volt D.C.



Method of re-magnetising a Bulle clock magnet by means of a powerful electromagnet.

mains, either in series or parallel with each other ? The dimensions are as shown in attached sketch (not reproduced).

Am I right in assuming that it will not be necessary to make additional coils with cores large enough to pass the bends on to the middle portion ?—A. D. Jones (Dorking).

WE suggest that you build an electromagnet core of soft iron or mild steel to the dimensions given in the accompanying diagram. A coil on the centre limb should be wound with 1,500 turns of 20 s.w.g. S.S.C. enamelled wire, this coil being fed from the 240-volt direct current mains through a 600-watt bowl fire element. The direction of current through the coil should be such as to give the shorter poles north polarity, and the long pole south polarity. With these polarities the permanent magnet should be attracted when placed on the top of the electromagnet after the current has been switched on.

To magnetise the permanent magnets the current should then be switched on and off for a few times. A magnet of this type may not have a great retentivity owing to the open magnetic circuit.

White Footballs

I AM interested in the white ball now being extensively used in League and other association football matches, and have experimented with painting ordinary (brown) football cases—but the white paint chips off after one game. Could you indicate how the ordinary brown leather case can be made white throughout ?—G. P. Williams (Dover).

OBVIOUSLY, there is no such thing as "white dyeing," since dyeing itself implies colouration and whiteness is usually taken as being an absence of colour. There is no method of whitening a leather football case apart, of course, from the use of the several white paints which are available for this purpose.

To get the type of article which you desire, you will have to make an entirely new football case from what is known as "white leather." This is not actually a bleached leather. It is a leather which has been subjected to prolonged extraction of grease and oils and has then been pigmented by the pressure-rolling of a white inert substance, such as zinc oxide or titanium oxide, into its pores. We do not suppose that you have available the necessary plant for processes such as this, so that, ordinarily speaking, we feel that any process of inherently whitening leather will be quite beyond your reach as an individual. The white leathers, however, are commercially available and you might obtain a quantity from a firm such as Messrs. G. W. Russell, Ltd., Hitchin, Herts, or from Dryad, Ltd., St. Nicholas Street, Leicester. Since you are interested in the matter, we suggest that you get into touch with the British Leather Manufacturers' Association, Milton Park, Egham, Surrey, who would, we think, be prepared to give you practical details of the latest processes of whitening hides or of rendering them light coloured.

Re-enamelling a Car

MY car is at present painted a cream colour with, I think, Valspar synthetic enamel. While the condition of the paintwork is not too bad, I wish to paint the car black. To do this I assume I shall have to use a synthetic enamel if I am not to strip off the old paint completely, or to take great pains in "sealing" the present enamel. The car was sprayed cream and the resulting finish is best described as "eggshell" in texture. My queries are :

1. Is there a special stopping material for use with synthetic enamels to fill in defects or can the ordinary stopping material be used ?

2. Is there any special undercoating that should be used ?

3. Is the "eggshell" finish mentioned above inherent in spraying with synthetic enamels or can a high-gloss finish be obtained ?

4. What percentage of thinners to enamel should be aimed at in the final coat ? I assume that the thinners for spraying are similar to the thinners for painting, i.e., pure turps.

5. Assuming that spray painting of synthetic enamel is not advised, can you suggest a good paint remover for the existing enamel ?—C. R. Alexander (Welling).

1. If your car has been painted with a synthetic enamel it should be readily possible for you to paint, quite satisfactorily, a black enamel over the existing cream enamel, provided that the black enamel is also of a synthetic nature. To get the best results the composition of the black enamel should be identical with that of the white enamel so far as the enamel medium is concerned. We do not think it will be necessary for you to strip off the old enamel before applying the new one, but if you prefer to do this you will find that the enamel will readily strip off after brushing it down with a mixture of equal quantities of benzene and acetone.

2. A good stopping material for your purpose would be the so-called "plastic solder," obtainable at the chain stores. This is merely a fine aluminium powder incorporated into a thick cellulose medium. It dries rapidly and, when hard, it will stand smoothing-off with fine sandpaper.

A good undercoating for use on metal would be either the lead pigmented enamel or paint which is manufactured under the name of Ledium by Messrs. Lewis Berger and Co., Ltd., Homerton, London, E. This is particularly useful when the metal is desired to be adequately rust-proof. Another undercoating for average purposes would be a thin layer of an ordinary aluminium paint.

3. The semi-rough or "eggshell" finish which you mention is always an inherent property of the varnish, not of the method of its application. The eggshell finish can be produced by incorporating a "flatting" agent, such as aluminium stearate, into the enamel, or by making up the enamel with a low boiling-point solvent so that the enamel dries rapidly. It can, of course, be produced by a judicious combination of these methods. But the point to note is that, normally, the finish of the enamel is conditioned by the composition of the latter and not by its mode of application. In ordinary circumstances the slower drying the enamel the higher the gloss obtained from it.

4. Thinners for synthetic enamels are very definitely not similar in composition to thinners which are used for ordinary oil painting or enamelling. In the latter case, as you say, pure turpentine, or a mixture of pure turpentine and white spirit, would be admirable for making a good job, but such would be totally inadmissible as thinners for synthetic enamels. Usually, these thinners consist of a mixture of the solvents which have been used in the making of the enamel itself. The mixture of thinners may be in this case (and usually is) rather complex, containing liquids such as acetone, ethyl acetate, amyl acetate, ethyl lactate and various other organic esters. A simple thinning liquid for average purposes can be made up by mixing together acetone, ethyl acetate, amyl acetate in approximately equal proportions, but the total amount of this mixed liquid should not exceed 20 per cent. of the volume of the paint or enamel.

5. A suitable paint remover for the existing cream synthetic enamel would be, as above stated, a mixture of equal quantities of benzene and acetone. This liquid will become more effective if it contains about 5 per cent. of dissolved wax—paraffin wax or beeswax, or even candle wax. The function of the wax is to prevent the too speedy evaporation of the softening liquid when it is brushed over the paint surface, thereby giving the liquid a longer time to act before it is completely dissipated.

Painting on Glass

CAN you give me any information regarding the painting of pelmets on the plate glass windows of shops ? I have tried different enamels, also flat oil paint stippled over, but none of these seem to make a successful job.—W. A. Pitts (Douglas, I. of M.).

OIL paints are quite useless for putting on glass because the oil does not spread on the glass easily. The best paints for the purpose you name would be the thin cellulose enamels which can be obtained from most paint dealers. In our opinion, you would get good results if you made use of the ordinary artists' cellulose paints for glass decoration. These can often be obtained in local handicraft shops, and in dealers in handicraft and artists' materials. If you cannot obtain them locally send an enquiry to Dryad, Ltd., St. Nicholas Street, Leicester. These people are well-known handicrafts dealers, and we think they will be able to supply you with the right paint for your job.

Alternatively you might inquire at the various firms producing artists' paints, such as :—Reeves & Sons, Ltd., 18, Ashwin Street, London, E.8 ; Winsor & Newton, Ltd., 38, Rathbone Place, London, W.1 ; George Rowney & Co., Ltd., 10 and 11, Percy Street, London, W.1.

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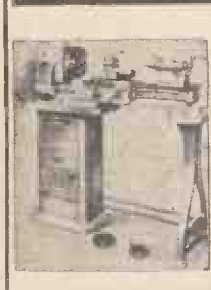

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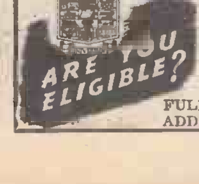

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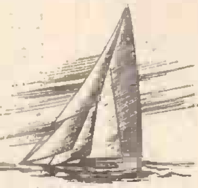

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COMMENTS OF THE MONTH

By F. J. C.

MASSED START—N.C.U. CAVES IN!

B.L.R.C. WINS 10-YEAR BATTLE

MASSED start racing was approved at the National Cyclists' Union General Council meeting on March 22nd, by the acceptance of the proposal to delete the "banning of massed starts" from the N.C.U. rule book. The proposal was discussed and passed in a matter of minutes. Thus, the fierce opposition put up by the Union during the past ten years against this modern form of racing came to an ignominious end. It is not the first time in the chequered history of the Union that it has been proved to be the apostle of a lost cause, and we are wondering what value can be placed on its words and its opinions by the Home Office and the Ministry of Transport in the future. It is true that the N.C.U. has been proved wrong in its gloomy forecasts as to what would happen after the war if massed start races were permitted on the roads by the march of events. Ten years of this form of racing have proved all the critics wrong. Moreover, the success which has attended these races has converted thousands of cyclists to its ranks. Little wonder, therefore, that for the past two years there has been dissension within the ranks of the N.C.U. which now finds itself between Scylla and Charybdis, for in approving massed start it now has to settle accounts with its uneasy bed partner, the R.T.T.C. Still, adversity makes strange bedfellows. It may be that by the time these words appear in print some sort of condominium may have been arranged.

The decision by the N.C.U. by 50 votes to 20 to run massed start races, raises a problem for the B.L.R.C., the secretary of which states that the League programme will be adhered to and will run strictly according to schedule. The Tour of Britain will run as planned. The *Daily Express*, sponsors of the Tour, announce that there is no reason why they should withdraw their support from the event because the N.C.U. decision has no bearing on it. At the time of going to press the R.T.T.C. is convening a meeting to take place on May 25th, to consider the position. Whether the B.L.R.C. would join forces with the N.C.U. or, as the originators of massed start in this country, will continue to operate as an autonomous body (as it has every right to do, since it has more experience of massed start than the N.C.U.), remains to be seen.

The massed start committee of the N.C.U. will formulate rules on which their races are to be run. They are to cover multi-stage racing as well as single stage events. The trade, which offered to act as arbitrators in the dispute between the three bodies, is naturally anxious, now that the B.L.R.C. has won the day, to effect unity between them. The harsh words of the past, however, and the methods adopted by the N.C.U. to impose its will may not soon be forgotten. The leopard cannot so quickly change its spots!

A Deciding Factor

WE like to feel that our continued efforts over the past ten years on behalf of the League have been a deciding factor in the conversion of the N.C.U. We drafted the memorandum on massed start, and with W. J. Mills and J. Kain formed the delegation which visited the Ministry of Transport to put the League case. At that meeting we learned of the methods which had been adopted behind the scenes to get massed start racing stopped. We said then and we say now that those methods were not worthy of a sport which is supposed to be clean. Indeed, it is doubtful whether without the considerable support we gave to the League that it would have survived. Percy Stallard was the first, in June, 1942, to challenge the N.C.U. by promoting the first British road race from Llangollen to Wolverhampton. He and his supporters were suspended because of a breach of the Union's rules. He then sponsored the Midland League of Racing Cyclists which later combined with similar break-away movements in London and Yorkshire and finally became the B.L.R.C.

No doubt the Tour of Britain last year and the success which attended it has had much to do with the final conversion of the N.C.U. It achieved more publicity in the national press than any other form of track or road racing.

Now that the fight is over we may hope that the three bodies will get together and in future work on terms of amity with one another. From the rumblings which reach us, however, there seems little possibility of this taking place yet. There will be at least three months lapse before the N.C.U. can run its first race. Perhaps that time can be used to heal the breach, now that Great Britain is running cycle races on lines which are accepted in most other countries. This does not necessarily mean that there will be a decline in time trials, which are still run on the furtive, hole and corner and surreptitious lines which were necessary when the police attitude towards cycling was as severe as it now is towards motoring. Undoubtedly, however, many racing cyclists will divert their attention from time trials to massed start, preferring the glamour and the publicity of modern cycle racing to the small amount of publicity which is accorded to time trials—even classic time trials.

The dispute need never have arisen had wise councils prevailed at the start. The N.C.U. for over fifty years has been endeavouring to force cycle sport on to closed circuits. It banned time trials, whether paced or unpaced, attempts at road records and all other forms of road racing.

Another factor created by this new position is the attitude which the Government is likely to adopt if two bodies sponsor mass start racing. It has already threatened action, but promises to leave time trials alone. If massed start racing is banned, the N.C.U. will be entirely responsible for it, and in that unhappy event there will be a secession of members from its ranks, since the majority of its members want massed start racing.

It is our fervent hope, now that all has been said and victory won, that unity should replace the splitting discords of the past, and the personal vendettas forgotten.

Rusper Sussex

A little village close to the county border near Capel The interesting church contains two old brasses and a font thought to be Saxon. The village is set in lovely wooded country

Zebra Crossing Regulations Amended

THE pedestrian crossings regulations have been amended by the Minister of Transport, the Hon. John S. Maclay, C.M.G., M.P., in the light of experience gained since "zebra" crossings were introduced on October 31st, last year. The new regulations came into force on March 12th.

The main changes are concerned with the marking of crossings. Their effect is that, if it happens that a crossing does not comply strictly with the provisions of the regulations about the lay-out of the lines of studs or about black and white striping, the crossings will still be valid provided that the general appearance of the lines of studs and the black and white stripes is not materially impaired. Moreover, the first stripe at each side of an uncontrolled crossing is no longer required to be black.

Other changes are:

Bicycles, whether or not mechanically propelled, which are not fitted with side-cars, are exempted from the restrictions which may be imposed under the regulations on waiting vehicles on the approaches to crossings. It is also expressly provided that these restrictions do not apply to vehicles which are stopping to give precedence to pedestrians using a crossing.

The Minister is given power, in particular cases, to authorise crossings over 16ft. or less than 8ft. wide.

DYNAMO LIGHTING

With Notes on the Dyno-hub

By C. J. J.

THE dynamo has its advantages and disadvantages compared with the battery lamp, but for the rider who has to do a good deal of cycling after dark it is definitely a good investment.

The main disadvantage of a dynamo is, of course, the friction drag on the tyre, but to the reasonably active rider this should not be a drawback, although drag and the additional weight have been the main reasons why lightweight users and clubmen have not favoured this form of lighting in the past. A further disadvantage is that the lights go out when the cycle is at a standstill and, when stopping on a dark road, it would be well to remember this. Some of the more modern dynamo headlamps, however, carry a battery and have a two-way switch which enables the rider to change over to battery lighting when a stop is made.

Offsetting these disadvantages is the fact that a dynamo can produce a much more powerful light, which is constant (a battery lamp dims as the dry cells near the end of their life) and, having no batteries to replace, it is cheaper to run. To the country rider a powerful headlamp is almost a necessity for picking out the additional

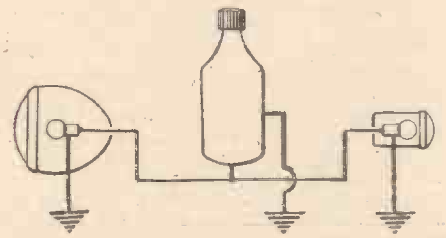


Fig. 1.—The lamps are connected in parallel with the dynamo, and earthing may be carried out either by using the mounting brackets or by connecting the casing of the two lamps to the dynamo casing by means of wires.

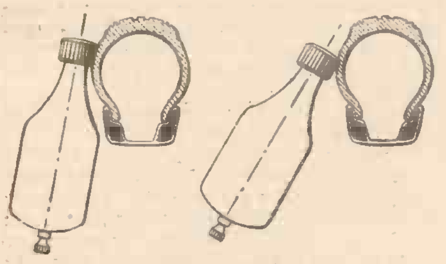


Fig. 2.—Ensure that the pulley wheel is bearing correctly on the side of the tyre.

hazards of an uneven verge, winding roads and unexpected obstructions where street lighting is almost non-existent.

The principle on which the dynamo functions is that magnetic lines of force due to the north and south poles of a permanent magnet cut the turns of a winding and induce a voltage into them; the winding being connected to an external circuit (the front and rear bulbs) a current will flow.

The magnetic field cutting the turns of the winding can be produced in two ways. First, by a stationary magnet and revolving winding and, secondly, by a stationary winding and revolving magnet.

In addition to the friction-driven dynamo there is on the market a type of dynamo included in a specially made hub, the prototype of which was introduced by the Raleigh Company. The design eliminates friction drag and, of course, less effort is required to obtain an effective light.

Since then the Raleigh Company have introduced car type lighting, and this combines the original type of dyno-hub with a three-speed gear. The current produced by the dyno-hub is passed to the accumulator unit which includes a rectifier for converting the A.C. to D.C. (accumulators may be charged by D.C. only). The accumulators are of the dry type and the only attention they require is to be fed with distilled water periodically. This type of lighting means that a steady continuous light is provided irrespective of the speed of the cycle or whether it is moving or at a standstill. Excessive standing, however, will, of course, as in a car, cause the cells to become run down, but provided that riding time exceeds standing time they may be recharged.

The Circuit

With the friction-driven dynamo both the headlamp and the rear lamp are supplied from the dynamo and are connected in the circuit in parallel (see Fig. 1). There are two methods of making the earth connections; either mount headlamp, dynamo and rear lamp straight on the cycle frame, cleaning away enamel under brackets, etc., so as to ensure a good electrical connection, and using the frame as a return to the dynamo for the current, or by using additional wiring and connecting the headlamp casing to the dynamo casing, and the same with the rear lamp. The other connections in the diagram (Fig. 1) from dynamo to headlamp bulb and from dynamo to rear lamp bulb are self-explanatory. The second system mentioned, using wires instead of the frame to complete the circuit, is the better of the two, there being less chance of making a high-resistance connection.

The Correct Bulbs

The bulbs in both lamps must be chosen with regard to the voltage and amperage rating of the dynamo. For instance, a typical dynamo is designed to yield a 6 volt, 3 watt output, which is a current rating of .5 amp., and the bulbs used should always be those recommended by the makers of the dynamo. The rear lamp bulb is nearly always a 6 volt, .04 amp., while that for the headlamp may be a 6 volt, .45 amp. For different types of units other ratings are used, but a good cycle dealer will usually know which are correct.

The sum of the amperages of both bulbs should not exceed the total amperage rating of the dynamo and the bulbs previously mentioned are used in this particular combination so that the greater part of the power is concentrated in the headlamp, the rear lamp receiving only enough to ensure that it is seen.

If bulbs of lower wattage rating than that which is correct are used, they are certain to "blow" after a very short time of use, and when bulbs of too high a wattage rating are employed, the result is a light which is much too dim.

Fitting the Dynamo

The dynamo may be driven by either the front or rear wheels, according to individual preference, but whichever one is used, the method of fitting is the same. It should be mounted as close to the wheel as possible, in the "off" position, so that the whole of the serrated portion of the driving pulley bears on the side of the tyre, see Fig. 2. If tilted at an angle the top edge of the driving pulley will bear on the tyre and quickly wear a groove in the rubber. In order that the driving pulley will lay correctly with the run of the wheel, the dynamo should be mounted so that its centre spindle is at right angles with the rim of the wheel, and this can only be achieved with the dynamo in such a position that a straight line drawn through its vertical centre and continued passes through the wheel spindle, see Fig. 3.

These adjustments may be made very easily as they have all been taken into account by the manufacturer and are usually only a matter of adjusting a nut and bolt or two.

The mere fact that you are using a high powered dynamo does not necessarily mean that you will obtain a light of maximum brilliance and the design of the actual headlamp and reflector must be considered. Various manufacturers claim different advantages for their own particular lamps; it may be a special type of reflector, a highly con-

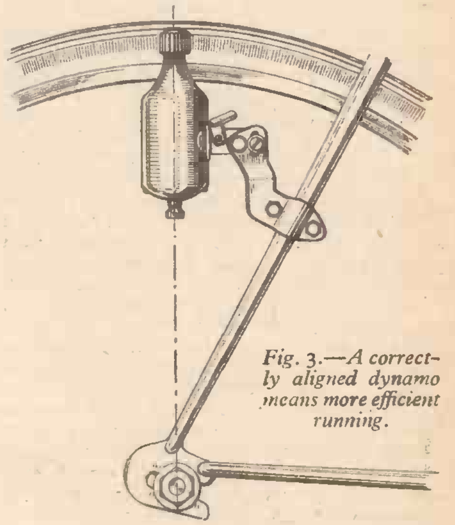


Fig. 3.—A correctly aligned dynamo means more efficient running.

centrated beam, and so on. Sometimes additional refinements are fitted, such as a dimmer or an arrangement incorporating an extra bulb and a battery, which may be brought into operation by the touch of a switch.

There are available, commercially, special rubber caps which may be fitted over the driving pulley and these help to minimise tyre wear and suppress noise. Whilst these are readily available on the Continent, where the dynamo is used far more than in Britain, they may not be so easy to obtain in this country. If they cannot be purchased, a good substitute is the rubber sealing washer which is fitted round the stopper of a quart beer bottle. The tractive qualities of the rubber are every bit as good as the serrated steel of the original driving pulley.

Cycle Racing Gossip

A Monthly Summary

By W. J. MILLS

LES WILLMOTT, the "forgotten man" of road racing, is hoping to get his big chance this month (May) to prove that the National Cyclists' Union have been consistently wrong about him.

Hundred miles record holder, 100 miles time trial champion, and a gallant second in last year's Isle of Man mass start road race, Willmott has persistently been ignored by the N.C.U. when picking international teams for road races, and no amount of pressure on Union officials will bring out a satisfactory reason.

But Willmott is now serving in the Army, and the Army Cycling Union have picked him as one of the team they are entering in the 14 days "Route de France" road race, which starts at Rouen on May 4th. (Other riders will be Pete Proctor, national mass start champion, Brian Robinson and Bernard Pusey. . . all currently serving.)

The N.C.U. are themselves entering a team in this race, which is, in effect, a Tour de France for amateurs, and they have named—Pete Proctor, Brian Haskell, Dick Henley and Gordon Thomas. Yes, Proctor is named for both teams!

I rather suspect that the Army will hold out to have Proctor in their team, and that the N.C.U. will substitute Bob Maitland in theirs . . . and the two four-man teams will actually compete in the race, to all intents and purposes, as an eight-man team.

* * *

BUT I look to the Army boys to put up the better showing, for the Proctor-Willmott combination should be formidable. If so, the Union will have to scrap much of its Olympic planning, which, so far, seems to be based on using the self-same riders who, year after year, have failed in the world's championship road race.

Willmott, although young and inexperienced, can be in my opinion, developed into a second George Fleming (remember, he won the Paris to London road race back in 1947?). I was in the Press car that followed him in his break away attack in the Isle of Man race last year . . . a solo effort with 30 mountainous miles in front of him. True, he was overhauled by the more experienced Dick Bowes, who beat him into second place, but Willmott surely proved that he has the courage and audacity, plus the proved leg power, that brings victory in international road racing.

* * *

LATER in May, the N.C.U. are to send two riders over to Finland, to compete in a road race on the Olympic course. They should bring back some useful information about the route, especially on the correct choice of gears and tyres.

* * *

ALTHOUGH Good Friday marked the opening of the Herne Hill track season, the month-long gap before the regular series of Saturday promotions start up means that the public have to be wooed afresh. The season proper begins on May 10th, when, after years of shilly-shallying, the N.C.U. have finally entrusted the running of all major promotions to a professional organiser.

To Johnnie Dennis goes the unenviable task of trying to pull Herne Hill out of the red, and he is pinning his faith on his newly-formed professional "school." By May 10th he hopes to have a full score of riders signed up in the cash ranks.

What he needs most to attract the public, though, are personalities, whether amateur or pro. In the days of the great Frank Southall, the mere billing of his name on the posters was sufficient to fill the track, and if he had Harry Wyld as an opponent, you could bank on a "sell out."

Of the newly-signed pros. I can only spot one who might fill the vacancy as personality No. 1 at the track, and that is the ex-rebel rider, Dave Bedwell, of Romford. He has quit the British League of Racing Cyclists and rejoined the N.C.U. His five feet nothing, his aggressive style of riding and his really good finishing sprint should soon make him a firm favourite with the crowd.

Ian Steel, Great Britain's champion long-distance rider for 1951, rides with "Palcos." Ian was the winner of the "Daily Express" Tour of Britain, and the Irish Grand Prix, at Phoenix Park.

* * *

GERMANY is sending over a full team, eight strong, of Olympic possibles for an Olympic style match against the N.C.U. possibles, and first encounter will be at Herne Hill on May 17th, followed by other matches at Manchester, Coventry and Birmingham, and perhaps a return match at London on May 24th. I wonder if the Germans will have found a second Toni Merkens? This Cologne boy was a great favourite in England before the war—he won the British sprint championship in the years before it was restricted to our nationals. (He died of wounds received during the war on the Russian front.)

Which reminds me of yet another great German sprinter, the professional Albert Richter, also a popular visitor to Herne Hill. A staunch enemy of the Nazis, Richter was shot while resisting arrest on the Swiss frontier—he was, the Nazis claimed, trying to smuggle currency out of Germany.

* * *

WEMBLEY is well advanced with plans for the six days' race at the Empire Pool Arena, from May 18th to 24th, but there will be a big change in this year's event.

Instead of being a continuous 144 hours' race, with the riders creeping around at two miles an hour in the morning hours, the race will shut down completely at two in the morning, and all riders will sleep until early afternoon, when racing resumes.

While this destroys the continuity of a "six," it must be admitted that the early morning crawl, with the riders mounted on touring bicycles, fat tyres and sprung saddles, has become a farce.

Names of riders are not available at the time of writing, but we are promised a very much stronger British participation than in previous events—Wembley now having the Herne Hill pros. to draw upon.

* * *

THE Australian team of professional road-men now in France have not made an impressive debut, and their hopes of getting an invitation to ride in the famous Tour de France (their main objective) are small.

In the six days' Paris to Nice race, at the end of March, Pete Anthony and Dean Whitehorn were so far behind that they were eliminated on the second day; Eddy Smith retired at the end of the same day, leaving only Johnnie Beasley to struggle on, well down the list, to the closing stages.

* * *

ALSO in Europe is another Australian, Russell Mockridge, track champion down under, and over here at his own expense, with an eye on the Olympic sprint title.

But just because he has paid his own fare over, Mockridge is in trouble with the Australian Olympic Federation. All Australian Olympic entrants, in return for the heavy expense of sending them to Helsinki, have to sign a £800 bond guaranteeing that they will stay amateur for two years after the Games.

Mockridge, so far, has refused to sign the bond on the plea that he his paying his own expenses throughout.

Seeing that he was only narrowly beaten, after getting a very rough ride, by the Italian Sacchi in the final of the world's championship last year in Milan, Mockridge is Australia's main Olympic hope—and I am sure some compromise will be found so that he can get his revenge over Sacchi in Finland.

The Italians, by the way, have no such scruples about keeping their men amateur; Sacchi has been told by the Italian Cycling Federation to stay amateur until the Games, then, the day after, with, they hope, an Olympic title, he is to turn professional and rush down to Paris to compete in the world's professional sprint championship.

* * *

IAN STEEL, winner of the 1951 *Daily Express* Tour of Britain, and Alec Taylor, Belgian born London boy, who was second to Steel, are probables for the forthcoming Warsaw-Berlin-Prague 14-day race. Six riders have been invited to compete in this 1,265-mile event and these will be selected from Ian Greenfield, M. Howarth, J. Wilson, F. Seel, B. Woods, and K. Jowett. The party, including three officials, manager, masseur and mechanic, will fly from London to Warsaw on April 25th, and return from Czechoslovakia on May 18th. As with the Tour of Britain, there wil be 12 days of racing interspersed by two rest days. The race starts on April 30th, the first rest day being on May 5th in Gorlizt, Germany; the second rest day will be on the 10th in Bad Schandau. Although this race has its fair share of mountainous country over which the riders must travel, their great difficulty lies in the appalling road surface. Indeed, the cobbled sets of the Mile End Road, London, or those of many northern towns in this country, would be a welcome relief from "roads" that more nearly resemble ploughed fields hardened but not flattened by pressure.

AROUND THE WHEELWORLD

By ICARUS

Cyclists and Motorists

ARE the interests of cyclists in respect of the use of our roads really in antagonism to the interests of motorists? Are these interests not coincident in that both cyclists and motorists are eagerly desirous to ensure safety as well as convenience in road traffic? It is now getting on for 50 years since the advance of motoring prompted the wish to have motorists as members.

The Cyclists' Touring Club was incorporated in 1887 under the Companies Act as a limited company for purposes not of gain. Being so purposed, it could obtain the Board of Trade's licence to be registered with limited liability without the need of including "limited" in its name. By 1906, motorists on the roads increasing monthly to an amazing extent, the Club thought it to be advisable so to alter its memorandum as to change its name to Touring Club, and to admit motorists as members. For many motorists had ceased to be members of the Club, its membership then being about 32,000 as against 60,000 a few years before. The existing members were far from unanimous in desiring the change, many thinking that, if in fact the interests of cyclists should clash with interests of motorists, promotion of the latter would have preference. Still, there was a majority in favour.

Changes in a company's memorandum are possible in spite of dissenting members, but only to a limited extent and only if the Court confirms the changes, and this Chancery Judge declined to confirm. He may have attached more weight than was its due to a statement in the affidavit by which the Council's chairman supported the petition for confirmation "that touring on bicycles has gone out of favour chiefly on account of the introduction of motor-cars, which, besides being more attractive in themselves, have to a great extent destroyed the pleasure of cycling and have increased the risk of accident in the use of bicycles."

The legal mind delights in an argument that is plausible even when unsound, and the learned Judge saw in the affidavit the ghost of a conflict. "It seems to me," he said, "that one of the present objects of the Club, namely to protect bicyclists in their touring, would be to protect them against that very danger which the chairman has emphasised in the affidavit which he has filed. If the business of catering for motorists is combined with this, the club could only protect bicyclists against the dangers arising from motors by taking measures against another class of its own members. The result would be that it would be impossible to combine the business of catering for and protecting the rights and interests of motorists, with the business of catering for and protecting the rights and interests on the roads of those who ride bicycles and tricycles." So the petition to change was refused; a petition made to-day might well succeed.

Spending the Club's Money

THE Cyclists' Touring Club is an incorporation. It is a company in which the liability of its shareholders is limited to the amount of their guarantees. This is so, although the word "limited," which forms a necessary part of the name of a trading company, does not appear. For the Cyclists' Touring Club is not a profit-making association; it exists solely to promote the interests of its members. From 1878, when the Club began its long career, till 1887, the Club existed as an unincorporated association of members.

Among the many interesting episodes in the Club's history was the legal question that arose when, in 1910, Mr. Shipton retired from his office as secretary. He had served the Club well over a period of twenty-five years, and the council of the Club wished to give him a pension. The great majority of the members agreed, and the gift seemed to be an eminently reasonable one. But then one of the objects of the Club is that "no portion of its income shall be paid directly or indirectly to the members of the Club"; and Mr. Shipton was a member. A proviso that payments "for services rendered to the Club" could be made.

The council sought guidance from the Chancery Judge. Was the pension a mere sentimental gift to an old servant who had already been paid all that was legally due to him? If so, it could not be in return for services rendered. But, though gratuitous, was it not conducive to the objects and interests of the Club?

The Chancery Judge had no difficulty in sanctioning the payment. Directors of a company are not to keep their pockets buttoned up and defy the world unless they are liable in a way that could be enforced at law; for most businesses flourish by liberal dealings. This is what the Judge said: "The payment to a retired servant of the Club by way of annuity is within the powers of the Club as being a payment in furtherance of the best objects of the club. The fact that the payment is made by gratuity and not under any legal liability does not make it a payment outside the objects of the Club. Payments for services actually rendered are not limited to payments legally due under legal contract. The payment is not a payment to a member as such, or because he is a member. It is a payment to a person because he has rendered services to the Club, and it is not necessary for Mr. Shipton to resign his membership to enable the Club to pay this pension or to entitle him to receive it."

To be able, by generous treatment of old servants, to attract really good officials is conducive to the objects of the Club. Payment for long and faithful service already rendered is within the powers, none the less because payment was gratuitous and there was no legal obligation to make it.

The Cyclists' Touring Club began its career in 1878 during the days of the boneshaker and the Ordinary. Its members were all men. When you examine the bicycles of the period you can see why it was never intended for women! For what woman in a dress complete with bustle, corseted and encumbered by thick and heavy petticoats could ride a bicycle, let alone find pleasure in it? Women, however, were determined to invade this new domain of man and changes in dress styles, at first timorous but later daring for the time, began to take place. The changes coincided with the arrival of J. K. Starley's safety Rover in 1885. Dunlop produced his pneumatic tyre in 1888. Roads began to improve and bicycles were made for women as well as for men. Motor cars had scarcely commenced to come on the roads, and it is not surprising that women joined the ranks of the C.T.C. in increasing numbers. They were obliged to flout existing styles in dress and adopted rationals, bloomers, the zouave and shorts, as well as divided skirts.

Road Accidents

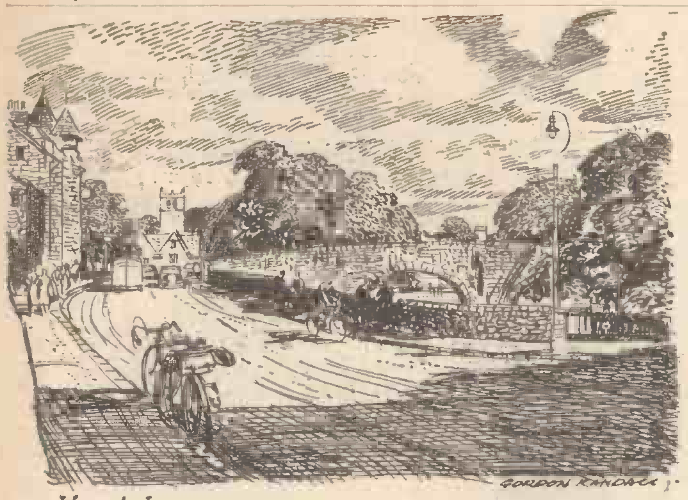
ACCIDENTS on the roads of Great Britain in January resulted in 14,195 casualties, including 377 killed and 3,347 seriously injured.

Compared with January, 1951, there was an increase of 678 in the total and of 13 in the killed. The chief increases were in the figures for pedal cyclists, which rose by 199 to 2,709, and those for passengers in vehicles, which rose by 255 to 3,543.

Figures for pedestrians, on the other hand, showed little change. Casualties to adult pedestrians numbered 2,762 and casualties to child pedestrians 1,423, making a total of 4,185 or 20 more than in January, 1951.

Despite the continued upward trend, the accident figures for January were still considerably below those for January, 1938, when 15,745 casualties, including 514 killed, were reported.

Mary Queen of Scots was a prisoner here for six months. The castle dates from about 1379.



Kendal Westmorland.
The ancient town, gateway to the Lakes noted for its cloth, Kendal Green, the industry dating from Flemish weavers of the 14th century

Wayside Thoughts

By F. J. URRY

The Application

PRACTICAL cycling means in its degree practical mechanics, and if they are not applied to your property, practical cycling goes lame. Fortunately, the bicycle has been so designed and, in the years of its existence as a mobile vehicle, so improved that the attention it requires for perfect response to your muscular efforts is very small, but it is important, far more important indeed than is generally recognised. I say that because the average bicycle will function under the most appalling neglect. We all see large numbers of them so suffering and complaining of their treatment, or lack of it, every day, and by that indication alone we should be keen enough to see our property is considered as a piece of delicate machinery which we have to make work, and for the selfish sake of conserving our own energy, not to mention our decent pride in ownership, ought to give it the attention it deserves. After all, there is comparatively little to do in the way of adjustment, for the good machine usually runs thousands of miles without attention other than lubrication. But when a bearing does show a bit of a shake, take it up ; when a chain is too "loopy" tension it, and just occasionally adjust pedal bearing and tighten cotter pins. Simple tasks requiring but a few minutes of attention, yet how thoroughly neglected. I hear dozens of squeaky bicycles in the course of a week's riding asking for oil, or cotter-pin tightening, and the people propelling them do not seem to care, for if you dare mention the matter the reply is usually a rude one. Of course, it is their own business ; if they prefer to ruin their machinery and make the going hard for the sake of five minutes' attention that is their look-out ; but you may depend on it that neglect of this nature spills over to brake adjustment and enters into the risky part of slack attention affecting every road user.

How It Pays

HAVING delivered myself of that homily, suggested by a rough examination of the bicycles at the works, let me confess I do not clean my own machines, but have always personally attended to their lubrication and adjustment. Perhaps I am pernickety about these matters because I like my machine to run silently even over the rough stuff, and so always see that brakes and guards are properly anchored, and run over the nuts and clips at infrequent intervals, and if a rattle does develop between these attentions then I ferret it out and make the cure. Even the change-gear trigger can be quietened when the machine is travelling over granite setts by the twist of a rubber band; and when on tour I aways carry bits of elastic for emergency guard fixing, or a parted bag strap. I believe in being the complete cyclist, ready for any of the small emergencies of the road, and it is astonishing how often these things are wanted, mainly by my companions.

I also carry a tiny first-aid set when touring, and have never used it on my own behalf, but dozens of times for the benefit of other people, as often as not strangers to me. I suppose the habit has given in me a certain sense of security, and now the folk I ride with seldom take the trouble to provide such extras, but rely on me. I suppose the whole of my emergency kit does not weigh half a pound, but it has been good value on numerous occasions. For the machine itself, in addition to a minimum of tools and repair outfit, a few nuts, washers, spare valve parts and chain links are frequently of value and no great handicap in weight. No doubt this habit developed in me when bicycles were not so reliable, when we carried a small soldering iron and its necesssities to repair parted brake cables, and spare tubes and repair gaiters for badly cut covers. Those days of roadside adventures have gone ; tyres and brakes are now wonderfully reliable, and even change-gears (a bugbear of old) seldom give any cause for complaint. This generation of cyclists is fortunate, without knowing it.

Soon on the Road

THE days are near when we shall all be thinking in terms of touring, for the Easter recess sets us free for a few days to make anticipation a reality. After that some fortunate folk will be taking the road every week of the season, making of this lovely land a playground for a limited period of their existence. Old as I am I think there is no finer game extant ; to sally forth over the friendly shires knowing little of your luck until you have tested it, and invariably finding it gracious. To go well found as far as machine and man can make it so is to go comfortably, and usually to find the rest of the adventure acting accordingly. Now and again you might strike a bad patch of weather—that will depart in due time—or a poor response to all the good accommodation you have dreamed about—and that will only be for one night—and in any case these things are part of the expected fun awaiting every roamer to match the philosophy of his living, and should be taken as such. The true traveller ought not to expect everything favourable, but if it so happens to be then he is indeed a fortunate soul ; but he should not grouse when things go a trifle awry, since in any case they are usually of short duration, and only punctuate the long list of experience. This touch of spring trembling in the air carries on its wing a hundred remembrances of such hinted journeyings, and if I could see my years again I do not think I would have one of them altered. And similar magic stirs me now, though the distances are clipped by the passage of the years ; by the same process the hours of freedom are lengthened, for the year's work has been shortened for me, and its leisure time extended. I shall be out and about now that the Easter holiday traffic has died down, initiating several young friends of mine into the gentle art of cycle touring with a hope and kindly expectation that later in life they will follow a good habit and remember another old cyclist of bygone days.

Habit is Safety

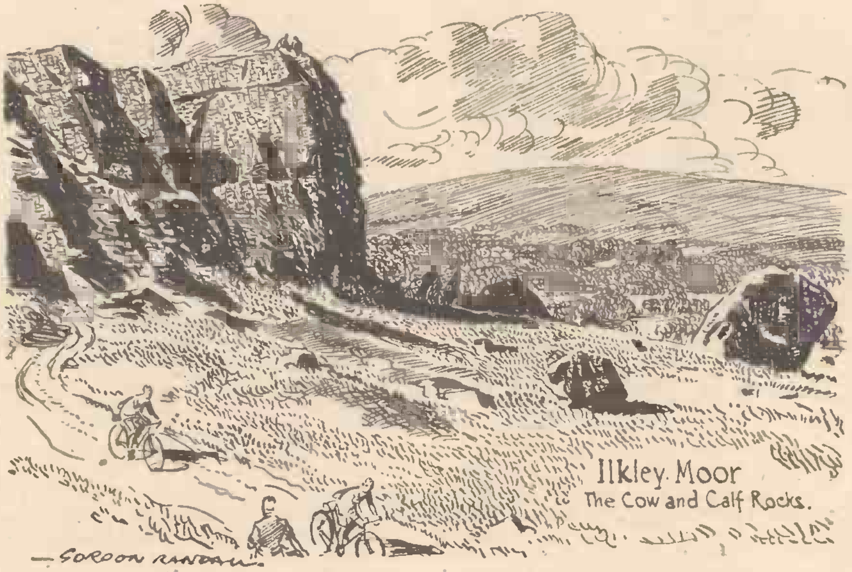
IN the meantme I am keeping pretty fit by the process of my daily journeys and the week-end wanderings that take little notice of the weather. In the earlier part of the year both these habits were slightly interrupted by the frost, glazing road surfaces in such a manner that an even keel was a matter of luck. I do not like such conditions and confess they make me nervous, for I cannot fall to-day so athletically as was once the case, and if there is a car following closely I hate to think what it may do to me. As a winter cyclist I do not like these ultra-smooth road surfaces, and think the pebbly mantled highway is far safer, not only for my kind, but for all the traffic. But I understand this type of surface finish does not wear so well in heavy traffic conditions as the tight, smooth road. Suction is the great destroyer of the pebbly surface, something we seldom thought of in the old days before the giant tyres of the heavy vehicle ; so we have to take the risks of icebound roads occasionally or do as I do, travel my daily journeys more sedately. That is the only road risk I really fear; all this talk of traffic congestion just goes over me; I don't like it, but it does not worry me in the least when I am on my home to work and back journeys. Come the opportunity of a long week-end or a tour I can dodge most of it without any trouble, for if you can read a map it is astonishing how many lane ways you can find to almost anywhere, ways that take you into the rich heart of the country and present new scenes at the price of a few more miles and possibly a few more hills.

Making a Choice

PEOPLE frequently ask me to suggest the best bicycle—a tall order. I do often write a specification for friends in the hope they will follow the advice and give to cycling the interest in comfort most of us give to other things, but when they ask me what transfer this machine should carry, I feel a diffidence in making a decision for them. I will tell you why. At the moment I have nine bicycles in use and on loan, mostly in use, and they are made by different manufacturers, and quite candidly I can find no disparity in their running qualities. They are all good ones, and two of them are more than twenty years old, but seem to me to be as lively as ever. Now and then I hear an individual aver, and occasionally a writer indite, that such and such a machine is the finest made, or ever made. All I can say to that is the person concerned never had a really good bicycle before, and is mistakenly comparing the new possession with his previous ownership without any competent knowledge of the products of the dozens of makers' who can and do build an equally good bicycle.

CYCLORAMA

By H. W. ELEY



A Note from Newbury

HOW I enjoy receiving letters from cyclists who are readers of this "Cyclorama" feature! My mail often contains a cheery note from a rider who calls my attention to some wayside curiosity, or to an ancient inn, or to a village church where perhaps some Norman arch has enchanted the eye, or where some effigy, reposing on a stone slab, has brought back memories of ancient days. Last week I received a letter from a Berkshire cyclist, chiding me for so rarely referring to that charming county, and asking whether I knew Speenhamland, a part of Newbury. Well, I have ridden through Newbury more than once, but I did not know of the verse written by Quin in the visitors' book of "The Pelican" . . . formerly the King's Arms. I like these quaint lines:—

"The famous inn at Speenhamland,
That stands beneath the hill,
May well be called the Pelican,
From its enormous bill."

Newbury is an ancient place, of course, in the old days a clothing town, and there is a quaint and very old Cloth Hall still surviving. I must make a note to see more of Berkshire and its immemorial downs. I recall that at Wantage, at the foot of the downs, Alfred the Great was born . . . in the year A.D. 849.

May Day Revels

THEY have almost disappeared, the old-time gay revels which marked the coming of the merry month of May! Only in a few of our towns and villages are the old customs kept up, and I think it is a pity that they have been permitted to die out; but we live in an unromantic age, and seem to be too busy for the simple revelries of our forefathers. But in Knutsford, in Cheshire, May Day is still a day on which to rejoice and parade the streets, and dance around a Maypole and welcome the spring. I have been in this pleasant town on the 1st of May, and recall with pleasure the garlands, the ribbons, the laughter and the dancing with which the good inhabitants greet the "Queen of the May." We could well do with a revival of old customs, for they have their roots deep in the past, and some of the "seasonal ceremonies" go right back to ancient pagan times.

The Prestige of Cycling

I HAVE often thought that something might be done to raise the prestige and status of cycling. For far too long it has been the "Cinderella" of our national pastimes, and I read recently of some suggestions put forward at a meeting of the Pedal Club. What about a University "half-blue" for cycling? What about a fine central club, in London, for cyclists from all over the country—a kind of super headquarters—an "opposite number," in the cycling movement, to the R.A.C. in the motoring world. Another suggestion was for the publication, by H.M. Stationery Office, of a comprehensive "Blue Book" on cycling. I am not sure that I can visualise the useful nature of this, but at any rate, here are a few suggestions for raising the prestige of the cycling movement; a movement which means so much in health and pleasure and convenience to all our people, young and old.

Putting Back the Clock

BACK to 1913 . . . a year before a peaceful world was plunged into the first "Great" War! The year was brought back to my mind by finding, amid a welter of papers in an old desk-drawer, the souvenir programme of a Dunlop Cycling Club "outing" from Birmingham to historic Stratford-on-Avon. I recalled the hot July day. I remembered the ride, with fairly frequent stops for refreshments. I chuckled as I recalled the efforts of some of the party to display their oarsmanship on the romantic Avon. The cycling movement was strong, indeed, in the Dunlop organisation in those far-away days; of course, cars were few, and restricted to top-line executives. Everyone rode a bike. The Para Mills factory at Aston Cross was the hub of the business. Gigantic Fort Dunlop had not been built, and on the land where it now stands, sportsmen shot snipe and hares! Ah well! Time marches on . . . and it is better to put that faded programme back in its drawer, and "slip the gears" into 1952!

Derventio

THE village where I spend my happy retirement is but a few miles from ancient Derby, and I never visit the place without remembering the lessons of my school-days, and recalling that Derby is the site of the Roman "Derventio." I like to wander through Derby streets, for the place, despite its throbbing modern industry, retains rare bits of the olden days. All Saints' church, now the pro-cathedral, has a noble late perpendicular tower. Inside, there is a stately tomb, enriched with marbles, colour and gilding, of "Bess of Hardwick," the termagant Countess of Shrewsbury. There is also a somewhat grotesque monument to the second Duke of Devonshire and family. Much of Derby's fame and importance derived from the fact that here, in the old days of railway supremacy, were the great locomotive works of the old Midland Railway. To-day, Derby is the home of Rolls-Royce! Yes! there is much pleasure in a ride to "Derventio" . . . a wander through the famous Municipal Art Gallery, a pot of ale in the ancient Dolphin Inn, and a bit of musing upon the fact that along those same streets, where factory workers now cycle in hurrying throngs, Roman soldiers once marched, manifesting the might and majesty of Rome.

Ready for the Tour

QUITE soon, before the year advances into full summer, and while the hedges are at their green best and the birds in full song in thicket and woodland and copse, I hope to be a-touring—wheeling away to quiet Suffolk, and the lanes which Constable loved. The bike is tuned up, tyres in good trim, little drops of oil have been injected into vital parts, and I have a roadworthy mount, with a comfortable saddle and good brakes. When I set off, in the early hours of a June morning, I shall be able to give my full attention to the sights and sounds of the English road. It will be a road of romance, for I plan to travel through parts of leafy Warwickshire, to touch Northamptonshire, Bedfordshire and Cambridgeshire, and so come to Suffolk, where I have always found rare delight and scenic charm. I look forward to a peep at Clare, a visit to Long Melford . . . and a few days at Southwold, that quiet place by the sea, quite unspoiled by the horrors of the up-to-date, noisy seaside "resorts." Maybe I shall ride to ancient Dunwich, once the capital of East Anglia, now the victim of serious coast erosion, and but a shadow of its former self. At Southwold I shall enter that glorious church, and see the old "stocks" by its entrance; I shall again be thrilled by the medieval "jacks"—in the form of men in armour—quite a feature of this grand church, which is the glory of the town. I just want good weather, with lots of sun, but even if it rains, and clouds are my lot, I shall be happy in the saddle and find joy in every mile.

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