DYNAMO AND MOTOR PROBLEMS

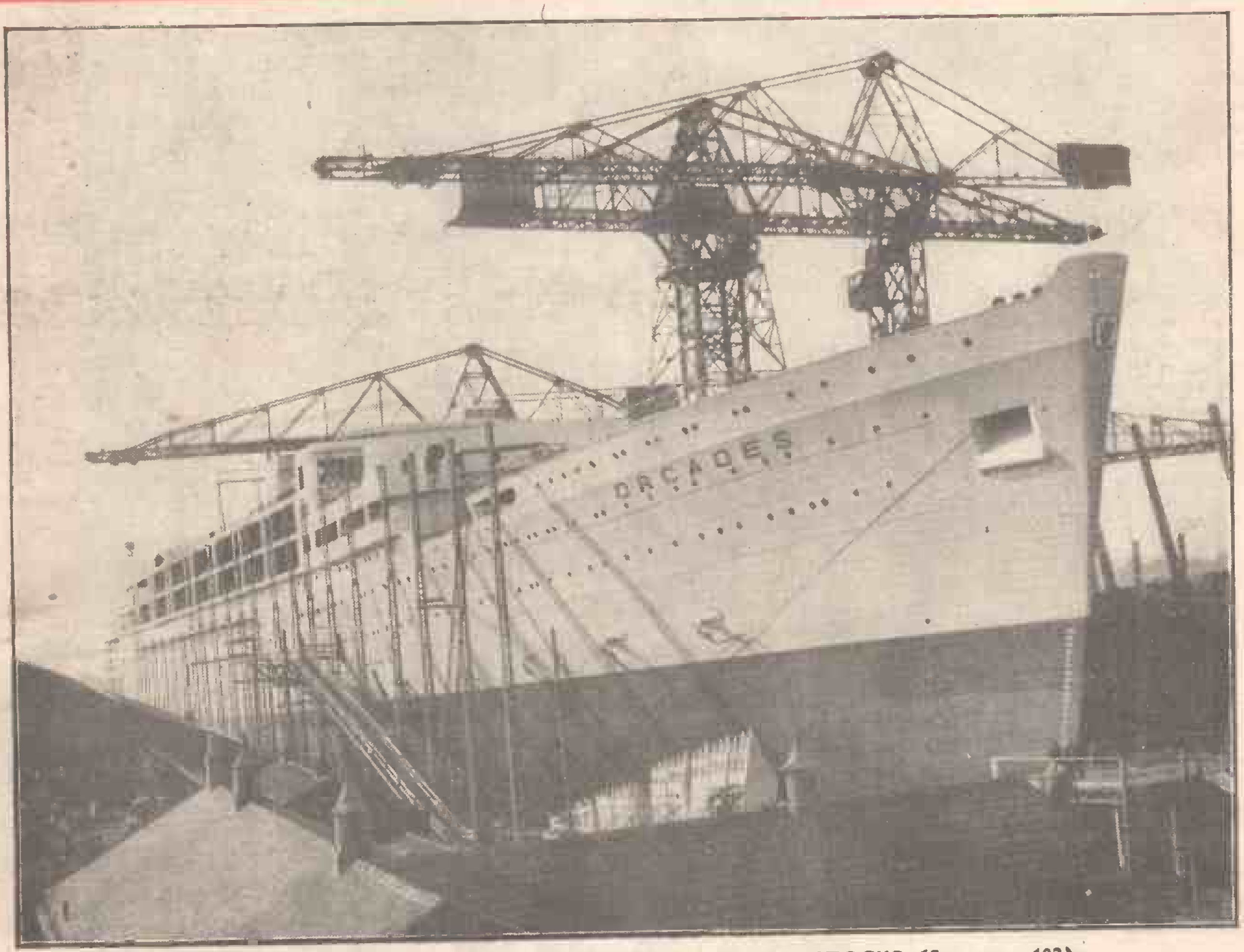
NEWNES

PRACTICAL MECHANICS

9d.

EDITOR : F. J. CAMM

DECEMBER 1947



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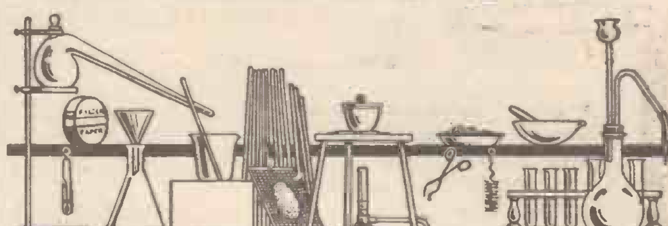

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XV DECEMBER, 1947 No. 170

FAIR COMMENT——BY THE EDITOR

About Inventors

THERE are certain pieces of mechanism and certain ideas which fascinate those with an inventive turn of mind. As each new generation comes along it produces the usual crop of people with bright ideas for harnessing the water power of the country, converting coal into power at the pithead, of inventions for perpetual motion, such as the motor which drives the dynamo and the dynamo which drives the motor, and a goodly proportion of those who "want a list of things to invent."

Now, one of the devices which has attracted inventors for many years is the lock-nut. I do not know why people want to add to the many thousands of inventions relating to lock-nuts, few of which have been commercially successful and fewer still achieve success in practice, but the fact is that lock-nuts are invented each year by the dozen. We cannot see that there is need for a new one. For this reason and in order to prevent readers from wasting further time on this hoary old subject, concerning which I get quite a large number of queries, I want to deal this month fully with this problem.

One of the major problems which has confronted engineers since the invention of the screw thread has been to devise a satisfactory means of preventing the nut working loose. Many devices have been invented to this end, but few of them have been found satisfactory and that is why designers still specify the split-pin and the castellated nut.

Lock-nuts hitherto have been unsatisfactory not because the principle of the lock-nut is wrong but because the screw threads were not made to the close limits now commercially possible. The time has arrived for the old prejudices to be swept away in view of our improved methods of nut and bolt manufacture and our advanced knowledge of the subject.

Why do nuts work loose? Many of the earlier designs of lock-nuts have been based upon the false premise that it is the nut itself which works loose. This is not always the case. The material bolted together may yield under the pressure exerted by the nut, which places the bolt in tension and the parts bolted together in compression.

The softer the material the more rapidly will it yield, so that frequent tightening of the nut will be necessary. A simple experiment will demonstrate that it is not always the nut which works loose. Solder a simple pointer to the outside of a nut and make a scratch mark on some adjacent part to coincide with its sharp end point. Use this nut on a bolt which clamps two pieces of bakelite together, using excessive pressure on the nut to get a more rapid and convincing result.

Within a week or so it will be found that the nut is quite loose, although the pointer will still coincide with the scratch mark, showing that it is the material which yields, not the nut.

The inventor of the spring washer realised this fact, for the spring washer to some extent takes up the slack caused by the material yielding under compression.

There are many other ways of locking nuts, such as by means of grub screws—a really humorous solution because you need a further device to lock the grub screw. There is the mechanic's method of centre popping the end of the bolt, and many other methods which tackle the effect instead of the cause.

However, it would be idle to deny that nuts subjected to heavy duty and vibration do work loose beyond the slackening caused by the yield of the material—for it must be remembered that a bolt is in tension and itself will stretch as a result giving rise to loosening of the nut.

It is absurd that with the progress made in screw-cutting we should still be using old-fashioned methods to lock nuts. The castellated nut is not always successful. The nut has to be tightened and then the bolt drilled to take a split-pin. If this nut is removed (it is a troublesome business withdrawing a split-pin), or if the material yields, or for any other reason the nut works loose, the split-pin hole when the nut is tightened or replaced seldom coincides with the slot in the nut.

As there are six such slots the angular movement of the nut to bring another one into line with the hole is 60 degrees, and this may be impossible of attainment, which means that the nut in practice is slackened back to bring the holes coincident. Thus the whole object is defeated.

Small nuts with comparatively fine pitch screw threads do not often work loose, and in any case they are only used on small or unimportant parts where nut slackening is not accompanied by serious results, and in any case can be rapidly tightened. The finer a screw thread the less is the tendency for the nut to work loose, for an angular movement of, say, 60 degrees means that the nut has slackened back one-sixth of a pitch. One-sixth of a coarse pitch screw thread, however, is a reasonably large angular movement.

The heavier the duty the coarser must be the screw thread and, as has been proved above, the greater will be the tendency for nut slackness and the more vital the need for positive locking. Coarse pitch screw threads can be manufactured, of course, to closer limits than small ones, rendering the design of a satisfactory lock-nut possible.

For such a lock-nut to be acceptable to engineers it must have a number of advantages not hitherto possessed. It must, in the first place, lock positively. It must not distort the screw threads. It must be possible to use the nut over and over again. It must be possible to remove it easily. It must be reasonably cheap. It must not occupy much more space than ordinary nuts.

Starting a Small Business?

MANY readers leaving the Services are anxious to start business on their own account. They write asking for advice as to the best methods of setting about it. We cannot too strongly advise readers at the present time not to waste their savings by starting small businesses. Quite apart from the difficulties imposed by Government control and the licensing necessary, there is a great shortage of raw materials. Firms old established are unable to obtain sufficient of these to fulfil their export commitments. It is not generally realised that in most cases a licence to manufacture particular goods is only granted by the Board of Trade on the understanding that at least 60 per cent. of the output is exported. No small firm could possibly enter the export market at the present time. It would not pay them to do so. These small firms may have an expected turnover of about £2,000 a year, but the formalities with which a small firm has to comply are just as onerous and formidable as if their turnover were a million pounds a year. Finding export markets is an expensive job, and unless the turnover is at least £50,000 a year it simply does not pay.

Capital is another problem. A small firm cannot possibly buy at favourable terms. It cannot afford to pay cash, and even if it could raw material suppliers are unlikely to open out fresh accounts when they are unable to fulfil existing commitments.

An increasing demand for the diminishing supply of raw material naturally forces prices up. We do not think that there is any room at the present time for new firms. The moment is simply not propitious; trading under present conditions is extremely difficult, and the form-filling alone would be a burden to the inexperienced.

Dynamo and Motor Problems—2

"Cutting" Lines of Force : Distribution of E.M.F. in Armature : Field Distortion : Reversible Motors

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

(Continued from page 377, September issue)

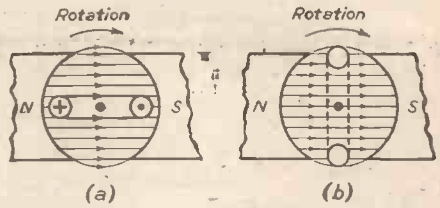


Fig. 7.—If a conductor or coil were stationary, and the field started and stopped, maximum e.m.f. would be induced when in position (b). This is the position of zero e.m.f. if the coil is revolving in the stationary field.

ONE or two questions call for further discussion from the first article.

The first concerned an odd fact about the "kick test" for finding brush neutral position. Why, when making and breaking the shunt field from a small-current battery source, do we get *zero* deflection in a millivoltmeter connected across the brushes, whilst the "neutral position" is the one which gives *maximum* output voltage when the machine is running normally at full excitation?

I suggested the anomaly was worth a little thought. Often in studying the practical bearing of theory, it is the contradictions—the exceptions to the rule—that are interesting. Indeed, there are people who will tell you that theory is invariably "wrong" (disproved in practice), but that statement generally means there are too many indeterminate factors to a problem to permit of a simple solution.

In trying to understand dynamos and motors, at any rate, we cannot get on without theory, and this query is a case in point. It provides a demonstration of the first laws of electromagnetic induction—the same sort of fact which puzzled Faraday for a time, in those classical experiments to find out the mysterious connection between magnetism and electricity.

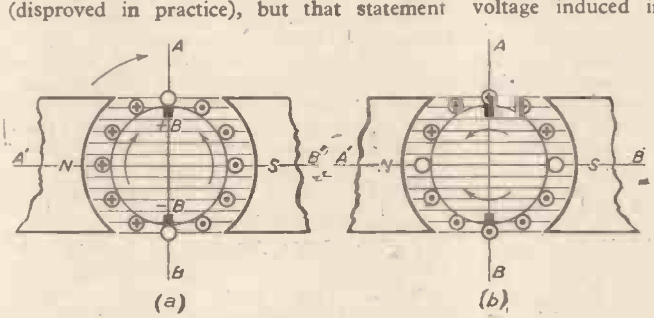


Fig. 8 (a).—2-pole dynamo, showing brushes in geometrical neutral position, i.e., no allowance is made for the shape of coils. (b).—If the field is started and stopped (armature stationary), maximum e.m.f. will occur in position A' B'; the potential-difference across brushes will be zero.

On "Cutting" Lines of Force

In fact, Faraday himself invented as a working hypothesis the concept of wires "cutting" imaginary "lines of force."

The more you think about it the more strange it will seem why these ideas should be true. What does the conductor really "cut"? Is there any reason for supposing that "lines of force" have an objective existence, or has the space around a magnet some queer properties of its own? Intriguing problems of modern physics these, but we must take Faraday's laws as the last word on the subject.

A conductor revolving in a magnetic field cuts across the lines in position (a), Fig. 7, but is "moving along" the lines in (b)—not "cutting" any, and therefore having no e.m.f. induced. Position (a) is that of maximum e.m.f., and in intermediate positions between (a) and (b) the rate of cutting and the resultant induced e.m.f. will be less than the maximum, falling to zero at (b).

Suppose, now, the conductor was not moving: it is stationary, say, in position (b) when we *start and stop the magnetic field*—by doing as in the kick test. Will the induced e.m.f. still be zero, or maximum, in position (b)? There is *relative* motion—between a field coming into, and going out of existence, and a stationary wire. Is the relative motion such that the wire is still, virtually, moving along or cutting (being cut by) lines of force?

It is a little difficult to answer from the point of view of cutting magnetic lines. Before giving any answer it may be an interesting experiment to carry out—if you have a galvanometer sensitive enough to indicate voltage induced in a single wire (with a strong enough field, some deflection would be got in a low-reading milliameter).

Otherwise, if we substitute a coil or a loop, as indicated in (a) and (b), the answer becomes evident.

In (b) all the flux "threads through" or "links" with the loop, i.e., when the field is started or stopped. The induced e.m.f. will be *a maximum*, though, if the loop was rotating in a steady field, (b) would represent the position of zero induced e.m.f.—in this case we should say that while the flux threading the loop is still a maximum, its *rate of change is zero*.

Conversely for position (a). It is the position of maximum rate of change of flux and maximum e.m.f. if the loop is revolved. But, if stationary, starting and stopping the field, the flux linkage is zero—no lines thread the "turn" (or "turns," if a coil). Still, it seems, lines of force must in some sense cut the sides of the loop, but in such a way as to induce equal and opposite e.m.f.s in (a), but additive e.m.f.s in (b).

Is this last viewpoint correct? It is one of those finer points of theory which some readers may like to argue.

Distribution of E.M.F.s in Armature

The discussion should make clear why we get reversal of the order of things in the kick test.

Fig. 8 will offer further elucidation. On an armature there are a number of coils connected in series. The total voltage output is the sum of the e.m.f.s generated in one series group, i.e., in one of the two or more *parallel circuits* which make up the winding.

Let us get this point quite clear. In a 2-pole dynamo, there are "two ways" round the armature from + to − brushes. The coils are connected up (in *series*) to form a winding which *closes upon itself*—all modern armatures are of the *closed-circuit* type. The result is that there must be at least two paths (circuits), each containing the same number of coils in series.

This is shown in Fig. 9a. An equivalent would be a number of cells in series-parallel, as in 9b. If the total e.m.f. is 10v., as indicated, this is the voltage of *one* group of cells—the e.m.f. of any number of similar rows of cells in parallel is that of one row. Similarly, in 9a; the output voltage is that generated in one-half of the armature. But, of course, in the case of the armature coils a given coil is carrying only half the total output *current*—"amperes" divide between the two parallel paths.

Reverting to Fig. 8a: the armature is supposed to be revolving in the direction of the arrow. E.M.F.s will be induced in the two halves of the windings, which "meet" in the neutral plane where the + brush is fixed, and "diverge" from the negative brush. Maximum e.m.f. will be generated in the coils whose sides are opposite the pole centres, but the "maximum e.m.f." from the whole armature—in the sense of being the total due to *all* the coils forming one series group—will be got where the + and − brushes are set, i.e., in the neutral position AB, where actually no e.m.f. is generated in the individual coils.

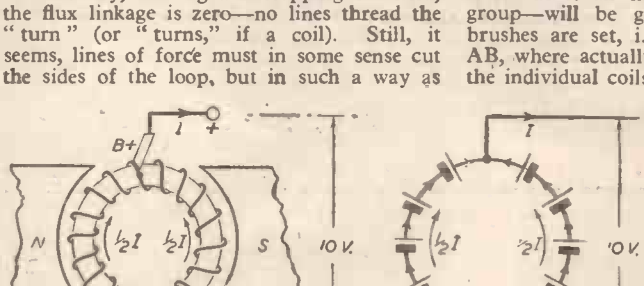


Fig. 9.—An obsolete type of armature winding is shown in (a) to illustrate the "closed-circuit" principle, and division of current between two (or more) parallel paths—the e.m.f. (10 v.) will be that due to one parallel circuit. The equivalent battery circuit is given in (b).

In the kick test the armature is stationary; the field is started and stopped. From what was said above, greatest e.m.f. will be induced in coils located *in the neutral* plane AB—which were totally inactive during normal rotation. Once again the total induced e.m.f. in the armature will be due to all the coils forming one group.

But we have a complete reversal of the conditions shown in 8a. The induced e.m.f.s will be of the same polarity at AB, but will converge to give + and − points *opposite the pole centres*—at A′, B′, Fig. 8b. If the brush rocker were shifted to this position we would get greatest deflection in our millivoltmeter during a kick test—not zero deflection.

That, of course, is not what is required. The object of the test is to locate the exact neutral position under normal running conditions, when the brushes are at AB. When starting and stopping the field, we get equal and opposite e.m.f.s here (or A and B are equipotential points in the windings, say + +), hence zero "kick" in our test instrument when the brushes are set to exact neutral.

Actually, we would get the same kind of result in a dynamo normally running if we held the leads of a voltmeter across points on the commutator 90 deg. (electrical) away from the brush position. The reading will be zero, because there is no potential-difference between such points in the windings.

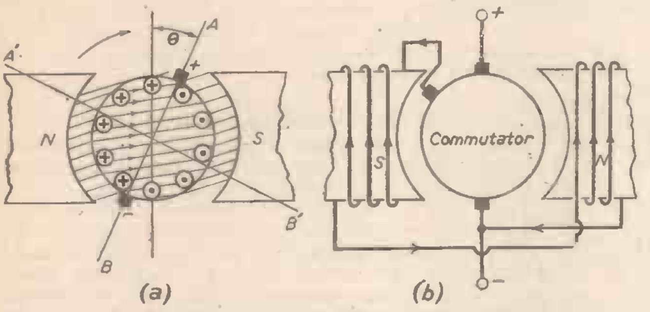


Fig. 10 (a).—How the potential distribution in the armature changes with forward distortion of the field. (b).—"Third-brush Control" on car dynamos makes use of this shift to control the field current as the speed varies.

The matter should be perfectly clear by considering what a voltmeter would read if connected across points A′ B′ in the battery circuit of 9b—or, better still, compare with the "null" deflection obtained in a balanced Wheatstone bridge.

In the kick test these equipotential or null points move round 90 deg. electrical.

Shift in Neutral Points with Field Distortion

I have discussed the theory of this simple test in considerable detail because, as seen, it brings out quite a number of points important to understand in studying generators.

Before going on to the next question left over from the first article, it is opportune to mention another bit of theory of great practical importance. I made a passing reference to it in the previous article: how, once, attendants had to keep a steady eye on the load and give brushes a "forward lead" (in dynamos) as the load current increased.

Armature reaction remains to be discussed in detail. All I will say now is this: the reader should be able to understand what we mean by saying that any distortion of the field, for example, in the direction of rotation, will alter the normal *potential-distribution* in the armature: the normal distribution shown in Fig. 8a.

If—for reasons which need not be explained now—the armature-current causes the field to be "twisted" forward, we shall get a new potential distribution, such as in Fig. 10. The points AB and A′ B′ have moved forward, because coils previously in the neutral plane will now be cutting some flux. In other words, the neutral position of the brushes will have moved forward by an angle θ.

If the brushes were left fixed, two things would occur: first, severe sparking at all the brushes; and, secondly, some slight fall in output voltage, since the sum total of the e.m.f.'s generated in coil groups will now be got with the brush-position shown in Fig. 10.

In modern machines, interpoles prevent field distortion, together with any necessity for readjusting brushgear at different loads. But the theory considered has an important bearing on such things as third-brush control in car dynamos. One end of the shunt is connected to a third brush (Fig. 10b) and this brush is located at a point on the commutator where the voltage undergoes fairly rapid change, due to field distortion—if the current supplied tends to increase due to an increase in engine speed. Thus the flux can be made to vary inversely as the speed, maintaining the generated e.m.f. and the charging current sensibly constant.

An Exercise in "Deduction"

The second problem outstanding from the first article concerned a dynamo which failed to generate, but showed a very small voltage when a voltmeter was put across the terminals.

What are the most likely causes? From the list of possible troubles given, what would you *not* waste time looking for?

I gave "loss of residual magnetism" first in the list, because so many will fall for this extremely rare type of fault. Obviously, it cannot be a likely cause in this case. It is generally the most improbable. The fact that a small voltage is generated proves: (a) there is some magnetism in the poles; (b) there are no broken connections to brushes and commutator; (c) that the brushes are at least touching the commutator, though there may be faulty contact.

The voltmeter indication eliminates quite a few things. What else may be deduced? Well, if your voltmeter happens to be on a switchboard (or dashboard), or you make another test at that end, it will save a lot of time searching for broken connections in the + and − *main leads* from the dynamo.

But do not forget the shunt field circuit. All indications point to loss of excitation, i.e., failure to build-up the weak residual magnetism. That is what is usually meant by "failure to *excite*"—not the loss of residual magnetism itself. The shunt is not getting any current, or possibly not enough to start the building-up process.

This last point is worth noting. All the connections may be O.K., yet there may be some high resistance in series with the shunt which will totally prevent self-excitation. I will touch upon this *critical resistance* again presently.

Where are we to find such a high resistance? Well, I have known a film of oil or oxide or grit, etc., on the commutator to stop machines building-up — many a time. Remember, too, that you can get such things as badly corroded terminals, or sometimes ones that have worked loose. But, first of all, there is a regulating resistance in the field circuit. Here we have a decided weak spot because resistances can give rise to a deal of trouble: bad contacts on the studs, broken or burnt resistance elements, loose screws, etc.

So, before making any very detailed examination or testing, have a look at the field rheostat. Very often it is not necessary to look any farther. All the resistance may have been left "in" the field—the arm turned right over to the "Voltage Lower" position—with the result that excitation cannot take place.

Thus cause (3) in our list may take first place, though it is possible you will have to go on to cause (4). The rheostat may be set O.K., but there may be an internal break or bad contact. That is quickly settled. Turn the rheostat full-on, or eliminate it completely by shorting the two leads with a piece of wire.

If the dynamo now builds up to full voltage, the trouble is clearly in the field rheostat. If it does not, well, it is time to start looking farther afield. Remember, we are concerned only with the shunt circuit. There must be a "break" somewhere in the circuit, but it may be as well to look at commutator and brushes for possible "high resistance" contacts due to grit, etc.—not forgetting that protruding micas can cause trouble.

Finally, it may become necessary to make continuity tests: (a) first, of the entire shunt circuit from the switchboard rheostat, right back through the field winding to the opposite terminal or brush; (b) the field lead between dynamo and switchboard; (c) the circuit through the field coils of the dynamo. It may happen that the end of the shunt joined to + or − in the terminal box of the machine has become disconected.

In all continuity tests, if (a) reveals a break somewhere (b) and (c) will reveal in what part of the circuit it is located. Sometimes more complicated faults can arise due to "earths" (or a combination of two or more earths) in the machine and external circuit.

The "Critical Resistance" of the Shunt

We must now go on to consider further technical principles.

One has already been referred to in reference to failure to excite, namely, that there is a certain *critical resistance* of the shunt circuit, above which self-excitation cannot occur. It is important to realise that the value of this resistance is "critical," i.e., if exceeded, the field cannot possibly build-up.

In Fig. 11b is shown a typical form of a magnetisation curve. A dynamo is run at a constant speed, and the field amperes I_s are increased in steps, from zero, by varying the resistance F.R., observing at the same time

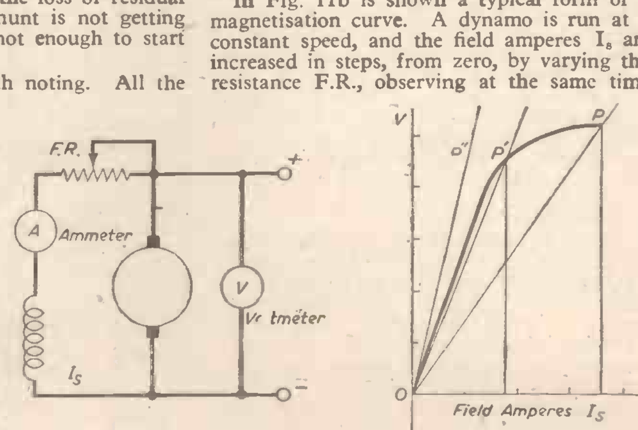


Fig. 11 (a).—Connections for plotting Magnetisation Characteristic. (b).—Straight lines illustrate the "Critical Resistance" of the shunt. Thus the dynamo cannot build up its field along a line such as "OP," which is "off" the characteristic.

In Figs. 8 and 10, and the discussion in the text, the brushes are shown in the "geometrical neutral," i.e., to avoid complicating matters no account is taken of the coil-shapes in modern drum armatures, where the brushes would be set opposite the pole-centres as explained in Fig. 5, previous article.

how the terminal volts V increase. The curve shows the relation between V and I_s at constant speed, and on open-circuit—no load on the machine.

At first V rises steeply with increase in magnetisation of the poles, but bends over and becomes flat as magnetic saturation is reached. If we consider any pair of values of V and I_s, drawing a straight line OP through this point on the curve, then the *slope* of this line is expressed by, Ordinate/Abscissæ = $V/I_s = R_s$ — the resistance of the shunt field circuit (including the field rheostat) for these particular values of V and I_s.

Other lines such as OP′ give the corresponding resistances at other values of voltage and exciting current. The steeper the line the larger the resistance—shown also by the smaller exciting current I_s. The resistance of the shunt field winding itself is constant. All we are doing is varying a rheostat to give various values of I_s.

Observe that OP′ nearly coincides with the steep straight portion of the magnetisation characteristic. A slight further increase in resistance would make it coincide exactly, and this is the *critical resistance* value above mentioned. Any further increase in resistance would bring the line right off the curve, such as OP″. Since it *is* off the magnetisation curve along which excitation takes place, that simply means the machine *cannot begin to excite* along a line as steep as OP″.

A Riddle

I have just given you what amounts to a purely mathematical explanation—or a graphical representation of critical resistance.

Many technical explanations are of this type. Reference is made to characteristics, curves, tangents, etc., and, in many cases, it is exceedingly difficult to do anything else.

Indeed, by logical principles it is difficult to see what the account of critical resistance illustrated in Fig. 11 can mean. According to Ohm's Law, a current should flow in a circuit of any ordinary resistance value, however small the voltage applied.

Thus if we suppose the machine to begin generating a small e.m.f. of e volts, under residual magnetism, how can R_s be so "critical" (no matter how large) as to make it untrue to write, a current $I_s = e/R_s$?

Some current *must* start in the shunt. If it does, it must strengthen the weak residual magnetism, causing more volts to be generated in the armature, hence a larger "I_s," and so forth. However small, a current must cause some increase in magnetisation when it passes through field coils consisting of some hundreds of turns.

I think I will leave the question open for discussion. What we have to ask ourselves is, not so much whether a current can "start" in the field, as whether it can cause such an increase in generated e.m.f. as will ensure a continuance of the process. For instance, unless the increase is more than a certain amount, is it not possible that the extra volts will all be dropped in resistances?

Reversible Motors

I want to turn now, to consider one or two questions connected with motor circuits.

First, about reversing the direction of rotation of d.c. motors. The general rule is simple: reverse the two armature, *or* the two field, connections, but not both. For example, if the two main supply leads to a motor are changed-over, armature and field currents become reversed and rotation will be unchanged.

While this general rule is well known, there are frequent pitfalls, and one is occasionally asked: which is better, reversing the armature or the field? Is it possible there may be an objection in some cases to doing one or the other? Theoretically, the result is exactly the same, but there are reasons "for" and "against"—depending on other things.

We headed this section "Reversible Motors," implying that a reversing switch or controller is to be put in circuit for frequent reversals. In that case, there is decided advantage in putting the switch in the shunt field circuit (if a shunt machine), because the current is only a fraction of an ampere, whereas a heavy-current, more costly type of switch would be necessary in the armature circuit.

Against this: it is very undesirable or even positively dangerous to break highly inductive field circuits, without suitable discharge resistances. Even then, it may not be entirely satisfactory for quick reversal from full speed in one direction to the opposite direction. But if only occasional reversals are necessary, made when the motor is at standstill with the power switched-off, a small switch in the shunt circuit should be perfectly satisfactory.

It must be assumed, too, that we are considering at present motors *not fitted with*

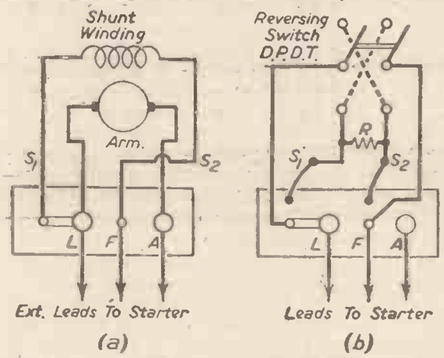


Fig. 12 (a).—Typical Terminal Box arrangement in a shunt motor (or dynamo). S_1 and S_2 are the ends of the shunt winding brought into the box. (b) A Reversing Switch in the Field Circuit. Ingoing leads S_1 and S_2 are taken off their terminals, to a pair of contacts on the switch. Another pair of leads is taken off terminals "L" and "F." R is a "discharge resistance," as a safeguard against breaking the field when fully energised.

interpoles, and, of course, no series windings in addition to the shunt. Interpoles will come up for later discussion. If there are interpoles, it will be well to note at this juncture that most severe sparking ("flaring" perhaps is a better word) will occur at all the brushes if these auxiliary poles are left of the wrong polarity relative to the main poles.

What was said above about a light-current switch for occasional reversals of shunt motors cannot apply to series machines where the field winding consists of a few thick-wire turns *carrying the same current as the armature*. Here, it is largely immaterial whether armature or field connections are reversed, and, in fact, most reversible motors for driving cranes, vehicles, etc., are series machines.

But let us get down to actual circuits, starting with the simplest.

Pitfalls

It might be thought hardly possible to go wrong in doing such an easy job as reversing a shunt motor. All I can say is: don't treat even shunt motor circuits too lightly—as some who pride themselves upon being "advanced technicians" tend to do.

Consider the very simplest piece of wiring—as motor circuits go. Fig. 12a shows the terminal box connections of a typical shunt motor. One end of the shunt is strapped to "Line" (L) in the box; the opposite end (F) is taken right back to the starter for reasons explained before.

How would you "swap-over" the field connections in this box? Think carefully! Let me tell you one thing you may do, without thinking.

Strap "F" to "A," taking off the lead that goes to the starter. Connect the latter to the shunt terminal that was previously strapped to "L"—removing this strap. Next, you put in the main switch and proceed to start the motor. If running light, it races; if loaded pretty heavily, you will probably blow the fuses. There are all the symptoms of—what?—and why? Draw a complete schematic of the circuit to see what you have done.

Leave the strap and outgoing lead to the starter severely alone. Re-connect them to the same terminals, after you have changed-over the two *ingoing* shunt leads going from the box *into the motor*.

If you want to fit a reversing switch for occasional use, you could disconnect these two ingoing leads, take them to the D.P.D.T. Switch, Fig. 12b, returning two more leads from the switch to "L" and "F" in the terminal box.

About "Discharge Resistances"

I would like to reiterate my warning here about sticking switches indiscriminately in the shunt field circuits of machines.

If a highly inductive circuit is broken suddenly, the collapse of a powerful flux will induce an e.m.f. in the coils far in excess of the normal working voltage for which they were designed. It is quite possible to self-induce a few thousand volts in the shunt coils of a machine whose ordinary working pressure is perhaps 250v.

Apart from other dangers, the risk of insulation break-down is considerable. There will be a long drawn out arc at the switch contacts, hence some tend to get the idea that a "quick-break" switch is essential. A quick-break switch will certainly tend to break the arc rapidly, but, in doing so, it is the worst possible switch to use in an inductive circuit. The current is interrupted still more rapidly, with still larger induced pressures.

So, go slowly about opening field circuits, and especially inserting switches therein for any purpose other than making a change-over when the main switch is off.

Fortunately, there is one very easy safeguard against excessive induced voltages. It is simply to connect permanently a suitable value of discharge resistance directly across the inductive winding, on *the field side* of a reversing switch as shown in Fig. 12b.

The effect is to cause the induced potential to give rise to a current in the closed circuit formed by the field system and the resistance, when the flux dies away slowly. The correct value of resistance can be calculated from a knowledge of the inductance of the shunt, and thus depends on the size of motor, etc. For instance, a value can be found which gives a peak voltage rise (at the instant of opening the switch) equal to the normal supply voltage of the motor or generator.

(*To be continued*).

The Elements of Mechanics and Mechanisms—2

Laws of Motion–Friction–Mass and Momentum

By F. J. CAMM

Absolute and Relative Motion

THE true motion of a body through space independently of any other motion is known as *absolute* motion, and when the motion of one body is compared with the motion of another it is called *relative* motion. We all know that the earth is not standing still, but that it possesses at least two different motions. Firstly, it moves in a circle around the sun once in a year, and secondly, it turns on its axis once in 24 hours. Approximately, therefore, it can be said that in consequence of motion around the sun the earth moves rather more than 1½ million miles a day, and in consequence of it turning round on its axis a place on the equator also describes in one day a circle having a circumference of about 25,000 miles.

All things and all people on the earth therefore have these two motions, and when we say that an object on the earth is at rest we mean that it is at rest as far as the earth is concerned and not that it is absolutely at rest, because that is impossible.

Similarly, when bodies fall the motion we observe is not their whole motion but only their motion relative to the earth. Moreover, if, say, a suitcase is placed on the seat of a railway carriage it is relatively at rest as far as the other things or persons in the carriage are concerned; it does not change its position in relation to them. But it is in motion in relation to the trees and hedges adjacent to the railway, and it has in addition the motion of the earth.

We do not, of course, notice the motion of the earth, but we can establish it by common observation.

If two railway trains are side by side in a station and one of them commences to move the passengers are often at a loss to know which of the trains is moving. They see relative motion, but until they look at some object known to be at rest, such as a tree, they are uncertain as to whether their own train or the other is moving.

The Laws of Motion

Sir Isaac Newton discovered the laws of motion, and he gave us most of our knowledge concerning moving bodies. His first law of motion states: "When a body is not acted on by any force, if it be at rest it will remain at rest; and if it be in motion it will continue to move in a straight line with a uniform velocity." This law, unfortunately, is not capable of absolute proof, since it is impossible to place a body on the earth so that it will not be acted on by any force. For example, gravity will always affect it.

Consider the first part of the above law. Place a ball on a table; it is at rest relative to the other things in the room. It will remain at rest forever if it is not acted upon by some force. The ball cannot move of its own volition; if it does move some force has acted upon it.

This property of inactivity is known as the *inertia of matter*. The first law of motion is often known as the Law of Inertia. Matter offers no active resistance to any force acting on it. Inertia merely means that there is no power residing in matter by which a body can either move itself or bring itself to rest if it be set in motion.

If a small weight be placed on a sheet of

(*Continued from page 53, November issue*)

paper, when the paper is slowly drawn along the weight will be drawn with it because gravity is pulling the weight downwards and causing it to press on the paper. As neither the paper nor the weight is perfectly smooth friction is created.

A part of the force exerted by the hand will therefore be transmitted by the paper to the weight; if, however, the paper is pulled with a jerk the weight will be left behind because the friction was insufficient to pass on to the weight sufficient force to cause it to move with the paper. As the weight could not move itself it is left behind. This is an example of inertia and many other examples will occur to the reader.

The inertia of water is taken advantage of in the well-known arrangement for supplying railway engines with water while the train is running. A scoop dips into the water and is connected with a pipe leading to the tender. As the engine travels along the mouth of the scoop dips into the water and before it has had time to acquire the velocity of the train it slides up the pipe leading to the tender and rushes into the tank as if it were impelled by a force pump. The water is transferred to the tank, it will be seen, by inertia.

Now let us consider the second part of the first law of motion, namely, that when a body is not acted on by any force if it be in motion it will continue to move in a straight line with uniform velocity. This seems quite contrary to our everyday experience, because all bodies as we know sooner or later cease to move. This is because it is acted upon by some force. In the case of a clock, for example, it stops because the mainspring, or rather the force stored in it runs out. There is friction, and a moving body is bound to touch something, causing friction. That is why, when designing machines, we try to reduce friction to a minimum so that we can get a higher percentage of the work put into the machine out of it.

When we use a hammer we take advantage of the force of inertia. When the hammer is made to move quickly through the air on reaching the head of the nail it tends to continue in its state of motion and in so doing drives the nail into the wood. The pile driver is a further example of the use which is made of inertia.

The flywheel is perhaps the best known example. This is attached to engines and other machines in order to make them run smoothly; its inertia is so great as to compel all the moving parts of the machine to maintain a nearly uniform speed.

Friction

Friction means the rubbing together of two surfaces. The smoother these surfaces are, the less, under certain circumstances, will the friction be. It is impossible to produce a perfectly smooth surface, for every body has upon it projections and hollows which perhaps are invisible to the eyes. Even a piece of polished steel, such as a needle, if examined under the miscroscope will be found to have these projections and hollows. So that when two surfaces are rubbed together the projections of one will fit into the hollows of the other. Friction between pieces of the same material is greater than between pieces of different material, and that is why shafts made of steel revolve in brass or gunmetal bearings. In watches the pivots run in jewels. When the hollows are filled up bodies will slide over one another with greater ease, that is why oil is used between surfaces subject to friction.

A considerable part of the power used in driving machinery is lost because of friction, therefore, we say that no machine is 100 per cent. efficient. The most efficient machine is that which gives out the highest percentage of the power put into it. Of course, friction has its advantages. Without it it would not be possible to build a house, for example. The slightest disturbance would cause it to fall to pieces. We could not walk without the friction between our feet and the earth. It is more difficult to walk on ice than on land, because there is less friction between the two. We rely upon friction to hold things in our hands. When the short fibres of cotton or wool are woven into long threads it is the friction between them which holds them together.

Now friction is of two kinds—sliding friction and rolling friction. Rolling friction is produced, for example, by a wheel rolling over the ground, and it is very much less than sliding friction, and that is why, whenever we can we try to substitute rolling friction for sliding friction.

A labourer having to move a heavy load will put rollers under it. Chairs and tables are often fitted with casters so that they may more easily be moved about. Sometimes it is an advantage to change rolling friction into sliding friction. For example, when a heavy wagon is moving down a hill a drag or sprag is placed under one wheel so that the extra sliding friction will retard its descent. This is an elementary example of a brake such as the brake fitted to the rims of bicycle wheels or into the brake drums of the motor-car wheels. They are all examples of sliding friction.

Friction causes heat. If the sprag to which we have referred is felt when it has reached the bottom of a hill it will be found to be hot. During its descent it will become so hot indeed that sparks may fly from it.

Mass and Momentum

Matter is that which affects the senses of touch, sight, and smell. The force of gravity attracts all things towards the centre of the earth, and the force with which any substance presses downwards is called its weight. Now matter exerts force; thus the earth exerts the force of gravity. A magnet exerts the force of magnetism, and a piece of amber rubbed with silk exerts the force of electricity.

Matter does not only exert force but force always acts on matter. Indeed, it is not possible to recognise force until it is acting on matter. We should not know, for example, that a magnet was possessed of magnetism until we saw it attracting a piece of iron. The force itself is entirely beyond observation, and we can only form certain conclusions about it by studying its action on matter.

A portion of matter large enough to be handled is called a *body*. All bodies take up a certain amount of space; in other words they have a certain size. The amount of space taken up is called its *volume* which is measured in cubic feet or inches.

(*To be continued.*)

Eyes and Ears of the Air

Instruments Which Enable You to Fly Safely Through Clouds

IMAGINE you are sitting in the comfortable cabin of a B.O.A.C. aircraft, bound, say, from England for the Far East. Idly you're looking out of the window at the fields and woods of Northern France spread out like a relief map below. Now the captain pulls back the controls and the aircraft climbs into cloud to gain height in order to avoid hills on the route. Meanwhile, mist blots out your view and you are totally—but safely and comfortably—enclosed in a world of opaque whiteness. It is at this time that the pilot and his crew rely on the aids which modern science provides to make safe your flight through all this cloud some thousands of feet above the earth.

The pilot flies by his instruments, operated by gyroscopes which are no more than a scientific adaptation of the toys we played with as children. You may remember that once you set your toy wheel spinning, the gyroscope would maintain its position at whatever curious angle it was placed. In the aircraft, gyroscopes are set spinning in a vertical and horizontal plane, maintaining indicators in vertical and horizontal directions which do not move as the aircraft turns about them.

An air traffic control room, shown by the Ministry of Civil Aviation, in operation recently at Radiolympia.

Artificial Horizon

The horizontal indicator gives the pilot an "artificial horizon" to replace the one he cannot see through the cloud, and he knows whether he is flying straight and level, losing height or climbing by the related movements of a minute model aeroplane with the "artificial horizon" on the indicator. From other gyroscopic instruments in front of him the pilot can also read degrees of turn and bank, and these also form the basis of "George," the automatic pilot of which we heard much during the war, and of the special compass free of magnetic errors.

As the pilot watches his instruments, the radio operator is in touch with the ground—acting as the ears and, to some extent, the eyes of the pilot and navigator. Just as you use the telephone in home or office, so the radio operator and pilot can use their R/T (Radio Telephone) to talk to the control officers at airports and receive from them, for example, information about heights at which to fly to avoid other aircraft, weather reports, directions for landing or take-off and taxying. In fact, instructions such as these were being passed by the control officer to the pilot as your aircraft moved round the airfield before taking-off while the steward was making you comfortable.

Remember, too, while you are in your world of whiteness, that, by means of an R/T "homer" on an airfield, control officers on the ground can take bearings on the voice of the pilot talking from the aircraft and from these the controller knows the direction of the aircraft and can give the pilot, in return, directions to reach the airfield and come down safely through cloud away from hills which cannot be seen from the air.

At some time or other, you've no doubt been walking on moorlands when a sudden white mist has blotted out everything around you. Your friends are within hailing distance but you can't see them; so you shout and they judge the direction of your voice and shout back instructions—based on the increasing or diminishing strength of your voice as you call—until you rejoin them safely. They have "homed" you or "brought you in."

"Homing" an Aircraft

The same idea is employed in "homing" an aircraft, although it is a much more scientific process. You may have noticed that the strength of reception of some radio sets with interior frame aerials can be increased by turning the set *towards* and the aerial at right angles to the broadcasting station. It is a development of this idea which enables the ground "homer" station to determine the direction of an aircraft from the voice of the pilot or radio operator talking on the R/T.

This knowledge is reassuring to us in our cloud world, and, although we are not yet due to land, similar ground stations help us on our way along the route, using morse-code when we are out of R/T (or voice) range. Just now, if you were allowed on the "flight deck," you would see the wireless operator busily tapping his key. Over the "inter-comm," or aircraft house telephone, the navigator has asked for a QTE on Le Bourget airport, Paris. Now what, you may wonder, does QTE mean? Well, with all the different countries, each with their own language, operating air lines, some international "basic esperanto of the air" had to be agreed upon, and this is known as the "Q" code. It consists of a whole series of questions in combinations of three letters each beginning with "Q," and each meaning the same, say, to French or Dutch aircrew as it does to the British radio officer of a B.O.A.C. air liner. "QTE?" therefore, means "What is my true bearing from you?"; and, having taken bearings from the aircraft's transmission, Le Bourget is able to give the information and the navigator checks that the aircraft is on the correct course.

The pilot calls for a weather report as he heads southward over France. The wireless operator taps out the message: "QAM?" (What is the weather?), and perhaps the changing note of the engines will tell you that you're climbing through the clouds, as you eat your lunch in comfort, and you emerge into a world of brilliant sunshine carpeted with a seemingly endless flooring of cotton-wool.

Later you fly between two layers of cloud and, unable to take bearings on the sun or check the aircraft's position through the cloud below, the navigator asks the radio officer to get him a "fix." Three widely separated ground stations take bearings on the aircraft's transmission, which are then plotted by a ground controller on a map. Where these bearings cross or "intersect," broadly speaking, is the position of the aircraft. To understand this you have only to remember how searchlights were used during the war. The sound detector, located near the searchlight sites, would pick up the sound of an aircraft. Then searchlight beams for miles around would be lit and, with accurate readings from the detectors, they would intersect each other and form a cone of light around the aircraft. They had, in effect, got a "fix," on it.

The steward comes through with a message from the captain. You can still see only cloud below but you read: "Over Lyons. Bound for Marignane 'Marseilles.' ETA (estimated time of arrival) 15.50 hours local time." Other unseen aids have been used to bring you to this position. By using his radio compass, the pilot may have "homed" on transmissions sent out from radio beacons on the ground in a similar way to the "homing" already described. Or he may have "ridden the range," that is, picked up in his earphones the morse signals "A" or "N" from ground radio range beacons indicating that he was left or right of his correct track and held his course if he heard the continuous high-pitched or "on course" note.

Standard Beam Approach

At some airfields, equipment on similar principles may be used to direct the aircraft's correct approach to the runway in conditions of low cloud or poor visibility. The device used may be the Standard Beam Approach (SBA for short) or its newer development, the Picao SCS.51, or, to give it its full title, "The Instrument Landing System approved by the Provisional International Civil Aviation Organisation."

In SBA, a combination of morse signals in the pilot's earphones and visual indicators on his instrument panel, tell him whether he is left or right of the correct line of approach. "Marker" beacons at known distances from the runway also transmit high-pitched notes as well as flashing light signals. The pilot reads the height of the aircraft from a sensitive altimeter and starts coming down through the cloud towards the runway in use. He is told by the air-field control officer, over the R/T, when it is his turn for landing approach and is given other information, such as the height of the cloud base.

These radio aids to navigation are installed throughout the Empire air routes, and, in addition, radar equipment is being shipped overseas and placed along these routes and, indeed, is already working at many points. Such words as Rebecca, Eureka and Babs may be used by the radio operator if you have a chance of talking to him at one of your stopping places, but you'll find he is talking neither Greek—nor of charming ladies! These are radar devices, developed during the war, and being fitted to all B.O.A.C. aircraft as a further aid to approach and landing in low cloud and bad visibility. Rebecca is the equipment in the aircraft and Eureka and Babs the ground counterparts. For flying-boats the equipment is different by name, but it is similar in design and use to Rebecca and Eureka.

"Blips"

If you are interested you learn that Rebecca in the aircraft has a green translucent screen somewhat similar to a television screen, with a distance scale down the centre. On this screen sharp light indications from the ground equipment, Eureka, appear. These indications are known as "blips." The ground equipment is quiescent until activated or "triggered" by the aircraft equipment, when it sends out impulses in a predetermined and known direction. These are the "blips," already described, and according to whether they appear left or right of the distance scale, the heading of the aircraft can be altered until the "blips" are centralised and the aircraft's distance from the beacon can be read off from the scale. The pilot and navigator then know their exact position and can "home" on the Eureka beacon if they wish.

When nearing the airfield, if there is much low cloud about and visibility is poor, Babs may be called in to help. Babs, short name for Beam Approach Beacon System, is sited on the airfield opposite the approach end of the runway, and also sends out impulses which appear on the Rebecca screen as dots if the aircraft is to the left of its correct line of approach and dashes if it is to the right. If it is "on course" a steady "blip" is seen, and distance from the runway may be read off the distance scale. In this way, through radar's "magic eye," the aircraft can come down safely through cloud and approach the runway.

These, then, are some of the aids available on your B.O.A.C. flight—the eyes and ears of the air. There are others, all, to some extent, developments of principles already described, and as you continue on your journey to the Far East you imagine the pilot and radio officer talking to the control tower or listening to signals indicating they are flying "on course" and you are reassured to know that, although on stages of your journey you may be out of sight of the ground, you are not out of touch.

An Effective Alarm

Constructional Details of a Novel Electric Alarm Operated from a Front-door Letter-box

By C. BRADSHAW

IN these days of acute shortages there are few who have not experienced the difficulty of securing a reliable alarm-clock. Even if we are fortunate enough to come across one of these very essential nuisances, it usually turns out to be very poorly constructed from the flimsiest material, and most unreliable in performance.

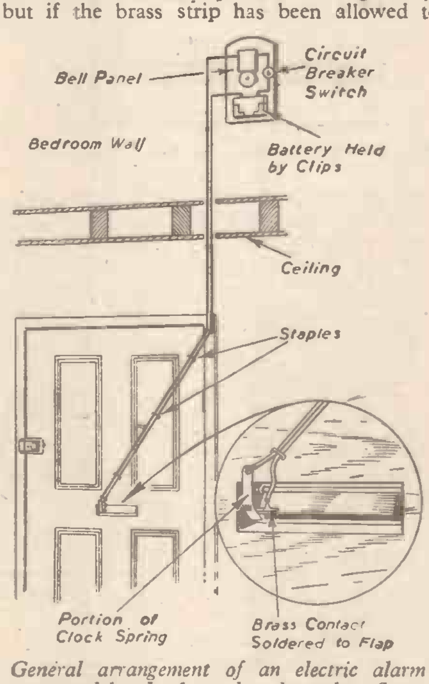
In my own case, if I can be aroused somewhere around 6.30 in the morning on working-days (other days don't matter so much) I have no difficulty at all, outside the usual scramble for buses, in arriving at work punctually. It was only recently that I noticed that my daily newspaper is slipped through the letter-box at approximately that time each morning. Now, I thought, if I can make that letter-box ring a bell in my bedroom as the newsagent delivers his paper through it each morning then I will have a very effective alarm. I have evolved a very simple system that can quite easily be put into practice by any handyman. The following components will be required:

1 electric bell.
6 or 7 yards of bell-wire.
1 circuit-breaker switch.
1 piece of clock-spring about 3ins. long and $\frac{3}{8}$in. wide.
1 strip of brass about $1\frac{1}{4}$ins. long and $\frac{1}{8}$in. wide.
1 base-board for holding the bell, switch and battery, and 2 clips for holding the battery in position on the board.

Having obtained these components, proceed in the following manner:

Contact Strips

First cut the bell-wire in two and bare about 1in. of each end. Next remove the whole letter-box cover complete with its hinged flap, through which the letters, etc., are delivered, and to the bottom left-hand corner of the flap (at the back of it) solder the $1\frac{1}{4}$in. strip of brass horizontal with the bottom edge, but protruding about $\frac{1}{2}$in. over the side of the flap. Fix one end of the bell-wire at this junction also, so that it is in good contact with the strip of brass. Make sure that the brass strip and the wire are fixed firmly to the flap, then replace the metal facing of the letter-box to the front of the door. The flap should swing freely, but if the brass strip has been allowed to protrude too far over the edge it will impede the movement of the flap. If you find that this has happened, remove the letter-box facing and file the brass until the necessary clearance is obtained, then replace.



General arrangement of an electric alarm operated by the front-door letter-box flap.

Now take the 3in. piece of clock spring, which should have a small hole bored about $\frac{1}{2}$in. from one end so that it can be screwed into position. The spring should be curved to about a quarter of a circle. It should be screwed to the back of the recess in such a manner as to allow the brass strip on the letter-box flap to come into easy contact with it when the flap is pushed inwards. The idea is for this contact of the brass strip and the clock-spring to complete the circuit that rings the bell in the bedroom. Before the screw used for securing the piece of clock-spring in position is finally driven home, take the other length of bell-wire and wrap one end firmly around it. We now have one length of bell-wire attached to the flap of the letter-box and another attached to the piece of clock-spring fastened to the back of the door. Using a few staples, run these two wires diagonally across the door from the places where they are fixed to the top right-hand corner of the door, then across to the jamb. I find that running the wire diagonally thus eliminates any tendency for it to wear and break, through the opening and closing of the door. After crossing on to the jamb the wires can be run vertically up the wall, passing through the ceiling into the bedroom, after a hole has been made in the ceiling for the purpose.

Connections

When the bell-unit, switch and battery have been fixed to the base-board, the alarm is wired in the following manner: Take one lead from the letter-box and connect it to the positive terminal of the battery. The other lead is attached to the left-hand bell-terminal. A short-length of wire is now connected to right-hand terminal on the bell and the other end is connected to one point of the switch. Another short length is run from the remaining switch-point to the negative terminal of the battery. When the alarm is ready for action the switch is left in the *on* position.

Since the alarm will only continue ringing whilst the flap of the letter-box is open, it is essential that some method of preventing the newspaper from passing right through the letter-box and falling behind the door is introduced. This can be done very simply. Take a piece of cotton material about 7ins. wide and 18ins. long. Tack one narrow end of this material about 1in. above the letter-box and tack the other end of the strip about 1in. below the letter-box. This will prevent the newspaper from being thrust too far through the letter-box and the brass contact will thus be kept on the piece of clock-spring causing the alarm bell to continue ringing until you get out of bed and switch *off* at the base-board.

One thing to remember: see that you put the switch to the *on* position before getting into bed each night.

Electric Light and Power Installation—2

Further Notes on Layouts and Wiring Methods.

By S. T. CORNER

IT is the general practice to "run" steel conduit for electricity installations before the builder lays the flooring or plasters the walls and ceilings. In the trade this is called "carcass" wiring. The work must, of course, be done in co-operation with the contractor, or the whole building operation may be disorganised.

For all good class work the conduit installation is completed before the wiring is run. It is advisable to give the house time to dry out, and to wire to the fittings just before painting and internal decorations are started. Wires should not be drawn in until all nailing is finished and the house is reasonably dry.

Tubing should not be started until the roof is on the house and the dwarf walls and joists of the lower floors are in position. Usually the tubing on the upper floor is run first, and the work continued downwards, but the wiring of the upper floor is done lastly. By that time the middle floors will have been laid and can be used for ladders and other necessary appliances.

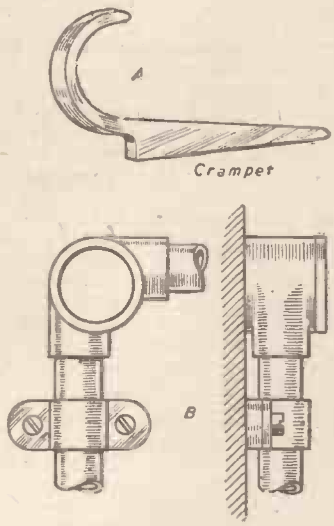


Fig. 7.—Methods of fixing tubing.

Locating Lighting Points

Before starting any work, it is most essential to study the plans, so that the exact locations of the lighting points and switches can be fixed by accurate measurement. One of the most important items is the choice of the position for the "rising main," Fig. 6. This conduit carries the main feeding wires from the meter board to each floor level. Owing to the fact that the meter board is usually fixed under the stairs, the run to the first floor is often the most awkward. All such tubing must be given ample bends and a junction box provided on the landing in a convenient position to draw in the wires. Alternatively, intermediate inspection boxes must be fitted at awkward angles and bends.

Wiring is drawn into the tubing with a wireman's "snake," which consists of a coil of spring steel wire or tape, with a brass ball at one end and a loop at the other. It is advisable to test all tubing by passing the

(Continued from page 13, October issue.)

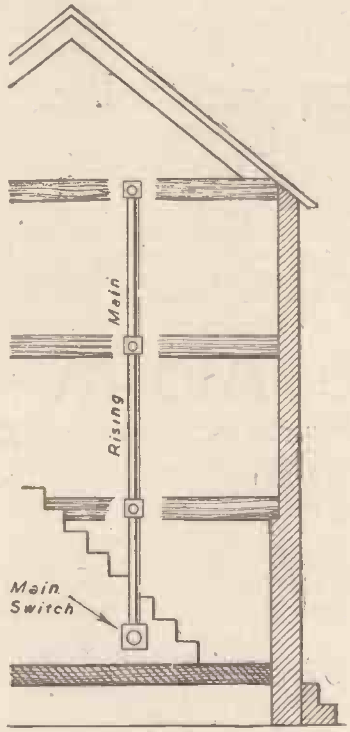


Fig. 6.—Showing position for "rising main."

tape through it to make sure that it will go round the bends and there are no obstructions in the conduit. To remedy any faults after the plastering has been done would be a costly business. All inspection covers must be carefully replaced to exclude dirt and damp while the plastering is being done.

Inferior electrical installation work can be as dangerous as leaking gas pipes. Unfortunately, much wiring work is cheap and shoddy, and this causes considerable trouble in a few years after installation. Cheap slip-in tubing is often used under the roof, which, next to a cellar, is the dampest place in the house. In many instances it is laid loosely across the joists with no clamps. If the space under the roof is used for storing boxes, the least movement of the conduit pulls it from the fittings. The sharp edges of the tubes cut the insulation of the wires and cause short circuits. Most fires originated by fusing are due to poor electrical work of this kind.

All tubing should be cut to exact lengths so that it can be gripped or screwed securely in the fitting to which it runs; but it must not project too far into the joint, or the sharp edges will cut the wires when they are being drawn through. The most satisfactory results are obtained by securing the fittings temporarily in position and then measuring the distance between them; by adopting this method, the tubing can be marked off and cut exactly to the required length. Before final fixing, the

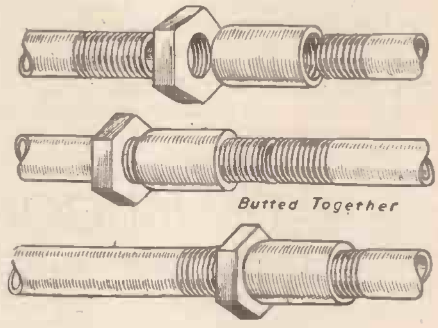


Fig. 9.—Three positions of a running coupler.

ends of the tubing should be carefully filed and rounded in the bore.

Saddle Clamps

All tubing should be secured and supported at intervals of not more than three feet, by saddle clamps to joists and other woodwork and by crampets to brick walls, as shown in Fig. 7a. Spacing saddles are used to secured tubing, where it runs into a fitting, to bring it into alignment with the threaded inlet, as shown at Fig. 7b. There are, of course, numerous kinds of fittings for various purposes, some of which were shown in the previous article; other fittings are shown in Fig. 8. Fittings with inspection plates simplify wiring drawing and they should be used at all angle turns in preference to plain elbows. When a bent tube is used to turn

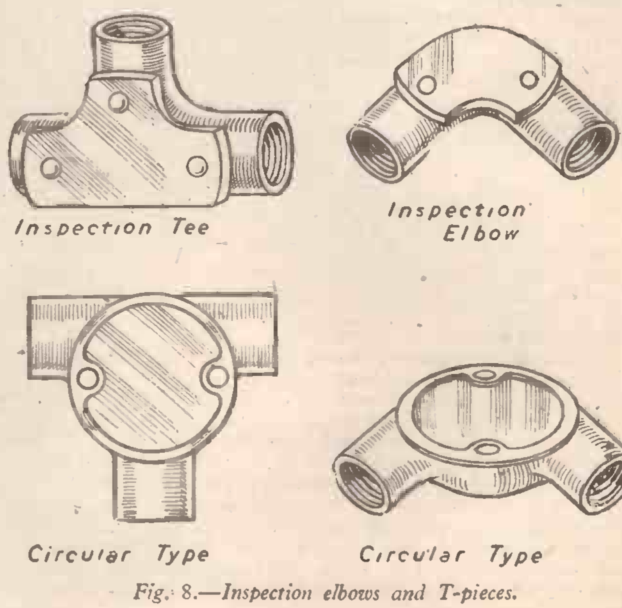


Fig. 8.—Inspection elbows and T-pieces.

a corner it should be as generous as possible, and of never less than four inches radius. All runs must be planned so that the draw wire can be passed from point to point.

Running Couplers

Long lengths of tubing for straight runs, or tubing in such a position that it cannot be turned, may be joined with a running coupler as shown in Fig. 9. One conduit end is screwed to a length sufficient to take a coupler and locknut. The two conduit ends are then butted together and the coupler is run back on to the other length of tubing; the locknut is screwed tightly against the end of the coupler to prevent it turning.

Where tubing is run into junction boxes or other fittings that are not threaded either of two methods can be used to secure it in position. By the first method, a sleeve coupler is screwed on to the end of the tubing, and a screwed bush, passed through the hole in the junction box and screwed into the coupler, as shown in Fig. 10a. The rounded end of the bush prevents the wires from chafing. A second and simpler method is to run the tubing through the hole in the box and secure it with two locknuts, one on the outside and the other on the inside, see Fig. 10b.

It is sometimes necessary to join two runs of tubing of different sizes, or to join up to a junction box that has a larger opening than the tube size. In both cases a reducing nipple is used, which is threaded externally to fit the larger screw thread, and internally to take the smaller, as shown in Fig. 10c.

Carcass Wiring

Simplicity should be the keynote of all carcass wiring, and the runs planned with as few junction boxes as possible. This method is not only economical in the cost of fittings, but it also reduces the number of traps to be made. Bends are easy to form (but they must be generous) and are preferable to a multiplicity of connections. They should be so placed that the wires can be drawn into and out of the tubing with a minimum of structural disturbances.

Junction boxes should be arranged so that they are in the least conspicuous positions; where likely to be unsightly, the face of the box should not protrude above the plaster surface of the wall. In such cases the conduit must be sunk into the brickwork far enough to make this possible. The position of the groove is first marked on the brickwork with a carpenter's pencil, and also the position of the recess for the junction, switch box, or wooden fixing block. The chase, or channel, is neatly cut with a special tool known as an electrician's chaser, or with a bricklayer's bolster. Both tools resemble very wide cold chisels, and they must be really sharp. A small chaser is just the width of a brick, i.e., 3ins., and is used to line out the positions marked; the pieces of brick must be carefully removed. Extreme precaution must be taken not to dislodge the bricks.

Conduit is usually sunk in the brickwork to a depth of about half its diameter, which should bring the face of the box level with the finished plaster surface. The box is secured in position and the conduit run into it. It is advisable to cement round a large box to keep it square with the wall. Where junction boxes are fitted to joists, before the floor boards are laid, arrangements should be made with the carpenter to make traps that can be easily lifted to facilitate wiring. All runs should be planned so that the cables may be passed from the junction box to outlet points without the aid of a draw wire. It should be necessary to use a draw wire only when there are several bends in a run. All conduit runs under the floor boards must be kept near to walls so that the joists are not notched near their centres, which would weaken them where the greatest strain has to be taken.

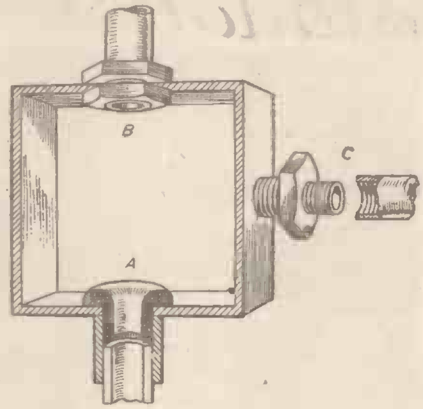


Fig. 10.—Section of a junction box showing connections for tubing.

Wooden Switch Blocks

The use of wooden blocks for fixing switches and ceiling roses is fairly common, but it is neither good practice nor a really safe method. A more satisfactory way is to use iron-clad fittings, as shown in Fig. 11a. These are screwed or otherwise secured to the end of the tubing and ultimately set in the plaster. By this method the switch does not need a wooden surface mounting block, and the fitting is therefore much neater because it does not protrude above the wall face. When adopting the former method a wooden block, about 4ins. square and 1in. thick, is nailed to the brickwork, and the tubing terminated with a vulcanite or rubber bush to protect the wires, as shown in Fig. 11b.

Light Points

Several different methods can be adopted for light points. A ceiling point can terminate in an iron flush box, which has two tapped holes for fixing the ceiling rose or pendant. The box must be securely anchored on each side with battens to keep it in place, as shown in Fig. 12a. If the point ends with a bushed tube it must be terminated at the under surface of the ceiling, Fig. 12b. Where the point is dropped from the back of a junction box, blocks must be provided to carry the ceiling rose or pendant. If the point is run from a bend the tubing can end near a joist, and this may be used as a fixing point, Fig. 12c.

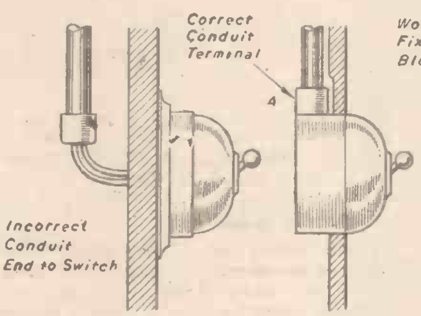


Fig. 11.—Methods of mounting switches.

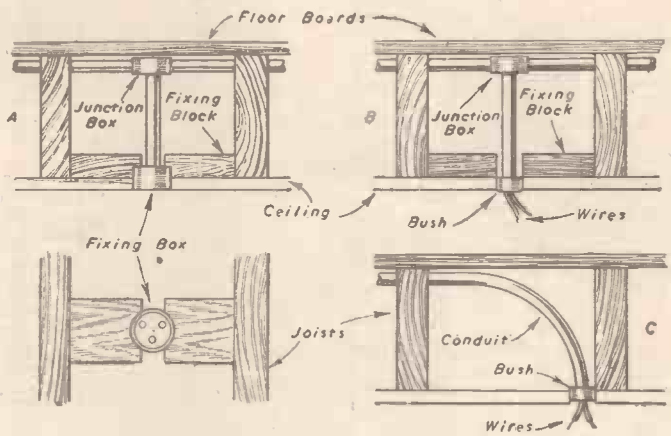


Fig. 12.—Various methods of anchoring light points to a ceiling.

Bow Bells. By A. M. L.

WE say, in London, that anyone born within sound of Bow Bells is a Cockney. I am not fond of bells myself nor of spherical decorations, for all these suggest problems to me. And bells are so savage that I feel ashamed of them. Tom-toms on a big scale.

Please do not tell me about the Bush telegraph, the Indian rope trick and the Mango tree; I, too, know dozens of people who know someone who saw them. I will give you instead an amusing little experiment by which you can hear bells as beautiful as those of Notre Dame or St. Paul's.

Obtain a fairly heavy poker and at one end tie a piece of string, leaving ends about 18in. long. At each end of these ends tie a small loop about ½in. diameter or less into which the forefinger of each hand fits comfortably. Now press your ears tightly shut with your fingers and, without letting the string touch anything, bend forward and swing the poker until it taps the table.

Nearly everything has its own rate of natural oscillation in this way. A wine glass rings a certain note, and if that note is played it might break the glass. If there were no friction, a child could upset a battleship by pressing regularly upon its side.

Flames are very sensitive to vibrations, and if you arrange a small gas jet from a tiny hole, fitted via football bladder in order to smooth out any irregularity of pressure between the jet and the main, the flame will become sensitive and will duck if you clap your hands or hiss. Even a bunch of keys well rattled will make the flame bob. With low pressures and the flame enclosed in a chimney you can make it sing like an organ.

A Mobile X-ray Unit

THE problem of the satisfactory X-ray examination, *in situ*, of welded high pressure pipe lines has been solved by Philips Electrical, Limited, by the production of a fully mobile X-ray unit.

Completely equipped for immediate service, this unit is housed in a 4-5 ton van, the body of which is divided into compartments which accommodate all the necessary X-ray equipment and provide a complete darkroom service.

The necessity for this apparatus has arisen in connection with the urgent need for the provision of power generating stations. The testing of materials for these projects takes time, which, under present conditions, can ill be spared. Any means that can be devised therefore for speeding up the necessary test inspection without loss of efficiency is greatly to be desired.

Complete Macro 300 inspection unit assembled at the foot of the ramp at the rear of the van. (Philips Electrical, Ltd.)

Film loading bench with built-in cassette racks and film storage cupboards. (Philips Electrical, Ltd.)

Messrs. Stewarts and Lloyds, Ltd., one of the largest metal tube makers in the country, have recently taken delivery of the first of these Philips' mobile X-ray vans. They will use it for the routine examination, *in situ*, of their welded, high pressure pipe lines to ensure that the welds are free from defects.

Internal Layout of the Van

The dark room arrangement consists of the following:

A special film-loading bench for the storage of X-ray films, chemicals, cassettes, etc.

The processing unit and a wash basin; special "Philora" viewing lantern and facilities for the quick drying of X-ray film.

Stainless steel tanks for processing, each with a clip-on, spill proof lid.

X-ray Inspection Equipment

The rear part of the van houses the X-ray equipment and is separated from the forepart by a light-tight partition. The equipment itself is held in position during transit by means of spring-loaded attachments.

For ease in unloading, the tailboard of the van is designed as a double-hinged ramp which, when lowered, gives a gradient of 1 in 6. The h.t. generators for the X-ray equipment are moved by small two-wheeled trollies.

The type of equipment supplied for the van is a Philips Macro 300 inspection unit, capable of examining steel up to a thickness of 4½in.

Lighting

The lighting in the dark-room is concealed in the angles of the roof and consists of six 10in. tubular strip lights fitted into reflectors having a flat opal glass front.

Ventilation

Ventilation of the darkroom is effected by means of two refrigerator-type ventilators fitted in the roof of the van and also by a Vent-Axia exhaust fan fitted in the forward bulkhead of the darkroom.

Special cable and hose drums are housed in compartments below the chassis of the van, which, when coupled to external supply sources feed the various water and electrical circuits.

A 34-gallon storage tank is housed above the driver's cabin to boost the water pressure

Stainless steel processing tanks and film viewing desk fitted with "Philora" viewing lantern. (Philips Electrical, Ltd.)

Studies in Electricity and Magnetism

A Discussion on Some Fundamental Electrical and Magnetic Quantities

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

THERE are plenty of excellent books covering "Electricity and Magnetism," and a thorough study of the subject will always be worth while. This, of course, applies to those readers interested in electrical matters.

But there will always remain a real need to supplement bookwork by lectures, notes, or articles, particularly if these are designed to give a practical approach to theoretical topics—or to relate "theory" to "things," such as circuits, machines, lamps, heaters, instruments, etc.

In writing, I have tried to show the need for "thought" even on relatively elementary questions. It will be best—if space is available—to discuss a few topics adequately, rather than attempt the impossible, e.g., to condense the contents of a fair-sized text-book within the space of a few articles!

To start with "Electricity," I feel I cannot do better than to take for my theme certain aspects of Ohm's Law—things which instructional experience indicates constantly need elucidating.

The big difficulty to beginners, and many more advanced students, is not with expressions such as "$I=V/R$." The worry is not so much Ohm's Law as in its *concepts*—the *ideas* or intangible, unpicturable quantities the symbols stand for: *pressure, electromotive-force, potential-difference, voltage-drop, voltage-to-earth,* etc.

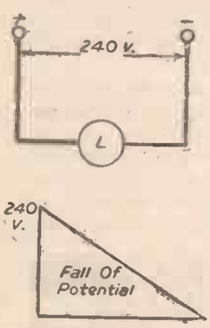
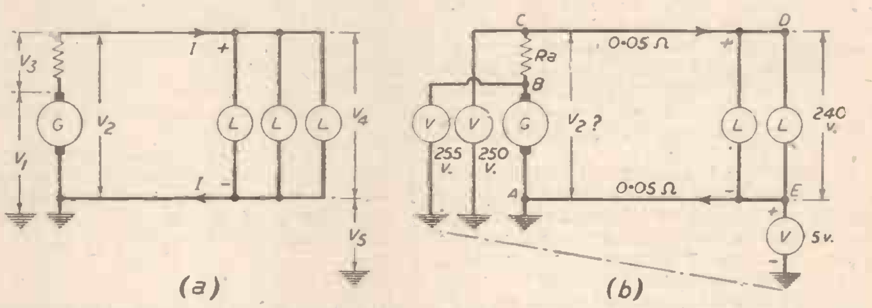


Fig. 1.—(Left) Is there a "drop" or a "loss" of 240 volts in a 240-volt lamp?

Fig. 2.—(Right) Study of voltmeter indications (2b) at various points in a two-wire earthed circuit.



Different Meanings of Voltage

It is useful sometimes for explanatory purposes to ask apparently nonsensical questions, if they help to clarify our ideas—and not all questions which appear so are nonsense.

One, which I recall asking at one time was this: if 240 volts are "lost" (*dropped*) in the filament of a 240-volt lamp, Fig. 1, what drives the current back along the negative wire? For that matter, what drives it along the positive? For, remember, "voltage" is a sort of *electric pressure*; a "driving force," maintaining electrons in motion throughout a circuit.

The question is useful because the answer will bring out clearly the different meanings to be attached to the word "voltage"; for example, the fact that potential-differences exist across other parts of the circuit.

Unless it is clearly specified what particular "voltage" is meant, the word can signify many things: (a) the *total e.m.f.* generated at the source by a battery or a dynamo; (b) the *terminal p.d.* at the generator; (c) the *terminal p.d.* at some point in the line, such as the distant end; (b) the *potential-drop* in a wire or cable; (e) the *internal potential-drop* at the source; (f) the *potential-to-earth* at various points in a system. Fig. 2 indicates these "p.d.s" in a typical circuit, using symbols such as V_1, V_2, etc.

Of course, "voltage" generally signifies only one thing—the voltage or potential-difference across a pair of lines, or a pair of terminals. But in setting out to use Ohm's Law, it is hard to realise that "V" *can* denote other things. Also, the concept of volts "dropped"—giving rise to a potential-difference across some *part* of a circuit—is often peculiarly difficult to beginners.

In using $I=V/R$, it is commonly supposed that V *must* represent the supply voltage. But if R is the resistance of a cable, possibly forming only a small part of an entire circuit network, "V" is the *drop*, the potential-difference across that part—usually only a few volts.

Numerical Illustration

Let us give values to the symbols of Fig. 2a, as in 2b.

Suppose a voltmeter V is connected between various points and "earth"—we have indicated an "earth" in order to make the problem fairly typical of the sort of thing apt to be troublesome to a beginner, and to illustrate important ideas regarding "earthed mains." The voltmeter readings are as indicated.

What does the reading of "5 volts" from negative line to "earth" indicate, when the supply is at 240 volts? What current is carried by the lines?

Because the earth forms an additional conductor, the voltmeter from point E to earth is virtually connected right across the *ends* of the negative line, from E to A. There is a potential-difference of 5 volts between the ends. The end E is 5 volts *positive* with respect to end A—or, what is the same, end A is 5 volts *negative* with respect to the far end E, though *A is at zero potential relative to earth.*

Now, if there exists a *difference* in potential of 5 volts between the two ends of a single isolated wire, how is this brought about? Clearly, there must be a *loss*, a *drop* of 5 volts in this single conductor—in overcoming its resistance. The current is given by $I=V/R$, where V= the drop, and R=the resistance of the line =0.05 ohm. Hence, $I=5/0.05=100$ amperes.

Alternatively, if as is usual V denotes the line voltage, which is 240 at the load end, and R denotes the total resistance of a load—say, a large number of lamps in parallel—it is also true to write: 100 A$=240/R$, whence $R=240/100$ $(R=V/I)=2.4$ ohms.

At the generator end the "terminal p.d." is shown as being 250 volts. The extra 10 volts represents the drop in the *two* lines. The current of 100 A. will be the same everywhere, so the total resistance across the external terminals of the dynamo will similarly be $R=250/100=2.5$ ohms—of which the two lines account for $2\times0.05=0.1$ ohm.

Finally, the internal resistance of the generator—armature winding, brushes, etc., is shown as a "lumped" resistance Ra. Strictly, of course, this is an *internal* resistance, and cannot be put extraneous to the armature as indicated. By doing so, the armature itself may be supposed to have no resistance, and cause no voltage-drop, when the reading of 255 volts from point B to earth will represent the induced voltage in the armature windings.

Evidently we have a further drop of 5 volts in Ra—making the terminal p.d., 255 v. − 5 v. = 250 v., when, Ra = 5/100 = 0.05 ohms. In an actual dynamo there will be other causes than "resistance" for a falling voltage characteristic; for example, the reduction in shunt-field current if the p.d. falls by, say, 1.0 volt due to resistance—the overall resultant fall will be more than 1 volt. In non-interpole machines *armature reaction* may weaken the effective flux which the conductors cut, and so reduce the e.m.f. generated.

Electromotive Force

Otherwise, the 255 volts is the total e.m.f.—or the total volts available for overcoming *all* resistances in the circuit, internal and external.

If we neglect the effect upon the field-excitation, and of armature reaction in weakening the field, the load current will have no effect upon the *generated* e.m.f.—provided, too, the speed remains constant.

Hence, unlike terminal potential-difference, the *electromotive-force* may be regarded as constant, and *independent of load current.* Mathematically:

E.M.F., E=

Total rate of change of flux-linkages/10^8.

$=BLv/10^8$ volts.

for a single conductor.

We shall devote some space to this basic formula presently. As long as the *flux-density* (*B*) and the *velocity* (v), are constant, the induced e.m.f. will be independent of any drop in resistances.

In the case of a battery, the generated e.m.f. will depend only upon the chemical composition of the electrodes and electrolyte. Again, there may be a large voltage-drop due to internal resistance, affecting the terminal volts, but not the e.m.f. In many types of cells, however, "polarisation" will give rise to a counter-e.m.f. opposing the main e.m.f. generated, so the result will be equivalent to a reduction in the total e.m.f. developed.

Potentials "To Earth"

Observe that with the end A tied to earth—as shown in Fig. 2b—the potential of the *negative line* "to earth" will be of *positive sign* everywhere along its length up to point A.

Thus at point E, the potential is 5 volts positive with respect to earth; half-way along the line, it will be 2.5 volts positive; if a voltmeter had one lead connected to earth whilst the other connection was gradually slid along the negative line towards A, the reading would successively fall from 5 volts, until, at A, there is no difference of potential relative to "ground."

Here we have the curious fact that an *earthed* cable or line which is carrying current *may* have a small potential-difference relative to ground of *opposite sign* to the potential of the line itself relative to another line. Simply a matter of "volts-dropped," of course, but this point regarding "signs" is worth thinking over.

If end E were tied to earth instead of A, a moving-coil voltmeter (the type of instrument which will indicate + and − polarities) would show end A 5 volts *negative* to earth—as might be expected from the fact that end E was positive when the earth was located at A.

The opposite reasoning would apply if the + line were earthed, at C or D.

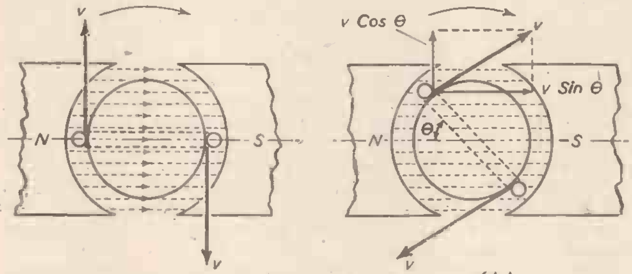


Fig. 3.—Rotation of a conductor in a stationary magnetic field.

Much more could be said on simple earthing problems. As a theoretical point which did give rise to much learned argument among certain radio academicians, the reader might consider from our illustrations whether a *potential-difference* across *part* of a circuit has the same or an opposite sign to the applied e.m.f.?

As a matter of some practical importance in using a voltmeter to locate "earths," suppose Fig. 2b represented an insulated system, and that an earth occurred somewhere along the + or − lines, not at the ends. The foregoing discussion should show how a low-reading instrument might be used to find the approximate location of an earth at any time, but in the case now mentioned the meter would show a *negative* reading (or reversed reading) at certain parts. Can you see why?

To return to our "nonsensical" query: it should not be difficult to understand where a voltage is derived from to drive the current "along the + or − lines"! Any resistance, anywhere in the circuit, simply "drops" the amount of pressure required to drive the current along that particular part.

But I can see many beginners still asking: How can it be true to say that 240 volts are "lost" across a lamp—or whatever the load may be? It requires an effort of the imagination to see how "volts" can possibly be absorbed, and, of course, it is really a question of *energy* being converted into heat.

I must leave the subject here, to go on to one or two magnetic problems.

The "BLv" Formula

As an introduction to many elementary design questions, it may be of interest to consider the "BLv" formula mentioned earlier.

If a straight conductor of length L *centimetres* moves across a magnetic field of density B *lines per square centimetre*, at a velocity of v *cm. per second*, the induced e.m.f. will be:

$$E\ (\text{volts}) = \frac{B \times L \times v}{10^8},\ \text{or BLv} \times 10^{-8}.$$

This is an easy expression to use, and, as always, a concrete example will make things a bit clearer.

Suppose, then, we had a magnetic field whose strength was known to be 10,000 (or 10^4) "magnetic lines" in every square centimetre of space—probably the most difficult job will be to arrive at anything like a reasonably accurate estimate of the "flux density," but we cannot go into that now.

Let us take a piece of copper wire of "active length" L = 10 centimetres, i.e., whatever the actual length, 10 cm. will be actively cutting magnetic lines. Let us proceed to "cut lines" by moving this wire across the field at a uniform velocity of 1,000 cms. per sec.—another difficult quantity to estimate, but easy enough when dealing with the circumferential velocities of armatures.

As an experiment, you may well think our procedure somewhat academic or far-fetched! What is interesting, however, is that a voltmeter joined across the two ends of that conductor will register a definite *induced* e.m.f.—when a conductor "cuts" across magnetic lines of force, its state of electrical potential is altered.

What is more interesting at the moment is to get some idea of the "amount" of induced voltage. Our quantities are: B = 10^4, L = 10 cm., and v = 10^3 cm/sec., so that:

$$E = \frac{10^4 \times 10 \times 10^3}{10^8} = \frac{10^8}{10^8} = 1\ \textit{volt}.$$

Quite a respectable e.m.f. in one single conductor. If we added many more, with 1.0 volt induced in each, and connected them all in series to form the "turns" of an armature coil, then add still more coils in series, it is not too difficult to get some idea of the quantitative aspects of armature design.

Or, if we had the means in a laboratory of measuring accurately the velocity v (possibly its average value), then, knowing E and the active length of conductor L, we could calculate the "field strength" B, i.e.,

$$\text{Flux Density, } B = \frac{E \times 10^8}{Lv}$$

The e.m.f. E may be measured by a precision voltmeter or calibrated galvanometer, whilst L needs nothing more than a centimetre rule. I am not suggesting that flux-densities are measured quite in this crude fashion, but it helps to answer a question sometimes put by zealous students: How are magnetic lines "counted"?

Besides, "Magnetism and Electricity" become more instructive when it is fully realised that 1.0 volt can be generated in a piece of wire approximately 4in. long, if moved across a strong magnetic field at a "speed" of about 28ft. per second.

Alternating E.M.F.

Our object is not so much to give "formulæ" and to see how well they "work" when applied to concrete examples. The "BLv" expression states a wider truth, applicable generally to many things besides a wire moving across a magnetic field.

But a little more about the "equation" for a moment. If the conductor is one of a large number fixed at a radius r cm. on the periphery of an armature making n revolutions per sec., Fig. 3a, we get:

Peripheral velocity, $v = 2\pi rn$, cms. per sec.
$= 2\pi r \times \text{Rpm}/60$, cms. sec.

This shows that for a given length of active conductor and a given speed of rotation, the e.m.f. will increase with the diameter of the armature—or, what is signified in design, a lower speed can be employed for the same voltage (obviously the speed has to be reduced the larger the armature, to restrict centrifugal forces).

The circumferential velocity is uniform, but our conductor will not be equally effective in generating an e.m.f. at all positions during a revolution—or a half-revolution.

The velocity v is fully utilised when the conductor is opposite the pole-centres, and so moving exactly at right-angles to the magnetic field, as in Fig. 3a. This is the position of *maximum e.m.f.*, and, unless otherwise modified, the BLv formula always gives the maximum value.

In a position such as Fig. 3b, where the conductor makes an angle θ (*radians* or *degrees*) with the position of maximum e.m.f., the velocity is still v cm. per sec. tangential to the armature, but this velocity is in a direction oblique to the horizontal direction of the field. It has, however, a "perpendicular component," v × *cosine* θ (or v *cos* θ), which will be less than v itself. Hence the e.m.f. equation becomes

$$e = \frac{BLv}{10^8} \times \cos\ \theta.$$

If, as is usual, the angle θ is specified from the position of *zero* e.m.f., the multiplier changes to:

$$e = \frac{BLv}{10^8} \times \sin\theta$$

Thus at $\theta = 0°$ (conductor in the neutral position), $\sin\theta = 0$, and therefore E = 0; 90° later, $\sin\theta = \sin 90° = 1$, and E will be the maximum value given by the BLv formula.

At 180° the sine again becomes 0. From 180° to 360° it will be *negative*, signifying the e.m.f. has reversed.

Since θ makes 360°, or $2\pi r$ radians, every revolution, the *sine* will pass through two zero values, and two maxima of +1 and −1. It follows that an *alternating* e.m.f. is being generated, varying sinusoidally between the two maxima of +E and −E. In mathematical language, the voltage will be a "sine function of time."

If we write $BLv/10^8 = E_{max}$ = the *maximum* e.m.f., we get the well-known

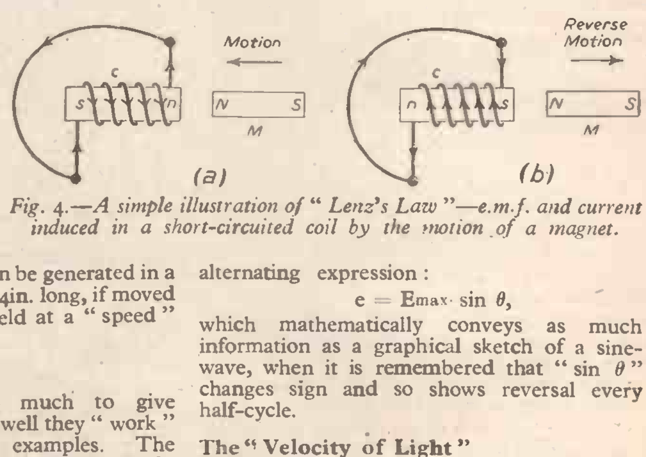


Fig. 4.—A simple illustration of "Lenz's Law"—e.m.f. and current induced in a short-circuited coil by the motion of a magnet.

alternating expression:

$$e = E_{max} \cdot \sin\theta,$$

which mathematically conveys as much information as a graphical sketch of a sine-wave, when it is remembered that "sin θ" changes sign and so shows reversal every half-cycle.

The "Velocity of Light"

Our basic expression offers more food for thought.

It is not so strange perhaps why "imaginary" lines of force, or their numerical specification, should give results which agree with the readings of voltmeters. It does suggest that mathematicians and physicists have managed things very well, even though voltmeters and ammeters are calibrated against standards based upon the electromagnetic units of measurement.

The formula we have been discussing can be translated into the more familiar quantitative ideas of Faraday's Laws.

If a conductor of length L cm. moves "v cm." in one second, it sweeps out an *area* A of L × v sq. cm. = Lv sq. cm., and since there are "B lines of force" to each square centimetre, the total number of lines cut across in 1 sec. is obviously B × A = BLv lines. Thus the formula reduces to:

$$E \text{ (in volts)} = \frac{\text{Total lines cut per sec.}}{10^8}$$

i.e., 1 volt is the e.m.f. generated if a single conductor cuts 100 million (10^8) magnetic lines every second.

The C.G.S. or *electromagnetic unit* (e.m.u.) of e.m.f. is much smaller. Theoretically, it is the e.m.f. generated if a conductor cuts "one line of force" every second. It may not be so easy to conceive physically how that could be possible—a single magnetic line "cut" in one second or in any finite interval of time? There are very weak fields where the e.m.f. developed would be equivalent to such a performance, but somehow the concept of isolated "lines of force" (with spaces between where there are no lines) does not seem entirely satisfactory.

Another unit of e.m.f.—the *electrostatic unit* (e.s.u.)—is equivalent to 300 volts in the practical units, or to $300 \times 10^8 = 3 \times 10^{10}$ e.m.u.'s, i.e., the ratio, *electrostatic unit/electromagnetic unit* $= 3 \times 10^{10}$.

Readers who know a little physics will recognise this curious figure. It is the *velocity of light* in centimetres per second. Whatever electrical quantities are considered, an electrostatic unit divided by an electromagnetic unit will always give the same answer—the speed of light in free space?

Electromagnetic Waves

We cannot go into the significance of this fact now, but it is interesting to note that electromagnetic waves—light, heat, wireless waves, etc.—all travel through free space with the same velocity: 186,000 miles per sec. $= 3 \times 10^{10}$ cm./sec.

Our BLv formula could be employed, for instance, to calculate the e.m.f. induced in a vertical aerial fixed upon a chimney or in the back garden.

The aerial wire is stationary, but is "cut" by the horizontal magnetic field of a "wireless wave" from some distant transmitter—it would also be possible to look at matters from the viewpoint of a vertical *electric* field, such a wave being said to be *vertically polarised*. In terms of horizontal magnetic lines, the "conductor" may be regarded as being cut by a field of maximum intensity "B" or "H," sweeping past at a velocity of 186,000 miles per sec.

The induced e.m.f. calculated by a formula of the form $BLv/10^8$ would thus be the *maximum* or *peak* value—the e.m.f. itself will be alternating, since from the present standpoint the wave may be considered stationary in space, whilst "B" undergoes sinusoidal alternating changes. Often, radio field strengths are given "R.M.S. Values," when the estimated induced e.m.f. would be that indicated by an a.c. voltmeter capable of giving correct readings at radio-frequencies.

Of course, the magnetic and electric fields at some miles away from a wireless transmitter are exceedingly weak, but the "velocity" (or "rate of change") is large, giving an e.m.f. in a receiving aerial of the order of *microvolts* (μV)—*millionths* of a volt.

Lenz's Law

It is hoped that Faraday's Law will look somewhat more attractive the next time the "dry bones" of the subject are tackled in textbooks—and I have known students to groan audibly when listening to dissertations on electromagnetic induction.

This state of hopelessness was at the same time heightened, and relieved, when the name of "Lenz," was mentioned. But, if anything, *Lenz's Law* is a wider generalisation than Faraday's. In one sense it is a particular case of the Law of Conservation of Energy. There are several ways of enunciating the principle. The most useful for present purposes is the following: *The direction of an induced e.m.f. (or the resulting current) is such as to tend to stop the motion producing it.*

The space that remains will not permit us to do more than glance at a few examples of the law.

Perhaps the best known is eddy current "damping", or "braking", in meters. A light aluminium disc, or an aluminium coil-former closed upon itself, moves in a strong permanent-magnet field—under the action of some other driving force such as the coil in a moving-coil meter. It cuts magnetic lines. A small e.m.f. is induced, which gives rise to a circulating current in the metal—each "conductor" may be regarded as a thin strip of metal short-circuited upon itself through the rest of the metal. The aluminium former of a moving-coil instrument forms a single short-circuited "turn."

The direction of the induced e.m.f. and current *must* be such as to tend to stop the motion: in other words, the magnetic field set up by the induced current will be such as to exercise a "magnetic drag" *opposite to the driving torque*, so giving a braking effect.

Additional damping can be given the movement of a moving-coil instrument when it is to be packed for transit by short-circuiting the two main terminals with a piece of wire. On top of the ordinary effect of the coil former, the *coil turns* will then provide an extra heavy damping to prevent the pointer swinging about.

Take another example of Lenz's principle. When a heavy load comes on a generator an extra "pull" has to be exerted by the engine to overcome the increased magnetic drag on the armature. Were this not so, the same driving-power (horse-power) would suffice on full-load as for no-load.

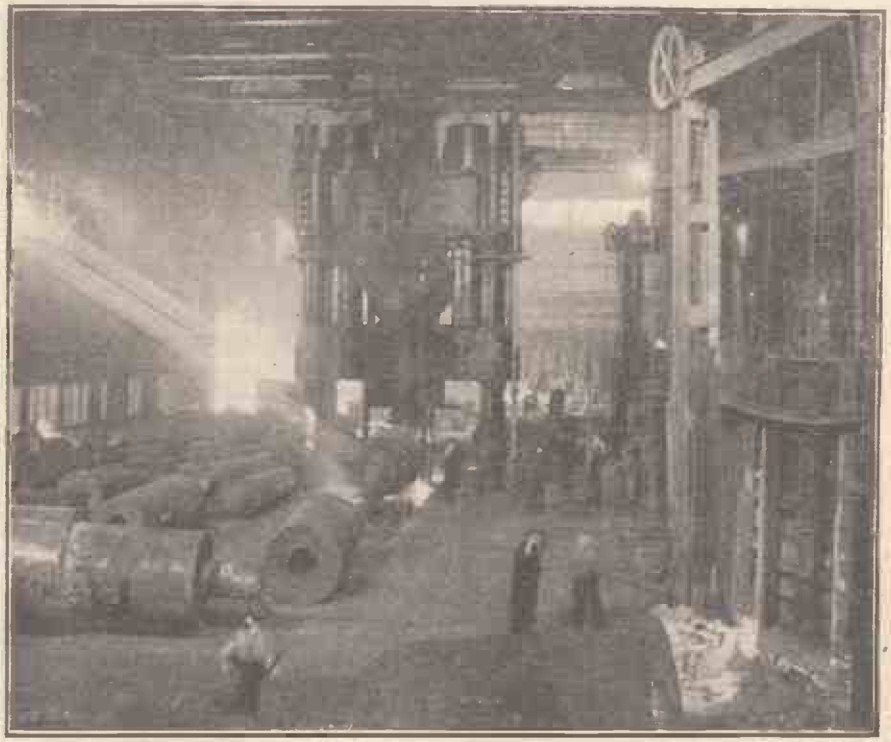
Again, the electric motors used for traction can be utilised as a most effective "electric brake," by quickly shutting-off the main power supply and manipulating a control which changes the circuit connections so as to "short" the machine upon itself—usually through a controllable amount of resistance. The "momentum" or kinetic energy of the vehicle is dissipated as heat in the resistance —much the same, of course, as it would otherwise be dissipated in the form of frictional heat in a mechanical brake. The motor(s) act as generators ("regenerative braking"), supplying a heavy current which retards the motion producing it.

To conclude this article we will take a simple magnetic illustration of the Law. In Fig. 4a is shown a short-circuited coil c wound on a soft-iron core. A bar magnet (or other electromagnet) M is brought up *towards* c, the direction of motion being as indicated by the main arrow. What *must* be the direction of the induced e.m.f. in c?

Apply Lenz's Law. A current will flow in the shorted coil in such a direction as to exert a magnetic force on M "trying" to stop its motion. The induced e.m.f. will have the same positive direction as the current. What direction is this? Clearly an induced current as indicated by the arrows on the coil turns, giving the ns polarity shown in the soft-iron—the n-pole next to the N-pole of the magnet causing magnetic *repulsion*.

In 4b the bar magnet is being moved away from c—direction of motion reversed. The polarity due to the induced current must reverse, becoming sn, and such that s *attracts* the N of the magnet—again "opposing or tending to stop the motion." This can only come about by reversal of the induced e.m.f. and current.

Sheffield Steel

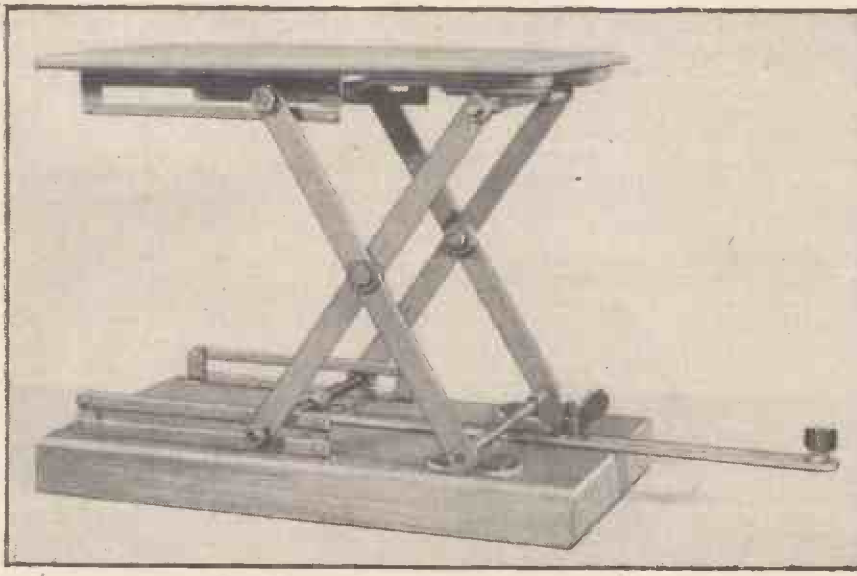


Sheffield is now forging ahead to provide the steel badly needed for world markets. Our illustration shows an important operation in the heavy forging section at Firth Brown's Steel Works, Sheffield. Two ship's propeller shafts being forged out of an 83-ton ingot in the 6,000-ton press.

An Adjustable Focusing Stand

Constructional Details of a Useful Unit for the Amateur Photographer

By L. C. MASON

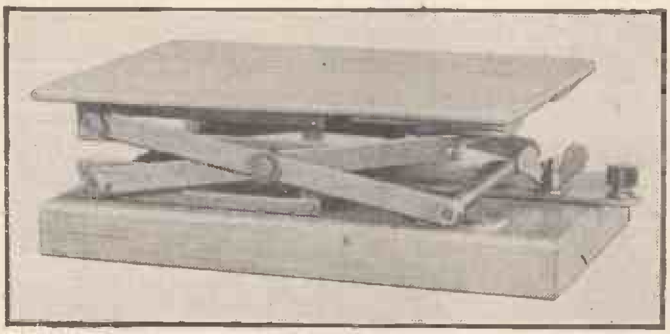


The completed focusing stand in its fully extended position.

THIS stand was evolved for use when copying or photographing small objects which require the use of double extension bellows or extension tubes. It is actually used with a double extension plate camera, but is applicable in all respects to any other camera set-up for close range work. It was found that when trying to focus with the bellows almost fully extended, the point of sharpest focus was difficult to determine, as a considerable movement of the lens appeared to make little difference to the sharpness of the image on the focusing screen. If the focusing movement is applied to the object to be photographed, however, it will be found that very small movements are sufficient to alter the focus enough to provide a large margin either side of "critical," due to the very small depth of field.

"Lazy-Tongs" Movement

Accordingly, the stand illustrated was built to take advantage of this. The subject to be photographed is laid on a light platform or table, which is mounted on a heavier base by means of a "lazy tongs" assembly. This enables the table to be raised and lowered to adjust focus, while remaining in all positions horizontal and parallel to both base and the film.



The focusing table in its lowered position.

The movable table is a piece of 3/16in. three-ply for lightness, while the base is a piece of ¾in. wood the same size. The metal cross pieces of the lazy tongs movement are ½in. wide strips of 1/16in. duralumin, as are the guide bars along the edge of the base (Fig. 1). This material was to hand, so was used, but no doubt strip brass would do equally well. The ends of the cross strips are joined to their opposite numbers on the other side by four 3/16in. steel rods screwed 2 B.A. at the ends, and screwed into the strips with lock nuts outside. The pivot at the cross-over can be either a small nut and bolt or a rivet, with a washer between the arms. The upper and lower rods at one end are free to turn in bearings, each consisting of a short length of tube soldered to a small plate. The two pairs of plates are screwed to one end of the table and to the base, while the rods at the other end are free to slide between guide bars. The bars are ½in. wide strips of the same material as the crossed arms, riveted by 1/16in. rivets to small angle brackets and spaced apart just sufficiently to allow the rods to slide freely between them with the minimum of play. A washer on the rod between the side arms and the outside of the guide bars makes for smoother working. If necessary, the bearing plates or the guide bar brackets should be packed up with pieces of thin cardboard until the table is perfectly parallel with its base. To the lower sliding rod is attached the end of a sliding strip by which the table is raised and lowered. To allow the rod to turn while being drawn along, the fixture to the sliding strip is merely a short strip like the side arms bent round the rod and screwed or riveted to the end of the sliding strip. If the loop is made from a fairly wide piece it will prevent sideways movement of the sliding strip.

Locking Device

The table is locked in any position by a clamping arrangement on the sliding strip. This strip has a slot cut in it through which protrudes the end of a ¼in. Whit. coach-head bolt inserted from underneath. A wing nut on the bolt, when screwed down firmly, grips the strip tightly to the base, retaining it in any position.

Operation

It will be seen from the illustrations that the higher the position of the table, the further the operating strip projects. This indicates the method of operation; slack off the wing nut sufficiently to allow the strip to slide freely, and then pull it out to raise the table. Lowering is effected by allowing the strip to slide gently back, which it will do automatically by the weight of the table. A small knob attached to the outer end of the sliding strip will make operation easier. It is desirable to adjust the fits to give completely free movement, as operation can then be carried out with one hand if necessary.

Dimensions are a matter of personal choice and material available, but in the one illustrated the table and base are both 6in. x 4in., which has been found amply big enough. If a thin print larger than this is being copied, for instance, it is a simple matter to lay a piece of stiff card on the table first to hold the print flat. The side members are 5in. long, and this length affords an up and down movement of some 4in.

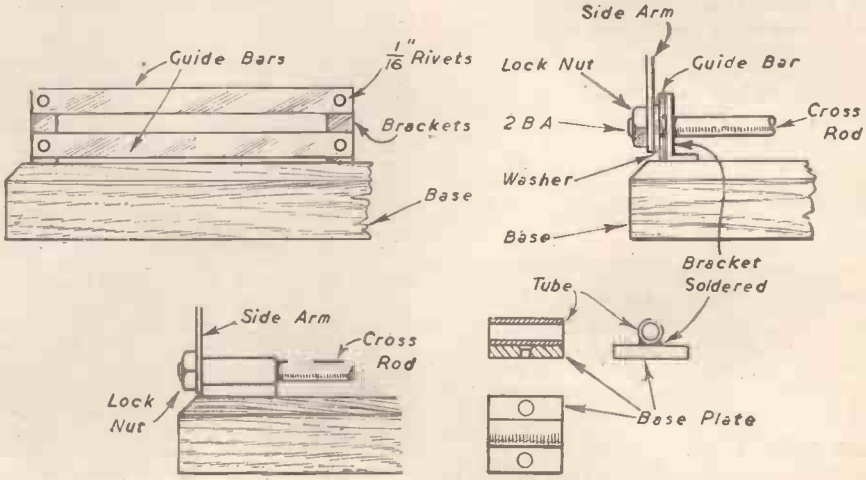


Fig. 1.—Details of guide bars and bearings for cross rod.

For Floor or Table

The device was designed for use on the floor or table with the tripod standing over it and the camera aimed straight down. The procedure in this case is to place everything in position, raise the table about 2in. and then focus as near as possible to the size of image required by rough adjustments of the tripod. The final focusing is then done by raising or lowering the table slightly as required. If a small object such as a coin is being photographed by extreme angle lighting to show up the relief of the design, take care that any adjustment of the focus by movement of the table does not disturb the lighting.

Photographing Objects in Vertical Plane

If it is desired to photograph an object in a vertical plane, dispensing with a tripod, a small hook can be screwed in one end of the base so that the table can be hung on the wall and the camera and lights placed on a small table in front of it. In this case the object to be photographed will have to be pinned to the table. If this is done frequently, it would be worth while gluing a layer of thin cork (such as is used for table mats) on the top of the table to make it easy to insert and withdraw pins.

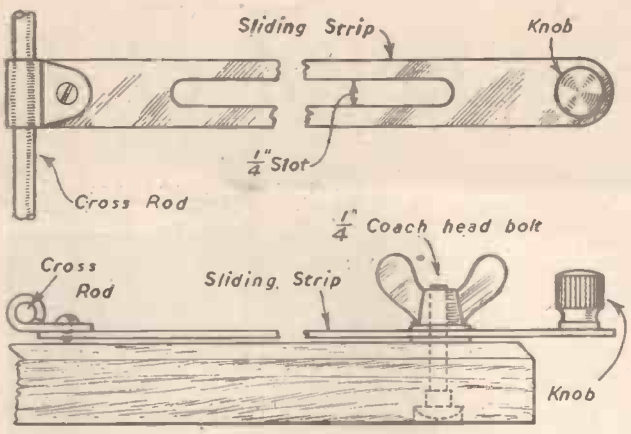


Fig. 2.—Plan and side view of the sliding strip.

Observations

Interesting Facts About Everyday Topics.

By Prof. A. M. LOW

Instability

A RADIO valve is full up with an electric charge which "falls over" like water from a bucket and enables current to be reversed or amplified. A street regulating stop or "go lamp" works on the principle that each vehicle charges a condenser as it passes over the strip until the charge is sufficient to operate a relay, thus working the lights.

It is lucky that stability is almost non-existent. Nothing is permanent; even our finest buildings will be mud and dust in due course. Everything changes; it is the principle of life which you see in the forms which renew your own body. A drop of water in a rainstorm cannot exceed a certain size without breaking up, and this is lucky for you. Tiny drops have pressures of 20lb. per square inch and more inside their controlled surface, but at a certain diameter they fall to pieces because the localised grip has been exceeded by the total strain. It would be very unpleasant to be hit on the head by a drop of water the size of a large bucket, even if it was round!

The water assumes a globular form because it balances out the internal force and this is a condition which we see relatively reproduced in the atom bomb where certain isotopes such as that of uranium become mildly unstable. Their solar system has its Milky Way clear, and bombardment is allowed to reach the inner nucleus.

From this you will guess that above a certain size a bomb might be too easy to set off, and below the size of a kilogram or so the bomb becomes so stable that nothing much can be done with it.

Hot One Minute—Cold the Next

I AM told that ancient mariners lick their finger, hold it up in the air and say, "Nor', nor' by east, abaft the binnacle," or words to that effect. In short, they feel which side of the finger grows cold and know that it is facing the point from which the wind comes.

This is the principle of nearly every refrigerator. Even savages used to put their water, or "twala twala," as the boys' books used to call native beer, in a porous vessel. As the water, better still the beer, evaporated, the liquid gave up its heat, and the resulting cold provided the necessary refreshment.

To this day it always pleased me to see someone light a gas-jet under a refrigerator burner and to know that heat is producing cold. Cold is merely the absence of heat, and these machines work by a series of evaporations and condensations in a continuous cycle.

Some liquid, such as sulphur dioxide, under pressure, is caused to evaporate, and in doing so cold is produced. The gas is then condensed again by pressure, when it becomes liquid ready once more to go through its cooling evaporation and the further cooling regeneration of the contents of the whole machine.

If carbon dioxide is used in liquid form and allowed to evaporate quickly into gas, the cooling is so quick that solid particles of carbon dioxide "snow" are formed. You will realise that whether the evaporation is caused by a sudden lowering of the pressure or by the application of heat to the liquid does not make much difference.

The working fluid, for that is all it is, merely serves as a method of transferring heat; whether you use carbon dioxide, sulphur dioxide or ammonia solution is a matter for design and economics.

In the same way, as I think I once explained, water is used in a boiler to be turned into steam and the steam merely acts as a vehicle for heat in order that, in its anxiety to expand, it may produce power. Other liquids are equally effective. Air is rather difficult to heat, but mercury makes a splendid carrier and is only inclined to failure by its cost, and some danger to those who may use it without precautions.

When you see vacuum pumps at work in a steam engine you will know that the engineers want to condense the steam as soon as it leaves the engine, not only so that the water can be used again for warming the boiler, but so that the waste steam can get away from the engine quickly without having to be pushed out. In the old days they used to squirt water into the engine cylinder, but they soon found that if the cylinder was cooled in this way, the entering steam from the boiler wasted its energy by merely warming the metal of the engine.

You Can See By It

WHEN writing about light I think I did not make it clear that what you and I call light is only one form of an ethereal oscillation. It mildly resembles wireless waves except that its frequency is vastly higher. Grey light from the sky is a combination of all the spectrum colours, and if you paint a white disc about 3in. diameter with segments of each of these rainbow colours and then spin like a top you will soon find that the colours blend into white. There are many other kinds of light each different from its neighbour. There is the cathode ray which makes some of the platinum compounds fluoresce, a property very useful to makers of television screens. X-rays are also light, but have quite different properties, and are capable of penetrating opaque substances owing to their very short wavelength with which the particles of normally solid matter are liable to interfere. If you had eyes which were sensitive to X-rays you would be able to see through walls, if you had eyes like a microscope you would see the air full of living creatures, and if it did not happen that the sun's rays were composed mainly of these spectrum colours, you would never have taken white to be plain and not coloured. If the sun's rays had been green your relative eye sensibility would have been different, for you are a creature of evolution in nature's plan. You would have looked at a pair of bright red pants and remarked, "what a pity they are not coloured." While white would no doubt have seemed most glaring and out of place. Heat is merely a slightly different form of light with a longer wavelength. It can be focused, as in the normal electric fire, and its rays can be bent like those of light by using the proper material. In the early days of infra-red photography when it was first discovered that photographs could be taken through cloud the first experiments were made with lenses constructed of rock salt because this substance did not cut out the heat ray. There is no real difficulty in taking a photograph inside a dark room by the light of a kettle of hot water.

At the other end of the stick we have ultra-violet light which is invisible, and which does not pass through lenses containing lead. That is why special glass has to be employed if the full benefit of the sun's rays is to come into your house. In this world we know very little about light, but we do know that it is a somewhat material thing, and I think that when atomic power has been further investigated, and we have found how to change matter into energy quite easily, we shall be able to write knowledgeably about the weight of light. For light has weight and actually hits us all the time. It has been calculated that if a cent was raised to the temperature of the inside of the sun the actual weight of light proceeding from it would knock down everyone within a radius of over 5 miles.

Memoirs of the Metals—4

The Reign of Radium

Its Peculiar Properties and Characteristics

By J. F. STIRLING, M.Sc.

RADIUM, now and again, has been dubbed by various writers a veritable "prince" of metals. The simile, however, is to say the least, a strained one. True it is that radium constitutes one of the most amazing substances which men of science have ever hit upon. It has given us the long-sought key with which, for weal or for woe, the secrets of the atom and the stupendous forces which exist within it are, one by one, being laid bare.

Such is the significance of radium at the present day. In this direction the element certainly domineers over the commoner elements and enjoys a scientific reign over them.

But, as a mere metal, radium is one of the weakest and the least important of the world's metals. Were it as common as cast-iron the engineering industries would have very little use for it, just as they find but sparing employment for metallic barium, calcium and strontium, its closest partners in the family of metals. You might, perhaps, be able to devise one or two useful amalgams with radium and mercury, or, alternatively, one might possibly be able to include metallic radium as a constituent of certain soft bearing metals in much the same manner in which a soft alloy of calcium, sodium and lead used to constitute the *Bahn-metall* of the German railways.

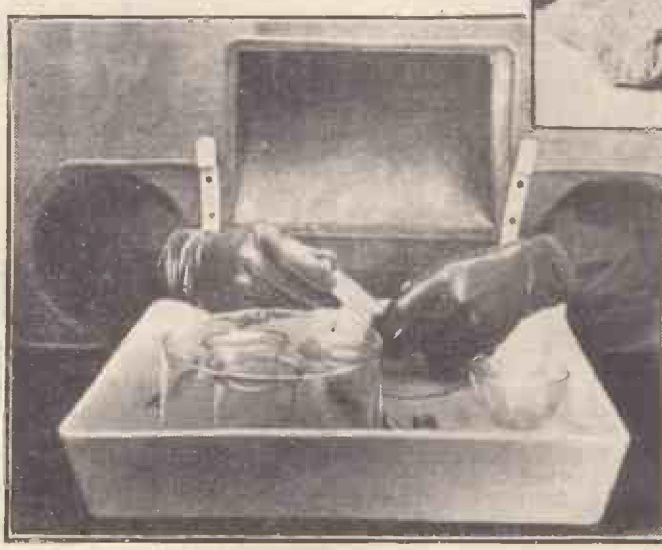
As a structural metal, however, radium, even if it were shorn of all its dangerous properties, would be useless. It would be too soft, too reactive, too plastic for any such ordinary use. You might as well try to build a bridge out of sodium or potassium as to construct it out of radium metal. For sodium and potassium are almost as soft as cheese, and can be cut readily with a blunt knife. What is more, they absorb atmospheric oxygen greedily, and rapidly become converted into crumbly, white oxide. Radium, too, has similar properties, but, as one might expect with such a curious metal, it differs from the rest of these soft metals in that it prefers nitrogen to oxygen, so that when exposed to the atmosphere at ordinary temperatures it combines not with the oxygen of the air, but with the nitrogen, rapidly turning into its nitride, a white powder not dissimilar in appearance and physical properties to the sodium and potassium oxides.

Radium in Rocks

But, of course, radium will never become common, even in spite of the fact that very delicate physical methods have proved it to exist in minute traces in the most abundant of rocks and minerals. It is too unstable a substance for that. It is a metallic element which is here to-day and gone to-morrow, if we can use those phrases to signify a matter of a few thousand years each. So that the world's stock of radium is gradually disappearing. It is slowly but quite surely fading away like the proverbial old soldier. And nothing can be done about it, unless, perchance, some future atomic scientist is able to hit on a method of building up a sort of synthetic radium from fragments of other elements. That, however, is a problem with which we cannot deal here.

Madame Curie, radium's discoverer, and the first person to isolate radium metal.

Radium is an element which has now had nearly half a century of scientific publicity. More has been written and talked about radium and its properties from a spectacular standpoint than has been uttered about most other metals. This is because the accidental discovery of radium gave a sharp shock to the scientific world which at that time thought it knew everything about atoms and their adventures, but realised afterwards that it had really very little exact knowledge concerning them.



The commercial handling of radium salts. Here, the hands of the operator are heavily swathed in protective gloves, whilst his arms are thrust through apertures in a thick lead screen. The operator remains behind the screen and looks through a thick sheet of plate glass.

Becquerel Began It

It all came about in 1896, when a French chemical worker, Antoine Henry Becquerel, was studying the brilliant fluorescence which is shown by solutions of uranium salts, such as uranium sulphate or uranium nitrate. Becquerel, quite by chance, happened to place a tube of uranium salt on a box of photographic plates in a dark cupboard, and on using the plates to photograph some other object he found, on developing them, that they were all spoiled, having apparently been fogged by exposure to some source of light.

That is how radium made its preliminary bow to the world of science just fifty-one years ago.

At that time the scientific world had been set rocking by Röntgen's epoch-making discovery of what, for want of a better name, he called his "X" rays. Scientists were all going mad on these "X" rays, and Becquerel's seemingly insignificant observation about uranium salts being able to affect a photographic plate in the dark was given scant attention.

But there was one individual who became particularly interested in Becquerel's discovery. This was a girl, Marie Sklodowska by name, the clever daughter of a Polish science master in Warsaw. She had gone to study science in Paris, where she came into contact with Henri Becquerel, and also with another science lecturer named Pierre Curie, who himself was beginning to be attracted to Becquerel's work.

Pieces of pitchblende—radium's chief ore.

The year before Becquerel's discovery Marie Sklodowska had married Pierre Curie. The two were very poor. Sometimes they were almost on the verge of starvation, so little in demand were science lecturers at that time. But Pierre swept the floor of their little apartment and helped with the washing-up, and Marie did the shopping and cooked the meals, and they appear to have been very happy, because they both found some time for original investigations in science, particularly Marie, who, on being told by Becquerel about his discovery, began in her spare time to test out all sorts of mineral substances for "rays."

In this way, she soon found out that this ray-producing property ("radioactivity," we now term it) of uranium was independent of the exact *kind* of uranium salt, but was proportional to the concentration of the element existing in the salt. Hence, inferred Madame Curie, this mysterious radiation is concerned with the atoms of the element themselves, and is not a result of certain chemical combinations of those atoms.

In 1898, Madame Curie discovered that thorium salts were ray-producing in much the same way as uranium salts. She found, also, that these ray-producing compounds had the property of being able to ionise the surrounding air and to render it electrically conducting.

The next step, and perhaps the most important one of all, was taken by Madame Curie when she noticed that certain grades of pitchblende (the mineral ore of uranium) seemed to have more radiation activity than could be accounted for by their estimated uranium content. This, inferred Madame Curie, could only be due to there being present in these pitchblendes traces of an unknown element which was much more active than uranium itself.

Radium Revealed

Through the good offices of their friends and the generosity of the Austrian Government, the Curies obtained a free gift of a ton of pitchblende from the famous "Dollar Mine" at Joachimstal, a mining town in Bohemia. Together the Curies dissolved up the whole of the crushed ore, chemically concentrated it, precipitated it, and in this way they obtained two chemical substances which were each strongly radioactive. One of these substances was precipitated with bismuth, and to the element which it contained Madame Curie gave the name of "Polonium," in honour of her native Poland. For the other substance which had been precipitated with barium compound, and which showed the greater amount of ray-producing activity, Madame Curie happily conceived the name of "Radium," a title which she little thought was eventually to become world-famous.

A carrying-tube for small quantities of radium compounds. It is made out of a thick-walled lead water-pipe. Containers of tungsten-copper-nickel alloy have recently been introduced for the same purpose. They have similar ray-screening powers, and are much lighter than lead containers.

For a long time, radium was only known in the form of its salts. Pierre Curie himself never saw metallic radium for, one evening in 1906, he went out to visit some friends and to have dinner with them. It was an evening's relaxation from which he never returned home. He met sudden death on the streets of Paris by being run over.

After the initial effects of the tragedy had worn off, Madame Curie found a degree of forgetfulness in her beloved science. She delved deeper and deeper into radium and into its many mysteries.

Four years after the tragedy this renowned woman first isolated radium metal. She electrolysed radium chloride solution, using a mercury cathode. The radium which was liberated by electrolysis at the cathode dissolved in the mercury, forming a radium amalgam. This was carefully dried and cautiously heated in an iron boat (for mercury does not attack iron) contained in a glass tube through which a current of very pure hydrogen was passed under a reduced pressure.

A lead bottle for the storage of radium and its salts.

The radium amalgam, which at ordinary temperatures had been plastic and semi-liquid, became solid as soon as a temperature of 400 deg. C. had been reached, most of the mercury volatilising away. At 700 deg. C. no more traces of mercury remained, and the bright globule of metal which lay in the diminutive iron boat itself suddenly liquefied.

Madame Curie, for the first time in the world's history, had prepared radium metal and had melted it.

Metallic radium has been made by other workers at later dates, but, naturally enough, owing to the extreme scarcity of radium compounds, only very small amounts of the metal have been produced.

A White Metal

Radium is a brilliant white metal, almost, indeed, as white as silver, which is the whitest of all metals. It melts sharply just above 700 deg. C., and at this temperature it volatilises appreciably. In contact with air, radium metal rapidly tarnishes and, in fact, corrodes. But, as we have already seen, the product of this action is not radium oxide, but the *nitride* of the metal. A few other metals, such as titanium, calcium, magnesium and lithium, will form nitrides, or combinations with nitrogen, when heated in an atmosphere of that gas, but radium appears to be the only metal which, when given a free choice, will at ordinary temperatures combine with nitrogen in preference to the more active oxygen.

An interesting feature of radium is that it is one of the mirror-forming metals. Silver, gold, copper and a few other metals can all be deposited as brilliant mirrors on glass or silica by various chemical means. By heating radium azoimide, which is a special organic nitrogen compound of the element, in a high vacuum at a temperature of between 185 and 200 deg. C., the radium metal is liberated and is deposited on the glass of the vessel as a brilliant mirror.

A radium mirror is necessarily a mere freak and curiosity of chemical science. Of enormous cost, it would, even if it could be protected at the back from atmospheric action by a thick layer of varnish, be of little use, for the radium rays would quickly discolour the glass and, in time, render it almost opaque.

Radium compounds all discolour glass and silica, turning such materials a deep purple-violet, not unlike the colour of iodine vapour. The "radium stain" on glass can be to some extent decolourised by heating the glass, but some of it, at least, is indelible.

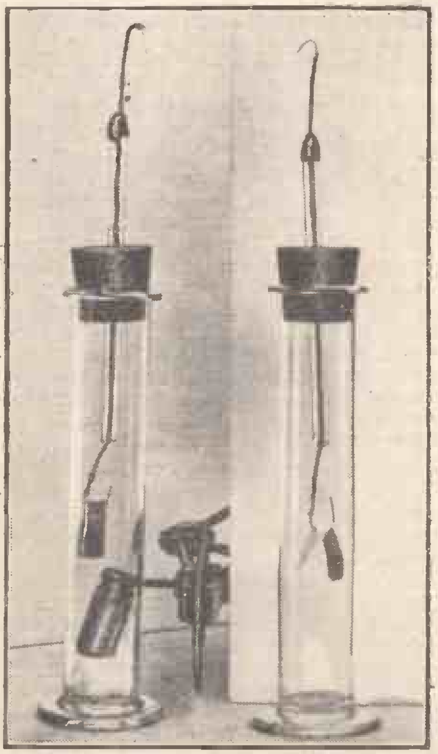
Held in a non-luminous flame, a fragment of radium metal (or of its salts) colours the flame a striking carmine-red, in just the same way as sodium colours the flame yellow and barium renders it green.

Decomposes Water

Metallic radium vigorously decomposes water, just as do the metals potassium and sodium. Hydrogen gas is evolved from the liquid, the radium metal disappears and the radium hydroxide, a milky alkaline substance, which is formed enters into solution.

To what extent metallic radium will alloy with other metals is more or less unknown. The cost of such experiments has been too great to allow of such knowledge being gained. Who knows, however, what future some as yet unknown radium alloy may eventually possess?

The metal which bears the closest resemblance to radium is barium, a member of the "alkaline earth" metals. Indeed, radium belongs properly to this family group of metals, and its chemical properties fit it in accurately with this group. What properties barium has, the same also will be shown more or less in the case of radium.



Two electroscopes standing side by side. Both have been given identical electrical charges. The electroscope on the right retains its charge, the gold leaves remaining apart. The electroscope on the left, however, contains a bottle having a fragment of radium barium bromide in it. The rays from this ionise the air within the electroscope, rendering it electrically conductable. The gold leaves thus fail to hold their charge, and they therefore collapse together.

Metallic radium (and all its chemical salts) is self-luminous. It glows brilliantly in the dark, manifesting an intense bluish luminescence. Likewise, owing to the internal activity of its atoms it is always a few degrees higher in temperature than its surrounding objects. Were radium and its compounds common, and were they without any semblance of danger, they would function admirably as perpetual sources of personal warmth for stitching into clothing on cold days.

Of the vital radio-activities of radium metal it is hardly within the province of this article to treat. Radium, as we know, is an unstable metal. Some of its atoms persist in exploding spontaneously and, in so doing, they give out energy in the form of "rays." Because of its self-destructive properties, radium is slowly decaying. One-half of any given mass of radium will decay in 1,580 years, this period being known as the "half life" of the element. After 4,740 years the original amount of the element will have reduced itself to one-eighth.

The chief emanation or "ray" given off by radium is the alpha-particle. So intense is the internal energy of a mass of radium that it is able to shoot off its alpha-particles with an average velocity of 9,380 miles per second.

In one second one gramme of pure radium would emit approximately 37,000,000,000 alpha particles. This stupendous number is no mere fancy, for it has been actually determined by counting the flash-impacts of alpha-particles on the zinc sulphide screen placed at a given distance from an accurately weighted fragment of radium.

A tube containing radium bromide. It is self-luminous.

From this consideration alone we are able to gain some dim appreciation of the enormous number of individual atoms which must be contained in a single gram of radium or of any other metal, and this is especially so when we learn that, despite the explosion and disintegration of 37,000,000,000 of its atoms every second, a given mass of radium only loses about 0.04 per cent. of its content per annum.

Rots the Flesh

Radium, of course, is one of the most dangerous metals known to science. Its intense radiation will rot away the flesh of any living being. It will break down complex molecules of organic matter, destroying the life-function with which such molecules may be concerned. That is why radium will, when uncontrolled, far oftener cause cancers and other malignant tumours than it will cure them.

Radium's chief minerals are pitchblende and carnotité, which occur in various parts of the world. The largest British Empire deposits of pitchblende are in the Great Bear Lake region of North-western Canada. This ore, which is mainly an oxide of uranium, carries quantities of silver and copper. It is concentrated locally and sent by aeroplane to a refinery at Port Hope, Ontario, where radium bromide and sulphate are extracted from it, along with uranium and silver.

In 1938—the last year for which figures are available—Port Hope produced about 70,000 milligrams of radium material, whilst in the previous year its production was only 23,770 mg.

With the enormous demands now being made on uranium ore for use in atomic power stations, the production of radium will be stepped up so that, relatively speaking, radium will become commoner.

Ethyl Silicate in Engineering

A New Organic Compound of Silicon

By A. E. WILLIAMS, F.C.S.

WHILE the inorganic compounds of silicon—so well known in the form of innumerable minerals—have been with us from time immemorial, it is only very recently that organic compounds of silicon have been evolved and developed for use in industry. The fact that organic compounds have been produced is something of an achievement in the chemical sphere, for silicon, better known as its oxide, silica or sand, is a very inert, refractory material which does not readily combine with anything, much less the mild organic materials. So that the production of an organic compound of silicon is regarded as a definite innovation in the chemical field.

"Lost Wax" Moulding Process

The chief of these new organic compounds of silicon is ethyl silicate, and as such it finds little commercial application up to the present time, but its hydrolysed solution is being used in a variety of ways. Its most important application at present being in the "lost wax" investment moulding process for the production of precision castings. Precision casting was originally developed for the fabrication of dentures and jewellery, but it has now been extended to all fields where intricate castings from special high-melting point and corrosion-resistant alloys are required. As, for example, in the manufacture of turbo-supercharger buckets for aero engines, parts for jet and gas turbine engines, chemical and textile equipment, diesel engine and pulverising machinery components, pump impellers, rock drills and cutting tools. The "lost wax" process is used to make extremely accurate castings of parts too intricate to machine or forge economically, or those made from high-melting alloys, such as special nickel alloys which are too tough to fabricate by conventional methods. It is important that the moulds prepared for this process should resist high temperatures and should not become cracked or distorted. Hydrolysed ethyl silicate acts as a bond which does not slag or burn out at high temperatures.

Precision Casting

A master pattern, accurately made from wood or metal, is used to make soft metal moulds from which wax patterns can be cast by injection of molten wax under pressure. The soft metal moulds are sometimes lubricated with the unhydrolysed ethyl silicate, which use represents one small outlet for the unhydrolysed material.

When solid, the wax pattern is removed from the mould, trimmed, sprayed with a slurry consisting generally of sodium silicate and powdered silica, and then allowed to dry. In this way the wax pattern is coated with what amounts to a facing sand. The sprayed pattern is next fixed in position in a moulding box and the "investment mixture" poured around it. This mixture consists of a slurry of powdered ceramics, such as silica flour and powdered grog, containing a little magnesium oxide, in a hydrolysed solution of ethyl silicate. The magnesium oxide (magnesia) is the alkali which accelerates the setting of the mixture, and its amount must be carefully regulated. The moulding boxes are vibrated so that the refractory material is compacted round the wax pattern and allowed to set. The setting time can be controlled by variation of the amount of magnesium oxide in the mix. After the preliminary set has taken place, the moulds are put into an oven to melt out the wax and harden the refractory mixture. The moulds are then put through a furnace, the temperature of which is gradually raised to about 1,000 deg. When they are up to temperature, they are removed and immediately clamped to a tilting electric furnace containing the molten metal, which is forced in by air pressure. The mould and casting are allowed to cool slowly and the refractory material is then broken away from the casting, which has only to be trimmed or shot blasted where necessary. The accuracy depends on the type of casting, but it is usually about 0.003in.

Hydrolysed Ethyl Silicate

Ethyl silicate itself, as manufactured by Albright and Wilson, Ltd., is a mixture of ethyl silicates of different degrees of condensation, and it has an actual silica content of about 40 per cent. It is a colourless mobile liquid of specific gravity 1.06 at 20 deg. C., and has an initial boiling point of about 170 deg. C. at ordinary pressures. Its flash point is approximately 53 deg. C., and it is insoluble in water, but is soluble in alcohol and other organic solvents. The most important chemical property of ethyl silicate is its ability to undergo hydrolysis to give silica or highly condensed ethyl silicates. This hydrolysis is usually carried out by the addition of a very small amount of acid, dilute hydrochloric acid being the most suitable, to a mixture of ethyl silicate, industrial alcohol and water. Hydrolysed solutions of ethyl silicate, suitable for use in precision casting, may be prepared by a variety of methods, but the following suggested example gives a mixture which is initially homogeneous and consequently does not require shaking or stirring:

500 cubic centimetres ethyl silicate
1,500 cubic centimetres industrial alcohol
50 cubic centimetres water
10 cubic centimetres hydrochloric acid (5 per cent. strength).

The above materials are mixed thoroughly and then allowed to stand approximately 12 hours before use.

Electrics for Beginners

2.—A Small Shocking Coil

By "HANDYMAN"

(*Continued from page 21, October issue.*)

THE beginner will find the construction of this small shocking coil a fairly simple job, and when completed it will provide instruction and entertainment. The coil described can be made quite cheaply, and will work efficiently when connected up to a 4-volt accumulator or two large dry cells.

Principle of Working

Before dealing with the constructional details it may be as well to briefly explain the principle on which a shocking coil works. A shocking coil is an induction coil of simple form, and depends for its action on the peculiar property of electricity by virtue of which, when one coil of insulated wire through which an intermittent current of electricity is caused to flow is placed within another coil, a current of electricity is induced in the other coil. The inner coil in this case is known as the primary coil, and the outer one the secondary coil. To ensure that the electromotive force, or pressure, of the induced current shall be sufficiently high to cause a shock, the primary coil is wound round a laminated iron core, while the secondary coil of finer wire consists of a much larger number of turns than the primary winding. By means of a rapid make-and-break device the necessary intermittent current is caused to flow in the primary coil. It is on the rapidity of the make-and-break action that the strength of the shock depends.

Constructional Details

For the baseboard, A (Figs. 1 and 2), cut a piece of ⅜in. planed wood 6in. long and 3½in. wide. Ordinary deal will answer the purpose, and this can afterwards be stained and polished.

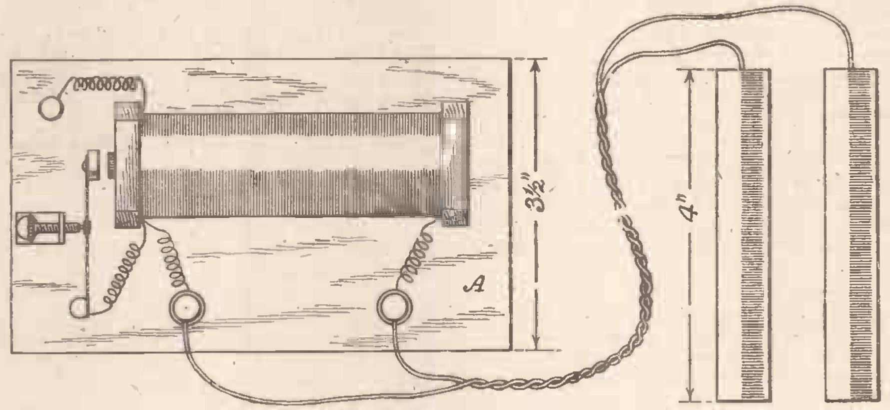


Fig 1.—Plan of the completed coil, with hand grips.

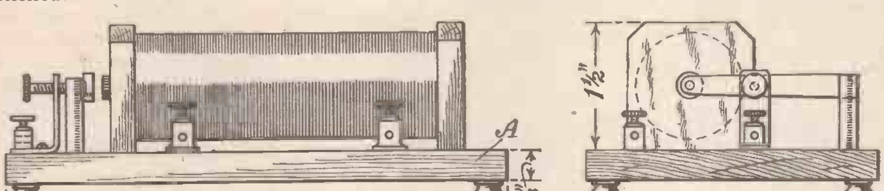


Fig 2.—Side and end views of the coil.

Two pieces of planed wood, 1½in. square and 5/16in. thick, will also be required for the end cheeks, B (Fig. 3), which support the core and windings. With a 5/16in. centre-bit bore a hole in the middle of each cheek for the ends of the core to pass through. Chisel off the top corners as indicated, and smooth the sides and edges of the cheeks and baseboard with fine glasspaper. The core consists of a bundle of soft iron wires, 4⅜in. long, and this is covered with a layer of thin brown paper, the edges overlapping ¼in. and stuck down with a smear of gum. The paper covering should be 3⅞in. long, so as to allow ¼in. of the core to be bare at each end, as indicated at C, C (Fig. 3).

Coil Winding

For the primary winding 5yds. of No. 22 cotton-covered copper wire will be required, and for the secondary winding 26yds. of No. 28 cotton-covered will be necessary. Carefully wind the primary wire on the paper-covered core, leaving a free end of about 6in. to start with, the same amount being left at the finishing end.

Bind the last two or three turns tightly with strong thread to prevent the coil from unwinding, and, after applying a coating of shellac varnish, cover the coil with a piece of thin brown paper. When quite dry wind on the secondary coil, leaving about 6in. free at each end for connecting-up purposes. Bind the last two or three turns with thread, give another coating of shellac varnish and put on one side to dry.

Mounting the Coils

To enclose the coils a thin cardboard tube 3⅜in. long and 1¼in. diameter, is used, covered by a piece of velvet or other material. Place the coils in the tube, make small nicks in the edges for the connecting wires to pass through and glue the wooden cheeks in place. One end of the iron core should project 1/16in. past the face of one cheek as shown in Figs. 1 and 2. Fix the coil in position on the baseboard by two screws driven into each cheek from underneath.

At this stage four small wooden knobs, to serve as feet, can be fixed to the baseboard near the corners. The stems of the knobs can be glued into holes made in the baseboard.

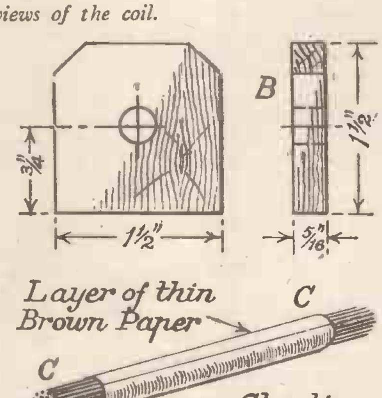


Fig. 3.—Details of coil cheeks, iron core and primary winding.

Contact Breaker

This consists of an armature spring, supporting pillar, contact screw and bracket. The armature spring can be made from a piece of thin, springy brass, about No. 35 gauge, cut to the dimensions given at D. (Fig. 4). The armature, E, is a soft iron disc ⅜in. diameter and ⅛in. thick, a hole being drilled through the centre so that it can either be screwed or riveted to the end of the spring.

The contact piece, F, is of silver, and for this part of a link from an old watch chain can be used. Straighten out the link, cut off a piece about ⅛in. long, and insert it in the hole, G, and burr it over on both sides of the spring by tapping it with a light hammer till a flat disc of silver is formed about ⅛in. diameter as shown in Fig. 4.

For the supporting pillar a piece of brass rod 3/16in. diameter and ⅞in. long will be required, and this has a hole drilled and tapped in one end to take a countersunk screw, as shown at H. At the top end a flat is filed to take the end of the armature spring, which can be neatly soldered to the pillar as shown in Figs. 1 and 2.

The bracket, J, for the contact screw is bent to shape from a piece of sheet brass 1/16in. thick, after drilling the two holes near one end for the fixing screw and terminal stem and drilling and tapping the hole at the other end for the contact screw. For the latter, obtain a brass screw, preferably with a milled head, and in the end drill a small hole and solder in a short piece of silver wire from the watch-chain link, leaving about 1/16in. projecting as shown in Fig. 4. Fix the bracket to the baseboard, in the position shown in Fig. 1, with a small round-headed brass screw and a terminal. Make sure that the end of the silver wire on the contact screw touches the centre of the silver disc on the armature spring when the latter is in its normal position. Another terminal can be screwed into the baseboard near one corner as in Fig. 1.

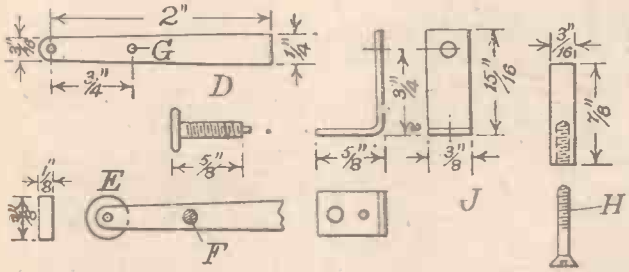


Fig. 4.—Armature spring, supporting pillar, contact screw and bracket.

Connections

Before making the connections it will be as well to form the free ends of the windings into spirals as indicated. This is easily done by winding the wire round a smooth wooden or metal rod about ⅛in. diameter. A more "business-like" appearance is thus given to the coil.

With the aid of a penknife, bare each end of the covered wire and fix one end of the thicker wire under the terminal near the corner of the baseboard. Clamp the other end of the thicker wire under the brass pillar which supports the armature spring. The ends of the finer wire, or secondary winding, are clamped under two terminals which also take the ends of the flexible leads attached to the hand-grips.

The coils can now be tested by connecting up to a single dry cell, the leads from the latter being connected to the two terminals at the ends of the primary winding as shown in the circuit diagram, Fig. 5.

On adjusting the contact screw so that the silver point presses lightly against the contact disc on the armature spring the latter should vibrate at a rapid rate, and continue to do so as long as the current is flowing. This indicates that the primary winding is all right. Now place the tip of a finger of each hand lightly on the two terminals attached to the secondary winding, when a slight shock will immediately be felt.

For the hand-grips, obtain two pieces of thin brass tubing about ⅝in. diameter and 4in. long. A piece of twin-flex wire, 2ft. long, serves for the connecting leads. The wire is opened out at each end, two of the ends being soldered to the grips inside one end. The strands of wire at each of the other ends, after being twisted together, can be dipped in some flux and soldered, so forming solid ends for clamping under the terminal screws.

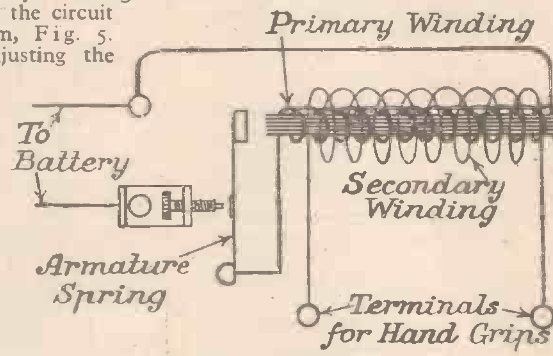


Fig. 5.—Circuit diagram.

Finishing Metal Surfaces—Cellulose and Synthetic

Methods of Applying Cellulose and Synthetic Enamels

By J. H. OUSBEY

THERE are two methods of finishing metal surfaces without the use of elaborate plant. These methods are (1) cellulosing and (2) enamelling with synthetic enamels.

Cellulose is normally applied by spray, whilst synthetics can be brushed or sprayed.

Preparation

1. Metals are prepared in the same manner for both kinds of finish, and the aim is scrupulous cleanliness and freedom from grease.

2. Where metal surfaces have been welded, soldered or brazed, there is a danger that some of the various fluxes used will lurk in cracks and defects, and later, either hinder the paint from drying or cause it to blister if it does dry.

3. To help combat these fluxes, it will be advisable to wash the metal well with paraffin or petrol, scratching the surface with either a wire brush or coarse emery cloth to clean any rough places. If paraffin is used finish off with turpentine substitute and wipe dry and clean.

4. All very smoothly finished metals such as aluminium need the surface made rough with emery cloth so as to provide a "key" for the paint, otherwise flaking and chipping will occur later on.

5. Galvanised iron does not readily take cellulose or paint and has a marked tendency to cause any coating to flake off, due mainly to saponification of the paint film.

6. A "mordant" is required to etch the surface sufficiently to take the finish it is proposed to apply. Formula for such a mordant is as follows:

To make approximately 1 gallon of Mordant.

Industrial spirit	5 pints
Toluol	2 ,,
Spirits of salts	½ ,,
Carbon tetrachloride	½ ,,

7. After applying this solution and allowing to remain on the surface for about 10 minutes, wash off with warm water and dry well.

After the preparation stage, the method has to be decided, cellulose or synthetic, the two cannot be mixed.

8. As soon as the cleaning is complete the work should be put into the first coat of primer to avoid the surface acquiring more grease from being handled or rust from exposure.

Spray Equipment

The spray plant will vary, according to amount of work being tackled, from a very small 1 cylinder model with a fractional h.p. motor to a large garage sized compressor with a 60 to 80 gallon tank and a large powerful motor with self-starting and stopping device.

Whatever the model or make, however, efficient spraying cannot be hoped for unless the plant can reach and maintain at least 50 lbs. per square inch; working pressures vary from 50 to 70 lbs. per square inch according to the type and consistency of the cellulose or paint being sprayed.

Guns.—The best guns are the suction or pressure feed type. There are too many disadvantages with the gravity fed type with the cup on top, the chief disadvantage is that the gun must be held upright.

When spraying, keep the vent hole on top of the container free from cellulose or paint.

The gun is held at a distance of 6 to 9in. from the work and a little experience will show the correct distance for each part of a job.

Spraying

The first coat is the primer, which is made to adhere to bare metal and may have a red lead base. Allow ¾ of an hour to dry before applying the next coat, which is a filler.

The condition of the metal decides how many coats of filler, from one for pressed steel to three or four for castings is the rule, 65 per cent. filler, 35 per cent. thinners being the usual consistency.

Lightly rub down with waterproof abrasive and spray on the colour until solid, allowing not less than 20 minutes between coats.

Snags to Avoid

Runs.—If a run occurs and the article is too large to permit of wiping all the cellulose off and re-spraying, allow to dry and rub down with abrasive paper and then re-spray the portion affected.

Patches not Dry.—If some parts remain tacky the remedy is to dab on some sub. turps. and leave for an hour or two, if successful re-spray to cover the marks left by the turps., if not it will be necessary to strip the affected part and start again.

Blooming is a common fault with cellulose and usually occurs through spraying in a damp place with no heat. The remedy is to get some heat on and re-spray, first with thinners alone, then carrying on with the colour.

Polishing

If a matt cellulose lacquer has been used and it is desired to polish it, use the abrasive compound supplied by the makers of cellulose lacquers and apply with soft cloths so as not to scratch the finish in any way.

A wax polish will give added lustre and protection to the finished surface.

Synthetic Enamels

The virtue of synthetics is that whilst they are not quite as hard as cellulose in as short a time, they have better drying qualities than ordinary enamels, and are less trouble to apply.

Prepare as described for cellulose, and prime with the primer supplied by the makers; or a red lead primer with no gloss is permissible. One of the most successful ways of applying synthetic enamels is that of spraying the undercoats and brushing the finishing coats.

The undercoating goes right on top of the priming, and a little sandpapering will be necessary after this coat is dry before putting on the final coat of finishing enamel.

If more than one coat of finishing enamel is proposed, the first should be well brushed out so as to dry hard for the final coat.

Synthetic varnishes are obtainable but are not advised on such colours as creams, greys, etc., as even the palest varnish turns these colours yellow in time.

When spraying synthetic enamels they should be thinned with the thinners provided, or with the best sub. turps. available. 10 per cent. of thinners is the limit, beyond which the obliterating power of the paint is reduced considerably.

After completion of any article in synthetic it is advisable to leave untouched for about 24 hours.

THE WORLD OF MODELS

Model Work at Exhibitions : Architectural Modelling in Sweden

By "MOTILUS"

AT the end of the year we all look towards the New Year, but at the same time some of us like to dwell for a short space on what the past twelve months have meant to us in our hobbies, and to recall our own particular achievements since we last looked forward to a New Year. As this space is devoted to the "Model World"—and I feel readers will agree that it has been a wonderful year for modellers—I would like to take this opportunity to revive memories of some important events in our "miniature" sphere, including some that have been mentioned in these pages since last January.

Fig. 1.—A peep at the Aircraft Section of the Model Engineer Exhibition, 1947. This section seemed to fascinate the younger generation more than the older model fans who still cling faithfully to their old loves, train and ship models.

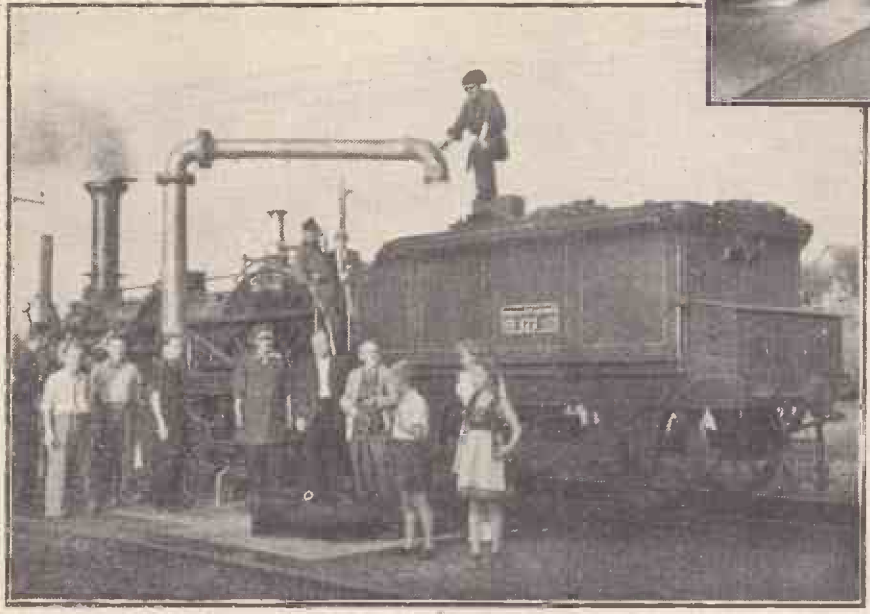


Fig. 2.—The French "Crampton" locomotive that was sent to Switzerland for the Swiss Railways Centenary celebrations. This photograph was taken while the locomotive was taking water at Brugg, near Baden.

Various Exhibitions

The item having claim to first mention is, without doubt, the Model Engineer Exhibition, the most popular "get-together" of the Model World in this country, which also attracts many of our friends from overseas. An innovation was made this year in the general layout of the Exhibition : The trade stands were arranged apart from the Competition and Loan Sections, which were in the centre of the hall. Also, in place of the familiar passenger-carrying railway there was a working models arena at the far end of the hall which provided for a display of model aircraft, power boats and racing cars. Workmanship was of an even higher standard than in previous years, exhibits were more numerous and trade stands showed signs of gradual return to pre-war production (Fig. 1).

The Model Railway Club Exhibition, held in the Central Hall, Westminster, in April, drew large crowds, although not so comprehensive a show as the Model Engineer Exhibition. The now familiar model railway running track is still a firm favourite and never lacks enthusiastic passengers.

The Shipwrights Exhibition, held in February, was an occasion when the finest collection of ship models ever brought together in this country was to be seen at the Royal Horticultural Hall, London. The models displayed were mostly professionally made, either by specialist firms or in the modelling departments of the various shipbuilding yards. Not only ship models, but many technical devices used in modern marine engineering were demonstrated here, and a series of lectures, covering many phases of shipbuilding and ship operation was given in the Lecture Hall.

A place among the "classics" must also be given to the Marine and Engineering Exhibition held at Olympia this autumn where some remarkably good models were to be seen on the stand of Messrs. Burmeister and Wain, of Copenhagen. The Welsh Exhibition was running simultaneously at Olympia, where there was again some splendid model work, although I must confess that my attention was rather distracted from my notebook during my visit there, by the delightful Welsh puppies and the charming, friendly little Welsh corgis. I forgot the "Model World" for a short time while admiring some of their sagacious tricks.

Another Exhibition which gave publicity

Fig. 3.—A Swedish architectural modeller at work in Stockholm. All the working modelmakers I saw in Stockholm were dressed similarly in white overalls and white peaked cap. This looks very smart and I presume the peak on the cap is to shade the eyes.

Fig. 4.—A vertical steam engine and boiler, built by Mr. Hare, secretary of the Percival Aircraft Model Engineering Society. This is Mr. Hare's first attempt at metal work.

to the use of models was that of the Institute of Marine Engineers. One of the most outstanding models was the sectional replica of the R.M.S. "Queen Elizabeth." This detailed exhibit showed the engine room and machinery of the great "Queen of the Seas," including her boilers, turbines, electrical plant, pumps, generating plant, etc. The work of Messrs. Bassett-Lowke, Ltd., it was made to a scale of ¼in. to the foot, and could be distinguished as one of the finest models showing the construction of a ship's interior mechanism.

To emphasise the success of model-making in its newest phases—those of aircraft and cars—mention must be made of the Eaton Bray Aerodrome and Car Track where so much has been accomplished in the past twelve months. New records, larger crowds and much fine work has been seen at this Mecca of all aircraft and road vehicle modellers.

During the summer, model-makers in Switzerland had a gala season on the occasion of the Swiss Federal Railways Centenary. Readers will recollect glowing accounts of this event in previous issues of PRACTICAL MECHANICS, and it will be remembered that great interest was shown in the travelling exhibition which toured the country and which contained a large number of railway models. Of these, many were made by members of well-known Swiss clubs, to illustrate the progress made in Swiss railroading in the last hundred years. Among the full-size locomotives used in the celebrations was a French "Crampton" locomotive, brought over from France for the occasion, and which is seen in the illustration (Fig. 2). Standing on the engine are the French driver, Mr. Walter Brast, and the French fireman. Mr. Walter Brast is one of the "Brast Brothers," the keen model-makers of Lucerne, about whom I have written in previous issues.

Model Making in Sweden

Another country which can boast a fine fellowship of model-makers is Sweden, where I was able to pay a short visit this year. The Swedes are principally interested in architectural and ship modelling (Fig. 3). While over there I visited two museums, the Marine Museum at Stockholm and the more historic one at Gothenburg. I found them both well planned and displayed and full of good examples of both ancient and modern ship models and equipment. When it comes to architectural modelling, the Swedes differ from us in their method of showing contours on landscape. Instead of making a realistic appearance as we do in this country, they reproduce on the model the contours of the ordnance survey map, so that the undeveloped part of the model is covered with what looks like a series of regular, thin steps, covering the various undulating areas. This tends to give the finished model a rather peculiar appearance, but the Swedish architects maintain that this is a simpler and more satisfactory way of showing contours on the land than a realistic presentation of a hilly countryside.

Fig. 5.—Model hydroplane, "Trailblazer," powered by a 2.5 c.c. compression ignition engine. The model was designed and built by Mr. A. M. Welter.

In our own country, model clubs and societies have been increasing in quality and quantity, and whether formed in works, district or school, great strides are evident. Mr. George Archer, previously mentioned in these pages, who is now group apprentice instructor for Messrs. Percival Aircraft, Ltd., has sent me some interesting photographs of the work of members of the Percival Aircraft Model Engineering Society. These photographs cover a large range of subjects, but illustrated here (Fig. 4) is the first attempt of Mr. "Bunny" Hare to work in metal a vertical steam engine and boiler. This model has been built on a total cost of 3s. for materials, and as it was constructed for the purpose of gaining experience for more ambitious metal work, it is a very creditable effort. I congratulate Mr. "Bunny" Hare and prophesy that we shall be hearing further from him in the future.

This year Northampton had its first model

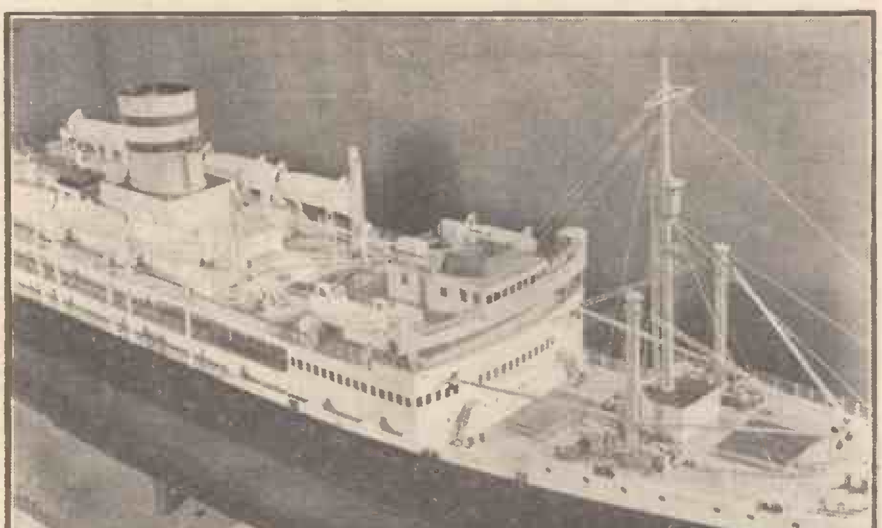


Fig. 7.—A close-up view of the forward portion of a model of the new passenger ship, "Patria." This ship was built by Messrs. John Brown, of Clydebank, for Cia. Colonial de Navegacao, of Lisbon.

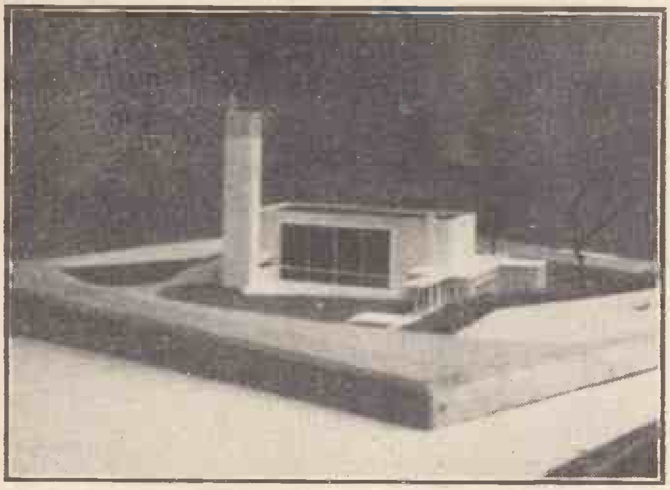


Fig. 6.—An original design for an Anglican Church, by Mr. H. C. Ward, of Leicester School of Building and Architecture. The design and the 1/16in. to the foot model were both Mr. Ward's work.

exhibition, an excellent effort on the part of the Northampton Society of Model Engineers, which met with well-deserved success. Held in the Guildhall, it presented an impressive array of work for a Society that has so recently been reorganised after enforced dormancy during war years, and drew large crowds during its "run" of three days.

The exhibits were divided into sections for locomotives, ships, aircraft and open competition, and the entries in all these totalled over 40 in number, all showing a good standard of work. There were also over 60 loan exhibits contributed from Northampton and district. A novel feature at the Exhibition was a cast-iron tank for the demonstration of model power boats, and there was also a working model railway.

Messrs. Bassett-Lowke, Ltd., offered a silver challenge bowl for the best model combining original design and fine workmanship. A unique model hydroplane, designed and built by Mr. A. M. Welter, a native of Switzerland, who has made his home in Northampton and who is chief designer at one of the shoe factories. The model, named "Trailblazer," is illustrated in Fig. 5. Built of balsa wood, the floats are planked and the body is also planked inside and outside. The seats in the interior of the 'plane are of stainless steel and there is a motor in the tail end, a 2.5 c.c. Dyno compression ignition engine. The hydroplane is not intended for racing, but for passenger-carrying on lakes or rivers, and is well suited for the conveyance of passengers from seaplanes to terminals.

This was only one of a variety of excellent models shown, and as the attendance during the three days the Exhibition was open was so high, the organisers have decided to make this an annual event.

Leicester Students Model Work

Visiting Leicester to assist in judging some models made by the students of the Leicester School of Building and Architecture I found the students there very keen on this work, and they designed as well as made their own models. The school is a very progressive part of the Educational Department of the city, and every encouragement is given to the students in this hobby. Consequently the work is of a very high standard, and some of the designs showed promise of great things. The Anglican Church model made by Mr. H. C. Ward was well proportioned, and was so simple in its detail that it reminded me of a modern Swiss church (Fig. 6). I wonder whether Mr. Ward has ever been to Switzerland?

News of professional model-making for the large shipbuilders also reaches me for my notebook. A very beautiful, detailed model of an entirely new ship, "Patria," has just been made by Messrs. Bassett-Lowke, Ltd., for the builders, Messrs. John Brown & Co., Ltd., of Clydebank (Fig. 7). This is a 12,500-ton passenger ship belonging to Cia. Colonial de Navegacao, Lisbon. She is fitted with a Brown-Sulzer turbine and will be used by the owners for service between Lisbon and East and West African ports.

In the commercial world generally it is very refreshing to note that materials are becoming gradually more numerous. Manufacturers are slowly getting into their stride, and most of the well-known model shops in London and the provinces are producing a better variety of goods. In most cases, although prices are higher, the standards are equal to those of pre-war days.

From this brief and not very comprehensive review, which only mentions some of the high spots of the year in the "Model World," readers will be convinced, without doubt, that model-making, both by amateurs and professionals, is very much alive, and its appeal is much wider than it was before the war. This, I think, is due to the great number of people who, during the war period, took up the hobby as a relaxation from the strain of the times. These new devotees, as well as the older model-makers, are now finding that materials, drawings, castings and parts are more easily obtained and this is encouraging them to greater efforts. I sincerely hope that the New Year will bring larger supplies of materials of all kinds, finer models and an even keener interest in the hobby.

New British Radio Compass

THE Royal Air Force is to have a new radio compass, which is the most advanced instrument of this type yet produced. It was shown for the first time at the recent Radlett Display and Exhibition.

The fact that this new radio compass has already gone into production will undoubtedly be pleasing news for past and present aircrew familiar, until now, only with an American instrument. Since it is understood that the radio compass will also be made available for civil aviation purposes, the news will, in fact, be of much wider, indeed of world-wide, interest.

In essence, a radio compass is a specialised receiver with specialised aerials, designed so that the signals received from a radio beacon, or other station, give a direct dial reading of the compass bearing of that station. Such bearings are used for navigational purposes in the ordinary way, or for direct homing to the site of the beacon itself.

The radio compass, which has been developed to meet the specification of the R.A.F. by Salford Electrical Instruments of the G.E.C., working in close collaboration with the Royal Aircraft Establishment, Farnborough, embodies most advanced electronic and "servo" practice, and takes the fullest advantage of the knowledge which the R.A.F. has gained by experience during recent years. Thus all remote controls are electrical so that no limit is imposed upon the distance between the various units, while the elimination of mechanical backlash reduces possible error.

The loop aerial, so familiar in its torpedo-shaped housing placed above the fuselage, takes on a very different, compact and flattened form, only a few inches in depth. For retrospective fitting to aircraft it is now housed in a shallow "blister" whose air resistance is one third that of the old standard loop and may, indeed, be less still. For incorporation in new machines, the loop is sunk into the aircraft body itself, with a cover moulded to the curvature of the fuselage, so that there is no projection at all.

Operation

In the operation of this type of equipment it is necessary to rotate the loop aerial to just that position where minimum signal is received from the beacon. With the new radio compass it is only necessary to tune in the beacon and the rest follows automatically—the loop takes up its correct position and the indicators for both pilot and navigator give their readings of the bearing.

If, for some reason, this automatic operation is not required, the loop may be driven round under manual control and the operator may determine the minimum signal position aurally. Both for tuning and for driving the loop, the operator has only to turn a small knob. If he turns it far, operation is rapid. If he slacks it back, movement is gradual, and if he turns it the other way, all movements are reversed. The whole operation is thus completed in a matter of seconds.

These are merely some outstanding features more readily appreciated by the layman. For the flying man there are other aspects of equal interest—the general presentation, for instance, and, particularly, the accuracy of the whole instrument, which is of the order of one degree or less—an exceptional achievement on the part of the engineers concerned both with the conception and development of this new British navigational aid.

Letters from Readers

Trisection of an Angle

SIR,—There appears to be a considerable amount of misapprehension on this subject. Most people when putting forward a solution to this problem say that it is usually regarded as being impossible of solution geometrically. The Greek Geometers (of whom Euclid was one) regarded geometry as an intellectual pastime and laid down certain rules for the playing of the game, and they said that within these rules there was no general method of trisection of an angle, and within these rules there is no general solution known to-day.

The chief rules are that, apart from the writing instrument (usually a pencil), the only tools permitted are a straight-edge (as distinct from a measuring "ruler"), and a pair of compasses; it is not permitted to measure any dimensions, nor is it permissible to transfer any dimensions. Most solutions break down on this last rule, as does the solution given by R. Rhodes in the October issue, as he transfers the dimension OE to EF and FG.

A simple device is sold at stationers' shops by means of which *any* angle may be divided into *any* number of *equal* or *unequal* parts. Its name? A protractor.—DERBIAN (Barking).

SIR,—May I correct G. H. Child on his two statements in a recent issue of PRACTICAL MECHANICS. Firstly, the method of trisection of an angle given by K. R. Saillard is perfectly true for *all* acute angles and can be proved geometrically as shown in the diagram, Fig. 1.

Given the figure in the May-June issue, join OC.

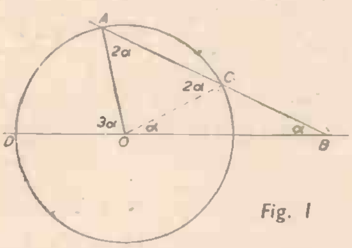


Fig. 1

Now, for the conditions of the trisection of the angle, OC = CB = radius of the circle

$\therefore \triangle OCB$ is isosceles and

$\angle COB = \angle CBO = \alpha$

Now since $\angle ACO$ is exterior to $\triangle COB$

$\angle ACO$ = sum of interior opposite $\angle$s $= 2\alpha$.

In $\triangle AOC$, OC = OA (radii of circle),

$\therefore \triangle AOC$ is isosceles

$\therefore \angle OAC = \angle ACO = 2\alpha$.

But since $\angle AOD$ is exterior to $\triangle BAO$,

$\angle AOD = \angle OAB + \angle ABO$

$= 2\alpha + \alpha$

$= 3\alpha$.

which is the required proof.

Secondly, G. H. Child is incorrect in stating that an angle cannot be trisected by geometrical construction.

It is well known that if we divide the base of an isosceles triangle into a given ratio, say m : n, and join the dividing point to the vertex, the vertical angle will also be divided in the ratio m : n.

A good method is as shown in the diagram, Fig. 2.

Given the $\angle BAC$ it is required to trisect this angle.

Construct an isosceles triangle ABD by cutting of equal parts on AB, AC.

Produce AD to X, and from D mark off three equal segments, DE, EF, FG. Join BG.

Now by ordinary methods construct FP, EQ parallel to BG.

$\therefore BP = PQ = QD$.

i.e., BD is trisected.

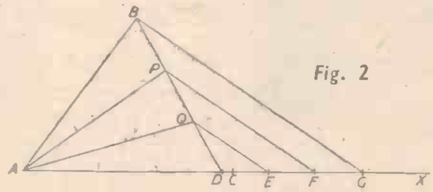


Fig. 2

Now join AP, AQ and any of the three angles so formed [$\angle BAP$, $\angle PAQ$, $\angle QAD$] is one-third of $\angle BAC$.—R. E. BRETT (Finchley).

SIR,—With reference to Mr. Rhodes's method of trisection in your October issue, this is interesting and fairly accurate; about 1 per cent. out at 60 degrees, tested by its equation

$\text{Tan } 2\alpha(2+\cos \frac{1}{2}\theta) = \sin \frac{1}{2} \theta.$

In regard to Mr. Coppelman's letter of the same page, I agree that $\theta/3$ satisfies the equation in this case, i.e.,

$\sin \theta = \sin \alpha \ (1 + 2 \cos \frac{1}{2}\theta + \alpha)$, but the construction is obviously inaccurate for large values of θ; as θ approaches 180° α should approach 60 degrees, but it approaches 0. I think Professor Burnside said about 40 years ago that the trisection was equivalent to solving a cubic equation graphically by noting where a line cuts a conic, and as it was impossible to draw the conic with compass and rulers, an accurate trisection was therefore impossible. If this is so, will one of your mathematically-minded readers kindly explain how it is that $\alpha = \theta/3$ satisfies the second equation above.—G. H. CHILD (Hove).

Fluorescent Paints

SIR,—On page 392 of the September issue of PRACTICAL MECHANICS it is stated in reply to H. Irvine (Edinburgh) that you do not know of any firm which is producing fluorescent paints.

May I point out that Messrs. Thomas Tyrer and Co., Ltd., Stirling Chemical Works, Canning Road, Stratford, London, E.15, manufacture fluorescent paints in a number of different shades. Whilst I have no actual experience of these, I certainly have had excellent results from their fluorescent varnishes, which are available in eight colours, all of which I have used recently. —J. POTTER (Whitley Bay).

Sailing Pools for Model Boats

SIR,—In your issue for October I noticed a photograph in "The World of Models" of Mr. Welter launching his model cabin cruiser from a rather high bank.

In the laying out of playing fields, I think that it would be a good idea if the model boat designer and sailer were catered for, by providing a basin with the surface of the water slightly above ground level.

This would be of great convenience, and it would provide a good view of the models and interest many who are not active participants in what is undoubtedly a most interesting and instructive hobby that appeals to all ages.—DONALD A. STEPHEN (London, W.).

Books Received

"The A.B.C. of Electronics." By E. B. Watton, A.M.I.E.E. Published by Percival Marshall and Co., Ltd. 134 pages. Price 7s. 6d. net.

THIS book is intended to meet the demand for a concise explanation of the scope and possibilities of electronics as related to everyday life. The treatment of the subject is, of necessity, brief, but the information given should prove particularly useful to the student and the general reader interested in the subject.

"Modelling the 'Archibald Russell'." By E. Bowness. Published by Percival Marshall and Co., Ltd. 84 pages. Price 5s. od. net.

SHIP modelling enthusiasts will find in this book all the information necessary to enable them to construct a model of what is recognised as one of the finest ships ever to sail the seven seas. The book is well illustrated with half tones and line drawings.

"Gear Wheels and Gear Cutting." By Alfred W. Marshall, M.I.Mech.E. Published by Percival Marshall and Co., Ltd. 92 pages. Price 3s. 6d. net.

THE purpose of this useful handbook is to describe the various types of gear wheels in general use for the transmission of motion and power, and to explain the principles which govern the formation and number of the teeth for a given mechanism. The earlier editions of this handbook enjoyed considerable popularity by reason of the simplicity of its treatment of the subject and, no doubt, the present revised and enlarged edition will be equally popular.

Other books recently received from Percival Marshall and Co. are:

"How to Make an Electric Clock." By R. Barnard Way. Price 3s. od. net.

"The Atom Minor, Mark III." By Edgar T. Westbury. Price 3s. od. net.

"Practical 'Two-Rail' Electrification." By Ernest F. Carter. Price 3s. 6d. net.

"Planning and Layout." By Henry Greenly. Price 3s. od. net.

"How to Make a Telescope." By Ernest F. Carter. Price 3s. od. net.

Club Notes

Eccles and District Model Engineering Society

RECENTLY, at well-attended meetings held in the club room of the above society, interesting lectures were given as follows:

October 26th: The Steam Engine. By W. J. Thompson.

November 9th: Fabrication. By W. Taylor.

November 23rd: The Steam Engine (continued). By W. J. Thompson.

On December 7th various members will take part in current work on hand, and on December 21st there will be a jumble sale.—W. J. Thompson, hon. sec., 16, Prestwood Road, Salford 6, Lancs.

Our Cover Subject

THE liner *Orcades*, of 30,000 tons gross, built by Vickers-Armstrongs at their Barrow-in-Furness works for the Orient Steam Navigation Company, was launched recently by Lady Morshead. The *Orcades* will be the largest ship to be launched in the world since the end of the war. The previous *Orcades*, of 23,500 tons, launched from the same yard late in 1936, was torpedoed and sunk in the South Atlantic in 1942 after a struggle lasting three hours.

The illustration on the front cover shows the liner on the stocks, dwarfing the two-storey building in the foreground.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back of cover, 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.

Plumbago Crucible

COULD you please tell me where I can obtain materials for a plumbago crucible and the correct mixture for same? I am melting aluminium and propose using dry sand for the moulds. I have a quantity of "Pyruma," water glass and plaster of paris. Is this of any use as a bonding agent?—J. A. Wood (Harefield).

IN making a plumbago crucible, mix equal parts of plumbago and fireclay to a stiff dough. Keep this in a cool place for three days, and knead it frequently, when it will become more plastic and less sticky. The clay should be almost too stiff to work at the time of moulding.

Use an iron or steel mould with a central plug or core to fit it. Fill the mould with the moulding mixture. Then hammer the plug or core in to form the hollow of the crucible. The mould is kept in a warm place for a few days, during which time the formed crucible will gradually harden and contract; thereby making its removal from the mould fairly easy. Finally, after removal from the mould, the crucible should be put aside for two weeks in a warm place to complete its drying and setting. When used for the first time, it should be very gently and slowly heated.

Pyruma mixed with plumbago *might* form a serviceable crucible, but plaster of paris would be useless.

Plumbago can normally be obtained from the following firms: Messrs. Wm. Cumming and Co., Ltd., Kelvinvale Mills, Maryhill, Glasgow; Messrs. Thomas Hill-Jones, Ltd., Invicta Works, Bow Common Lane, London, E.3; The Morgan Crucible Co., Ltd., Battersea Works, Battersea Church Road, London S.W.11. The last-named firm supplies ready-made plumbago crucibles in various sizes.

Luminous Powder

COULD you supply me with a formula for making a good luminous (phosphorescent) powder? I have prepared such powders from the sulphides of the alkaline earth metals containing minute quantities of heavy metal compounds such as bismuth and uranium, but the luminosity (even after long exposure to sunlight) was invariably weak.

At the same time I would be obliged if you would inform me how such powders are made up into luminous paints.—D. J. C. Pirie (Peterhead).

WE can only give you formulæ for luminous powders such as you obviously have worked from. Since you report that your trials have not been very successful (which is often the case), we suggest that you purchase a small amount of a good luminous compound, such as luminous zinc sulphide. This can be obtained (priced about 5s. per oz.) from most laboratory supply houses, such as Messrs. Griffen and Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2, or Messrs. Vicsons and Company, 114, Pinner Road, Harrow, Middlesex. Permanently luminous compounds containing radium may also be obtained at a much higher price—say, about 20s. per gram.

To make up luminous paints from any of these powders, use clear oil varnish or cellulose varnish. This should be obtainable from a local paint store. Alternatively, you may make a suitable cellulose varnish by dissolving scrap celluloid in a mixture of equal parts of acetone and amyl acetate, but, since these solvents are very difficult to obtain at the present day, you would be advised to purchase your clear varnish ready. If you cannot obtain such material locally, try Messrs. James Beard, Ltd., 16, Great Ancoats Street, Manchester.

The reason why your luminous powder formulæ have not given you the success you desire is because commercial luminous powder manufacture is a secret process, and it is quite impossible to imitate it on a home scale.

Spray Painting Metal Sheet

I HAVE spray painted some lead-coated iron sheet with cellulose paint, but when dry I find it peels off. What can I do to make it adhere firmly?—J. H. Johnson (Erdington).

UNLESS your sheet metal is excessively greasy, the cause of the subsequent peeling seems to lie in the quality of the paint used. It may not be flexible enough. Try adding a very small amount of castor oil to it (a few drops to a gill) and see if this makes any difference.

If not, it may be that you are not sufficiently degreasing your metal surface before the application of the paint. Scrub the surface down with a hot medium-strength solution of caustic soda or soda ash. Rinse well with water. Then allow to dry. Paint applied to this surface should hold well. If it doesn't, try matting the surface with sandpaper, if this operation is convenient. If otherwise, you will have to apply a very thin coating of an oil-bound priming paint and, after it has dried, to cellulose over it.

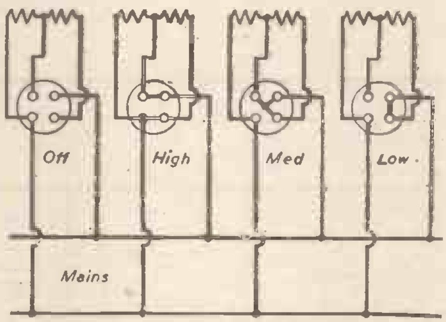
Electric Heater Control

WILL you kindly advise me on the following problems?:

Two 750-watt heater elements are to be connected to a control switch which has the following settings: high, medium, low and off. There are four terminals in the switch which have these markings: 4RL—3C—1L. I would be grateful if you could give me the circuit for operating on 500 v. and 250 v.

I have a small medical heater apparatus. There are two heater elements and two carbons which are all connected in series. The elements turn, but I cannot get the carbons to strike. I have fitted two new carbons, but with no success. Will you kindly give me the circuit, also any other reason for the fault? This apparatus is working on 250 volts.—C. W. Smith (Tottenham).

APPARENTLY the switch is arranged to connect the two units in series for low heat, one unit alone in circuit for the medium heat, and the two units in parallel for high heat, as indicated in the sketch. Assuming the elements are rated for 250 volt,



Circuit for a medical heater apparatus.—(C. W. Smith.)

the above connections would be used on a 250 volt supply. For use on a 500 volt supply only one connection would be possible, i.e., with the two elements in series. With such a connection the rate of heating would be the same as obtained with the two elements in parallel on 250 volts, i.e., "high."

Assuming your carbons are of the correct size and type for the supply, and that the connections are correct, it is possible that the arc may be short circuited. In this case the heaters would be "on" even when the carbons were not in contact with each other. Another possibility is that the two heating elements should be connected in parallel with each other and in series with the arc. In this case the present connection would not allow the elements to reach their correct temperature.

However, we think it most likely that the carbons are not of the correct type, and would advise you to obtain new carbons from the makers, if you have not already done so. Note that metal electrodes require D.C.

Glazing Pottery

I WOULD be most grateful if you could tell me by what process such articles as cups, plates, etc., are treated externally, and what is the composition of the "glaze" used—also whether the materials are obtainable, and from whom?—R. R. Steavenson (Circencester).

UNLESS you have considerable knowledge and experience, you will not be able to glaze pottery yourself.

In principle, the finely powdered glaze is mixed with water to a thin cream. The pottery is dipped into this cream, allowed to drain. Then it is "fired" in electric ovens at a temperature of 800 deg. C. to 900 deg. C. for several hours. During this process, the materials of the glaze unite together and form a species of soft glass which runs in a uniform film over the pottery article. The furnace is then slowly cooled down and the glazed articles withdrawn.

The colour and various other glaze materials may be obtained from Messrs. Wengers, Ltd., Etruria, Stoke-on-Trent, and from various other ceramic firms in the Potteries district.

A typical glaze composition is the following:

White lead	13 parts (by weight).
Feldspar	20 "
Zinc oxide	3 "
Plaster of paris	1 "
Flint glass	13 "
China clay	2½ "
Paris white	1½ "

Glaze compositions vary enormously. Their compositions depend on the character of the potting clay, the character of the glaze which is required, its hardness, softness, opacity, colour, and on many other factors. It is, therefore, quite impossible to formulate a sort of universal glaze which would be applicable in all cases.

If you are interested in the practical side of potting, the following books would be of use to you:

C. F. Binns: "Manual of Practical Potting."
S. W. Anthonies: "Pottery and Modelling."
H. Barnard: "Art of the Potter."
C. F. Binns: "The Potter's Craft."
R. Lunn: "Handbook of Practical Pottery."
H. and D. K. Wren: "Handicraft Pottery."
C. J. Cox: "Pottery for Artists, Craftsmen and Teachers."

Astronomical Telescope

I WOULD like to construct an astronomical telescope of suitable power for the scanning of most planets, etc. What magnification must I use, and what is the cost of objection and eyepiece? How will I be able to determine "body-length"?—S. Cheetham (Bath).

WE presume that you wish to make a telescope which will enable you to examine all the astronomical "exhibits" such as the phases of Venus, the satellites of Jupiter, the rings of Saturn, and so on. For this purpose, the instrument should carry an object glass of 3in. or, at least 2⅞in. diameter, and the instrument will want a body length of from 3½ft. to 4½ft., depending on the exact focal-length of the object glass. A simple (non-erecting) astronomical eyepiece will also be required.

At the present time it will be very difficult for you to make such an instrument yourself in consequence of the shortage of materials. If, however, you can procure a suitable objective and eyepiece, together with a long brass barrel and at least one sliding tube carrying the eyepiece, you will certainly make a success of the task. Your best plan is to write to one or two suitable firms asking for quotations for object glasses and eyepieces, or, alternatively, for complete instruments secondhand.

Suitable firms are: Messrs. Broadhurst, Clarkson and Co., Ltd., Farringdon Road, London, E.C.4; Messrs. C. Baker, High Holborn, London, W.C.

It is impossible to give you any exact idea of present-day prices. They are greatly in advance on pre-war costs, when it was possible to purchase a *new* telescope of the above description for about £7 10s. You might be able to pick up a 3in. objective for three or four pounds, and an eyepiece for half that amount. But, unfortunately, as in the case of all scientific instruments, the demand is great and the goods are few.

Silvering Plastics

I SHALL be pleased if you will give me any information on the possibilities of silvering transparent plastics, and the best way to obtain a

frosted effect on them. I require curved mirrors of no great accuracy, so any details of the most suitable material would be very welcome.—A. Slack (Macclesfield).

MIRRORS can be produced on the surface of most plastic materials by methods used for the silvering of glass, particulars of which can be obtained from any standard book of recipes and formulæ.

A typical silvering formula is the following:

SOLUTION A

Silver nitrate .. 60 grains
Water .. .. 1oz.

Pour this solution quickly into a boiling solution of 48 grains Rochelle salt in about 1oz. of water. On cooling, filter the liquid, and make up to 12oz. with water.

SOLUTION B

Silver nitrate .. 60 grains
Water .. .. 1oz.

Add ammonia drop by drop until the precipitate which is first formed almost (but not quite) re-dissolves, leaving a faint milkiness in the liquid.

For silvering, mix equal amounts of the above solutions and pour them on the surface to be silvered.

Use distilled water for making up the solutions if possible. The plastic surface must be perfectly grease-free.

Silver does not adhere as well to plastics as it does to glass, in view of the difficulty of wetting the plastic surface. It is an aid to pour a solution of stannous chloride over the plastic surface just before silvering.

To obtain a frosted effect on a plastic surface, merely apply to it a paste of silica and water. Rub in all directions beneath the fingers and then wash the paste away.

If the plastic material is soft, ordinary glasspaper will give the required matt surface.

Electric Soldering Iron

I HAVE an electric soldering iron for 110 volt mains which I wish to use on 220 volt mains. Please inform me if this could be done by including one 110-volt lamp in the flex leads.—W. G. Jones (London, E.C.).

THE soldering iron could be operated from the 220 volt mains in series with a suitable resistance; a lamp could be used as the resistance if one of the correct rating can be obtained. This should be a 110-volt lamp of wattage equal or very slightly lower than that of the soldering iron. The size of lamp can be taken as correct when the measured voltage across the iron or lamp is 110 volts or the lamp lights with normal brilliancy.

If the mains are A.C., a 220-volt iron could be operated from 110 volts through a transformer. Alternatively, the iron element could be rewound with wire having half the cross-sectional area of the present wire and four times the present resistance, i.e., if the same type of wire is used the new element wire should be half the present cross-sectional area and twice the present length.

Paints for Perspex

I WISH to obtain small quantities of paints (coloured and metallic finishes) which will adhere to clear Perspex.

Can you furnish me with names of suppliers of these and also favour me with the necessary formulæ for making them myself?—M. F. Jones (Bewdley).

THE paints which you desire are not commercially obtainable. You can make them for yourself by dissolving clear scrap Perspex in trichlorethylene (obtainable from Messrs. A. Boake, Roberts & Co., Ltd., Stratford, London, E.15, or from Messrs. W. & J. George & Becker, Ltd., 157, Great Charles Street, Birmingham, 3). When a solution of syrup-like consistency has been obtained, dry paint colour or metallic powders are ground into the material, the whole then being squeezed through muslin. Paint prepared on these lines will adhere well to Perspex.

Metallic powders for paint-making are obtainable from Messrs. John & Bloy, Ltd., Metana House, Hind Court, Fleet Street, London, E.C.4. These powders are somewhat expensive.

Cleaning Oil Paintings

I HAVE some oil paintings which are becoming faded and dusty-looking. Can you suggest any method for cleaning these in order to freshen up their appearance? If some special solution is required, could you please inform me where it can be bought, or how it can be made?—A. England (Kirkham).

OIL paintings are very difficult to restore, and if yours are valuable, your best plan is to wash them well with soap and warm water; dry them and hang them in a good light, thereafter leaving them well alone.

There is no chemical method which you can apply to freshen up the paintings.

When an oil painting becomes dirty and faded and dusty-looking, the cause is generally due to the accumulation of dirt on the surface or else a yellowing of the varnish. The dirt is readily removed by washing with soap and water and, perhaps, with a little soda dissolved in the water. If the varnish is yellowed, if it has cracked and become darkish and brittle, the best thing to do is to remove it completely and to re-varnish the picture.

It is here that the tricky business comes in, and unless you feel that you can afford to experiment on the picture, we should not advise you to proceed further.

However, the varnish can be removed by gently roughening the surface in a local area and then by rubbing it with the bare finger-tip. If the varnish is at all brittle, this will serve to powder it up and bring it away. Very fine glasspaper may also be used for the same purpose. Great care must be taken not to "dig" down on to the canvas too deeply for fear of removing the actual paint below the varnish.

A good picture varnish may be made by dissolving gum mastic in about double its bulk of pure turpentine, the turpentine being used warm. The resultant product should have the consistency of thin syrup. This varish is spread thinly and evenly over the picture with a very soft brush, and the picture is then put aside for the varnish to dry, which takes about six weeks.

Gum mastic, unfortunately, is very expensive at the present time, but it can be obtained from any wholesale chemical house, or from a good firm of artists' materials dealers, such as Messrs. Winsor & Newton, Ltd., 38, Rathbone Place, London, W.1.

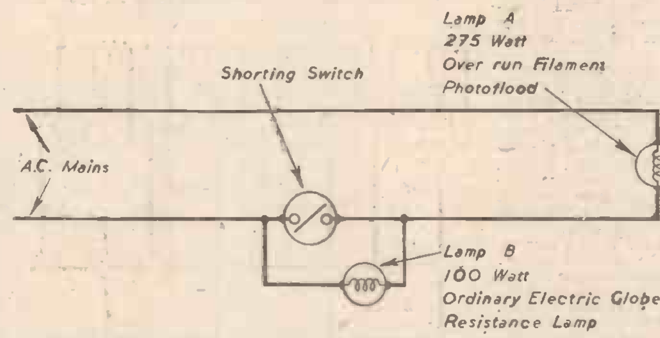
Please note that there is no quick and "easy" method of picture-cleaning and restoration. It is all difficult, slow, painstaking and sometimes very risky work. It requires experience, skill and, above all, patience. Do not try a prentice hand on any picture of value.

Circuit for Photoflood Lamp

I WOULD be obliged if you could give me some particulars relating to the enclosed diagram of a wiring circuit used for indoor photography.

Lamp A is a 275-watt over-run filament photoflood lamp, which if connected directly to the 220-volt mains would burn out in about two hours.

By dropping the voltage the lamp life is considerably increased.



Circuit diagram for a photoflood lamp showing the position of the 100-watt lamp used as a resistance.—(Wm. Grogan.)

The voltage is dropped by lamp B, which is 110 volt 100 watts.

Is it possible to put a wirewound resistance in place of lamp B?

The resistance is approximately 100 ohms and 1 amp. Could a resistance of 100 ohms to carry 1 amp be suitable?—Wm. Grogan (Liverpool).

IT is not possible to say exactly what value of resistance would be required, as the resistance of the lamp filaments will vary with the current and filament temperature. It would have been useful to know the current and the voltage at the 110-volt bulb or the 275-watt bulb. However, a 100-ohm resistance to carry 1 amp should be approximately correct. Since power is wasted in heat at such a resistance it is bound to get warm or hot. If a resistance of small gauge wire is used a short wire will be required and this will reach a high temperature; whilst a larger size of wire would run at a lower temperature but a longer wire would be needed. The heat generated would be the same in each case.

Twenty-five feet of 30 s.w.g. Brightray resistance wire, as supplied by Messrs Henry Wiggin and Co., Ltd., of Grosvenor House, Park Lane, London, W.1, would make a suitable resistance with probably a little to spare.

Staining and Polishing Bowls

CAN you describe a method of removing the old polish from a bowls "wood" without scratching or damaging the surface of the "wood"? Also, what is the polish used and how is it applied to repolish the "wood" with a black finish?—S. Fidler (Mountain Ash).

BOWLS are usually stained with a logwood preparation and subsequently given a wax polish which itself may carry a black stain. Sometimes, also, a thin film of shellac polish is also applied.

In your case, you will be able to remove the old polish by carefully scraping the bowls with the upturned edge of a copper coin. This requires patience, but the method will remove all applied surface without injuring the underlying wood.

You can then stain the bowls with a wax stain made by dissolving paraffin wax in turpentine containing an oil-soluble black dye, or you can make a logwood stain by boiling for two hours in an iron vessel 1lb. logwood chips, ½lb. green copperas, 1oz. nut galls, 2oz. lampblack and 1 gallon of water. This liquor is then strained and applied hot to the bowls. Two or three coats may be necessary. Finally, the bowls should be rinsed in cold water, allowed to dry slowly and then wax polished. A final thin coating of shellac varnish may be necessary if a very high gloss is desired.

If the preliminary scraping with a copper coin is too slow a process, soak the bowls overnight in a strong solution of washing soda. Then rub them over with fine sandpaper to remove the softened varnish.

Preparing Surface of Asbestos Sheet

I AM panelling a staircase in flat asbestos sheet, as I am unable to obtain wood.

Can you please inform me how to prepare the surface of the asbestos for painting so as to get rid of the "ripple" which seems to be a characteristic of this material?—J. B. Louie (Oldham).

WE think that you will have much difficulty in getting rid of the slight degree of "wave" or "ripple" which characterises the surfaces of so many sheets of the asbestos-cement type. This is because any thin coating of material which you may apply will always tend to follow the "ripple" and therefore to reproduce it on the newly-prepared surface.

The best treatment is as follows: Smooth the sheets down as much as possible. Then apply a thin "cream" of white Portland cement and water, using a brush for the purpose. Allow the coating to dry. Brush the surface with a dry brush. Repeat the process to build up the surface. After the final dry brushing give the entire surface a coating of glue size and over this a thin layer of some suitable priming paint or distemper. When this has set and hardened, you can apply your final coats of decorative paint to the surface.

Colouring Lino

I HAVE recently purchased a length of lino, but find that it is far too light in colour for the use it gets in a kitchen.

May I ask your advice on any method by which I may darken it, say, to a brown colour? I wish to avoid, if possible, the use of one of the many lino paints now on the market.—A. S. Bampton (East Dulwich).

TO darken your lino, merely make up a solution of a brown aniline dye in methylated spirit or, alternatively, in an oil-like turpentine or linseed oil. Brush this sparingly on to the clean lino surface and allow it to dry. The lino will be stained at once.

The exact strength of the dye solution depends entirely on the degree to which you desire to tint the lino. Bismarck brown and other spirit and oil-soluble dyes can be obtained about 1s. 6d. per oz. from any London chemical supply house, as, for example, Messrs. Griffen and Tatlock, Ltd., Kemble Street, Kingsway, W.C.2; or Messrs. W. and J. George and Becker, Ltd., 17-29, Hatton Wall, E.C.1.

CAN you advise me as to a method of preserving the cleanliness of such things as Indian ink drawings, mounted on white cardboard, cuttings and photographs from periodicals, etc.? I desire to "fix" them, and to prevent their becoming hand soiled.

I have in mind some kind of transparent liquid (not dangerous to handle) which can be applied with a brush and which would set hard.

Is there such a proprietary product, or a method of making up such a liquid?—C. E. Pilcher (Croydon).

DISSOLVE five parts of the best leaf gelatine in 95 parts of water and add to the solution a few drops of carbolic acid in order to prevent it from going mouldy. Use the solution warm (it will set to a jelly when cold) and, with a camel's hair brush, paint a thin layer of it gently over the surface of the drawing or other illustration which you wish to preserve. The solution will, in this manner, fill the pores of the paper and form a semi-matt surface over the illustrations.

An alternative method is to paint collodion (highly inflammable) over the illustrations. This liquid may be obtained from a local druggist, or it may be made by dissolving nitro-cotton in a mixture of equal volumes of alcohol and ether.

Celluloid solution may also be used for the same purpose. This is made by dissolving scrap celluloid in a mixture of equal volumes of amyl acetate and acetone.

In the case of any illustrations, drawings, etc., of commercial value we should think twice about applying any surface treatment whatsoever to them, since, in our opinion, any such treatment might reduce their value. After all, a good degree of protection can always be achieved by binding a sheet of clear Cellophane over the surface to be preserved, and this method has the advantage that the protective film is readily removable when required.

We do not think that any commercial preparations on the above-indicated lines are available, but an inquiry addressed to any well-known firm of art material dealers would soon bring you up-to-date information on this point. Two such firms are: Messrs. Windsor and Newton, Ltd., 38, Rathbone Place, London, W.1. Messrs. Reeves and Sons, Ltd., 18, Ashwin Street, London, E.8.

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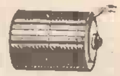

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Comments of the Month By F. J. C.

The Road Safety Campaign

MR. G. R. STRAUSS, M.P., Parliamentary Secretary to the Ministry of Transport, was the chief guest at the Congress of the Royal Society for the Prevention of Accidents, and the main theme of his speech was the Road Safety Campaign and the results it had achieved. It is not possible to relate reductions in road accidents to any specific remedial measure, but in support of his statement that the campaign has produced worthwhile results, he said that whilst in the second quarter of 1939 1,560 persons were killed on the roads and 58,722 were injured, in the second quarter of 1947 1,174 persons were killed and 43,154 injured. In other words, the 1947 figures are about 25 per cent. less than those for the similar period in 1939.

The number of vehicles licensed in the 1947 period was slightly higher than that in 1939, and so was the total fuel consumption. Neither roads nor vehicles are in as good a condition as they were before the war, and owing to the shortage of manpower the police are not able to devote as much attention to road traffic.

We do not agree with Mr. Strauss that there has been a "remarkable" drop in the number of accidents. He attributes the drop, such as it is, to the need to conserve vehicles and the difficulties in obtaining spare parts and tyres, which have led to more careful driving and to the Road Safety Campaign. It is, of course, impossible to segregate or to measure the effect of these two factors. It is natural that Mr. Strauss, as an official of the Ministry of Transport, should assume that the Road Safety Campaign has been the more important factor.

We do not think so. We think that one of the causes of the drop is the greater skill of drivers as a result of wartime training. We do not think, in view of the limitation of mileage imposed by petrol rationing, that so many miles have been travelled, and this would naturally account for a drop in the number of accidents. The average mileage covered by a motorist before the war was about 10,000 miles. Under the petrol rationing scheme it would be less than 5,000 miles.

The total fuel consumption, if as a fact it is in excess of 1939, can be accounted for by the fact that most cars on the road are old cars, and are not doing so many miles to the gallon, by the slightly increased number of vehicles on the road, and by the greater consumption for industrial purposes.

It would be wrong to assume that now the basic petrol rationing is withdrawn there is no longer the same need for the Road Safety Campaign. One effect of taking vehicles off the road will be to speed up the remaining traffic in busy streets, therefore the risk of accidents on those streets is not likely to be much less than it is at present.

The object of the campaign is to form enduring habits of safe and sensible road behaviour based on the principle that self-preservation is the first law of nature. The Road Safety Campaign, therefore, in our view should go on.

The Committee on Road Safety express the view that vehicle defects may have been a contributory cause of a larger number of accidents than is shown in the pre-war road accidents statistics. With this point of view we entirely agree.

As part of the American Road Safety Campaign a check was made by the United States police last year on nearly 3,000,000 vehicles. Of this number it was found that at least one-third were defective in some important respect. In this country the Road Traffic Acts enable technical officers of the Ministry of Transport to examine public service vehicles and goods vehicles.

As a part of Safety Weeks arranged by some local authorities the Ministry's technical officers have collaborated with the police in the inspection of goods vehicles on the roads.

Of 209 vehicles examined 108 were found to be defective, and in 53 cases the defects were sufficiently serious to justify prohibition of use of the vehicle. Steering and brake defects were the main faults.

The Committee on Road Safety, believing that those concerned with road accidents and their prevention should have complete information about the cause of accidents, has recommended in its final report the setting up of a comprehensive system of road accident statistics. This recommendation has been accepted by the Ministry of Transport.

Control of Pedestrians

IN the memorandum submitted by the Roadfarers' Club to the Ministry of Transport, several recommendations were made which have been adopted by the Committee. The Roadfarers' Club suggested, for example, that there should be control of pedestrians.

We hear too much talk about motorists being in charge of lethal weapons, and too little about the crass carelessness, leading to accidents which motorists cannot possibly avoid, on the part of pedestrians.

Roads are mainly made for vehicular traffic. In the name of road safety large numbers of experiments have been made and a number of regulations introduced controlling the use and construction of motor vehicles. Many of these experiments have proved failures since they have not materially affected the accident problem. We do not think that road traffic should be reduced to a farce if they fail in their object. The man most responsible for obstruction, which creates conditions under which accidents can occur was Mr. Hore-Belisha, who smothered the country with thousands of unnecessary traffic lights which do no more than to coagulate traffic instead of keeping it fluid and separated, and reduce speed to something little better than walking pace.

Pedestrians must be educated to the view that the roads are not specially made for them and that they cannot do what they like on them. If the Road Safety Campaign is really responsible for the 25 per cent. reduction referred to earlier, then we may expect a continuation of its beneficent influence, so that in a matter of five years the number of accidents will be negligible. It is fatuous to select the first post-war year, which is bound to show a reduction, anyway, and compare it with the year before the war. The time to assess the Road Safety Campaign is in three years' time when, if accidents continue to show a decline of 25 per cent. per annum there will be some justification for saying that the money and effort involved has been worth while.

At present we are of the opinion that a large amount of money has been wasted. The Road Widow poster, for example, has not, in our view, been responsible for preventing one accident, yet it has cost large sums of money.

Not until we have practical road users in the Ministry of Transport, not mere politicians and statisticians, will road affairs be sensibly directed and correct conclusions drawn. The traffic muddle in London, for example, is a scandal. If Ministry of Transport officials had to use the roads of London we have no doubt that the conditions would have changed a long time ago. But then, most Ministry of Transport officials, when they use a motor-car at all, are chauffeur driven in a State-owned car.

It is our view also that too much authority is given to the police in the matter of traffic control. They have power to close roads, causing the most chaotic traffic conditions, because of some mediæval ceremony like the opening of Parliament. What is required is less traffic control.

Scarcer Still

IN view of the export drive bicycles and accessories are going to be scarcer than ever. We think this is a mistaken policy on the part of the Government. The bicycle is the means by which hundreds of thousands of people get to and from their work. It is cheaper than any other form of transport, and relieves the public service vehicles of undue pressure during rush hours. Because many bicycles cannot be put into good service, an added financial burden is to be thrown on to the user and public services already overcrowded will be less comfortable than ever.

The bicycle is a door-to-door vehicle. Many workers reside in districts which may mean as many as three changes if public service vehicles are used. Apart from the shortage of new machines there is a greater shortage of spares. It is adding an extra and an unfair burden on workers to expect them to work harder than ever before as they have so often been exhorted to do by politicians quite out of touch with the public, and then to travel home by public service vehicles which take twice as long as a journey on a bicycle. The Manufacturers' Association have been pressing to have this position changed.

Paragrams

Not the Right Spot

A LETTER has been received by the Urban Council of Sleaford, Lincs, from a woman now living at Pampas, Queensland, asking if her husband's ashes can be sent to England and buried at the foot of his grandfather's monument, the Handley Memorial, which stands at the junction of Southgate and Boston Road, Sleaford. Unfortunately for the idea, the council is proposing to move the memorial because of the traffic congestion which it causes, and they are suggesting that the late Mr. Handley's ashes should find a resting place elsewhere.

Menaces!

DESCRIBING schoolchildren cyclists at Brigg, Lincs, as "menaces to themselves and other road users," a member of Brigg Road Safety Committee stated that boys make a habit of cycling through the town without holding the handlebars, at the same time either doing their homework or reading thrillers. The boys are greatly offended at the suggestion that they are so keen on homework that they do it while cycling, a thing no decent schoolboy would dream of doing. The committee has decided to draw the attention of local schoolmasters to their complaint.

Successful Season

C. A. CLAYSON, of the Leicester Forest Cycling Club, has won the club's last time trial of the season by covering the 25 miles in 1 hour 4 minutes 43 seconds and beating 27 other riders. Clayson has set up a record this season by winning every club event in which he has ridden, with just a single exception.

Conscientious

ALDERMAN W. H. HENNESY, of Bristol, has resigned from the town's Road Safety Council because he considers he is not fit to serve on such a council. He says he was once convicted of failing to observe a halt sign while he was cycling and he considers that no one who has been convicted of a road offence, however trifling, should put himself in a position to tell other road users how to behave.

Upset His Budget

WHEN stopped in Peterborough and told he would be reported for riding without a light a cyclist told the constable: "You will only summon me for riding without a light. They will only fine me £1—and I have £1." The magistrates later caused a crisis in his financial affairs by fining him 30s. and the chairman commented: "We shall have to revise our tariff."

It's a Free Country!

A DERBY soldier who appeared at a Huntingdonshire police court charged with cycling without a light appears to have strange ideas of the rights of the individual. To the policeman who stopped him he said: "If one cannot ride without lights it is a pity." Another rider who was charged with a similar offence wrote to the magistrates saying: "I took every precaution by riding on the footpath!"

Highway Code Criticised

THE recommendation of the Highway Code that motorists should not use headlights in built-up areas was criticised by the Nuneaton coroner at the inquest on a cyclist who was struck by a car and killed while on his way to his ambulance class. The motorist, who was driving with his side lights on, said he did not see the cyclist until after the accident and the first he knew was when he saw a light—later proved to be a cycle lamp—fly into the air. The coroner commented: "Properly dipped headlights dazzle no one. These accidents happen with sickening regularity and I shall always use my headlights. No one can see very far with side lights—parking lights they are rightly known as in Canada."

Where the Energy Goes

EXTENSIVE research work into questions relating to fatigue in racing cyclists and other athletes is being carried out in the Department of Physical Education of California University. In one experiment a cyclist pedals a stationary cycle and as he breathes his exhaled breath passes through a meter, while other devices measure increases in the beating of the heart and the onset of fatigue symptoms. Experiments have shown that smoking affects the steadiness of the hand and pulse rate but the research workers refuse to say whether or not smoking has any actual harmful physical effects upon the body.

Flowers — But No Bouquet

ALTHOUGH concrete, labour and apparently everything else these days are in short supply, Leicester City Council has decided that now is the time to build concrete-bordered flower gardens in the centre of Charles Street to separate the traffic lines. The sight of the flowers and the thought of the concrete and other materials, not to mention the labour, that has been wasted will no doubt help to cheer up those unfortunate couples who, with luck, will have houses built for them some time during the next 20 years. One critic has suggested that the flower beds should be decorated with a series of maypoles, around which the citizens may dance to celebrate the crisis.

Looking Ahead

WITH a view, evidently, to the possibility that cycles will become scarcer than ever with the new export drive, Mr. H. T. Garley, managing director of the Garley Cycle Co., Ltd., Lower Street, Kettering, has bought himself a cycle at a local sale. He paid one guinea for the model—a wonderful old penny-farthing. It may be a bit hard on the rider, but it isn't a bad idea to have a spare in the stable, just in case.

Yorkshire Dealer's Death

THE death has occurred at the age of 62, of Mr. J. A. Bates, of 110, St. Sepulchre Gate, Doncaster, who was one of the best-known cycle dealers in South Yorkshire. He had been ill for some long time. Mr. Bates, who had carried on a cycle business in Doncaster for many years, was a founder-member of the Doncaster Wheelers' Cycling Club, which was formed in 1926.

Not So New

A PETERBOROUGH constable who stopped a cyclist and told him he would be reported for failing to observe a halt sign, was asked by the surprised rider: "Is this a new police order?" The constable wondered where the cyclist had been hidden away all these years, but managed to keep his emotions in check admirably. The cyclist later had to pay a 15s. fine.

North Lincs Pioneer

MR. GEORGE HENRY LAYNE, of Brigg, founder and former managing-director of Messrs. G. H. Layne & Co., Ltd., motor engineers, etc., Brigg, who has died at the age of 81, was one of the first men to enter the cycle industry in North Lincolnshire. Just 60 years ago he opened a small repair shop at Winterton, moving to Brigg a few years later, where he started a factory employing half a dozen men and producing his own cycle, the Glanford. Some of these cycles are still in existence to-day, one of them being now in Canada in the possession of a former Brigg schoolmaster, who took it with him when he emigrated 35 years ago.

How Will They Learn?

ONCE there was a fond mother who refused to let her children go near the water until they could swim, and South Derbyshire Education Committee appears to be taking up a similar attitude with regard to child cyclists. They are urging parents to stop their children cycling to school, and recommend that schools should stop providing accommodation for cycles, saying that the children cannot ride without being a danger to themselves and others on the road.

Really Black Spot

FOR its size the Leicestershire town of Loughborough has an unenviable reputation for road accidents. According to the local police superintendent: "So many black pins—used to denote accidents—have been stuck in the map this year that we have had to get a new map."

Expensive Ornament

AT Trowbridge, Wilts, there was an ancient lock-up which was used up to a century or so ago for housing drunkards until they sobered up, but during the late argument with the Germans a random bomb wrecked the place. To rebuild it will cost £200, and the council have agreed to the rebuilding so that they can get the money back from the War Damage Commission. But the lock-up will have to be rebuilt on the exact spot where it stood before and where it blocks the flow of traffic, otherwise the War Damage Commission will not pay up. The council have plans for widening the road where the lock-up stands, so no doubt in a few years' time more money will be spent in pulling it down again.

Scooped the Pool

IN one season, J. O'Connor, of the Grantham Road Club, has collected all the club's course records. His latest feat was the clipping of eight seconds off the 1935 club record for the 30-miles T.T. championship, which was formerly held by L. Page. In spite of adverse conditions, O'Connor covered the course in 1 hr. 19 mins. 36 secs.

No Encouragement

PRESUMABLY, with the shortsighted idea that if children do not cycle they are not likely to be involved in road accidents, Nottinghamshire Education Committee have approved a suggestion that children under 10 years old in the county should be discouraged from cycling to school. Cycle accommodation at the schools will only be available for those children who live more than a mile away. Those who live nearer will have to do their cycling after school hours.

Kenneth Horne and Richard Murdoch wish each other a fond farewell as they start a nine-week holiday from radio. The stars of "Much Binding in the Marsh" visited the Smethwick works of J. A. Phillips & Co., Ltd., recently to collect two brand new bicycles, guaranteed to stand up to anything, after their old machine had collapsed under the combined weight of the entire "Much Binding" staff. Phillips, a subsidiary of Tube Investments, Ltd., are sending 75 per cent. of their output for export, and to show their appreciation Horne and Murdoch gave a show in the works canteen.

Around the Wheelworld

By ICARUS

Arthur Whinnett Testimonial

DUDLEY DAYMOND, of 4, Grange Court, 31, Christchurch Road, Streatham Hill, S.W.2, is anxious to obtain the names and addresses of all Southern Road Record Holders, together with past private members and clubs—3939—in order to give them the opportunity of subscribing to a testimonial to show their appreciation of the services rendered by Arthur Whinnett to cycling in general and to the S.R.R.A. in particular. It is hoped to be able to make a really worthwhile gift to Whinnett at the 1948 S.R.R.A. dinner which will be held at the "Windsor Castle," Victoria, on February 19th next.

Whinnett was responsible more than any other man for the organisation of Frank Southall's records and Southall himself has stated on many occasions that a large measure of his success was due to Whinnett. I should like to add my own tribute to the great work which Arthur Whinnett has done. He was, of course, secretary of the S.R.R.A. for over 20 years, relinquishing the job last year to Percy Huggett.

Ealing Resolution

AT a special committee meeting of the Ealing Cyclist Club, the following resolutions were passed unanimously:

1.—That this meeting views with grave concern the action of the London Section B.L.R.C. in nominating A. H. Clarke and R. Morbey as delegates to the meeting of the National Executive Committee, B.L.R.C., held at Birmingham on October 11th and 12th, 1947, in view of the fact that these two delegates were directly involved in an appeal to be heard by that committee.

2.—That the Hon. Secretary write to the National Executive Committee registering a protest against the decision permitting A. H. Clarke and R. Morbey to form part of the committee that dealt with the appeal of these two riders against the judges' decision which disqualified them for infringing the feeding regulations governing the Independent Road Race Championship, held recently at Weston-super-Mare.

3.—Also, that the composition of the National Executive Committee was not as laid down in Rule 6 of the National Constitutional Rules.

4.—That in view of the appeal being heard under such irregular conditions, which left doubt on the integrity of Dennis Jaggard, who has resigned from the B.L.R.C. in consequence, we feel it will be in the interest of the League as a whole if these facts are publicised.

A meeting of B.L.R.C. officials also convened recently to consider a verbal protest lodged by the manager of the Dayton Cycle Team on the occasion of the Independent Road Race Championship held at Weston-super-Mare in September. It was stated:

That the placing of the first four riders was announced by F. Guy, the commentator, before the judges had had an opportunity of confirming their decision on the placings; that Mr. F. S. Durman, manager of the Dayton team, lodged a protest against the Paris cycle team immediately after the four leading riders had finished, first verbally (and later in writing, letter 21/9/47, Weston-super-Mare); that Mr. Durman produced five witnesses confirming the infringement concerned, which charged A. H. Clarke, H. Burville and R. Morbey with having taken a drink contrary to the regulations governing the race, at a point approximately five miles from the finish of the race (the motorist, who handed up the drink concerned, later confirmed that he had handed up the drink to a member of the Paris Cycle Team); that immediately the protest was lodged the two chief judges, L. Adams and J. Kain, made every effort to inform the event organiser, W. C. Rains, of the objection, in accordance with league rules, but considerable delay was unavoidably incurred in making contact owing to the assembled crowd. When contact was made, W. C. Rains, L. Adams and J. Kain agreed that the commentator, F. Guy, be instructed to announce that an objection had been lodged against the Paris Cycle Team and that the prizes were being presented subject to protest, and this was done; that the act of F. Guy in taking charge of the prize-giving ceremony was to be deplored, but in view of the advanced stage of this ceremony at the time decision had been reached, no useful purpose would be served by stopping the ceremony in the presence of George Allison, director of Arsenal Football Club, The Mayor of Weston-super-Mare, the Public Relations Officer of Weston-super-Mare, the Press and general public and it was feared that such a belated public announcement might even detract from the credit that was due to D. Jaggard, in the event of him being announced as the winner; that the instructions to competitors governing the race, as laid down in the third paragraph of the notice issued to "competitors and officials," had been infringed, this notice stating quite clearly, viz., "*Feeding*. Riders must make their own feeding arrangements, and all feeds and drinks must be handed up in a 300 yards stretch of road on the outskirts of Weston leading up to the main road. This will be marked with flags (approximate gradient 1—16). Infringement will lead to disqualification." That in view of this it was unanimously agreed that A. H. Clarke, H. Burville and R. Morbey be disqualified and that the race be awarded to D. Jaggard, Dayton Cycles.

Roadster, Sprite and Sports

PLEASING news announced by Dunlop is that the famous Dunlop Roadster, Dunlop Sprite and Dunlop Sports cycle tyres are now available in 26in. x 1¼in., 26in. x 1⅜in., 26in. x 1½in., 26in. x 1¾in., 28in. x 1⅜in., 28in. x 1½in., 28in. x 1¾in., 22in. x 1⅜in., 24in. x 1⅜in., and 24in. x 1½in. (Roadster); 26in. x 1¼in., and 26in. x 1⅜in. (Sports); 26in. x 1¼in., 26in. x 1⅜in., and 27in. x 1¼in. (Sprite). The quantities available are still limited, but are fairly distributed.

Town-to-Town Mileages

"TOWN - TO - TOWN MILEAGES," published at 1s. net (postage 1d.) by Iliffe and Sons, Ltd., size 20in. (wide) by 13in., folded in paper wallet size 5½in. (wide) by 6¾in.

There are numerous occasions on which the cyclist, either for business or pleasure, wants to know at a moment's notice the distance between particular towns.

This at-a-glance mileage chart gives the distances between 77 of the most important towns in Great Britain. Distances between nearly 300 other towns can quickly be obtained from a subsidiary table.

The distances are those of recommended R.A.C. routes; and the chart has been specially prepared by the R.A.C. for "The Autocar."

North Wales Road Club

THE above club is now representing the B.L.R.C. in Wales. All cyclists in the North Wales area should get into touch with Mr. J. P. Thomas, hon. sec., North Wales Road Club, Tan-han Road, Old Colwyn, North Wales. It is thought that this is the only organised league club in Wales.

Riders to Exchange Holiday Accommodation

EARLY in 1948 the complete race calendars of each country will be published, and arrangements will be encouraged whereby the riders who wish to take a holiday abroad may so arrange the holiday that it coincides with particular events in which they wish to compete.

British competitors going to France will be accompanied by a member of the French Federation, and French riders will be welcomed to the homes of B.L.R.C. riders in the same way when they come to Britain.

Ladies' Events

BOTH Federations encourage ladies' events on road and track, and arrangements will be made to include special programmes of international status during 1948. It is probable that such an event will be staged to follow the Grand Prix de la Bastille, in Battersea Park, on July 14th next, a French male team having already been invited.

N.C.U.-R.T.T.C. Rift

THE Annual Report of the National Committee of the R.T.T.C. provides further evidence that the strange "partnership" between these two bodies is breaking up. The row seems to have started in the early part of this year when the N.C.U. virtually approved the Paris to London race without reference to the R.T.T.C., who banned its members from taking part in it, but finally approved it by a face-saving agreement.

The R.T.T.C. seems to be greatly upset because equipment used by some of the amateur writers was advertised in the French Press. We would remind the R.T.T.C., however, that it has no power to control the methods of another nation, and that it is merely a domestic tribunal without international recognition, except by virtue of its strange bed-partnership with the N.C.U. The N.C.U. has now made a request that it should be recognised as the sole controlling body in Great Britain for all forms of international cycle racing. This raises some vital issues. It means, in effect, that the N.C.U. could run races on an international basis in this country, and as such races are not run in conformity with R.T.T.C. rules, it can hardly be expected that the latter body will agree.

The request does, however, reveal that the N.C.U., sprung into activity by the undoubted success of the B.L.R.C., is endeavouring to steal some of its thunder. The R.T.T.C. is naturally inviting its affiliated clubs to resist any such recognition. I do not think that the N.C.U. is the proper body to control road sport or any branch of it. It has no experience of such sport, since its activity has been entirely devoted to racing on closed circuits. It threw over time trialing and road records fifty years ago. It exists to-day to administer the activities of a few hundred track-racing cyclists. Its officials have been expressly forbidden to have anything to do with road racing, and its deplorably unsportsmanlike action in endeavouring to get massed start racing stopped has done a great deal of harm to all forms of road sport. The N.C.U. is in urgent need of reorganisation. It should get on, as I said at a recent public dinner, or get out. It is not wanted as a body, and has long outlived its usefulness. Recognising that it is dying as at present constituted, it is trying to horn in on a form of road sport which it has steadily opposed.

Wayside Thoughts

By F. J. URRY

Castle Acre Priory, Norfolk. Part of the remains of the great Norman fortress and House of the Cluniac Monks

Preaching the Gospel

IN the early part of the year I had a number of talking engagements with Rotary Club audiences and expected that my insistence on the value of cycling as a means of pleasantly sustaining the boy that is said to live in the heart of everyman would meet with considerable opposition. It didn't; rather the reverse, for it seemed to gain the compliment that a man not forced by circumstances to make cycling his main hobby possessed the wisdom to break down the common convention that the pastime is something just "not done" when an individual reaches a certain status in life. Now, these Rotary people are hard-headed business men who for the main part have forgotten the values of cycling to all types of human, if indeed they ever knew them. One bicycle to them is as another, and one cyclist just a unit in a crowd that sometimes annoys them at "knocking-off" times on week-days, and occasionally at week-ends when returning hastily from their motor trips. So in telling these people what the bicycle has meant to them in the happiness and convenience of their own employees, and stressing the certain truth that they too would be better and fitter people if they rode for the sheer joy, exercise and individual freedom that is cycling's special virtues, and—please forgive the egotism—presenting myself as a decent example of my own test, I seemed to persuade my audience that there was much more in the game than they had given it the credit for possessing. I do not expect to gain recruits from among these dapper business people—that would be a miracle—but I sincerely believe there is a high value in the matter of instruction that cycling is not "hard work" nor the travel resort of the purely impecunious. My object is and always has been to raise the status of the pastime, to make people realise that this geared walking is the best thing that has evolved in the way of games for a hundred years, because it can be played at the tempo to suit every age and condition, in company or alone. And its silence is indeed golden, its freshness revived with every dawn, its exercise ranging from the strenuous to the gentle, and its healthiness a positive measure of national value. Those are facts which cannot be denied, and underlying them are the glories of observation, scent, penetration and the loveliness of a land which, it seems to me, can only be assessed at its true value by the individual who has used his physical powers to see it. Yes, I have been surprised to find the little lessons going home so easily, and if this older generation will but encourage the younger to retain the manliness of cycling for their health and pleasure, however supreme they may become in the affairs of the world, the pastime will gain something, but never as much as the individuals who have the very common sense to remain cyclists all the length of their active lives.

Discipline and Contentment

PROWLING round the lesser roads running circularly a dozen or more miles from the city centre the other evening, I was met or overtaken by some twenty young men, in singles and couples, evidently intent on training, and I was reminded of the words of a very old friend of my father's, who, happening to be at home when I had returned from just such a jaunt in 1899, remarked what an excellent discipline and self-sacrifice it was for a young man to undertake, far better than wasting time hanging round street corners. At that moment I wondered precisely what the old gentleman meant, for it did not occur to me there was any degree of self-sacrifice in the fierce joy of a training ride. Now I know; and as these young folk met and passed me, often flinging an evening greeting, it struck me how little the old game has altered down the years. Road surfaces and bicycle building have improved, there are many more expert riders in the competitive ranks, and the lads and lassies know a good deal more about training methods than our old crude notions of riding as fast as we could until our knees knocked the top rail; otherwise the business of racing on the road is much as it was. What I am specially happy about is the fact that the game has remained clean in the true sporting sense of the term, for there was a period when the trade felt an inclination to exploit it. But the good sense of clubmen, led by the late F. T. Bidlake, overcame that phase, and for a time made the purely club event not only a racing fixture but a happy social one. That was in the early years of the century, when motorcars were few and far between, and we could hold our events on Saturday afternoons and make the evening of the day a chorus of club life. I suppose every old rider will regret the passing of those times, for the early morning event and the subsequent scattering of the clan on its private occasions lacks the joyousness of club contact which made the purely club programme such delightful fixtures. There are, as always, compensations, and the greatest of these is probably the fact that many more young folk are now interested in this graceful and comely sport. Anyhow, it is good to see the lads along the road practising to acquire a speed which far outruns the very best of our performances. There is no doubt the game will go on, but I do wish the little quarrels would cease and the blessings of peace return to the great, clean sport of road racing.

The Right Way

AND talking of sport reminds me of the criticisms recently launched regarding the sloppy running of sports meetings. I do not think there is anything so annoying to the average spectator at a sports gathering than to be kept waiting from race to race, or fail to understand the type of competition because the programme is faulty in description. There is no excuse for this kind of shortcoming, and it does untold damage to an entertainment that otherwise deserves a far greater measure of public support. I was at a race meeting some weeks ago which went with a swing from start to finish and quite charmed the crowd of 9,000 spectators. It started on time, was never more than a couple of minutes down on schedule, and when that happened the responsible officials gingered up everyone concerned, with the result that the last event of the day was off to the tick. Now, that meeting has been successfully undertaken for twenty-five years, has always made a fair, and often a handsome, profit; despite the fact that on more than half the occasions the weather has been distinctly unfavourable. Why? Because its public know the promoters' first consideration is for them and their interest and convenience, with the result that the gathering has gained a reputation and tradition, goodwill assets which count enormously when the year brings this fixture round. Far too many riders and officials seem to think they are the important people at such functions; nothing of the sort, it is the folk who make the ring round the track, for without them the others are less than nothing. If promoters would only realise that truth and act on it, I believe the success of enclosed cycle racing would be enormously improved.

Jeff Scherens, the Belgian professional sprint cycling champion of the world.

It is Answered

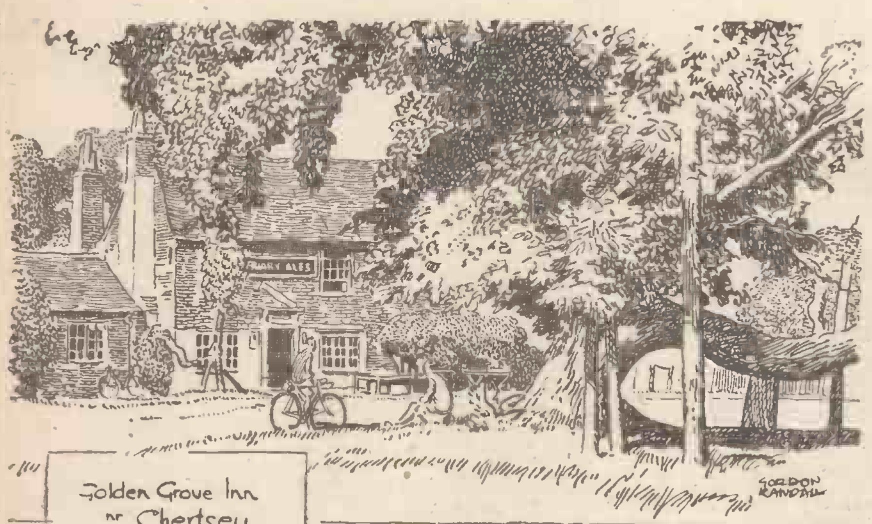
THE cry is still heard in the land that cycling is hard work, and that the delight in it is when you stop. There is a half truth in the latter phrase and none in the former, always providing the exponent is fairly fit, has the right kind of bicycle and is using it correctly. I am getting into the sere and yellow, out of sympathy with unnecessary hard work, nor seeking to add toil to life, yet I ride a bicycle daily because I like it, and whenever opportunity offers roam into the country on two wheels, taking from the change of scene and the exercise the joy that adds a sparkle to life and makes a man more glad to be alive. Having done this same thing for years, not as a matter of habit but through desire, it surely follows that the hard work slogan is utterly false in the ears of the competent cyclist, and further, there is no reason why any ordinary individual should not become such a rider. The hard work cries of the positively idle or utterly careless folk have always annoyed me, firstly because they are untrue, and secondly for the reason that the expression of such an opinion suggests I am a blithering idiot to remain a cyclist. Generally speaking I find the people who talk ignorantly on the subject of cycling possess very little knowledge of any game except as spectators. They have grown physically idle, often careless of a measure of decent muscular attention to their bodies, and when they want to travel prefer to loll at ease and thereby grow much older in activity and outlook than they should. I have seen so many such degenerations that I would keep on cycling if for nothing else than its superlative exercise. But the delight in cycling and its grant of glorious horizons is linked with the factor of exercise, that feeling of being alive and self-sufficient, that high pleasure of exploration, the splendid enjoyment of food, and the quiet personal satisfaction that the ending day has been well spent. Such indeed is the delight in cycling when you stop, when the country inn welcomes you, and the last thrill of a sleepy bird seems to light the evening star. Such then to me, in epitome, is a day on tour, a day to be remembered and revered, when food is ambrosial and the last smoke the incense of heaven. And some people would call this hard work! Well, it takes all sorts to make a world, but I prefer health and my simple image of enjoyment rather than a travelling cage with a cocktail bar at the end of the journey.

That Absurdity

I WANT to help break down that state of mind people are prone to accept—say what you will—that if you are a cyclist it automatically follows your status in the social scale is thereby lowered. That very persistent mentality has not been derived from cycling but from motoring, and it is part of the ostentation concerned with engine travel too frequently observable, which is a pity, for motoring as well as cycling. Naturally I consider the well-equipped cyclist is the happier individual as well as the more comely, and the question of the size of his bank balance has nothing whatever to do with the matter. Occasionally I meet the patronage of the motorist and quietly but firmly reverse the position, as he sees it. Why should the possession of a car be the sign of superiority? Nearly all the travel values are on the side of the cyclist, for the only one the motorist has *in excelsis* is speed, and that to my way of thinking is often, indeed mostly, a deterrent to the abiding virtues of roaming. I love the things that cycling has given me and am indeed thankful for them; but I have no desire to encourage a feeling of superiority in me because I think my way is the best. Why should the motorist? Probably most of them would disclaim such an attitude of mind if they were to argue the subject, as indeed most of them have when contacts of this nature have been made; but the notion unthinkingly exists and it needs eradicating before the two methods of travel can hope to be sympathetic. I would be the last to persuade anyone to ride a bicycle without a shadow of conviction showing on their part, for I know the cyclist of necessity is too often a critic of the pastime. I can only say what cycling has given me and is still giving, I can only imagine my activity and good health result from my 8,000 miles of riding per annum, and both of them are too precious in possession for me to lightly drop. The car is useful on occasions when there are urgent things to do, but I don't like it, for I can only glimpse the country, not see or smell or taste it, and a couple of hours of such journeying makes me feel like perished elastic—all the spring gone out of me. Yes, I'd rather be an ancient cyclist with a decent pride in my "grizzled youth" than a solid gentleman in a saloon, accepting his years without protesting that the boy in his heart is still alive. I can understand that man and his way of life without feeling superior; he has chosen it and it's his affair; but why on earth he should seek to patronise me—as he so frequently does—is one of those mysteries still existing in democracy which makes a man despair of ever discovering the shifting meaning of that much abused word.

CYCLORAMA

By
H. W. ELEY



Golden Grove Inn nr Chertsey. Surrey.
A pretty little inn on the slope of St Anne's Hill with its fine old tree still in full foliage, but needing a little extra support.

Winter Preparations

NOT a bad plan, now that the dark nights are here and we are thinking of winter riding, to give the bike a good overhaul. It is a job which many cyclists neglect, to the detriment of their winter riding—which, if the machine is in good trim, can be so enjoyable. In fact, some of my very happiest cycling memories are memories of winter rides: those good days in January when the roads are iron hard, and the big red sun is like a ball in the heavens, and the rime is on the hedges, and the air is crisp and keen. Then it is good to get out into the lanes and see the beauty of the stark trees, with their bare branches stretched out like lean arms. And on such days Mother Nature is not dead—the robin still sings on the farm-yard gate, and over the fields the lapwings cry as they forage for food in the hard rutted earth. But *do* get the bike in good running order now!

A Very Old Cycling Club

THE Southgate—founded, I believe in the year 1882, has had a long and consistent record of good performances. This year its annual dinner is going to be held at Beale's Restaurant, in Holloway, and I have been honoured by being invited to respond to the toast of "The Visitors"—and very gladly did I accept the kindly invitation extended to me. From past experience I know how enjoyable cycling club dinners and other functions can be. And, even in these austerity days, I know that this old club will put on a fine "do." I look forward to a happy evening.

The Happy Cyclist

I EXPECT that many readers saw that enthusiastic letter in the national Press from a cyclist who explained how he rode to and from his work each day, some ten miles morning and evening, and thus escaped the ever-increasing trials and turmoil of London traffic—the crushes in the Tubes—the "battles" to board the 'buses. This rider extolled the virtues of cycling and made a great plea for more folk to cycle to and from their work. It would be a good thing if we followed this sane advice. Not only traffic relief would result, but health would improve—and whilst I cannot claim to cycle to work now, for many years in the provinces I did so, and well do I remember how fresh I felt on arriving at the office.

Trees

CYCLING recently with some young folk with whom I fell in near Barnet, the talk turned on to the subject of trees, and I was a little grieved at the ignorance shown about our familiar trees—these young people could, of course, recognise an oak and an ash—but there their knowledge apparently ended. The alder, the hornbeam and the wych elm baffled them. Now it seems a strange thing that in this well-treed land, where we have such lovely varieties, there should be such ignorance in identifying the different species. And how it adds to the joys of a country ramble if one can recognise each tree and give some study to its habits, form and growth.

There are several simple and excellent little books published on trees, and perhaps the best for the beginner is "The Observer's Book of British Trees"—published by Frederick Warne & Company. "Tree study" goes well with cycling, and I commend the subject to all who love the shady woodlands, the forest glade and the thickets and coppices where the hawthorns and hazels grow.

"Works Relations Drive"

I SEE that my friend Noel Brealey, the advertising manager of the B.S.A. Company, is prominent in connection with the "drive" being made by the Birmingham Publicity Club regarding "production propaganda" in factories, and is closely associated with the approach to the Government by the Birmingham Club. Noel has a very fine record of work during the war years in connection with such matters as National Savings, Salvage and Production. He is one of the hardest workers I know—forthright in his manner and with a background of experience which I have found, personally, of enormous help on committees. I wish him good luck in his latest activity.

Sylvan Staffordshire

YES—sylvan! For it is a myth to imagine that all of Staffordshire is grimy and dirty. I know the county well, and while admitting that there are many sorry industrial scars in the Potteries and in the Black Country, one should not forget that there is a belt between—the lush and green Trent Valley, around Lichfield, which is lovely indeed. What happy hours I have spent at little Alrewas, fishing in the Trent. What sweet and unspoiled villages there are around Burton-on-Trent. Here is a fine cycling area which I commend to all riders who would see some new angle of England's beauty. There is Abbots' Bromley, where, every September, they still indulge in the centuries-old "Horned Dance"—in which twelve men, bedecked with antlers and greenery, dance to some ancient tunes. The origin of the dance is lost in the mists of antiquity, but the ceremony is most interesting. And do not forget that Derbyshire is only just over the border, and that one may meander by the silvery River Dove, sacred to all time to Izaak Walton and Charles Cotton.

The Incurable Habit!

I HEARD of an old Dunlop friend the other day—R. H. Bagnall, with whom I worked at Aston Cross in 1913. He is seventy-seven, and cycles thirty miles a day

Miller's Dale, Derbyshire.
The River Wye in a lovely setting. The dale lays 6 miles east of Buxton.

on three days a week! No wonder that my informant about him reported that he was "hale and hearty"! There is nothing like cycling for keeping the "old 'uns" fit!

My Point of View

By "WAYFARER"

Newark Priory, Surrey
The picturesque ruins of the 13th cent Priory standing by the River Wey near Ripley

Misconception Piled High

A BROTHER-ANFIELDER whom I have just met on tour—it was interesting to note that our last meeting was on Crib Goch (Snowdon) some 20 years ago—told me that he was "on his own" because his intended companion funked the holiday at the last moment. The reasons, threefold, were most interesting. There was the difficulty of obtaining accommodation. There was the likelihood of starving to death because of the food position. There was all the discomfort to be derived from overcrowded roads. Misconception piled on misconception!

I compared notes with my friend, whom I saw twice afterwards, and his experience agreed with mine. There was *no* difficulty in obtaining accommodation. As it happened, mine was booked in advance, and I encountered no problems. My friend was chancing his arm, and he, too, met no difficulties. We both did very well as regards roadside meals, which were easily obtained, and, mainly, of high quality and satisfying abundance. (More of this anon.) We did not find the "overcrowded roads." On this point I would say that, if all the traffic seen during the nine days I was on holiday had been crammed into one half-day, there would still have been no congestion. The scarcity of traffic, rather than its frequency, was really noteworthy. Thus my friend's friend missed a jolly fine trip, in perfect weather, solely through his imaginings as to the position of affairs along the road. That is what one must expect in return for swallowing all one hears about food and accommodation and for judging traffic conditions from our city streets during the business "rush" hours. One hardly expects a cyclist however, to be so misled.

Touring Plan

ON this holiday I followed my usual touring plan. Brief study of the map would tell me where to go, and I would set forth on a stripped bicycle for my day's ride, satisfied that the mileage, whatever it was, was well within my compass. It is to be supposed that the practised eye, looking at the map, can tell at a glance, more or less, that the distance is right. On one day, however, I did not quite follow this plan, and thought for one gaudy moment that I had "kicked a brick." My brother-Anfielder, above-mentioned, who was staying in a farm adjacent to mine, called for me at breakfast-time, and we decided that we would spend part of the day together. He was then bound for the North Wales coast, and I said that I would go a bit of the way with him. The "bit" lasted until after tea, when our routes separated. It was then that I sustained a mild shock. I had put up a fair mileage and had a decent distance still to do, when a sign-post told me that it was 21½ miles to Harlech. I did not doubt the statement, which meant that I was doing at least an 80-mile jaunt—rather more than I desired to achieve in mid-Wales, on a hot day. The time it took me to reach Harlech suggested that I am a perfectly marvellous rider—with the alternative that the signpost was woefully inaccurate. The latter, of course, is the explanation, and I have since taken steps to have the information put right.

When I reached home and reckoned out my mileage—cyclometer-recorded—I found that I had done 625 miles, or practically 70 miles a day, and that without trying. Had I been out for miles, I would have made a much earlier start than my usual 10.15 a.m.

Roads and Conditions

I FOUND the roads, practically everywhere, in satisfactory condition, at least from the cycling point of view, which is the only one which concerns me. The worst piece of road I struck was the four-mile climb from Newtown to Dolfor. This had recently been tar-painted and treated with granite chippings, the resultant surface being of a very coarse texture. It was uncomfortable to cycle over, and yet, though I am a poor hill-climber, I rode most of that long and rather weary slope. In Montgomeryshire I observed an annoying system (to which I have called official attention) of dumping loads of these chippings on the roadsides without any retaining device, with the result that the material spills over on the road, setting up dangerous conditions for cyclists and others. A cyclist driven into the gutter by the press of traffic (hard to imagine in Montgomeryshire!) would sustain a nasty fall if he were compelled to negotiate this loose stuff.

Another point perhaps worthy of mention is that in all these miles of travel I observed only two cases of bad motor driving. The one which concerned me was that of a big car pressing forward on a narrow road at Fairbourne and then having to pull up because of an approaching car, thus making things awkward for me. The other case was that of a Service vehicle being driven downhill on the wrong side of the road, to the grave inconvenience of a private car which was met on a corner. That is not a bad record for over 600 miles!

No Relaxation

EVEN those of us who have been cluttering up the roads for many years are not immune from the occasional need of a reminder that eternal vigilance is the price of safety. Let me amplify the point. On a recent Sunday night I was making my way through a complicated lane-route with which constant use is gradually creating a sense of familiarity. Nevertheless, a proffered opportunity to go astray was accepted, and, quickly failing to recognise my surroundings, I turned back and put myself right. A few moments later, riding up the stem of a T-piece, the existence of which had been completely forgotten, I suddenly found myself heading straight for a roadside bank and hedge. By dint of lightning evasive action, consisting of furious back-pedalling and urgent braking, I safely made the acute right-hand turn, and went on my way in safety, enriched by a reminder of the need for constant vigilance. It is quite clear that there must never be any relaxation.

Joint Concern

MAY I suggest, for the consideration of all readers, that safety on the roads is the joint concern of everybody who travels along the King's Highway. There can be no unilateral plan here; there can be no "leaving it to George." On the other hand, there must exist—there must be set up (and be maintained), where it does not already exist—an unofficial, automatic, and 100 per cent. partnership between pedestrian and motorist, between cyclist and lorry driver, between bus driver and the youthful population, in the sacred cause of safety, that partnership functioning in a two-way (and, indeed, in an every-way) manner.

It takes two to make a quarrel. Similarly, and as a general rule, it takes two to make an accident. Thus the avoidance of accidents is the joint concern of all. Experience shows that most of the accidents which happen are avoidable, and unnecessary. It is not too much to say that many of them are manufactured. Any ordinary observer, watching the roads, can see trouble being built up. With co-operation on a wholesale scale, accidents could be reduced to a minimum.

Unpleasant Sound

ONE of the most unpleasant and unwelcome sounds which can assail the ears of a cyclist is the sharp "crack" which denotes the bursting of a tyre. Twice, recently, within a few days, I heard this sinister note, though on neither occasion was I personally concerned. Nevertheless I felt very sympathetic towards the cyclists involved.

The Food Question

I CERTAINLY lived on the fat of the land, and I now know where to go when the food cuts, threatened at the time of writing, actually occur! One day I managed to put away five eggs. Every day I had, for breakfast, home-cured bacon and egg. I had substantial meals in the evenings. There seemed to be plenty of everything—yes! even sugar. At an isolated hotel up in the Shropshire hills I had a magnificent lunch of hot soup (delicious), meat and vegetables, fruit tart and cream, cheese, etc. Bread and *butter* abounded . . . and it was a bit of a drop to come back home to bread and "marg"! At a first-class hotel, in a place which shall be nameless, I obtained such a poor lunch that I was constrained to write to the proprietors, who run a group, or chain, of such hotels. I complained of the soup, which was merely coloured water. I suggested that the main course—bully beef (of which I happen to be very fond), with sausage-roll as an alternative—was lacking in imagination, which remark applied also to the sweets—stewed figs and custard, or what the waiter called "milk" pudding. I conceded that the coffee was excellent. On the other hand, I thought that the kitchen staff was quite out of control, judging by the "noises off" which were clearly heard in the dining-room. The prompt reply from the proprietors justified my complaint, and I was offered (but did not accept) the return of my money. It appeared that the local management had proved to be unsatisfactory and was under notice to leave. Thus everything—including the complete lack of imagination—was accounted for.

I had two other indifferent lunches at places far less classy than the hotel above-mentioned, and they now go on my black-list. My final lunch of the tour was in a farmhouse, where, in the absence of meat, I managed (!) with a couple of eggs, bread and butter, etc., at a cost of 3s., which I thought excessive. My plain tea that day cost me 2s., which was also an extortion. On the whole, however, I am more than satisfied with my experiences as to food and costs.

Wrong Lightness

WHEN riding with a boy cyclist—a complete stranger—the other day he told me that he was using a borrowed machine, his own being in "dry dock." It appeared that he had had to apply his front brake rather suddenly in order to avoid hitting something and the strain caused his front forks to recede. I have always advocated light bicycles, but it seems to me that it is almost criminal on the part of a builder so to cut down weight that the forks will not take a perfectly natural strain. That, surely, is wrong—very wrong—lightness.

Sixth Sense

I RECALL that one day, a few years ago, when cycling home from business on a blustery afternoon my attention was attracted to a bicycle standing at the kerb. "That machine," I said, "may be blown over." I took evasive action "in case," and, as it happened, my foreboding was fulfilled just as I rode by. Fortunately, my sixth sense had impelled me to leave a safe margin. Otherwise the standing bicycle would have fallen against me, with the possibility of unpleasant results. Similarly, last Sunday morning (as I write), it struck me that one of the crew of a stationary milk-cart on the left-hand side of the road might descend on the right-hand side and dash across the road. How correct was my intuition! A boy jumped into the road, started to run, changed his mind and returned to the cart, quite oblivious of the dangers he was creating for himself and others. Fortunately, I was ready for his gyrations, though these, in the circumstances, were not too easy for me to circumvent. The sixth sense is cultivated as the result of years of experience. It is well worth nurturing.

Distance if Required

ON two recent Sunday afternoons I had my tea in a village about three miles away from that in which I had obtained my lunch. On each occasion I travelled 21 miles between the two meals, enjoying to the full the beautiful weather conditions which prevailed, and making every use of the seclusion presented by lane routes. There was a little repetition in the two journeys, but for the most part the second jaunt varied considerably from the first. I was not out after miles: I just wanted to employ the afternoon hours advantageously and pleasantly—and to prove that to have two consecutive meals so close together geographically is not so silly as it looks. Thus, when we want to have a meal within walking distance of home, or of the spot where the previous meal has been taken, it is advisable to remember the possibility of "making a ride of it." The guest-house on your very doorstep, or a couple of fields away, can quite readily provide you with a journey of 20 or 30 miles—if you are so minded. Personally, I am very keen on these wayward jaunts.

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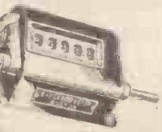

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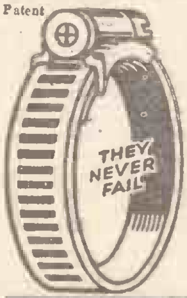

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