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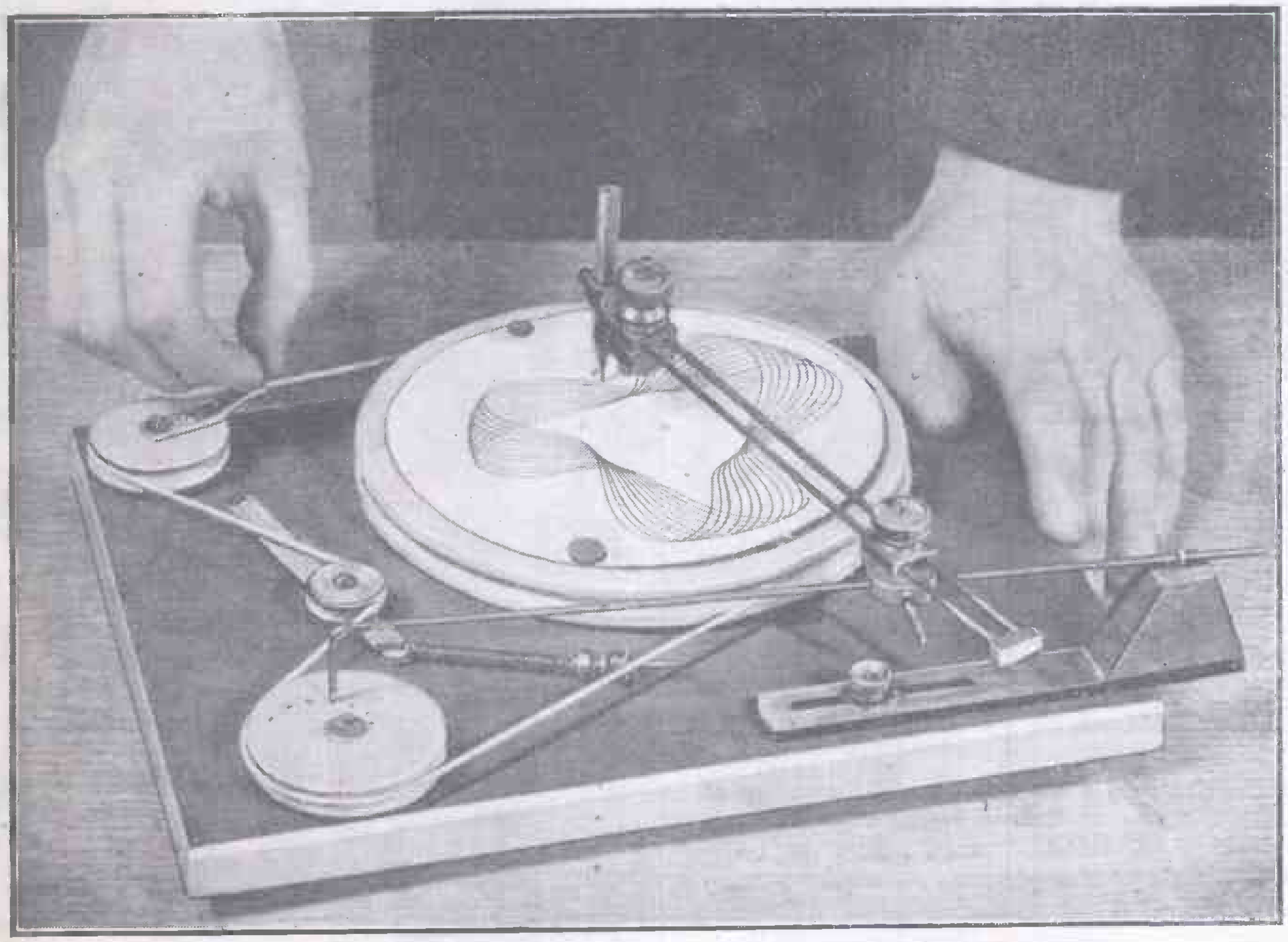
EDITOR : F. J. CAMM

APRIL 1948



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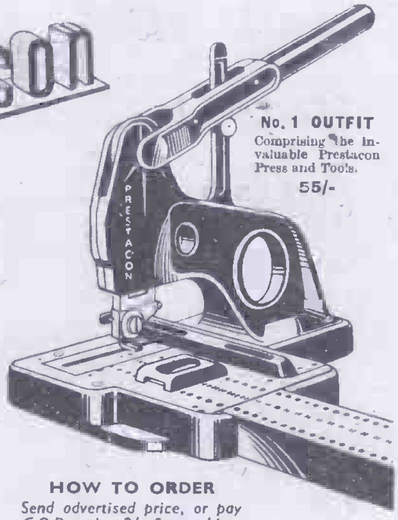

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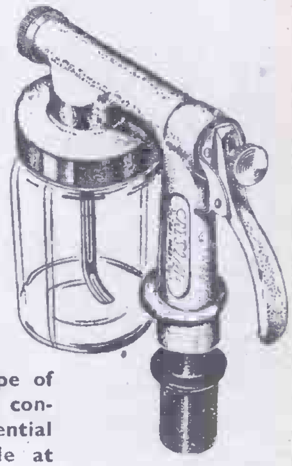

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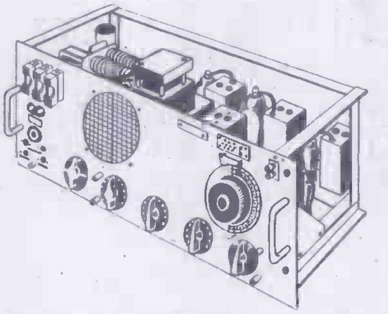

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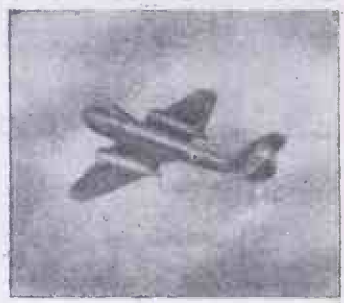

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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor: F. J. CAMM

VOL. XV APRIL, 1948 No. 174

FAIR COMMENT—BY THE EDITOR

Science in Industry

INDUSTRIES have developed as a result of the advancement in applied science. The invention of the steam engine was responsible for the industrial revolution of the last century. The discovery by William Murdoch that gas distilled from coal could be used for illumination established what is still our largest chemical engineering industry, the production of coke and coal gas. Tennant, a century ago, by the manufacture of bleaching powder, created a new industry, and Nelson's invention of the hot blast in the manufacture of pig iron revolutionised smelting.

The distillation of oil from shale was a discovery of James Young, and he virtually founded the petroleum industry. The surfacing of roads is due to Macadam. The waterproofing of fabrics was due to the discovery by Macintosh that naphtha dissolved india rubber. Most of these developments took place over a century ago when industry and science were detached. Both science and industry, however, have developed in complexity since that time, and they now run ancillary to one another.

The means for bringing science to bear on industrial problems is highly organised. Industrial research has to-day become a business in itself.

The scientific effort in Great Britain is in the hands of three branches—research in industry itself, Government research and research in universities and technical colleges. It is in the universities and technical colleges that really revolutionary industrial advances have their origin. The discovery of X-rays was made in the pursuit of fundamental knowledge, and it was only after their discovery that the possibility of their manifold applications in medicine and industry was realised.

Location of Aircraft

THE first attempt at the location of aircraft consisted in trying to detect them by the sound or the heat they emitted. These direct methods were unsatisfactory, and it was by combining a technique used for an entirely different purpose, namely, the study of the electrical layers of the upper atmosphere by wireless reflection, together with the chance observation that short radio waves were reflected by aircraft, that practical radar was founded.

It was Clerk Maxwell who placed the sciences of electricity and magnetism on a quantitative foundation, on which the radio and electrical industries of to-day are based.

The main provision made by the Government for the support of the universities comes from the University Branch Committee, but this does not preclude the Department of Scientific Industrial Research from making grants to assist individual research workers in the university in pursuing items of research which seem to have special prominence.

The D.S.I.R. already referred to was formed during World War 1, and it was charged by the Government with the important task of encouraging science in industry.

Now in D.S.I.R. there are 13 national research establishments, financed entirely from public funds; that is to say, that wherever they may be situated geographically they work for the country as a whole—for Scotland as well as England. Their work differs from that of universities mainly because their task is to apply science to particular objectives, to the building of better buildings, the making of better roads, the better use of fuel and so on. Our research stations have, of course, occasion to carry out a great deal of fundamental research—objective fundamental research, in other words. They do this because it has been abundantly proved that fundamental research on a problem is often the quickest way of finding a practical solution to it. For example, a full understanding of the way bacteria and other micro-organisms affect fish and the physical phenomena which take place when fish is frozen are often the most direct methods of discovering the best practical methods of preserving it. Again, a fundamental study of what happens when a metal corrodes will certainly help in finding the means of preventing corrosion.

From these brief observations it will be seen how very important it is that firms should make use of the assistance provided for them. Most large firms to-day have their own experimental laboratories, but it is desirable that every firm of any magnitude should have such a department, in view of the competition we are meeting in the industrial markets overseas.

We want new methods and new processes discovered. There are plenty of men available who are qualified to start such departments, which will provide an opportunity for employment of those whose education suits them for filling scientific posts.

Professional Engineers' Appointments Bureau

DURING 1947 the average number of engineers on the Register was 634, 127 of these being primarily civil, 260 mechanical and 247 electrical engineers. The number of registered engineers has thus been approximately two-thirds of the total for 1946, when the average was 964. A satisfactory number of vacancies has again been notified by employers, the total for the year being 1,048. Despite the reduced number of engineers available for nominations, the income from appointment fees increased by 10 per cent. compared with the previous year, the sum of £1,179 being received from 214 engineers.

This reduced number can partly be accounted for by the fact that there are fewer engineers actually out of employment and that the demobilisation rate from the Forces has been decreasing. It is satisfactory to be able to report that the decrease in numbers has been evident in all age groups, although this was slightly more noticeable in the groups under the age of 35. The average of the men on the Register has increased from 34.4 to 35.6, and the average of the men placed from 30.1 to 31.5 years.

An analysis indicates that less than 10 per cent. of the engineers on the Register are actually out of employment, and most of these are over 45 years of age. In the majority of these cases, other factors which render the engineers difficult to place include either a requirement that work must be within travelling distance of a specified address, a high salary indicated as a minimum, or work required in a specialised field.

In the final quarter of the year there was, as might be expected, some decrease in the rate at which vacancies were being advised, and in a number of cases, after the Bureau had nominated engineers who appeared suitable, the employer advised the Bureau that the question of making an appointment was being held in abeyance in view of the reductions in capital expenditure.

The number of offers made to engineers as the result of the Bureau's introductions greatly exceeded the number of actual acceptances, and the housing situation must be recognised as the most serious obstacle in the filling of vacancies. This factor not only presents itself in this country but overseas, and numerous cases have arisen where engineers have indicated that they would have accepted posts for which they were nominated were it not for the fact that living accommodation for their families could not be promised in the near future.

Since it commenced to operate the Bureau has succeeded in filling some 50 posts overseas, but, although a number of engineers on the Register are anxious to emigrate to the Dominions, the Bureau has had difficulty in finding candidates. F.J.C.

A Portable Enlarging Cabinet

Constructional Details of a Compact Appliance for the Amateur Photographer.

By L. C. MASON

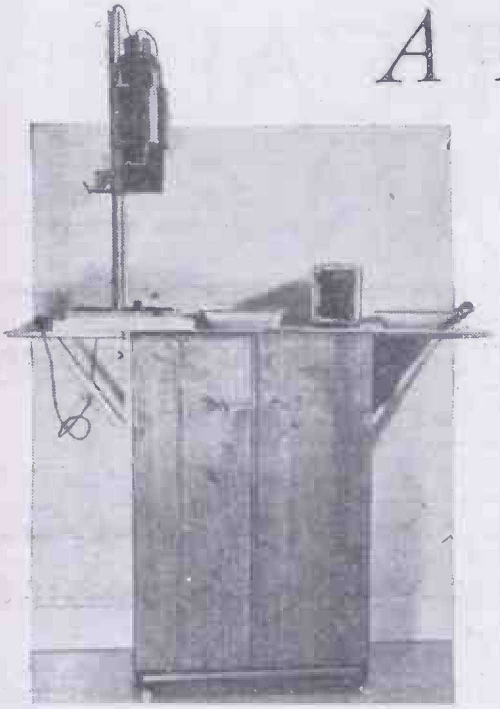


Fig. 1.—The completed cabinet with bench flaps erected as set up for enlarging.

To cut down the amount of time wasted in preparing for an enlarging session, and to keep all the apparatus ready to hand in one place, it was decided to build a mobile cabinet which would hold everything necessary, and at the same time provide space for working. The accompanying illustrations show the design finally evolved. Facilities which it provides are: storage for all necessary bottles up to 40 oz. size and for dishes up to 15in. by 12in., a paper storage drawer big enough to take up to 15in. by 12in. paper lying flat, space for the enlarger and masking frame without dismantling and, finally, a folding bench-top 48in. by 16in. Other features are the provision of castors, enabling it to be moved easily from room to room, and an external appearance when not in use which gives no indication of its real purpose. The outside finish can be arranged to match other furniture in the room where it will normally live.

The whole job was designed in conjunction with the other pieces of apparatus to be used with it, so as to produce the most serviceable article possible. The inside dimensions were fixed chiefly by the size of the enlarger; thus it was made high enough to take the enlarger column and deep enough from front to back to take the baseboard, with some half an inch to spare in each case, giving measurements of 36in. high by 16in. deep.

The width decided on was half the length of bench-top required, for a reason which will appear presently. The paper drawer is located on the right, as to work from left to right is—to me, at least—the most natural way. This means accommodating the enlarger on the left, where the space for it can be seen by the shelf arrangement in the photographs. This layout can be reversed, of course, if the other way is preferred.

Details of Construction

When it came to the actual building, material was unobtainable. It was originally intended to use plywood to cover a framework, but this proved out of the question. Eventually, after a long search an old office cupboard was purchased which provided more than enough material. This was rather thicker than was necessary, but by the time the old damaged surface had been planed off the final thickness came down to about $\frac{3}{8}$in. So the covered frame idea was abandoned, and a plain box type of job started from the solid timber. The length of the sides necessitated an edge to edge join, but as these are subject to little bending strain a glued joint with a reinforcing strip inside has proved quite satisfactory. The bottom consists of a sheet of hardboard supported by a 6in. wide plank front and back. The weight supported by the bottom is all widely distributed — consisting mostly of the enlarger baseboard —so that a fairly light floor is sufficient here. The back is much the same, being covered by another sheet of hardboard in the same way that a picture frame is backed. The back is further stiffened by a strip of thin wood running diagonally across, which gives rigidity to the whole structure. Further help in this direction is given by a shelf bracket fitted each side in the angle between side and bottom.

The drawer arrangement may be open to criticism in that the doors have to be opened first to give access to the drawer. This was realised before building was started but it was decided that the advantage of a clean and symmetrical appearance when not in use would outweigh any slight disadvantage in having to open the doors to get at the drawer. One visible drawer extending from one side about two-thirds of the way across the front would look distinctly odd. Partly for this reason, too, it was decided to fit two half-width doors rather than one large one. Another consideration—in view of where the cabinet would be used—was that narrow doors would take up far less room when opened than would one the whole width of the cabinet. So far, this arrangement has not seemed at all inconvenient, as both doors can be left open when working. The doors meet edge to edge down the middle of the cabinet, with as close a joint as possible. The left-hand door shuts on a spring-loaded ball catch, the line of the two door edges being concealed by a vertical strip glued and pinned to the front edge of the left-hand door. The strip is positioned

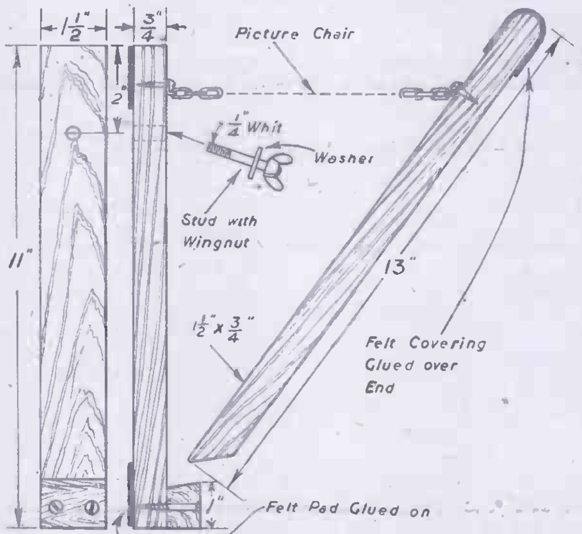


Fig. 3.—Detachable bracket for supporting the side flaps of the bench top.

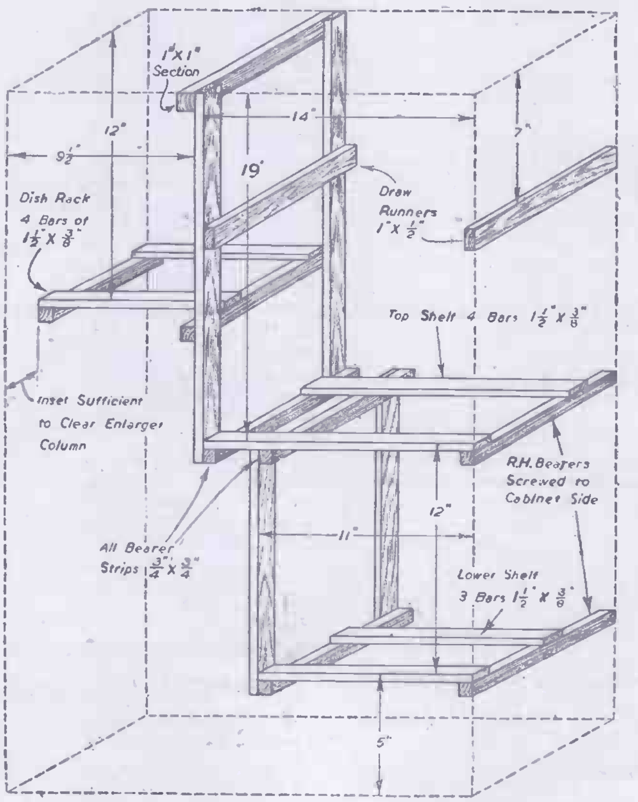


Fig. 2.—The framework of the cabinet, showing the arrangement of shelves.

exactly in the middle of the front, and in addition to providing some relief to the otherwise plain front, serves to keep the right-hand door closed. This strip could well be of a different kind of wood or finish from the rest of the cabinet as an aid to appearance, although it is all the same in the cabinet shown (Fig. 1). No handle for the door has been fitted, as it was found that the strip down the middle provided adequate finger grip for opening. However, a single drop handle mounted on the strip would no doubt add to the appearance if thought worth while.

Shelves

The shelves are small pieces of hardboard supported on racks. The left-hand edges of the shelves approach to within an inch of the enlarger column to provide the largest possible area; this means that nearly half of the enlarger baseboard is accommodated under the bottom shelf. Consequently the shelves cannot be supported from the bottom of the cabinet, nor is the back designed to take any weight, so their left-hand edges are fixed

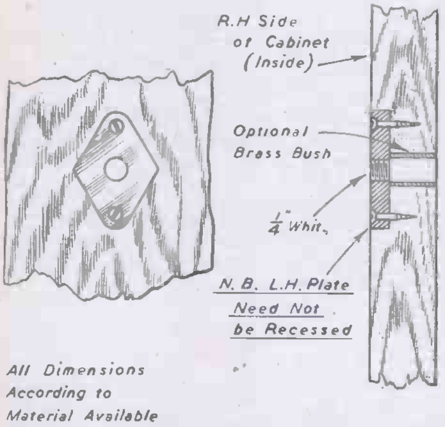


Fig. 4.—Details of the bracket-bolt anchorage on the side of the cabinet.

to vertical rails suspended from the top. A 1in. by 1in. strip is screwed to the underside of the top from front to back and the upper ends of the rails screwed to this. The complete assembly of racks forming the shelves can very well be made up as a whole and treated as a unit for fixing in the cabinet (Fig. 2). The right-hand edges are supported on similar strips screwed to the cabinet side. A narrow "fence" of the same hardboard as the shelves is fixed to the vertical rails along the left-hand edge of the upper shelf to prevent small articles being knocked off the shelf on to the enlarger. The upright rails also carry a 1in. by ½in. strip running from back to front of the cabinet to serve as one runner for the paper drawer. A similar strip attached to the inside of the right-hand wall of the cabinet forms the other. These should, of course, be exactly opposite each other so that the sides of the drawer do not bind.

The drawer is 7in. deep although the sides slope down to only 5in. deep at the back. This allows the drawer when halfway open to tip downwards in the front, providing easy access to the contents. There is no visible handle on the drawer; this omission is deliberate in order to provide the greatest possible size of drawer. The space available is utilised to the full, as the doors actually touch the drawer front when closed. In place of the usual drawer pull there is a small finger bar under the front edge of the drawer, attached by two screws through the bottom.

The shelves are spaced according to what they have to carry, and as it seemed reasonable to have developer and fixer bottle to hand on the top shelf this was positioned far enough below the drawer to accommodate nicely the biggest bottle in use—in this case a 40oz. bottle of hypo. The bottom shelf was raised high enough to give ample room for the enlarger baseboard to slide beneath it, with a coiled flex lead as well. So the location of the shelves is to a large extent automatically fixed. The dish rack on the left was fixed at a height which just clears the top of the enlarger lamphouse when in its lowest position.

Bench Top

Attention can now be turned to additional features affecting the working of the apparatus, consisting of a built-in workbench and the question of mobility. Various arrangements of detachable and folding tops were considered and discarded until the present system was evolved, which works very well. It has the merits of simplicity and sturdiness, and does not add appreciably to the size of the cabinet. The only addition made to the bare cabinet is a second top. This is in the form of two flaps, each half the size of the main top, and each hinged at its outer edge. The flaps open out, as shown in Fig. 1, to provide a workbench 4ft. long. As some sort of a detachable support for the flaps seemed the best arrangement, it was considered inadvisable to have these overhang more than 12in. as one at least would probably have to bear most of the weight of the enlarger. These two when folded in make a divided top to the cabinet 2ft. wide, thereby fixing the width of the cabinet itself, as was mentioned earlier. The hinges for these flaps are sunk into the cabinet top and into the flaps themselves so that the flaps lay perfectly flat when folded in, and form a working surface as free from projections as possible, when extended. With careful fitting the dividing line across the top when closed is not very noticeable.

Supporting Brackets

The supporting brackets are somewhat unconventional, but quite successful. As shown

Fig. 5.—Cabinet with doors open, showing the disposition of shelves and contents.

in Fig. 3, these each consist of two lengths of wood linked together with a short length of picture chain. One piece is clamped vertically to the side of the cabinet by a ¼in. bolt through its top end, while the lower end carries a step on which the strut piece rests while leaning out and supporting the flap. The step is a block cut off the same strip and screwed securely to the end of the vertical strip. The end of the block on which the strut rests is slightly angled inwards to ensure that the strut lodges securely. The bottom end of the strut is cut at an angle to match that of the step, and the top end rounded off where it contacts the underside of the flap. The weight of the flap is thus converted to a straight pull on the chain, the end of which is anchored near the bolt. This bolt is a length of ¼in. steel rod having both ends threaded ¼in. Whitworth for a short distance. On one end is fitted a wing nut, which is run tightly down to the end of the thread and the end of the bolt riveted over, fixing the nut solidly in one with the bolt. This is passed through the upright member of the bracket and through a hole in the side of the cabinet, where it screws into a hole tapped in a small metal plate about 3/16in. thick,

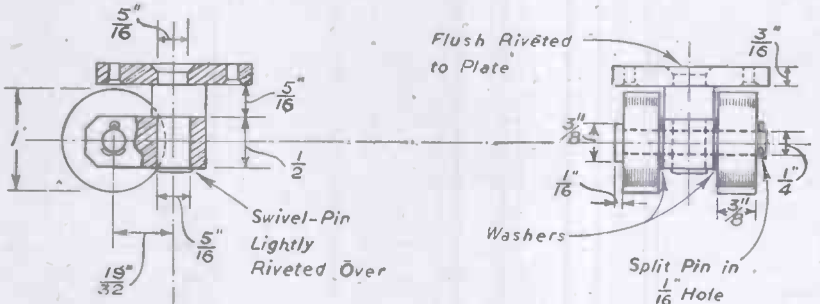


Fig. 6.—Details of the double castors.

attached to the inside of the cabinet (see also Fig. 4). This provides a simple but very secure fixing. The chain is attached at a point near the bolt by a screw through the end link. Small pads of green baize or felt are glued to each end of the upright on the side bearing against the cabinet, so as to avoid damage to the polish. A similar covering is glued over the end of the strut where it comes into contact with the underside of the flap, as this surface is the top of the cabinet when the flaps are folded in. The length of the chain is determined by adjusting the angle of the strut resting on its block so that a ruler edge laid along the flap and the cabinet top shows the two to be in line horizontally. The position of the end link of the chain is marked on the strut when its working position has been fixed, and the chain screwed to the strut. On dissembling, the collapsed brackets are stowed in the shallow space under the bottom shelf beside the enlarger baseboard (Fig. 5).

The left-hand plate into which the bolt holding the bracket is screwed is attached straight on the inner side of the cabinet, but that on the right has to be sunk flush into the side. This is to avoid fouling the right-hand side of the drawer. The plates can be any odd piece of strip steel or brass some 3/16in. thick, having a countersunk hole either side of the ½in. tapped hole. In the cabinet illustrated, the hole in the side through which the bolt passes was bushed with a short length of ⅜in. brass tube for the sake of appearance. A neat plate on the outside would look equally well, but whatever fitting is chosen (and such a fitting is purely optional) it must be flush with the cabinet so as not to interfere with the location of the flap support. It might be advisable to mark the brackets Left and Right when adjusted, to be sure of having the top always level.

Painting and Finishing

When all the construction work is finished the bench top should receive a good undercoat and a top finish of white enamel or hard gloss paint to facilitate wiping down. Let the paint dry thoroughly hard before closing the flaps down. The rest of the cabinet was stained dark oak and polished with shellac varnish in the manner of french polish.

Castors

It was originally intended to fit a set of sprung castors of the dinner-wagon type, but a change was made for three reasons: the weight of the cabinet when in action was deemed to be somewhat heavy for the smaller type of castor; as solid a support as possible was required for the enlarger and, lastly, as the height of the bench was very convenient for working, it seemed undesirable to raise it much more. So a set of special castors was made. These are all that could be desired, and drawings in Fig. 6 are given should the constructor consider their production worth while. It will be seen that each castor is fitted with twin wheels, which not only makes them a "heavy duty" type, but simplifies construction. A valuable feature is that they raise the cabinet only 1½in. The material throughout is mild steel, with the exception of the wheels which are ⅜in. slices off 1in. round aluminium bar and the spindles which are silver steel. The wheels are sawn off the bar, faced and drilled at the one setting in a three-jaw chuck, reversed in the chuck and faced back to thickness. The columns are plain turning jobs out of mild steel bar, flush riveted in a 1½in. square piece of 3/16in. steel plate. The links are ½in. square mild steel, and are just a straight sawing and drilling job. A smear of fairly heavy oil on the spindles when assembling ensures free running under load.

Electrical Connections

On the back of the cabinet, midway along the top edge, is fitted a two-pin socket. This is of the flat type and is actually the socket half of a pair of connectors. The two halves of the socket are held together by two 6 B.A. screws; these are replaced by two thin round-headed wood screws which attach the socket to the back of the cabinet. A flex lead from the socket hangs coiled on a hook just below, and when setting up is plugged into either a lighting point or a lampholder and connections for the enlarger, safelight, and any other electrical apparatus are then taken from a multiple adapter socket plugged into the one on the cabinet. Light rubber-covered cable is advised for the permanent socket, as this is less likely to lead to trouble in the event of chemicals getting splashed on it.

In use, all that is required to convert any room into a fully equipped darkroom is to wheel in the cabinet, attach the two bracket bolts and plug in. The time and effort saved in getting ready and clearing away has made the job well worth while.

If a cabinet of the dimensions shown is used in the bathroom, it will probably be found that either flap is high enough to overhang the wash-basin. By standing the cabinet sideways on to the basin prints can be transferred from a fixing bath on the flap straight into the basin for washing, thereby saving room on the bench and avoiding drips of hypo across the floor.

Mathematics as a Pastime

Reaching Towards Accuracy.

By W. J. WESTON

AN interesting and most instructive series of letters published recently in PRACTICAL MECHANICS dealt with the trisection of an angle. To what point of accuracy can we pretend? The correspondence brought out again this inescapable fact, that absolute accuracy in our measurements is attainable only by happy chance. For the most part we must content ourselves with approximation; and for the practical affairs of life approximation suffices. You have never drawn a real line, however fine a point on your pencil; for a line is length without breadth; and under the microscope your line is a broad black groove. You have never made a point on your paper, either; for a point has position but no magnitude. Yet your lines and your points serve well enough in practice.

It is the inadequacy of our powers and of our most exquisite drawing instruments that

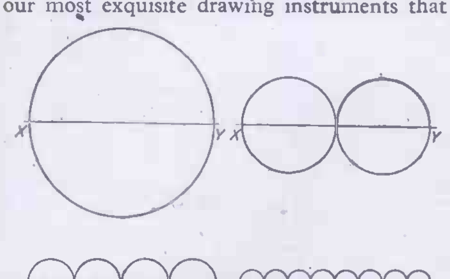


Fig. 1.—Diagrams illustrating the problem of circles and circumferences.

constrains us to be content with approximation. The inadequacy is well brought out in this, at first sight, puzzling conclusion. You describe a circle on the diameter X Y (Fig. 1): the circumference is π times X Y. You describe two circles on the two halves of X Y. Then the total curve of the two equals the circumference of the first, equals, that is, π times X Y. You proceed further to smaller sub-divisions, four, eight, and so on. The length of the curve remains constant.

But you come to such a division as makes the curve merge into the straight line. It would almost seem that the length of the curve has shrunk to less than a third of its first length, that π equals 1. But, of course, that is only because the limitation of our powers prevents us from discerning the circles that are yet there; our so-called "line" has the breadth of a diameter of a circle.

That no exact method of trisecting an angle is available was the conclusion reluctantly reached in the correspondence referred to. Yes; but even when you get what you call an exact method of division, absolute accuracy is not there. Here is A B, a two-inch line (Fig. 2).

You trisect it by marking off three equal divisions on a line at an angle and by drawing parallels. And Sir Oliver Lodge declared that your measurement of the length of each third cannot be expressed with infinite accuracy in figures; for figures go by jerks, by stops, whereas a line is continuous. "No measurement of length," he said, "could ever be expressed as a whole number of inches, nor yet as a whole number plus a definite fraction of an inch." You may get accuracy to two places of decimals; you are skilled far above the ordinary if you get accuracy to three places, which, of course, is ten times the accuracy. You may be able to read .66 inches for your third part; you are very unlikely to read .666 inches.

We must reconcile ourselves to the existence of incommensurables in our mathematics. There are measurements that we cannot, whatever our skill and our patience, express

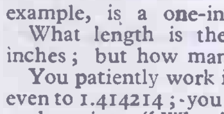


Fig. 2 (Above)—Trisecting a line.

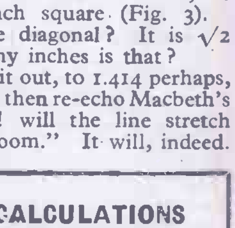


Fig. 3.—What length is the diagonal?

in terms of another measurement. Here, for example, is a one-inch square (Fig. 3).

What length is the diagonal? It is $\sqrt{2}$ inches; but how many inches is that?

You patiently work it out, to 1.414 perhaps, even to 1.414214; you then re-echo Macbeth's exclamation, "What! will the line stretch out to the crack of doom." It will, indeed.

Making a "Designograph"

Details of a Novel and Instructive Appliance for Producing Harmonographic Designs

By W. J. C.

THE appliance shown in the accompanying illustrations is capable of drawing an infinite number of designs, and can be constructed with odd scraps of material usually to be found in any amateur's scrap-box. For materials include part of a packing case, three motor-cycle spokes, a piece of broken car hinge, a few screws, and terminals from old electrical apparatus.

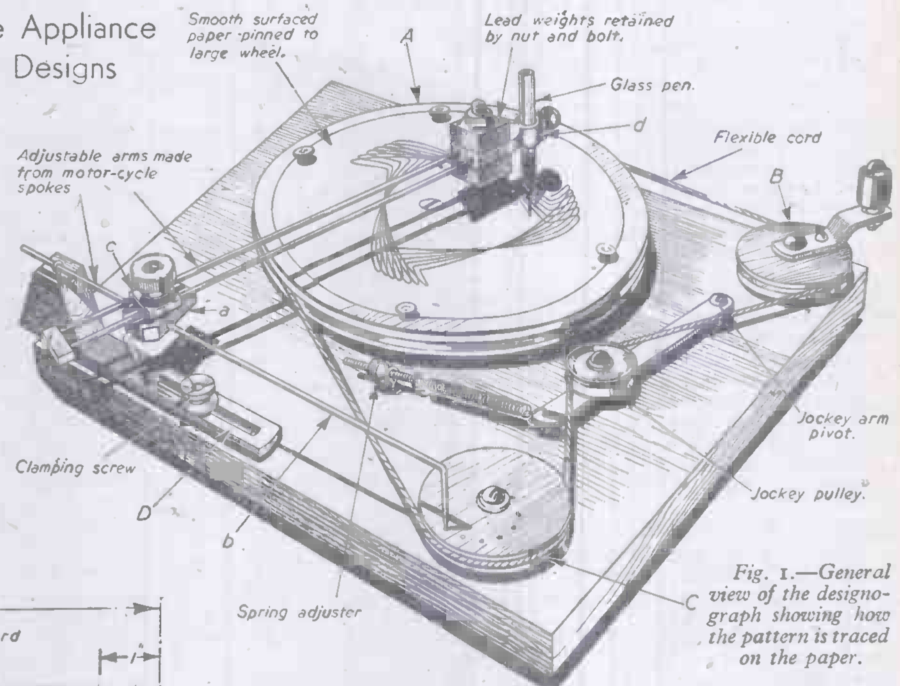


Fig. 1.—General view of the designograph showing how the pattern is traced on the paper.

Details of Construction

The base, as shown in Fig. 2, is made from the end of the packing case, and measures 11in. by 9in. Mounted on it are the large grooved wheel A, to which the paper for the design is fixed with drawing pins, and the two smaller wheels B and C. These are made with a double thickness of the thin sides of the packing case glued together, with the grain at right angles. A handle, shaped from a strip of sheet brass ⅜in. wide and 1½in. long, is attached to wheel B, a small knob being fitted, as shown in Fig. 1. It should be noted that wheel A is mounted ½in. off centre, as indicated in Fig. 2. Wheel C has a number of small diameter holes drilled partly through at varying distances from the centre of the wheel. The pointed end of the rod "b" engages in one of these holes when the appliance is operated. Each of the three wheels should be provided with a thin metal or wooden washer to raise them slightly above the surface of the baseboard in order to eliminate unnecessary friction.

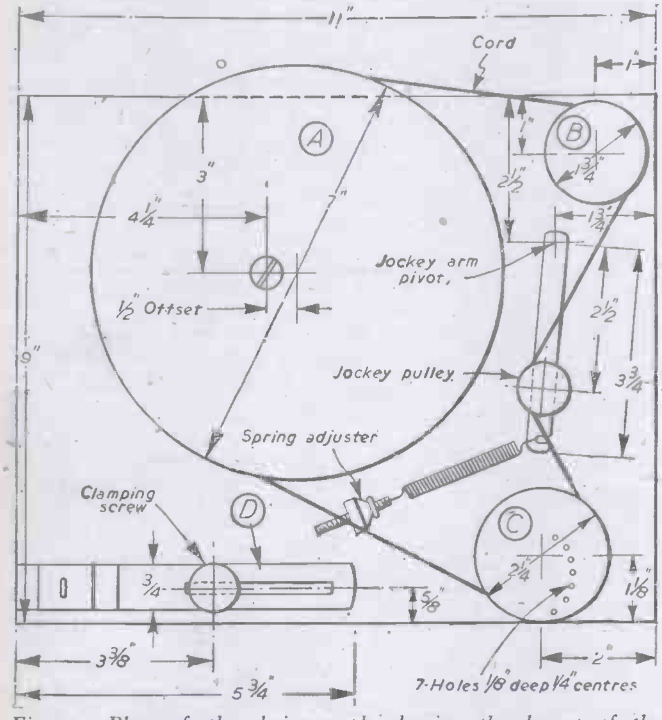


Fig. 2.—Plan of the designograph showing the layout of the various parts.

Adjustable Arms

The adjustable arms (see Fig. 1) are made from cycle spokes, the brass block "a" being drilled and fitted with a clamping screw for the rod "b," which is bent at right angles at one end, and pointed, as shown, to drop into one of the holes in wheel C, as already mentioned. The block a is also drilled to take a clamping screw for the bridge piece and double arm which carries the pencil or glass pen. An exploded view giving details of this fitment is given in Fig. 3.

In Fig. 4 details of the weighted penholder fitment are given, the centre brass part "d" being drilled to take a bolt for clamping the two lead blocks in position. These blocks are provided to ensure a suitable pressure being maintained of the pen or pencil point on the paper. The penholder is shaped out of a small piece of brass and drilled to take the glass pen or pencil which is clamped in position by means of a brass milled-head screw. One end of the penholder is filed to fit into a slot in the block "d" and is soldered in place, which is also drilled to take the ends of the double arm. The part D is made from hardwood, and is slotted, as shown in Fig. 3, to take a clamping screw. A shaped block E is glued and screwed to one end, and is provided with a small screw-eye in which the end of the rod "b" slides freely.

(Continued on page 232)

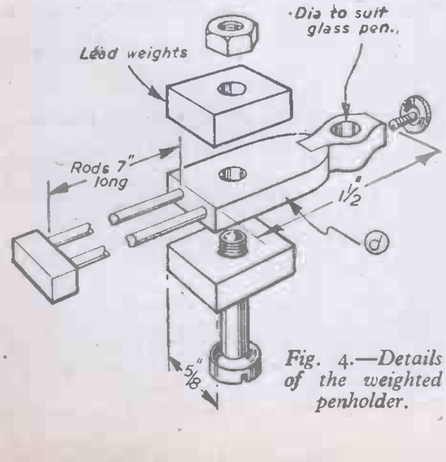


Fig. 4.—Details of the weighted penholder.

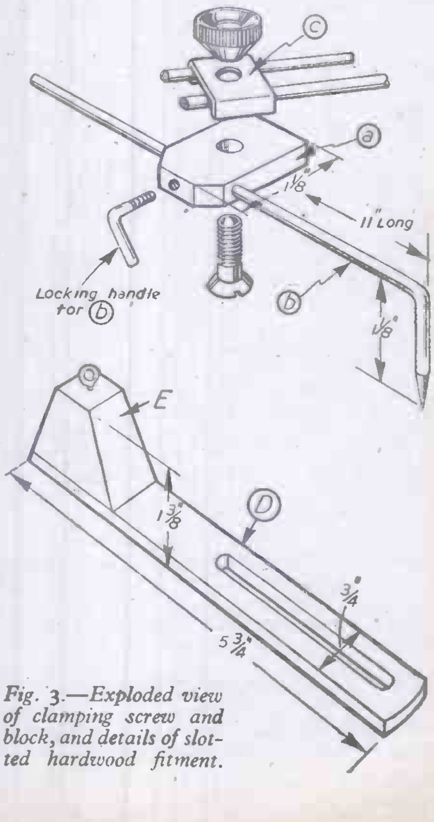


Fig. 3.—Exploded view of clamping screw and block, and details of slotted hardwood fitment.

Studies in Electricity and Magnetism–2

Ohm's Law : Voltage : Potentials to "Earth" : The BLv Formula : Alternating E.M.F.

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

(*Continued from page 91, December issue*).

HOW would you measure the internal resistance of : (a) a voltmeter, (b) an accumulator cell ?

I choose these laboratory experiments for discussion because they embody and extend important principles touched upon in the first article. But while you are thinking about them, I want to say a bit more about "voltage-drop." I want you to recall something which I said regarding potential-difference (p.d.) being of "opposite sign" to the e.m.f. in a circuit.

If you are interested in radio technical problems, you will know there has been a great deal of arguing in the correspondence columns of various journals about this question of the "signs" of potentials in valve circuits, equivalent circuits, etc.

We shall not enter into that controversy here, but much of it has to do with this fundamental fact that e.m.f. and p.d. are things of opposite signs.

How are "Volts" Lost ?

Suppose 5 volts are dropped in a wire or cable. If the e.m.f. at the supply end is 200 volts, that at the far end of the line will be 200 − 5 = 195 volts.

Elementary arithmetic. But why do we treat "drop" as *negative* ? Is it just because the minus sign stands for arithmetical subtraction ? Five volts are "lost," therefore they are a "minus quantity." Or is there some other meaning ?

How are "volts" lost ? Do they vanish into thin air, or are they changed into heat in the wire ?

Electrical *energy* reappears as heat, the rate of expenditure in joules per second, being, *Watts* = Volts × Amperes = *Power*. But that hardly explains matters. *Force*, or *pressure*, is generally lost because it encounters some *equal and opposite force*.

Is there such a counter-force in a resistance ? Electrically, are we entitled to postulate anything in the nature of a *back e.m.f.* in a resistance ?

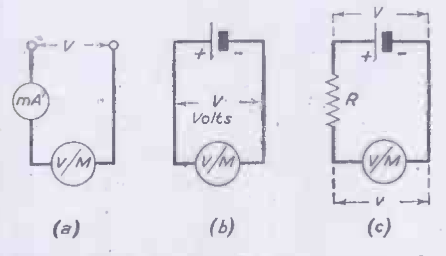


Fig. 6.—Ways of measuring the resistance of a Voltmeter.

Action and Reaction

Let us take a concrete problem.

The one we started with would do, but perhaps a simple cell generating an e.m.f. of 1.5 volts, and having an internal resistance of 1 ohm (Fig. 5a) will be more to the point.

The e.m.f. acts outwards, towards the + terminal, or away from the − terminal. That is, by definition, the "positive direction" of an e.m.f. If we connected across the terminals a voltmeter which took no current, it would register exactly 1.5 volts — the total e.m.f. generated.

But if we connected a resistance R taking 1 ampere (Fig. 5b), the terminal p.d. would at once fall to 0.5 volts.

We might ask : Where is the other 1.0 volt ? It is across the internal resistance r, of course. But that is not quite the point. We have a physical fact to explain, namely, *how* the 1.0 volt across r causes the terminal voltage to fall by 1.0 volt. If you fully grasp the import of the question, you will see there is a little more to it than arithmetic.

The cell still generates 1.5 volts, and everything looks as if the 1.0 volt across r is *in direct opposition*—acting like a "back e.m.f." We have 1.5 volts opposed by 1.0 volt, hence the effective e.m.f. in the rest of the circuit becomes 0.5 volt. It is a case of action and reaction being equal and opposite. Something like a "twist" of

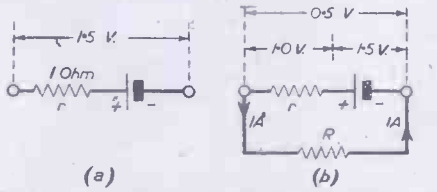


Fig. 5 (b).—Showing how internal "drop" in a cell is of opposite sign to the e.m.f., and thus subtracts from the volts available.

language is required to describe it : if in any circuit element, volts are *lost*, there must be a potential-difference of that amount acting against the applied e.m.f. (Consider the + and − signs across r (Fig. 5b). They are opposite to the e.m.f.).

So, it seems, the negative sign has a meaning quite apart from its use in denoting an arithmetical subtraction.

If a wheelbarrow or a train "reacts" with a force equal to the applied force, how do they move, etc. ? If the voltage-drop in a resistance gives rise to an electric force exactly equal and opposite to the voltage applied, how do electrons move ?

I will leave you to think about it for the present.

Measuring Resistances with Voltmeter

One obvious way of finding the resistance of a voltmeter is to apply a constant voltage, whose value will be indicated, and measure the current i with a milliammeter mA. in series, Fig. 6a. R = V/i, or = Voltmeter Reading/Milliamp. Reading × 1,000. To be exact, we should subtract the resistance of the milliammeter.

But if you have convenient values of known resistances, there is a neater method not requiring two instruments. The known values should be a few hundreds or few thousand ohms each, depending on the resistance of the voltmeter.

First, connect the voltmeter across a battery (Fig. 6b), *without* any resistance in series. Let the reading be V volts. Repeat the measurement with the known R in series (Fig. 6c) the reading will fall to some lower value such as v volts owing to the drop in R Then :

Resistance of voltmeter,

$$X = R \times \frac{v}{V - v} = \frac{R}{\left(\frac{V}{v} - 1\right)}$$

See if you can derive this formula from first principles. Referring to Fig. 6c, ask yourself these questions : What is the voltage-dropped across R ? What is the "drop" across the voltmeter ? What is the current, i, in the circuit ? Hence form an expression for X.

If V = n times v = nV, where n is some convenient round number such as 10 or 100,

$$X = \frac{R}{n - 1}$$

It may be interesting to note that this is the formula for finding the resistance of an *ammeter shunt*, if R = the resistance of the ammeter. Unless a decade box is available, it will not be easy to get v = 1/10V, etc., for the present test. But note one way which dispenses with formulæ or calculations : if in 6c we insert an R which reduces the reading to half (v = ½V), X = R.

Alternatively, if R represents the known resistance of a voltmeter, any other unknown resistance of comparable value can be found. The formula then becomes :

$$X = R\left(\frac{V}{v} - 1\right) = R(n - 1). \quad \text{(Why ?)}$$

Simple Voltage-balance

The second measurement (b) asked for in our question is of interest because it makes use of voltage-balance—a "null" indication.

What is the simplest way of measuring the internal resistance of an accumulator ? Again, one obvious way is to load with a variable resistance R, Fig. 7a, with ammeter A and voltmeter V in the circuit, and observe how much the terminal volts fall from no-load to full load. If v denotes this fall, Internal Resistance = v/I.

The method now to be considered measures v direct, by employing two cells (or two batteries of equal e.m.f.'s), inserting a *milli-voltmeter* between them (Fig. 7b), and connecting the load and ammeter, as before,

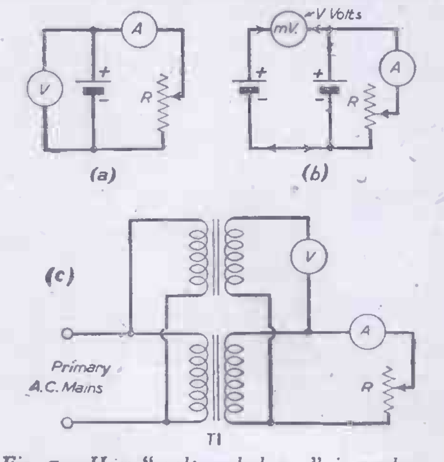


Fig. 7.—How "voltage-balance" is made use of for measuring the internal resistance of an accumulator (b). Compare with the more complicated-looking connections (c) for "back-to-back" regulation test on A.C. transformers.

to the cell whose resistance is to be measured. The current taken need not be anything so large (as in Fig. 7a)—if the milli-voltmeter is sensitive enough, quite a small amperage will do.

At first, the e.m.f.'s will be equal (on no-load), or will equalise themselves in a while, giving initial zero reading in the mV. Upon taking current, the comparatively high resistance of mV will prevent the second cell supplying any appreciable proportion of the total amperes. This cell is simply used to give voltage-balance to start with.

When on load the internal drop of volts will make the terminal voltages unequal, the difference v being indicated direct by the milli-voltmeter — v, of course, being the drop.

As before, the internal resistance = v/I, v being in volts. In A.C. transformer testing similar principles are used. The secondaries are connected up in opposition in the same way (Fig. 7c). Here the voltages are usually large, and a voltmeter V (low-reading type) registers the impedance-drop in the loaded transformer T_1, from which the percentage drop from no load to full load may be calculated. A number of readings are usually taken at different loads and a curve plotted showing overall percentage regulation.

Pogendorff's Method of Measuring e.m.f.

Mention of voltage-balance reminds one of all sorts of interesting applications. There is one more experiment which is worth noting here.

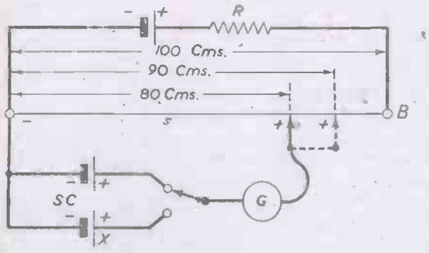


Fig. 8.—Another measurement making use of voltage-balance. Calibrating an ordinary Metre scale (not shown) to read "Volts."

It is a method of accurately measuring the e.m.f. of a cell without a voltmeter.

In Fig. 8, a slide-wire potentiometer is connected to a steady voltage source, such as a 2-volt accumulator. An additional resistance R being put in circuit to limit the current and thus prevent overheating the slide-wire s. The total fall of potential along s will be 2 volts, less the volts dropped in R, the end B being + to A. A metre scale is fixed along s.

First, a standard cell SC (or one whose e.m.f. is accurately known) is switched through galvanometer G to the slider which makes contact with s. Any sensitive measuring instrument could be used as "galvo," preferably centre-zero—but no measurement of voltage or current is required, only zero balance.

Suppose the known e.m.f. of SC is 1.05 volts. The slider is moved along the wire and carefully adjusted until G reads zero. Suppose this occurs at 80 cms. on the metre scale. Then the fall of potential along 80 cms. is exactly equal to the e.m.f. of SC, 1.05 volts, but of opposite sign—current cannot flow either way through G. Therefore, the metre scale can be calibrated in volts: 80 cms. = 1.05 volts, hence 1 cm. = 1.05/80 = 0.013 volts.

The cell of unknown e.m.f. X is next switched into circuit and the slider again adjusted for null deflection. Suppose balance is obtained at 90 cms. The e.m.f. X = 0.013 × 90 = 1.17 volts.

The + and − signs placed against the cells and slide-wire will show why the galvanometer gives no reading. For example at the first balance point, there is a potential drop of 1.05 volts in s—this drop being due to the steady current flowing from the accumulator, and of sign + − from right to left, as shown. Against it, the 1.05 volts from SC acts as a back e.m.f., hence no current can flow either way through G.

More on Lenz's Law

As exercises on the direction of induced current being such as to "tend to stop" the motion producing it, readers are invited to answer the following questions:

Two identical coils wound in the same direction and having similar terminal connections are placed on an iron core. A make-and-break device starts and stops a current in one coil. Show the directions of the induced e.m.f. in the second coil. What effect, if any, would result from short-circuiting the second coil?

The armature of a small motor runs very freely and takes some little time to come to rest when the power is switched-off. Show an easy electrical method of bringing it to rest rapidly, explaining what takes place.

I will comment on the questions in my next article.

Self-induction

The *self-induced* e.m.f. in a coil when the current is started or stopped is a subject having wide practical implications.

In another article on Dynamo and Motor Problems, I have mentioned, for instance, the risks of insulation breakdowns in opening highly inductive field circuits. Again, the current in every inductive circuit takes *time* to grow to its full value—a fact which accounts for an alternating current in a pure inductance lagging a quarter-cycle behind the voltage. Also this is a factor which must be taken into account in designing precision devices such as high-speed relays.

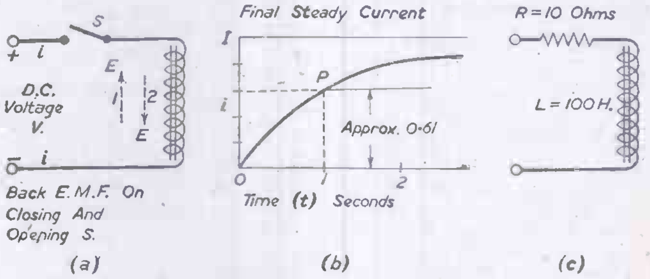
It may be regarded as another instance of Lenz's law. A self-induced e.m.f. (which does not itself cause a "current") tends to stop or delay the motion producing it—the motion of electrons, or the supply current.

Thus, in Fig. 9 a, on closing the switch S, the current grows rather slowly to its normal value, somewhat as indicated by the curve in Fig. 9b. Magnetic lines coming into existence, "cut" the turns of the coil, inducing a back e.m.f. E whose positive direction is opposite to the + and − of the supply (indicated by dotted arrow 1).

The effect can be seen in the inductive field circuits of large generators, transformers, etc. With a D.C. supply, the pointer of an ammeter creeps up, fairly rapidly at first (steep portion of the curve, Fig. 9b), then at successively slower rates. Several seconds may elapse before a steady value is reached.

For example, in the inductive circuit shown in Fig. 9c, i will take 10 seconds to grow to a value such as is shown by point P in Fig. 9b—about 60 per cent. (0.6) of the steady value I.

Fig. 9.—On closing switch S, current in the inductive circuit grows in the manner shown in (b), where I = V/R = the final steady value given by Ohm's Law. In (c), the current would take 10 secs. to reach the value i = 0.6I.



If the resistance could be made as low as 1.0 ohm, the time would be 1⅔ minutes. We shall say a little more about these time-intervals presently.

On opening the switch S (Fig. 9a), the field will suddenly collapse, an immense number of "magnetic lines" cutting hundreds or thousands of turns in a small fraction of a second—in more technical terms, we get an extremely high *rate of change of "flux-linkages."* In consequence, an e.m.f. will be induced acting in the direction of the second dotted arrow 2, i.e., in *the same direction as the supply voltage*, so tending to keep the current "going," or to maintain it at steady value when it is rapidly decreasing. Probably a long drawn-out arc will occur at the switch contacts. The self-induction thus partly delays the rate of decay—the spark at the switch tends to prolong the current flow.

Still, the rate of interruption may be large enough at "break" to self-induce an e.m.f. many times the normal supply voltage, thus causing breakdown of weak parts of the insulation. Here, too, we have the explanation of the 7,000 to 8,000 volts induced in the secondary windings of car ignition coils (and magnetos) when a contact-breaker rapidly interrupts a primary current derived from a 12-volt battery.

The Inductive "Time Constant"

I would like to discuss the curve given in Fig. 9b in some detail, because it exhibits a special "law" (Helmholtz's law).

If the reader cares to plot this curve on squared paper, the set of values given in the accompanying table have been worked from exponential tables. These values assume a *time constant* of 1.0 seconds, meaning that i will grow to approximately 0.6I in 1 second, as indicated at point P.

Supposing the final steady value (I) to be 1 ampere, the figures in the right-hand column of the table will then stand for the current values reached at instants of 0.1, 0.2, 0.4 seconds, etc. Alternatively, if I = 10 amperes, the values in the right-hand column can be read as 1, 1.8, 3.3 amperes, etc. It is interesting to note that a current of ½I will be reached in about 0.7 seconds—not in 0.5 seconds.

More precisely, point P in Fig. 9b corresponds to a time-interval during which i will grow to a value of 0.632I (63.2 per cent. of the final value). It is shown as 1 sec. in this instance; in 5c, it is 10 secs., but would become 100 secs. if R was reduced to 1 ohm.

Oddly enough, the inductive time-constant is given by the ratio, Inductance/Resistance (L/R) = Henries/Ohms. Thus, L/R = a *time in seconds*—the time the current will take to grow to 63.2 per cent. of its final value. To take another example: a coil of 48H. having a resistance of 60 ohms will have a time-constant of L/R = 48/60 = 0.8 sec.

There we will leave this subject, but laws of electro-magnetic induction which we started considering in the previous article must be developed so as to give more precise definitions of quantities like "inductance."

"Loop" or Coil in Magnetic Field

Some space has already been devoted to the "BLv" formula for the electro-motive force induced in a single conductor moving or revolving in a magnetic field, and we saw that it comes down to the fundamental law:

Induced e.m.f. (electromagnetic units) = Total number of lines cut in 1 second.

Since 1-volt is the e.m.f. induced in a conductor cutting 100,000,000 (10^8) lines every second,

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

It was pointed out, also, that the BLv equation gives the *maximum value* of the induced voltage. That is to say, the formula as it stands refers to a conductor moving *at right-angles* to the field. If we take account of the fact that, when revolving, the motion is at right-angles to the lines at only two points, we have to introduce "Sin θ" (or "Cos θ," depending on what is considered the initial position).

The formula then gives the *instantaneous value* of an *alternating* e.m.f., Em., i.e., the value at any instant in a cycle is, e = Em sin θ.

Consider, next, a "loop" or a single turn of wire revolving in the field—for example, single-turn armature coils. The maximum voltage generated may be calculated by BLv × 10^8, treating each active side of the loop as a conductor of length L cms. As there are two "sides," the formula must be x2. The velocity v = 2 πrn cms. per sec., where r is the radius of rotation.

But we want to approach this question of induction in loops and coils from a slightly different angle. While, as before mentioned, it is often convenient to regard each active side as a conductor cutting lines of force, the principle of "cutting" becomes difficult to apply to other cases such as circular coils.

Our object is not so much to "derive formulæ" as to grasp a wider principle applicable to self-induction, a.c. transformers, etc., where coils are themselves stationary whilst the magnetic field is varying or alternating.

This wider principle may be stated as follows: *the induced e.m.f. in a coil of T turns is numerically the same as the rate of change of flux-linkages.*

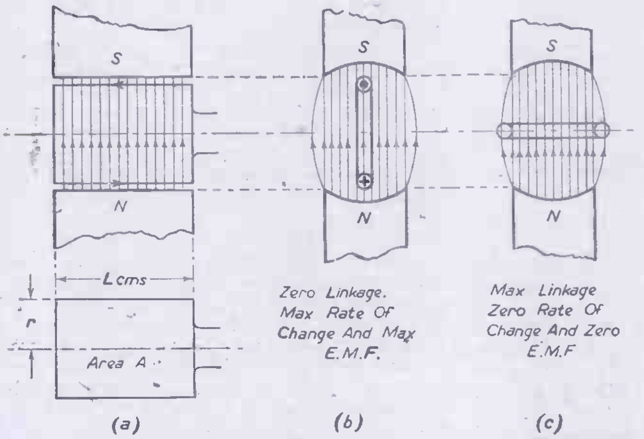


Fig. 10.—Explaining a generator in terms of "flux-linkage." Though the flux "linking," or "threading" the loop is maximum in (c), the induced e.m.f. is zero because the rate of change of flux is zero in this position.

Average Induced e.m.f. $= \frac{\text{Flux} \times \text{Turns}}{\text{time}} = \frac{NT}{t}$ (e.m.u.'s).

or E (in volts) $= \frac{NT}{t} \times 10^8$,

t being a time interval in secs., during which the flux varies between o and the value N. (The symbol N stands for *total flux* = BA, where B = lines per sq. cm. (flux density), and A the area traversed by the flux.

Observe, we must be careful to state, *flux-linkages* = flux *times* turns. One line of force linking with 100 turns will develop a hundred times the e.m.f. induced in a single turn. Hence 1-volt will be the e.m.f. induced in a coil whose total "linkage" is changing at a rate equivalent to 10^8 flux turns per sec.

A rate of change of 10^8 linkages per sec. may be: 100 million lines linked with one turn (changing between zero and maximum in one second); 10 million lines linked with 10 turns; 1 million lines linked with 100 turns; and so forth. Also, the time need not be 1 sec. A "rate of change" of 10^8 lines per sec., for instance, may result from 1 million lines varying in 1/100th sec., since $N/t = 10^6/10^1 = 10^8$ lines per sec.

In other words: a flux-change of 1 million lines in 1/100th sec. will have precisely the same induction effect in a coil of T turns as 100 million lines changing in 1 sec.

Another point to note is that formulæ which make use of N/t (Flux/time) give the *average*, not the maximum induced e.m.f.—the BLv formula gave the maximum. This is because N/t is an average rate of change.

A numerical example will show how both methods may be applied to simple design problems.

Two Ways of Calculating Induced E.M.F.

Let us work the following problem for a coil revolving in a two-pole field (Fig 10), the data being:

Turns = 100
Active Length L = 10 cms.
Radius r = 2.5 cms.
Area A = 50 sq. cms.
Flux Density B = 10,000 lines per sq. cm.
Speed = 3,000 r.p.m. = 50 r.p.s.
The total flux $N = B \times A = 10^4 \times 50 = 5 \times 10^5$ or 500,000 lines
Circumferential Velocity $v = 2\pi \times 2.5 \times 50 = 250\pi$ cms. per sec.
Therefore, using BLv:
Max. e.m.f. (two sides of 1 turn) = Em = $\frac{10^4 \times 10 \times 250\pi \times 2}{10^8} = 1.57$ volts.

This is the maximum (peak) value of an alternating e.m.f. of frequency 50 cycles per sec. Since there are 100 turns, the total peak voltage if a pair of sliprings were fitted would be $1.57 \times 100 = 157$ v. Hence an a.c. voltmeter would indicate the R.M.S. Value = 0.707 × 157 = 110 v.

Next, let us reason the same problem in terms of flux linkages.

During each ½-revolution the flux threading the coil will change from 0 to 5×10^5 lines (or the other way about). The time t of a ½-rev. = 1/200th sec., so that,

Average rate of change of flux = N/t = $\frac{5 \times 10^5}{1/200} = 10^8$ lines per sec.

Or, average rate of change of flux-turns = $10^8 \times 100$.

Average induced e.m.f. $= \frac{10^8 \times 10^2}{10^8} = 100$ volts.

The maximum as found above is 157 volts, the R.M.S. value 110 volts, and thus the ratio) R.M.S./Average = 110/100 = 1.1, the more exact figure (the *form factor*) for a sine-wave being 1.11.

Also for a sine-wave alternating e.m.f. or current: max. value/average value = 1.57 which is seen to be the case above, i.e., 1.57 volts/100 volts = 1.57.

Examination students should particularly note these facts. If given a problem to work the induced e.m.f. (or turns, or flux, given the e.m.f.) in terms of rate of change of linkages, and the maximum or r.m.s. value is asked for, the answer must be multiplied by 1.11 or 1.57.

Alternatively, the BLv formula can be applied to find the maximum e.m.f., multiplying by 0.707 to find what a voltmeter would read, and by 1/1.57 = 0.637 if the average value is asked for.

More care should be exercised to take account of such conversions when transposing to find the turns, flux, or speed, given the other quantities.

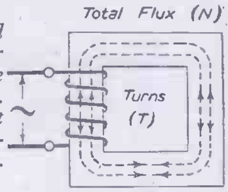


Fig. 11.—An iron-cored choke or transformer well illustrates linkage of N lines with T turns. The flux is varying at the alternating frequency of the supply.

Transformers

For transformer windings (Fig. 11), the N/t method is extremely easy to apply.

Here, we have a stationary coil of T turns, and a flux N in the core which is varying at the supply frequency, 50 cycles per sec. The self-induction effect will be exactly the same as if the coil was revolved 50 r.p.s. in a two-pole field, as above.

Thus, N varies between zero and maximum every ¼-cycle = 1/4f. secs. (or 1/200th sec. for f = 50 cycles) Working the same as above:

Average induced e.m.f. = $4.fNT \times 10^8$.
R.M.S. induced e.m.f. = $4.44.fNT \times 10^8 = 222.fNT \times 10^8$; for f = 50 c/s.

Now, see if you can do the following type of problem: How many turns are required on the primary of a transformer to work off a supply at 250 volts., 50 cycles, if the core has a cross-section of 20 sq. cms., and the flux density is not to exceed 8,000 lines per sq. cm.?

TABLE I

Values for plotting a curve of growth of current in an inductive circuit whose time-constant L/R = 1 second.

Time (t) in secs. from instant of closing the switch.	Current at instants t, expressed as a decimal fraction of the final steady current I.
0	0
0.1 sec.	0.1
0.2 ,,	0.18
0.4 ,,	0.33
0.6 ,,	0.45
0.8 ,,	0.55
1.0 ,,	0.632
2.0 ,,	0.865
3.0 ,,	0.95
4.0 ,,	0.98

(*To be continued.*)

The Schoolboys' Own Exhibition

Afterthoughts On This Interesting Show

By THE MARQUIS OF DONEGALL

THIS Exhibition was held at the New Horticultural Hall, Westminster. I pursued my usual technique of exhibition reviewing by making a quick ten-minute tour of the whole show and then going meticulously through the A to Z gamut of individual stands.

After my ten-minute run-around it was obvious what a great improvement had been made over the 1947 Exhibition. Why? Because there seemed to be so many more stands calculated to be of special interest to schoolboys.

As you came in the doors you walked straight into a large stand displaying and selling cigarette cards. In spite of the pressure of younger enthusiasts, I learned that the first set of cigarette cards was of actresses between 1892 and 1893. These are worth 50s. each to-day. Another valuable set is a military series by Wills which would cost you around £35 a set. Apparently the urge for collecting cigarette cards is still alive in the 1948 adolescent breast, even though there are no modern ones to be collected. In fact, it might interest a friend of mine who has 25,000 to know that his potential market is as firm as ever. He happens to be one of Britain's most eminent surgeons.

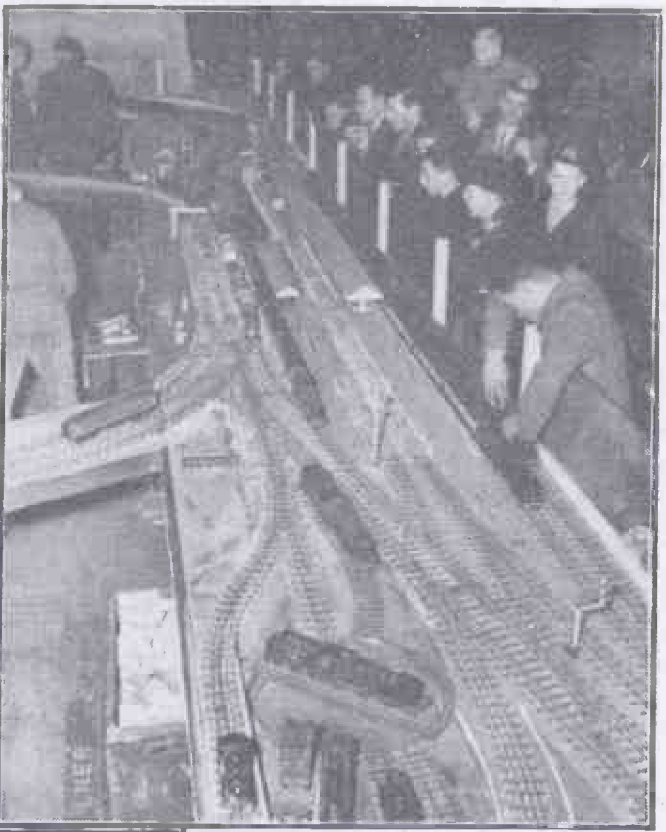
War Office Display

Next we passed to the War Office display of model soldiers. There was a Bailey Bridge and a complete model of the Trooping of the Colour. Apart from the mass of troopers and officers in their pre-war splendour, there were special models of King George V; the Prince of Wales, as the Duke of Windsor then was; the Duke of York, our present King; the Duke of Gloucester and the late Duke of Kent. The present King was in R.A.F. uniform and the Duke of Kent in the uniform of my Home Guard and Army Cadet Force regiment, the Royal West Kent.

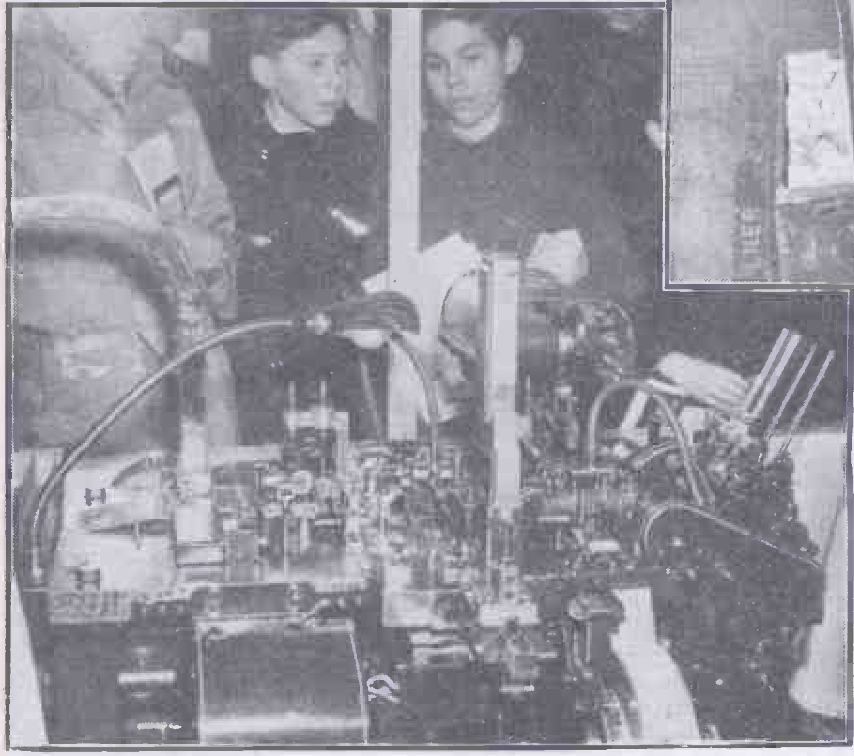
Another fascinating display in the War Office section was a complete model of the Grand Finale at the Aldershot Tattoo; and finally, with the background of Edinburgh Castle, a parade of the Scots Greys and the Black Watch. Captain Lightbody spent a month painting each piper.

Then we passed to the West London Road Safety Committee's exhibit which showed the E.R.A. racing car driven by Reg. Parnell. Later we are to see John Cobb's record-breaking Railton-Mobil-Special. This car broke the world's land-speed record on Bonneville Salt Flats a few days before the outbreak of the war at a speed of 369.7 m.p.h. It is possible that this car may reach 400 m.p.h. at the Utah Centennial Celebrations this summer over the 12-mile course.

The Royal Society for the Prevention of Accidents were there with their driving test consisting of an immobile car that "drives" along a road that unrolls before it on a screen. As I have already described this gadget at length in another article, I will leave it at that. British Railways and London Transport showed an extensive No. "0" gauge railway system.



A fine model railway layout, arranged by the British Railways, and shown at the Schoolboys' Own Exhibition.



Watching a machine which packs 120 razor blades a minute on the Gillette stand at the Exhibition.

We next come to the "Daily Mail's" exhibit, which filled the whole of the so-called dais. It was got up as a sports' arena, where displays by well-known champions were given in football, cricket, fencing, boxing, tennis, table-tennis and swimming. Where a display was impossible, as obviously in the case of golf, the various experts were interviewed by sports' reporters and gave talks.

Competition Arena

One of the most interesting sections, I thought, was the Competition Arena. There were a number of competitions, which included model-making; dressed-doll for schoolgirls under 18; art competitions divided between under 14 and 14 to 18 years of age; a stamp competition and a constructional set competition organised by Castos, Ltd.

On the day that I went a competition in cardboard-modelling was in progress, and one boy was well on his way to completing an astoundingly realistic model of a London bus when his time-limit tragically ran out.

Towards the end of our round we find the Army Cadet Force display. This was an extraordinarily good show. The exhibits, which were made in one of the Army Apprentice Schools, ranged from Elizabethan days to 1948. The controlling of working models by cathode-ray and photographic-cell drew a fascinated audience. They had an extensive collection of German medals, together with Hitler's will and his private telephone exchange.

R.A.F. Exhibit

The R.A.F. showed, among many other things, a model of an R.A.F. Station complete with hangars and aircraft. Next to it, a complete model of an Operations' Room during the war.

After this we came to a fluent gentleman who was demonstrating an adhesive paste which, under his expert demonstration, would apparently stick anything more solidly than before it was broken. Before a goggling audience of youngsters from eight to 80 he smashed mirrors, teacups, furniture, and stuck them instantaneously together again with a paste resembling gruel that he had brewed over a low flame. Having mended these sundry articles, he proceeded immediately to smash them again, and succeeded in demonstrating that wherever else these articles that he flung about like a poltergeist broke at the second effort, his joint remained intact. Immeasurably impressed, I invested a shilling or so, but it seems that I have not acquired the proper magic passes or abracadabra, as I have so far not succeeded in sticking anything with it.

Recording Studio

One of the most popular exhibits was the recording studio of a Leeds company. Since I have had a recording machine in my house I have been astounded at the number of my friends—some of them well-known public speakers—who have never taken the trouble to hear what their own voice sounds like. But, given the opportunity, I have never found one that did not practically insist on making a record immediately.

The same applied to the schoolboys who queued up to make recordings for sending as greetings to their friends. I know of no other organisation, except the Yorkshire Gramophone Library, who ran this exhibit, that has a postal gramophone record library service. Another feature was a series of records of the dialects now used in the British Isles.

Razor-blade Wrapping Machine

Next we came to Gillette. They showed a machine that wraps the razor blades. This machine, although slowed down for purposes of demonstration at the Exhibition, normally wraps up 150 blades a minute.

In 1944 I wrote an article on Gillette and discovered that not only was the Great West Road factory turning out a million and a half blades a day, but that a distinguished member of the firm, Mr. J. F. Kayser, was an unsung hero in the cause of hirsute humanity. In fact, he lent out portions of his face—and for all I know may still do so—as an experimental guinea-pig towards the improvement of shaving methods. For this purpose Mr. Kayser had a small tattoo mark about an inch from the right-hand corner of his mouth. This was to make sure that the micro-photographs of his growth of beard under varying conditions would always show exactly the same spot.

During my visit to the Gillette factory they put my head through a hole in an operating table. The result of this highly scientific experiment was that it was found that to detach one of my hairs from the epidermis required a pull of just under one ounce. I can only hope that my martyrdom was of some benefit to the march of science!

I was glad to notice that our childhood friend, the Ingersoll, is back with us. To be sure, he has gone from his traditional five bob for the cheapest model to 43s.; and he is soon to have his younger brother, the Ingersoll wrist-watch, as a companion. A watch is quite enough to interest a schoolboy, but this stand also provided the well-known conjurer, Mr. Ernest Sewell, who visits schools all over the country. The present Ingersoll is, of course, British workmanship.

There were several things that I didn't know before going to the Schoolboys' Own Exhibition:

(1) That the Gas Light and Coke Company is the largest gas undertaking in the world.

(2) That Arthur Rank's cinema clubs for children between the ages of seven and fourteen have a membership of nearly half a million.

(3) That you can get 13 stamps with Hitler's head on for a shilling.

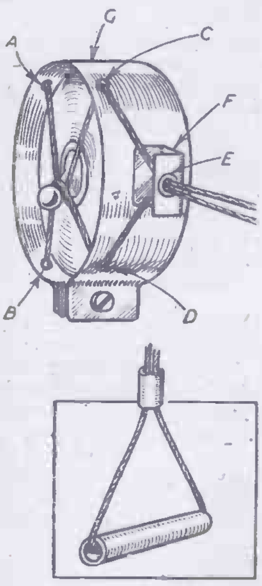
(4) That there was a car in the world that could do 150 m.p.h. on its lowest gear.

So, in conclusion, I repeat that there was plenty this year to interest the schoolboy, in particular, and grown-ups, in general. The organisers are to be congratulated, and I hope that they will pursue their efforts and delight the youth of 1949 even more than they succeeded in doing in 1948's most praiseworthy and well-thought-out display.

Controlling Electric Light from a Bed

IT is always desirable to be able to control the ceiling light from the bedside, more especially when a bedside lamp is not in use, but in some cases it is not always convenient to do this electrically. A very simple and efficient manner in which this can be done otherwise is as shown in the sketch.

The clip G and bracket F which is riveted to the clip were made of light gauge aluminium, and tightened to switch body by means of a 4 B.A. screw and nut. The sketch shows the arrangement of the cords, i.e., one under and the other over the tumbler.



A simple device for controlling a ceiling light from a bed, and detail of handle.

The cords are knotted at A and B outside the clip, pass round the tumbler, through the shoe eyelets at C and D, and converge to another eyelet in the bracket at E, which enables the switch to be worked from an acute angle, if necessary. Some types of switches have a square section tumbler, in which case the cord would normally slip over the end, but a ¼in. domed nut from the junk box just screwed on the end of the tumbler without dieing has proved an admirable solution in these cases. The cords can terminate at the bed in a loop, or in a handle, as shown. In several of these attachments I have made, I have passed the cords through plastic sheathing and terminated in a loop. With the whole fitting painted in a suitable colour it forms a very useful addition to the bedroom. When entering or leaving the room ordinarily the switch is operated in the usual manner.—W. R. Knapp.

The Pageant of the Hours

"THE Pageant of the Hours" presented by Smiths English Clocks Limited, at the "Daily Mail Ideal Home" Exhibition, held at Olympia, March 2nd to 25th, was an exhibit illustrating the evolution of man's efforts at time measurement through the centuries. We believe that this is the first time that such a presentation has been made public in this country. From purely the intellectual interest in clocks and time measuring devices from 1500 B.C. to the modern "Sectric" models of to-day this exhibit proved extremely interesting.

On entry one saw prints of period rooms illustrating how the clock has been established in the home and formed an integral part in the regulated day of each individual.

From the period rooms the visitor was taken in the form of a diorama from the earliest known method of time measurement as illustrated by the figure of primeval man studying the shadow cast from his spear by the sun. Included in the section was a cast from an Egyptian clepsydra or water clock dated from 1400 B.C. and early sundials including a copy of the hemi-cycle of Berosus the Chaldean made about 300 B.C., and a mural reproduction of a Saxon Scratch Dial from Kirkdale Church in Yorkshire.

Early Workshops

The workshops of the early clockmakers were also shown by means of enlarged prints, and examples of mechanical clocks by the world renowned British craftsmen formed a background to the old craftsman working at his bench.

Early foliot or cross bar escapements were replaced by recoil escapements and pendulums. One of the earliest known types of domestic clock was shown by a fine example of a weight driven Gothic alarm and striking clock made about A.D. 1500.

The discovery of the mainspring as a motive force for timekeeping is generally attributed to Peter Henlein and some of his first efforts were made about 1510. Other examples of this section included:

Two beautiful models of spring driven table clocks of about 1565. In these examples both dumb-bell and wheel types of balance were used and in one instance regulation was effected by short lengths of pig bristle.

Another interesting model was a wonderful astronomical clock with twelve dials having complete calendar mechanism showing signs of the Zodiac, Rising and Setting of the Sun, Phases of the Moon, and several other interesting features.

MAKING A DESIGNOGRAPH

(*Continued from page 227*)

Jockey Pulley

A brass jockey pulley is fitted, as shown, to take up the slack in the driving belt which may consist of blind cord or similar material. An adjustable coiled spring is provided to maintain the necessary pressure for keeping the belt taut.

Four small rubber feet, screwed to the underside of the baseboard, complete the appliance which will produce an unlimited number of varying designs by simply altering one or more of the four adjustments provided

The Elements of Mechanics and Mechanisms—6

By F. J. CAMM

Horse-power—Measurement of Force—Unit of Pressure

IN estimating the amount of work performed by machines, the foot pound is an inconveniently small unit because the number of them would be uncomfortably large in the case of machines of high horse-power. A larger unit has therefore been established, in exactly the same way as long distances are measured in miles, or furlongs, instead of in yards or feet. This unit of work is called 1 *horse-power*. Now this is an arbitrary unit, since there is no such thing as a standard horse. It was James Watt, the man who did *not* invent the steam-engine, who introduced this unit of power, or work, and he estimated that an average horse could raise 1 lb. 33,000ft. or 33,000 lb. 1ft. in one minute. It is now accepted as a standard.

When we say that an engine develops 8 horse-power we mean that it can perform $8 \times 33{,}000 = 264{,}000$ foot lb. of work in one minute. The unit is abbreviated to h.p.

It will be noticed that *time* is introduced into this unit, although it does not occur in connection with foot pounds.

James Watt assumed that a horse can travel $2\frac{1}{2}$ miles per hour for eight hours a day, performing the equivalent of pulling a load of 150 lb. out of a shaft by means of a rope. Thus $2\frac{1}{2}$ miles an hour is 220ft. per minute, and at that speed the load of 150 lb. is raised vertically the same distance. Therefore 300 lb. would be raised 110ft., or 3,000 lb. raised 11ft., or 33,000 lb. raised 1ft. high per minute. The latter is the unit of horse-power, i.e., 33,000 lb. raised 1ft. high per minute, or 33,000 foot pound per minute. Electrical equivalent is 746 watts.

Horse-power of an electric motor—

$$\text{I.H.P.} = \frac{\text{Volts} \times \text{Amperes}}{746}$$

Horse-power (indicated) of a single cylinder steam-engine (single-acting)—

$$\text{I.H.P.} = \frac{\text{PLAN}}{33{,}000}$$

where P = mean effective steam pressure in lb. per sq. in.
L = Length of stroke in feet
A = area of piston in sq. in.
N = number of revolutions per minute.

For a double-acting engine the formula is:

$$\text{I.H.P.} = \frac{2\text{PLAN}}{33{,}000}$$

Horse-power of petrol engines—

R.A.C. formula: $\text{h.p.} = \frac{D^2N}{16.13}$

Dendy Marshal formula: $\text{h.p.} = \frac{D^2SNR}{200{,}000}$

where S = stroke in centimetres
D = diameter of cylinder in centimetres
R = revolutions per minute
N = number of cylinders

A.C.U. formula: 100 cc. = 1 h.p.

Metric Horse-power

French h.p. (force de cheval or cheval-vapeur)

1 kilogrammetre = 1 kilogramme (2.205 lb.) raised 1 metre (3.281ft.) = 7.2346 ft. lb.

1 kilogrammetre per second = 434 ft. lb. per minute.

75 kilogrammetres per second, or 4,500 kilogrammetres per minute = 32,550 ft. lb. per minute, or about $\frac{1}{70}$ less than a British h.p., hence "chevaux de 75 kilogs," or metric horse-power.

French h.p. $\times$ 0.9863 = British h.p.
British h.p. $\times$ 1.014 = French h.p.
French i.h.p. = cheval indique.

We have already seen that force is that which produces or tries to produce motion. Force causes strain or pressure in the body on which it acts, and we may therefore say that force causes either motion or pressure.

In the case of forces acting on the same mass it is apparent that the greater the force acting on the body of a given mass the greater will be the velocity given to the body. Assume, for example, that a certain force imparts a velocity of 1ft. per second in a mass of 1 lb., twice the force will cause a velocity of 2ft. per second; six times the force, a velocity of 6ft. per second, and so on.

Also the longer the time a force acts on the body the greater will be the velocity produced, and if a certain force acting for one second produces in a mass of 1 lb. a velocity of 1ft. per second, the same force acting for two seconds will produce a velocity of 2ft. per second. If it continued to act for three seconds it would impart a velocity of 3ft. per second.

It is because of this fundamental fact that we are enabled to measure force by the velocity which it produces. Now let the forces which we wish to measure act on the same masses for the same time, and observe the velocity which is given to each of these masses, taking 1 lb. as our unit of mass, and our unit of time one second. In these circumstances the force which, acting on a mass of 1 lb. per second, produces a velocity of 1ft. per second is the unit of force.

Following this reasoning it is obvious that another force acting on a mass of 1 lb. and producing a velocity of 30ft. per second will be 30 times as great, and will have 30 units of force. The unit of force produces a velocity of 1ft. per second in a mass of 1 lb., but if this force acts on a different mass, say of 2 lb., it will impart a different velocity, in this case $\frac{1}{2}$ft. per second, and a force acting on a mass of 1 lb. producing in it a velocity of 20ft. per second will produce if it acts on a mass of 2 lb. a velocity of 10ft. per second, on a mass of 4 lb. a velocity of 4ft. per second, and so on. Expressed in another way, the same force acting on different masses produces varying velocities.

On multiplying each mass, however, by its corresponding velocity the product is the same in each case, and this product measures the momentum, so the same force acting for the same time on different masses produces the same momentum.

Summarising, the unit of force is that which, acting on any mass for unit time (one second), produces in that mass the unit of momentum. This is the *absolute unit* of force.

Measurement of Force by Strain or Pressure

Now there are plenty of examples of a force acting on a body and failing to produce motion, because of the action of some opposing force. In this case a strain or pressure results. Thus, if a 5 lb. weight is placed on a bench, gravity endeavours to pull the weight downwards, but is prevented by the opposite action of the bench. A push downwards on the table and upwards on the weight is the result, and the pressure is caused by the force of gravity.

Magnetism provides many examples where pressure is produced. Since gravity is such a constant force it provides us with the unit of pressure, and the pressure which gravity produces in a mass of 1 lb. is the unit of pressure, or the unit of force as measured by pressure. Any force, therefore, whether it be gravity, magnetism, cohesion, electricity, or any other force which acting on a mass of 1 lb. kept at rest produces the same pressure on a 1 lb. weight is said to have a magnitude of 1 lb., and this is called the *gravitation unit* of force.

Suppose we wish to measure the force exerted by a man pulling a barrow. We have only to connect the hook of a spring balance with the barrow, and let the man commence to pull it until the barrow just begins to move. The pull in pounds will be given by the index finger of the spring balance. Precisely this method may be used to measure the pull of a train. In fact, dynamometer cars are used on the railway in this way to measure the drawbar pull of a locomotive.

Relation of Absolute Unit to Gravitation Unit

We know that the force of gravity acting on a mass of 1 lb. for one second produces in that mass a velocity of 32ft. per second. But the absolute unit of force acting on the same mass only produces a velocity of 1ft. per second. That is to say, only 1/32 of the gravitation unit. Therefore, a weight or pressure of 1lb. is equal to 32 absolute units of force. One absolute unit of force is equal to the weight of $\frac{1}{2}$ oz. In other words, if the weight of $\frac{1}{2}$ oz. acts on a mass of 1 lb. for one second it will produce a velocity of 1ft. per second.

Energy

By energy is meant the *power of doing work*, and work has already been defined as the production of motion against resistance. Whenever a body is moved against some resistance, work is done, and the power which overcomes the resistance is called *energy*.

We have already explained that to measure the magnitude of any force we have to consider how many units of work it is capable of performing. Thus a force that can raise 10 lb. to a height of 10ft. would be said to be doing $10 \times 10 = 100$ foot pounds of work.

When we know the velocity of a moving body and its weight we can quickly find how many foot pounds of work the body is performing, and this is the measure of its energy.

(*To be continued*)

Making a Watch-repairing Bench

Constructional Details of a Useful Appliance for the Amateur Craftsman

By M. M. E. PEARSON

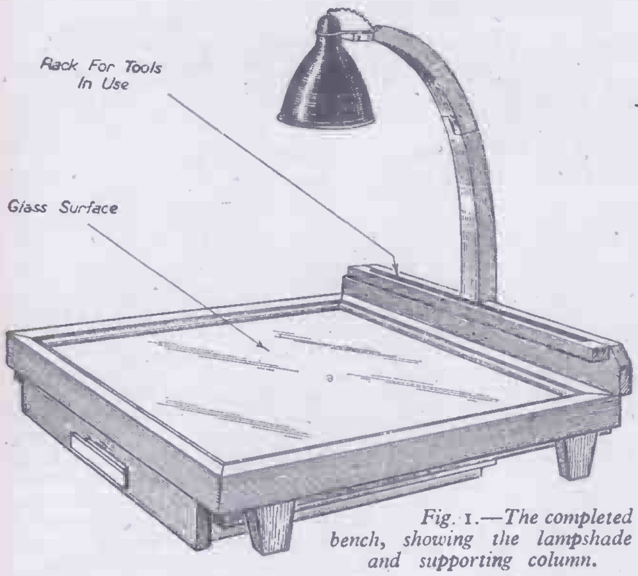


Fig. 1.—The completed bench, showing the lampshade and supporting column.

THE advantages of a portable bench for watch repairing or model engineering work are numerous. Particularly so during the winter months when such a bench may be safely used on a polished table—hence increased comfort from which better work is likely to result.

The bench to be described is made entirely from wood with the exception of five metal clips, and is easy to construct, involving only one half-lapped joint. The cost to make is only a few shillings, for it will, in many cases, only mean purchasing a square of glass, lampholder and flex, etc.

Fig. 1 shows the bench in its basic form, on to which other attachments, such as a part cover for the glass to which a small vice or

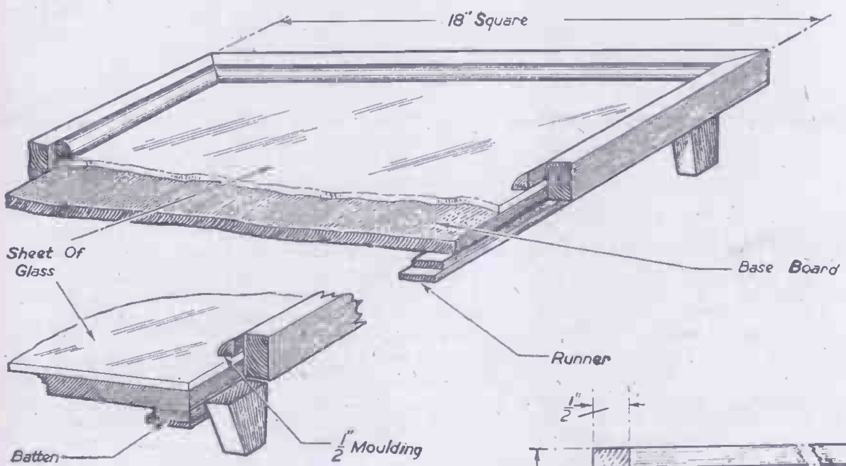


Fig. 3.—Assembly of top side of bench and detail of moulding and under batten.

bench drill may be fitted; or perhaps a flap cover fixed to the top surface of the drawer to provide an auxiliary bench top when assembling a complicated mechanism can be incorporated as the need arises.

The Drawer

Fig. 2 shows the details of the drawer, the width of which is $14\frac{1}{2}$in. to the insides of the runners. There is no real need for any other than butt joints, glued and screwed, or even panel pins in the place of screws. The handle of the drawer can be made in two pieces as depicted, finally glued and screwed as are the rest of the pieces which go to make the finished job. It will be noticed that the front of the drawer is $1\frac{3}{4}$in. deep, the drawer proper being $1\frac{5}{8}$in. deep. This is to ensure it sliding easily in use. Suitable divisions for such a drawer are a matter of individual taste, but those shown have proved satisfactory in use. The divisions in the front are for fairly large tools, the second row for tins containing small tools, and the back row for bits and pieces for which there is only occasional use.

General Assembly of the Top

The actual bench is seen to comprise a base (Fig. 3) around which there are four side

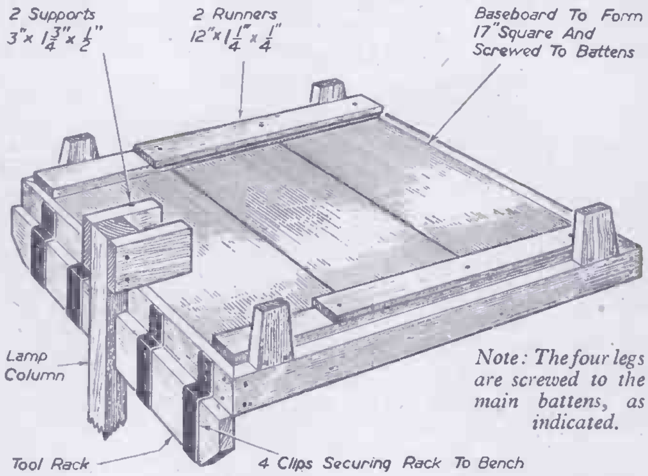


Fig. 4.—General assembly of underside of bench.

pieces, each of which is 18in. by $1\frac{1}{4}$in. by $\frac{1}{2}$in. These side members form a frame for retaining the glass, which is prevented from falling out by four lengths of $\frac{1}{2}$in. corner moulding. The moulding can be fastened to the framework by panel pins. The drawer slides in the slots formed by the baseboard, battens and runners. A square of glass is required, and should be slightly under 17in. square.

Underside of Bench

The baseboard can be made from a number of pieces of wood $\frac{3}{8}$in. thick held

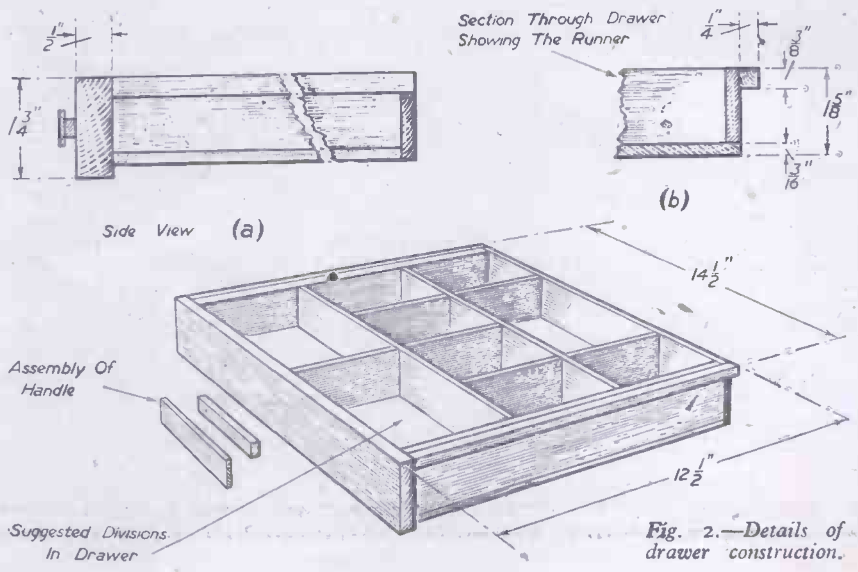
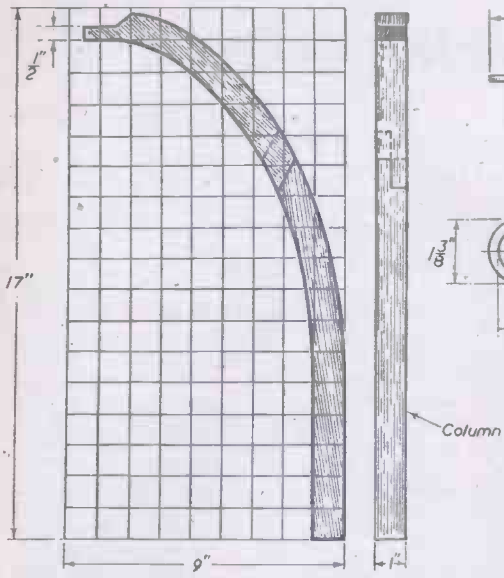


Fig. 2.—Details of drawer construction.



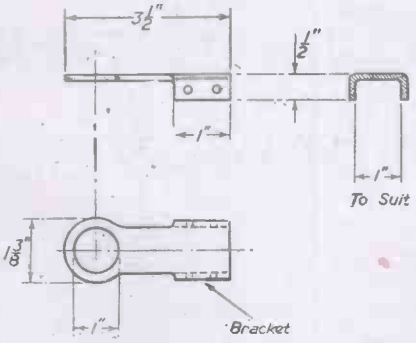


Fig. 5.—Details of lamp supporting column and bracket for the lampholder.

together by two battens 18in. x 1in. x ⅜in. As the drawer is only 12in. long, the runners need only extend for the 12in., these being glued and screwed to the battens.

Four legs, which are 1⅞in. long, 1½in. wide at the top, and 1in. wide at their base by ½in. thick, can now be fixed to the battens and the under edge of the frame, one inch from the corners (Fig. 4).

The lamp column is held securely by two support blocks as shown, and is further steadied by the two pieces constituting the tool rack body.

Lamp Column and Bracket

The illustration, Fig. 5, shows the profile of the lamp column laid out on inch squares. To prevent a large section of the column having short grain owing to the curve, it is necessary to half lap two pieces of wood each 1in. sq. at approximately the position shown, taking care that the grain in the wood is near enough as indicated in the diagram. The lamp bracket fits the ½in. part of the column, and is held in position by four small screws. The 1in. diameter hole is to suit an ordinary bayonet fitting lampholder. Any piece of steel or brass about 1/16in. thick is quite suitable for this bracket.

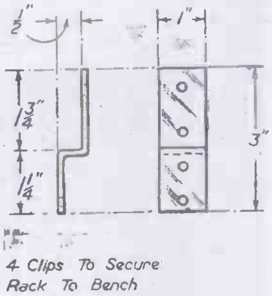
The Tool Rack

The rack body illustrated in Fig. 6 is made in two sections and secured to the framework of the bench by the four clips, which for preference should be 1/16in. thick. The actual tool holder is in one piece and has a number of slots in it to receive the various tools in use. The holder, being in one piece, stiffens the body and results in a rigid fitment.

Painting the Bench

To put the finishing touches to the bench, a coat of paint is a necessity. In order to finish this well, all screws and nail holes, etc., must be filled up. A good stopping mixture can be made by mixing powdered chalk (french chalk is excellent) and some of the paint to be used on the bench. Mix these two until a stiff smooth paste is obtained and smear over the parts requiring the treatment, leaving a slight surplus as when applying plastic wood. After this paste has hardened, smooth with glass-paper, and apply a flat or glossy coat of paint. Rub this down smooth after it is thoroughly dry and apply the top coat.

Fix an opaque lampshade after wiring the lampholder, neatly fastening the flex to the side or back of the column. The bench is then ready for use.



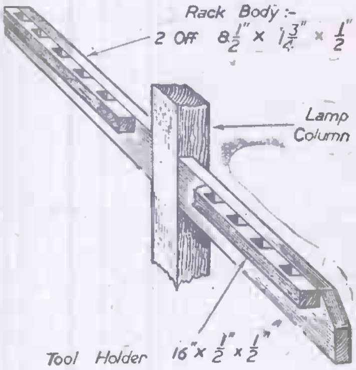


Fig. 6.—The tool rack and fixing clips.

Ferguson Tractors

A CONSIDERABLE contribution towards the solution of the world food shortage is being brought about by a revolutionary agricultural machine, the Ferguson Tractor, which is being produced in large numbers at the former wartime shadow factory of Standard Motors at Banner Lane, Coventry. The tractor is of lightweight specially treated alloy steels, designed to pull great loads with ease, and has finger-tip depth control, etc. Half the present output is now being exported to the eastern hemisphere, and this will increase as large-scale production commences.

The tractor company, Harry Ferguson, Ltd., of Coventry, are to send to the United States tractors worth £5,000,000. The first shipment left recently, and subsequent deliveries will be at the rate of £125,000 worth a week until the order is completed. It is believed that the Americans are prepared to take up to £15,000,000 worth of the tractors. Associated with Mr. Ferguson is Sir John Black, managing director of the Standard Motor Co.

Completed Ferguson tractors filling the bays at the Banner Lane factory of Standard Motors.

Making a 6in. Astronomical Telescope Reflector

The Methods, Tests and Techniques Employed in the Production of an Astronomical Telescope Mirror.

By T. J. MULLIGAN

(*Concluded from page 190, March issue.*)

The Foucault Test

At this stage, the polished mirror is approximately spheroid in form. In this condition it is optically unsuitable for use in a telescope; parallel light, such as would be received from a star, when received by a spherical mirror could not be reflected to a true point image; the more central rays would be brought to a focus further away than those from the periphery of the reflector. This defect must be corrected before the mirror can be incorporated in the telescope.

To do this the spheroidal surface must be made paraboloidal, as shown in Fig. 8. At first sight, this might appear to be a considerable undertaking with the limited resources at our disposal; yet the methods used are quite simple, and consist of polishing away minute amounts of glass from the central zones of the mirror, using a suitably modified pitch tool. This re-forming of the mirror surface, or "figuring" is controlled by frequent testing.

The apparatus used for testing, whilst making possible results of the utmost accuracy, can be simply constructed from odds and ends. The type of apparatus required is shown in Fig. 7; details can be modified to suit such equipment as may be available so long as the principle of the test remains unaltered. The essentials are these: an approximate point source of light; this must be a radiant source, that is to say the light emitted from the point must radiate evenly in all directions, and must not be parallel or convergent: the other essential is the knife edge, which is a straight sharp edge capable of smooth lateral movement in or about the plane of the light source. The knife edge and light source should be as close as possible.

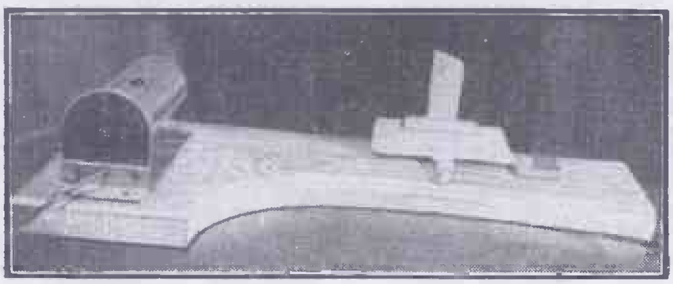
In the diagrams showing the Foucault test the knife edge is assumed to be on the right of, and approaching, the light source. The positions of light source and knife edge can be reversed if more convenient, but this must be kept in mind when interpreting the shadow figures, which would be reversed.

The apparatus must be fixed securely upon a common base, which in turn must be secured in a permanent position. This, for comfort should be about eye level, and a similar position provided for the mirror at a distance equal to the radius of curvature, which in this case is ten feet.

The pinhole light source should be sighted on the mirror, which is adjusted so that an image of the pin hole is formed upon the knife edge; this is best carried out in a darkened room, using a piece of white card to find the image. A support should be made for the mirror, so that it can be replaced in exactly the same position when required.

The image on the knife edge should be the same size as the pinhole light source and in sharp focus.

The eye is placed directly behind the knife edge, which is moved to the right, thus permitting the light reflected from the mirror to fall upon the eye; the mirror will then appear as a bright disc of light. This is because the image of the pinhole is formed so close to the eye that the eye lens is incapable of forming an image upon the retina; the aperture of the mirror being so small, however, all the reflected light enters the eye through the iris; the result is that whilst the shape of the mirror and its surroundings are in focus on the retina, the pinhole light source is not, and the mirror appears brightly and evenly illuminated.



The Foucault test apparatus.

The knife edge is now advanced slowly from right to left until the edge begins to encroach upon the light from the mirror; if the mirror surface is exactly spherical, and the knife edge at the focus, the light-filled mirror will appear to darken gradually and evenly as the knife edge advances.

Should the knife edge be within the focus, a shadow will advance across the surface of the mirror, the movement being in the same direction as that of the knife edge; outside the focus, the movement will be in the opposite direction.

The radius of curvature can be determined exactly by measuring the distance between the knife edge or the pinhole and the mirror. Since half this distance is equal to the focus of the mirror, a note should be made of the measurement for later reference when constructing the telescope.

Once the principle is grasped, the shadow phenomena exhibited by the Foucault test are easily interpreted. In the Foucault set-ups illustrated in Fig. 8, two types of surface are shown under test: (a) is a true spheroid, with shadow figures for three positions of the knife edge—inside focus, showing the shadow moving in the same direction as the knife edge; at focus, where the mirror darkens gradually as the knife advances; this is rather difficult to illustrate, as the mirror fades from full illumination to darkness without any movement of shadow either from right or left as the knife advances; and outside focus, with the shadow moving *towards* the knife edge.

Fig. 8 (b) shows a paraboloidal surface; with the pinhole radiant at the centre of curvature, no position can be found for the knife edge where the mirror darkens evenly over its entire surface; this is because the radius of curvature increases gradually from the centre outwards. In Fig. 8, for the purposes of illustration two zones are shown, inner and outer, and the knife edge is placed at the focus of the inner zone, at the mean focus, and at the focus of the outer zone.

At the focus of the inner zone the centre portion of the mirror is darkened by the advancing knife edge, whilst a fainter shadow advances from right to left around the outer edge.

At the average focus, the inner zone shadow moves from left to right, whilst the outer zone shadow moves from right to left.

At the focus of the outer zone, only the right-hand portion of the inner zone is free from shadow.

Other types of shadow figures are depicted in Fig. 9: (a) is a mirror with a turned-down edge, and (b) has a depressed centre.

Figuring

This operation is the "bogy" of amateur telescope makers; with a little extra care, however, together with common-sense interpretation of the Foucault test, the beginner may tackle figuring without undue trepidation, and with every expectation of producing a thoroughly efficient reflector.

Figuring consists of altering the spheroidal surface of the mirror to that of a paraboloid, as mentioned earlier; the difference in form between the two types of surface shown in Fig. 8 is greatly exaggerated for the sake of clear illustration.

In practice, the more central zones of the mirror are polished away to form the required paraboloidal form. The amount of glass removed by this operation is extremely minute, and is measured in millionths of an inch. This small surface difference, impossible to detect by mechanical methods, is easily and accurately controlled and measured by the Foucault test.

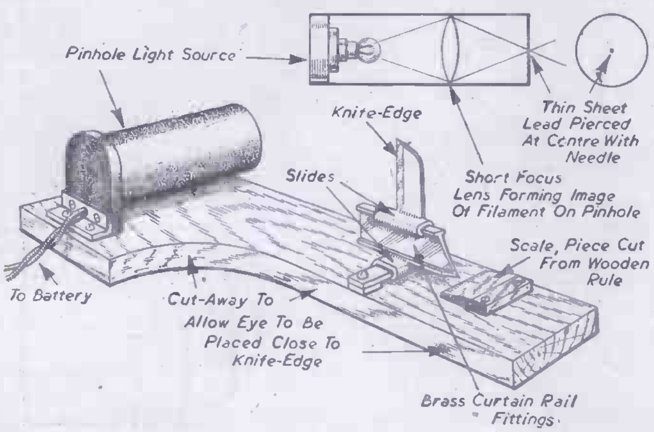


Fig. 7.—Details of the Foucault test apparatus and pinhole light source.

After the initial polishing, the mirror is tested by means of the Foucault knife-edge test; if the test shows an imperfect surface, such as a turned-down edge, time will be saved by returning the mirror to the glass tool and repeating the fine grinding. A turned-down edge, or a depressed centre, which amounts to the same thing, is very difficult to correct on the pitch tool. It is because of the possibility of having to return the mirror to the glass tool for re-grinding that the writer prefers to use a hard-wood base for the pitch tool.

If the preliminary test shows the surface to be spherical, then parabolising can be proceeded with. The pitch tool must be so modified that the polishing action is greatest towards the centre of the mirror; this is accomplished by trimming, as shown in Fig. 10. The facets are thus made to decrease in size as they approach the edge of the tool.

The mirror is then polished for a short period; it is wise to err on the side of caution in the first stages of figuring, so this first spell should be a short one, say 10 minutes. There are so many variable factors involved that it is impossible to give an estimate of the time required; such things as hand pressure, stroke, and pitch temper all influence the cutting speed.

The mirror is cleansed of rouge and the surface polished with a clean cloth; it is then placed in position on its stand on the shelf for the Foucault test and allowed to stand there for at least half an hour. This is to allow the heat generated in polishing to dissipate; if the mirror is tested immediately, this heat, small as it is, will so distort the surface as to give an unreliable knife edge reading.

At the end of the half-hour period the mirror is tested; the surface is carefully inspected by means of the knife edge for traces of tool edge zones; these are characteristic of hard pitch and regular polishing strokes, and are caused by the tool edges reaching the same radial distance from the centre of the mirror at each stroke. The remedy is to stagger the lengths of the strokes.

Two or three short spells may be required before the mirror exhibits the characteristic paraboloid shadows shown in Fig. 8b.

A perfect paraboloid would exhibit an infinite number of different radii of curvature, increasing in focus from the centre outwards. It is obviously impossible to measure the focus of each tiny zone separately, so for practical purposes the mirror is imagined to have two or three separate zones, each with its own centre of curvature, the inner zone having the shorter focus.

In Fig. 8 the knife edge is shown in three positions—at the focus of the inner zone, at the average centre of curvature, and at the focus of the outer zone (focus in this case refers to the focus when the radiant is at the average centre of curvature).

The difference between the foci of the inner and outer zones when measured from the centre of curvature is a definite quantity for any paraboloidal reflector, and is obtained from the formula $\frac{r^2}{R}$, where r is the radius of the mirror disc, and R is the mean radius of curvature.

In this case, where $r=3$in., and $R=120$in., the difference should be 9/120in. or 0.075in., and represents the difference in focus between the centre zone of the mirror and the outer edge zone.

A cardboard mask (Fig. 11) placed over the mirror will permit the measurement of three zones—centre, inner and outer; the formula, $\frac{r^2}{R}$ is applied for each of the two radii 2in. and 3in.

The two differences to be measured will be between centre and inner, and centre and outer zones, and are found as follows :—

$$d_1 = \frac{2^2}{120} = 0.033\text{in., and } d_2 = \frac{3^2}{120} = 0.075\text{in.}$$

The scale (see Fig. 7) is used for these measurements; the procedure is as follows: the knife edge is adjusted so that the centre disc darkens evenly—this is the focus of the centre, and a note is made of the scale reading, which will be termed f_1. The knife edge is then withdrawn a little, and f_2, the focus of the inner zone, determined. Similarly, f_3, the focus of the outer zone, is found.

Then, $d_1 = f_2 - f_1$, and should be 0.033in.

and $d_2 = f_3 - f_1$, and should be 0.075in.

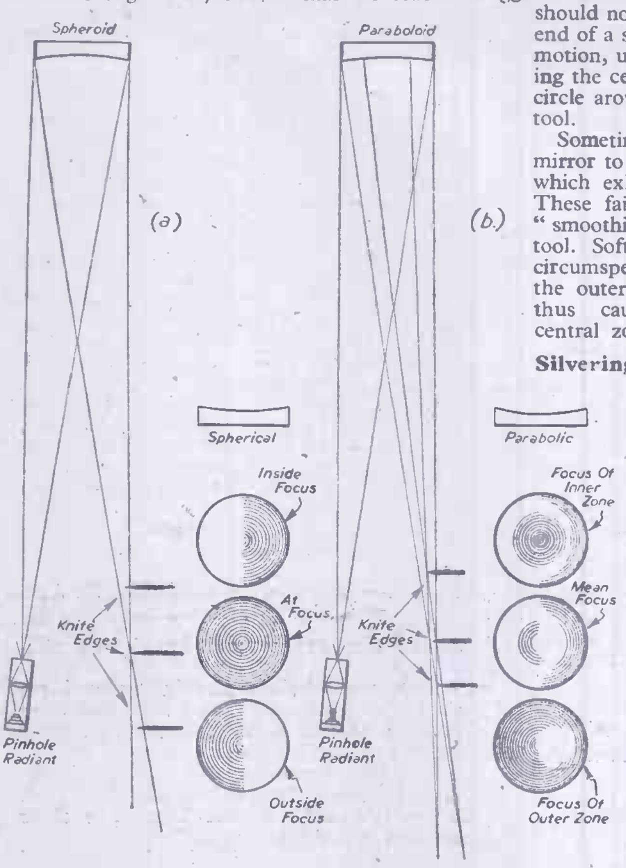


Fig. 8.—Diagrams illustrating the method of testing mirrors by the Foucault apparatus.

Actually, it is not likely that a perfect paraboloidal form will be obtained quite so easily as might be inferred from the preceding paragraphs. Knife edge tests are likely to show up various imperfections, such as turned-down edges or various forms of ring zones.

As mentioned earlier, the quickest and surest method of dealing with a turned-down edge or a depressed centre is to return the mirror to the glass tool. Repeating the fine grinding until the turned edge or depressed centre has been removed, followed by polishing, is preferable to long sessions on the polishing tool, with irritating delays for testing.

Ring zones, on the other hand, are caused by the edges of a hard pitch tool, and zones caused by the polishing tool must be removed by the polishing tool. It is difficult to give precise instructions for correcting these defects, which might have widely varying characteristics in individual mirrors; in other words, the remedy must depend upon the symptoms, and it is this stage which requires common sense and correct interpretation of the shadow test.

Ring zones are invariably depressed zones—raised ring zones are not likely to occur; the treatment is to polish the entire surface evenly until the level of the depression has been reached. The edges of the pitch tool are kept clear of the depressed zone at the end of each stroke, and to this end, shortened, staggered strokes are employed; the mirror should not be permitted to stop at the end of a stroke, but should be kept in motion, using an oval stroke, and working the centre of the mirror in a small circle around the centre of the pitch tool.

Sometimes it is possible to figure a mirror to a satisfactory paraboloid, but which exhibits faint tool edge zones. These faint zones can be removed by "smoothing" on a full-size soft pitch tool. Soft tools need to be handled with circumspection owing to the tendency of the outer facets to become depressed, thus causing a seriously-depressed central zone.

Silvering (Chemical Method)

The silvering process consists of depositing a thin film of pure silver upon the surface of the glass; this film will take the character of the surface upon which it is deposited; that is to say, silver deposited upon a surface which has not been fully polished will exhibit a corresponding lack of reflectivity in the silvered surface. A fully polished surface, on the other hand, will take a silver film of maximum efficiency.

It is evident, therefore, that since two reflecting surfaces will be required (objective mirror and prism) the mirror surface should be fully polished before any attempt is made to deposit silver upon it, so as to keep light losses to a minimum.

A cleansing operation of the most thorough nature is necessary before silvering. The mirror, after the polishing and figuring have been completed, is first of all well rinsed under the tap; the disc is then laid face downwards on a soft dish-cloth in the sink and the back and sides well scrubbed with soap and water. When all traces of rouge and pitch have been removed (a little paraffin is useful for removing any traces of adherent pitch), the disc is turned over and the surface well soaped, using a pad of cotton-wool. Particular attention should be paid to the edges; pitch and rouge and other contaminations lodge very readily in the innumerable tiny chips and splinters which are usually to be found around the edge of the worked surface. When the soap washing is finished the disc is thoroughly rinsed.

The surface is now treated with precipitated chalk; a swab of cotton-wool is wetted, dipped in the chalk, and rubbed over the surface of the disc; the chalk must be very thoroughly rubbed in to every portion of the surface. The swab must be used until nearly dry and then discarded, the disc is then rinsed and the treatment repeated with a fresh swab. It will

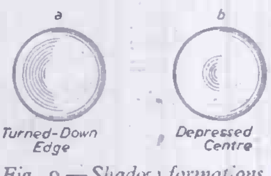


Fig. 9.—Shadow formations on the surfaces of mirrors.

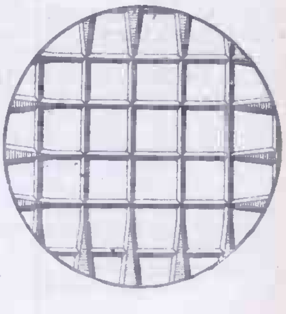


Fig. 10 (right).—Pitch tool modified for parabolising.

be found that an appreciable amount of rouge, etc., will be removed by this treatment. Repeated applications of the wet chalk will have the effect of removing the surface greasiness; it should be possible, after the precipitated chalk treatment, to wet the surface without the water drawing back and leaving the edges dry. When this condition has been achieved the disc is rinsed to clear it of all traces of chalk. *From this stage onwards the mirror surface should not be touched by the fingers or allowed to become dry until the silvering has been completed.*

The next operation is to swab the surface with concentrated nitric acid.

The acid is poured on and mopped over the surface with a swab made from cotton-wool tied to the end of a smooth ended glass rod.

The acid is rinsed off under the tap and all surplus water drained away.

A concentrated solution of stannous chloride is now prepared and poured on so that it covers the entire surface; this is allowed to stand for a few moments and then rinsed off under the tap. No traces of chloride can be permitted to remain and this rinsing must be very thorough.

After the tap rinsing the disc is rinsed in distilled water. The cleaning operations are now completed and the surface is ready to receive its deposit of silver.

If it is not convenient to silver immediately, the mirror should be kept immersed in distilled water. On no account should the surface be allowed to become dry until the silvering is completed.

Silvering—Brashear's Process

The following solutions will be required for the silvering process:

Solution A
- 75 c.c. water.
- 5 grammes silver nitrate.

Solution B
- 25 c.c. water.
- 3.5 grammes potassium hydroxide.

Solution C
- 15 c.c. water.
- 1 gramme silver nitrate.

Concentrated Ammonia.

Reducer Solution
- 30 c.c. water.
- 2 grammes dextrose.

All water used must be distilled.

The method of preparation is as follows: Solution A is poured into a clear tumbler and ammonia added to it drop by drop, using a medicine dropper; a brown precipitate will be formed, and the solution should be stirred with a glass rod as the ammonia is added. As the cloudiness begins gradually to disperse, the liquid should be stirred vigorously between each drop until the solution *just* clears. Great care must be taken not to add too much ammonia, and a few drops of the second silver nitrate solution—solution C—are added until the liquid assumes a faint straw colour.

The solution is now ready for the addition of solution B. This should be added cautiously, using a clean medicine dropper and stirring constantly. There is a possibility under favourable conditions of the solution forming crystals of the explosive silver fulminate; for this reason the solution should be stirred constantly, and the preparation of these solutions should be carried out in a cold room if possible.

When all of solution B has been added, more ammonia should be added, drop by drop, until the mixture just clears; as before, drops of solution C are added until a brown precipitate begins to appear.

The solution is filtered through cotton wool, and is then ready for use.

The temperature at which the silvering is carried out is most important—it should be not less than 65 to 70 deg. F. The solutions and mirror should both be at this temperature for satisfactory results.

If the operation is being carried out on a warm summer day silvering can proceed without further delay; but in cold weather steps must be taken to take the chill off the mirror and the solutions.

The mirror disc can be allowed to stand in warm water for a short time until the glass feels warm to the touch, taking care, of course, to handle only the back and sides of the disc.

A strip of clean stiff paper is obtained, 2 to 3in. wide, and long enough to wind once or twice around the edge of the mirror; a length of the red paper backing used on camera films is ideal for this purpose.

The paper is wound tightly around the edge

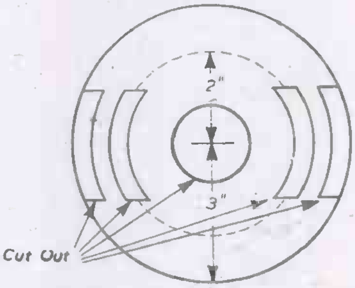


Fig. 11.—Mask used when measuring the focus of different zones.

of the disc and secured by binding with string.

The two solutions already prepared are then filtered through cotton wool into clean glasses; to each solution is added an equal volume of distilled water.

The glass containing the reducer solution is also allowed to stand in warm water until it has absorbed sufficient heat. The silver solution is *not* heated.

Assuming that the disc has been warmed and bound with its paper "collar" the silvering operation can now be carried out.

The solutions are mixed by pouring the reducer into the ammoniated silver nitrate solution in the proportion 1 to 2; that is to say, if there is 100 cc. of silver solution, then 50 c.c. of reducer would be poured into it.

The mixture is stirred, when it will become straw-coloured and then dark brown. At this stage it is poured immediately over the mirror; the whole of the solution is poured on, and the mirror gently rocked. If properly bound on, the paper will prevent any serious loss of solution over the edge.

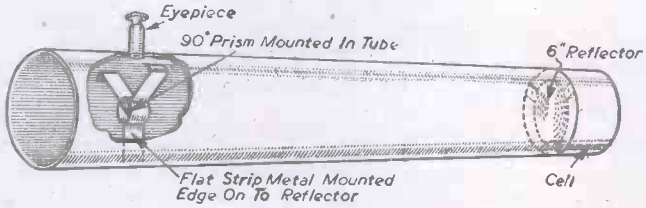


Fig. 12.—A telescope tube—part broken away to show the mounting of the prism and eyepiece.

By this time the liquid will be quite black, with broken films of silver floating on the surface. As the disc is rocked, a heavy black precipitate will be seen in the solution; this must not be allowed to settle on the surface of the mirror, but must be kept in motion; if necessary, the surface can be lightly swabbed with cotton-wool.

In a short time—5 to 10 minutes—the liquid will clear; the disc is immediately rinsed clear of solution and the paper removed.

The mirror, which should now have a perfect silver surface free from stains, is immersed in clean water and allowed to stand for an hour. At the expiration of this period, it is removed and excess water removed with clean blotting paper. A little alcohol is then run over the surface and removed with dry blotting paper; the mirror should then be completely dry in a few minutes.

The silvered surface is then burnished, using small clean pieces of chamois leather. The pressure applied should be very light at first, and very gradually increased. Each piece of chamois leather should be used for a short period only, and then discarded.

A little dry rouge may be used after the first two or three pieces of chamois, but this is usually not necessary.

The Telescope

The actual construction of the telescope is outside the scope of this article; in any case since design is likely to be dictated by available materials it is unlikely that any two home-constructed telescopes will be alike.

As mentioned in the opening chapters, the optical system is very simple, and consists of a 6in. reflector, small 90 deg. prism or silvered flat mirror (surface silvered—an ordinary back-silvered mirror would be useless, producing a doubled image) and eyepiece. It is important that the prism or silvered flat should possess high quality worked surfaces; it is of little avail to spend long hours working the 6in. reflector to a high state of perfection if the resulting image is to be marred by prism distortion.

The design of the telescope tube is shown in Fig. 12; the reflector is seen mounted in a cell, which should be removable so that the mirror can be covered up when the telescope is not in use. The author's tube was made cheaply and efficiently of tin plate by the local tinsmith, with a simple bayonet type release for the cell. There is no necessity for the tube to be cylindrical—it can be square section and built of wood, if more convenient. Indeed, a tube is not entirely necessary, and many of the world's largest reflectors are of open-work girder construction.

The prism fitting should be constructed of flat strip metal, edge on to the reflector to minimise the effect of silhouetting.

The completed telescope tube will be quite heavy, and will require to be mounted on a stout base, with provision for horizontal and vertical movement.

The image is inverted, as in a refracting astronomical telescope, so it is not convenient for use as a terrestrial telescope, although an erect image can be obtained by turning one's back to the view, and looking down into the eyepiece.

In these days of shortages, the construction of the telescope mounting will provide many difficulties; but the constructor who has the patience to grind, polish and figure a 6in. reflector, and who constructs a makeshift mounting, is not likely to abate his efforts until he is the proud possessor of a first-class home-made telescope with an efficient equatorial mounting.

A Useful Radiator

An Easily Constructed and Efficient Heater

By E. S. BROWN

THE portable radiator herein described consists of a simple and easily-made heating unit and parabolic reflector attached by suitable means to an ordinary paraffin pressure stove.

During the early spring evenings such a radiator is invaluable, as it provides a very convenient and inexpensive means of heating, and is, of course, ideal for the bathroom, where the presence of steam and general dampness prohibits the use of any portable form of electrical heating.

The dimensions given for the various components are a generalisation, and although suitable for the average pressure stove, they may have to be slightly varied to suit individual circumstances.

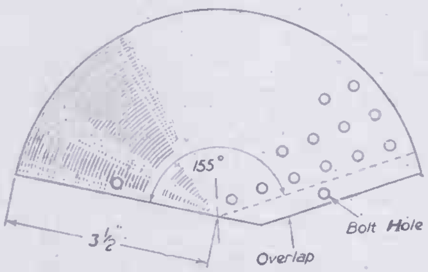


Fig. 1.—Shape and dimensions of heating-cone blank.

Heating Cone and Reflector

The heating cone is made from a piece of stout tinplate, 7½in. by 3½in., and shaped as shown in Fig. 1. A series of ¼in. diameter holes is drilled in the tinplate, which is then carefully shaped to form a cone. The measurements of the cone, allowing a ¼in. overlap for joining purposes, should be 3in. diameter by 3½in. long. The overlap is drawn together and secured by two or three small nuts and bolts.

The reflector is made from a piece of 16 or 18 gauge aluminium 12in. square. A ¼in. diameter hole is drilled in the exact centre of the reflector to take the heating cone, and two more holes of the same dimensions are made within ½in. distance from the two sides for the flame-guard supports. A further four 3/16in. holes are suitably drilled along the bottom edge to bolt on the clips which secure the reflector assembly to the stove. (See Fig. 2.) When the holes are drilled, remove any dross that may be present around same, and well burnish one side of the aluminium sheet with a good quality metal polish. The reflective powers of the radiator depend absolutely upon the quality of the finish imparted, so every care should be taken to ensure a perfect mirror finish.

The aluminium sheet must now be carefully bent into the concave shape as indicated, and the heating cone fixed in position with a ¼in. by 4in. bolt interposed with a distance-piece of ½in. by 3½in. tubing, as in Fig. 3. The flame-guard is made by bolting a piece of ½in. by 12in. tubing, flattened and suitably drilled at both ends, to two tubular side-members ½in. diameter by 7in. long. (Fig. 4.) Two ¼in. by 7½in. bolts will be required, and the assembly is securely bolted to the reflector, thus ensuring a particularly robust and rigid form of construction.

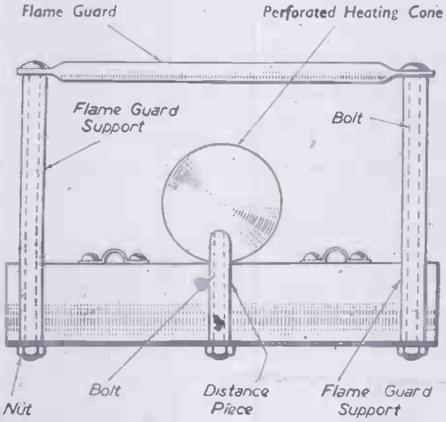


Fig. 4.—Plan of radiator showing the assembly layout.

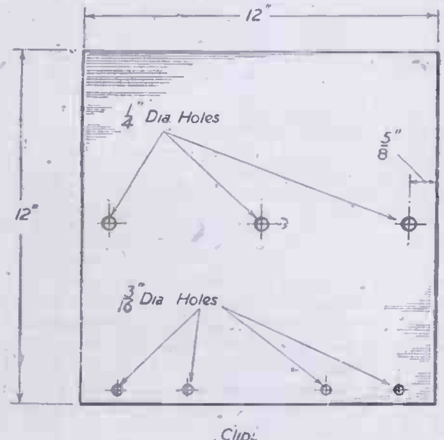
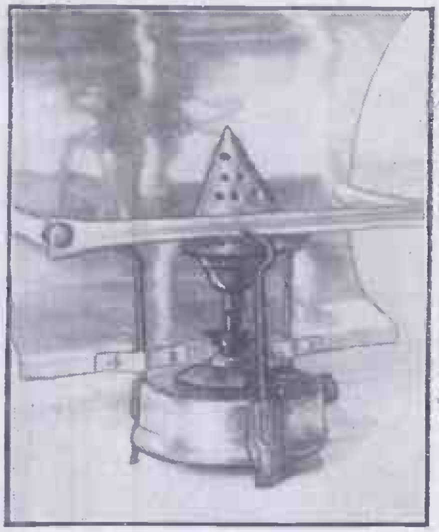


Fig. 2.—The reflector plate drilled for the fitting of heating cone and flame-guard, and also showing fixing clips.

Fixing Clips

The clips securing the radiator assembly to the stove are preferably made from aluminium. Strips of suitable size are cut, and are bent around the stove supports with a pair of pliers. Holes are next drilled in the strips to correspond with those made in the reflector, and the assembly is then bolted to the stove supports. The clips allow a certain amount of vertical movement to be made, and this is necessary in order to correctly position the heating cone over the burner. Experiment will decide the most satisfactory distance. In the writer's case the best position for the cone was found to be 1in. above the burner.

The object should be to contain all the flame within the heating-cone, and to also heat the cone to a bright red to obtain the maximum radiation. When this has been attained, bolt the clips tightly to ensure a permanence of position.



The radiator fixed on the pressure stove, ready for use.

Pre-heating the Burner

When lighting the stove, make very sure that the burner is sufficiently pre-heated with methylated spirits before applying air-pressure, otherwise a smoky flame will result and spoil the reflector. Also see that the stove is not in a draught, as otherwise the flame may bt deviated from heating the cone, and the radiator's heating power will be correspondingly impaired.

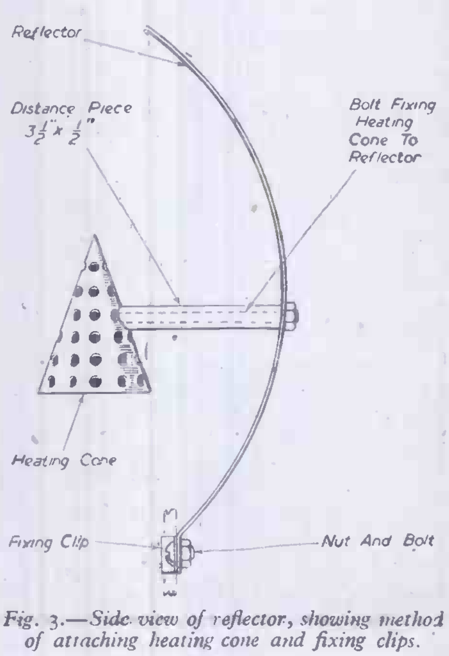


Fig. 3.—Side view of reflector, showing method of attaching heating cone and fixing clips.

THE WORLD OF MODELS

The National Maritime Museum, Greenwich

By "MOTILUS"

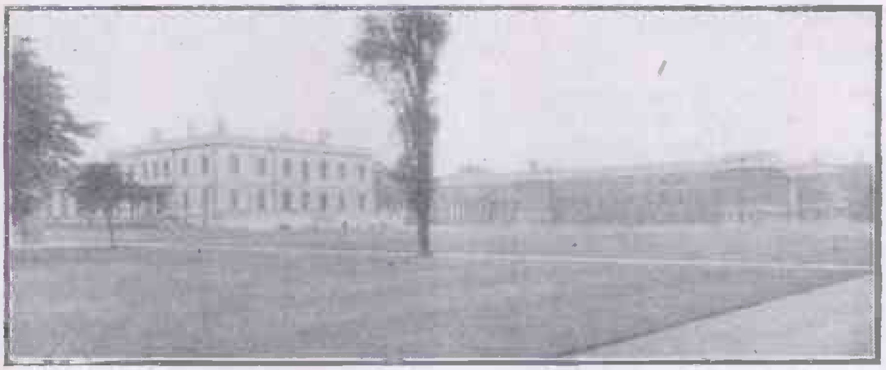


Fig. 1.—The National Maritime Museum, Greenwich, showing the Queen's House and the West Wing, viewed from the north-east corner of the grounds.

THE Thames below Tower Bridge—Deptford, Greenwich, Wapping: what diverse associations these names call to the minds of Englishmen, whether they have visited these historical places or not. Even among London's eight million the ideas such names suggest must be many and varied. The historian recalls entries in Pepys' diary —"By water to Greenwich"—written by this Thames-lover in the days when the gilt-decorated Royal Barge was frequently to be seen on its tranquil journey from Westminster Palace to Greenwich. The sailing ship lover conjures a picture of the last sailing barges now remaining on London River—the spritsail barges, so characteristic of the Thames. The modern shipping student links these names in his thoughts with the Port of London and the Isle of Dogs. For the merchant they mean the warehouses in the Port, where so many of Britain's imports find a temporary resting-place: timber from the Baltic, grain from Canada, sugar, bananas and rum from the West Indies. What associations, then, might a model enthusiast have with this part of the world? If he had visited the National Maritime Museum at Greenwich, as I did recently, he would without doubt have the most vivid recollection of some of the wonderful models that are to be seen among the vast collections in this home of nautical history.

The present National Maritime Museum developed from the Royal Naval Museum in Greenwich Royal Hospital (now the Royal Naval College) and was envisaged in the early 1930's. It opened in 1937, but was closed at the outbreak of war in 1939, when the valuable exhibits were sent away for safety. Now, however, they are being slowly but surely restored to the galleries at Greenwich, which have been redecorated to receive them. The fine buildings housing the Museum (Fig. 1) lie adjacent to the Royal Naval College and were converted for use as a Museum through the generosity of Sir James Caird, Bart., having been previously the Royal Hospital School for educating sons of seamen and marines. The School, founded in 1712, was originally housed in the Greenwich Royal Hospital but later moved across the road to the Queen's House, a villa designed by Inigo Jones for Henrietta Maria, wife of Charles II. In 1807 colonnades were erected to the east and west of the Queen's House and two flanking wings were subsequently built, so that the Museum now consists of three principal buildings.

Before referring to a few of the many intriguing and varied ship models, I would like to mention the appointment, nearly 12 months ago, of Mr. F. G. G. Carr, M.A., LL.B., F.R.G.S., as Director of the National Maritime Museum. Mr. Carr has a lifelong experience of sailing and shipping round our coasts, as well as a wide knowledge of books and manuscripts, obtained through his previous appointment as Assistant Librarian to the House of Lords. So, with his untiring enthusiasm, he is well equipped for the large task of organisation that confronts the director of a museum dealing with the records of those achievements which have made the maritime history of Great Britain so vital. When I visited Greenwich I had the pleasure of meeting Mr. Carr, and he was good enough to devote a considerable amount of his valuable time to pointing out to me many interesting exhibits and also new features, arrangements and amenities of the Museum. The latter, incidentally, include a modern restaurant. I feel that under Mr. Carr's able direction the Museum will become a very live attraction for both Londoners themselves, and all who visit London from other parts of Britain and from overseas.

We enter the Museum through the East Wing, whence a colonnade leads to the Queen's House, containing various exhibits from

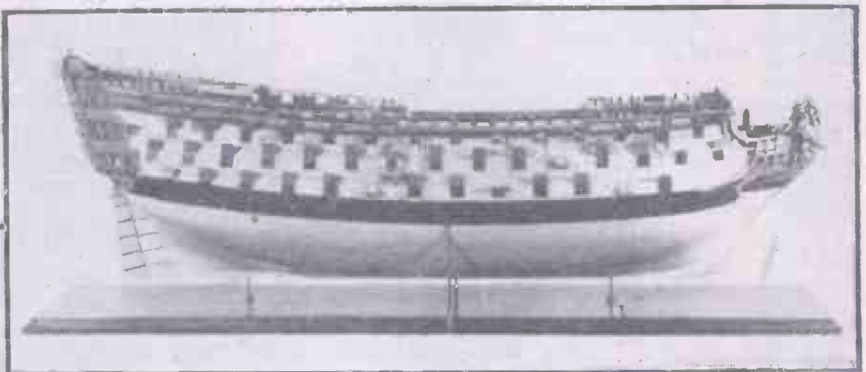


Fig. 3.—Model of the hull of the "Royal William," a ship of 100 guns, built at Portsmouth in 1719. Her guns were reduced to 84 in 1757 and she was finally broken up in 1813. Scale of the model is 1/48 actual size=4ft. to 1in.

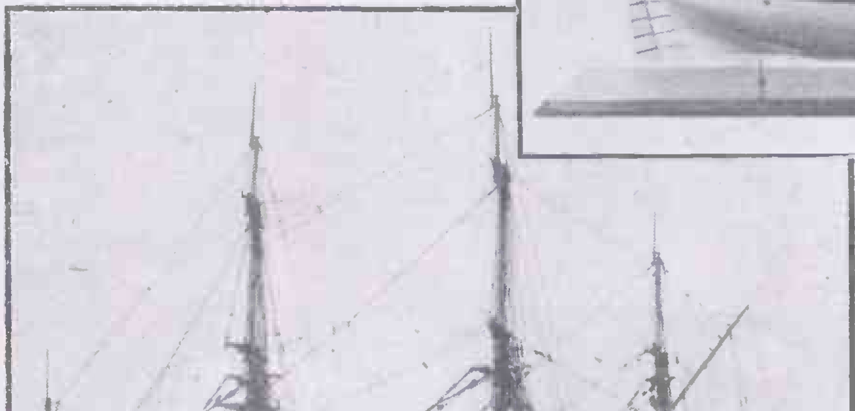


Fig. 2.—Model of the "St. Michael," a ship of 90 guns, built at Portsmouth in 1669. Scale of the model is 1/48 actual size=4ft. to 1in.

early times up to 1702. A paved way passes right through the centre of the Queen's House to a further colonnade connecting with the West Wing. This is the path of the old Deptford-Woolwich Road. The Queen's House was built on either side of the road and the two portions were connected by one room built across the roadway and which thus became known as the "Bridge Room." Later, other rooms were built over the road, but the original room still retained its name.

Dockyard Models

In this room and others in the Queen's House are some of the earliest contemporary scale models of ships in existence. These are known as dockyard models, as in nearly all cases they are built to reveal the interior of the ship, the hull being left unplanked to show form of construction. Many of these models show in perfect detail the elaborate carving and gilding on the upper work of their prototypes. I particularly noted a model (scale 1/48 actual size) of the "St. Michael" (Fig. 2), a ship of 90 guns built at Portsmouth in 1669. This model stands in the Bridge Room and is beautifully decorated and gilded. Another fine model, showing distinctive grace of line in her hull, is that of the first English Royal Yacht, given to Charles II by the Dutch, in 1660, after which many similar vessels were built in this country. The model of the yacht was made about 1675, to a scale of 1/32 actual size. There are many of these revealing dockyard models amid numerous other treasures in the Queen's House.

The Caird Galleries in the West Wing contain extensive collections of portraits, maritime pictures and prints, medals, seals, navigation instruments and authentic relics of such famous figures as Drake, Cook and Nelson, as well as comprehensive records in the magnificent library of over 50,000 books.

Contemporary Ship Models

Among the contemporary ship models in Gallery III, Mr. Carr drew my attention to a model ship of 96 guns (scale 1/60 actual size), dated about 1703. Various clues in the construction of a model often have to be relied on in deciding the date of the ship represented. In this case the model shows gilding on the upper-work of the ship, a form of decoration that gradually disappeared after 1703, but it also bears the initials "A.R." (Anne Regina) in the carving, so could not have been earlier than 1702. A remarkable feature in this model is a windlass transmitting the steering to the rudder by a chain, which is believed to have been a forerunner of the steering wheel. The model was presented to the Greenwich Hospital in 1830, by William IV. A further development in the history of the steering wheel can be seen in another model of a 50-gun ship of about 1703, in the same gallery. Built to a scale of 1/48 actual size, it shows the steering wheel used in connection with the earlier whipstaff and is probably the first evidence of such a fitting as the wheel being used in an English ship.

In Gallery IV, which covers the period from 1739 to 1748, I was shown a model (scale 1/48 actual size) made for Admiral Anson in 1747 of his ship "Centurion." Built at Portsmouth in 1732, the "Centurion" carried the Admiral on his voyage round the world. A portrait of this Admiral hangs in Gallery V, and another, painted when he was a Commodore, in Gallery IV.

Most of us know the famous "Royal George," the 100-gun ship launched at Woolwich in 1756, of which there is a dockyard model here. She was the first English three-decker ship with channels fixed above the upper-deck guns, an innovation which did not become general for another 30 years. This dockyard model, to a scale of 1/48 actual size, shows excellent workmanship, especially in the remarkable detail in the stern carving. Hanging near the model is a fine painting, by John Cleveley, the Elder, showing the "Royal George" lying at Deptford in 1757. The ship was lost at Spithead in 1782, when Admiral Kempenfelt was drowned. Cowper gives a romantic account of this in his poem, "On the Loss of the 'Royal George'," but he was apparently blissfully ignorant of the telling fact that the loss was due to a large part of the ship's bottom falling out! A sad token of the bad condition of the ship and Admiralty neglect in those days.

Ascending the northern staircase of the West Wing you pass a glass-case model of a galley of the Knights of Malta. These Mediterranean galleys varied very little from the sixteenth to the eighteenth century, and it is often difficult to fix the date of any particular model. This one, to an approximate scale of 1/30 actual size, has been placed at about 1780, as it has a mizen mast and these were only used in the latter part of the eighteenth century. This large model, presented to the Royal Naval Museum, in 1828, by the Duke of Northumberland, shows the typical lateen sails of these galleys and the long oars that were manned by galley-slaves when the wind was unfavourable.

Some of the contemporary ship models of the late eighteenth century have the distinguishing feature of the sliding keel, or centre-board, as designed by Captain John Schank. There are two model sloops in the Museum, one of 16 guns, dated about 1790 and another of 14 guns of about 1795, both built to a scale of 1/48 actual size. These have keels on the Schank system, but neither has been identified with any particular ship. Another sliding keel model is that of the six-gun brig, "Lady Nelson" (scale 1/32 actual size), built in 1799. She served in Australian waters as a store-ship and surveying vessel from 1800 to 1825, but was then captured by natives in the Timor Sea. The sliding keel enabled a vessel of very shallow draft (keel up) to sail to windward (keel down). It was also possible to use the keel, of which there were three sections, forward, amidships and aft, respectively, to alter the sailing trim of the vessel and thus help with the steering.

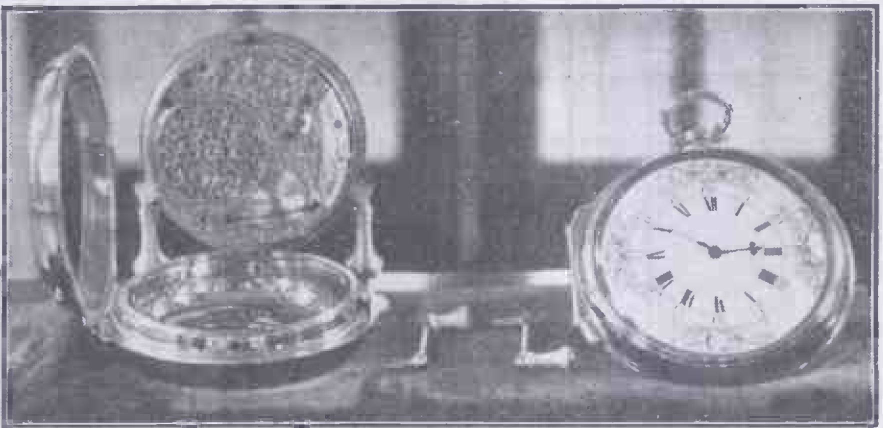


Fig. 5.—John Harrison's fourth chronometer, with which he won the £20,000 prize offered by the Board of Longitude. On the right is the replica made by Larcum Kendall and used by Captain James Cook on his voyage between 1772-9.

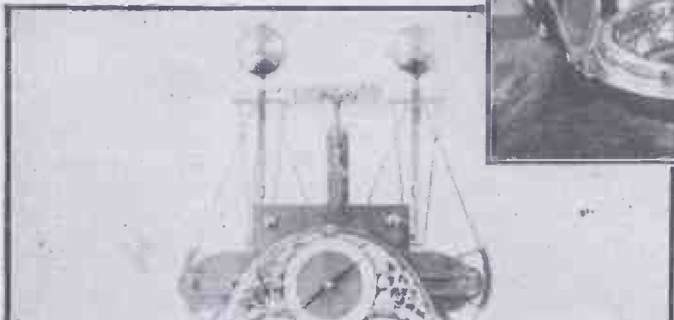


Fig. 4.—John Harrison's first chronometer, constructed in 1735. This was used on a voyage to Lisbon in H.M.S. "Centurion" in 1736.

Navigation Instruments

One of the most fascinating rooms in the whole Museum is the one devoted to the history of navigation. Here is to be seen that very ingenious but rather impracticable piece of work, Drake's pocket astrolabe, as well as other early astrolabes, cross-staffs, back-staffs and quadrants. Here also are John Harrison's four chronometers. Harrison, a Yorkshire carpenter and mechanician, made his first chronometer in 1737. (Fig. 4.) It was so constructed that it needed no oil at all to maintain its smooth running, although it became necessary in the later developments. In 1713 the British Government offered a reward of £20,000 for discovery of a method of determining longitude at sea to within a maximum error of 30 miles. Although Harrison claimed the reward for his fourth chronometer (Fig. 5), the Commissioners of Longitude did not pay him in full until 1773, and then only after intervention on the part of the King. Unfortunately, Harrison was too old to enjoy the fortune by that time. A copy of Harrison's maritime watch, made by Kendall between 1767 and 1769, was used by Captain James Cook on his voyages between 1772 and 1779. It is remarkable to note, from an entry in Cook's Journal on his return to England, after having been round the world, that he records the watch as being out by only seven minutes 45 seconds (in arc), which is roughly an equivalent of two minutes in normal time. I wonder how many modern watches, even Swiss made, could be proved so reliable!

Examples of more up-to-date models can be found among the varied exhibits in Neptune's Hall. (Fig. 6.) One case in this large hall contains a representation of the Battle of Trafalgar, made to a scale of approximately 1/16in. to 1ft., the ships being shown as waterline models, set in an imitation sea. There is also a model of "Cleopatra's Needle" and the craft in which this now familiar Thames Embankment landmark was towed to England. Modern craftsmanship is well to the fore in some excellent British-made ship models; H.M.S. "Arrow," superbly modelled by her builders, Messrs. Vickers Armstrongs, Ltd., and the Royal Mail Line hospital ship, "Atlantis," showing the first-class model work of Messrs. Bassett-Lowke, Ltd. There are also several German-made models of German seacraft: a submarine, a pocket battleship and Hitler's private yacht, the "Grille."

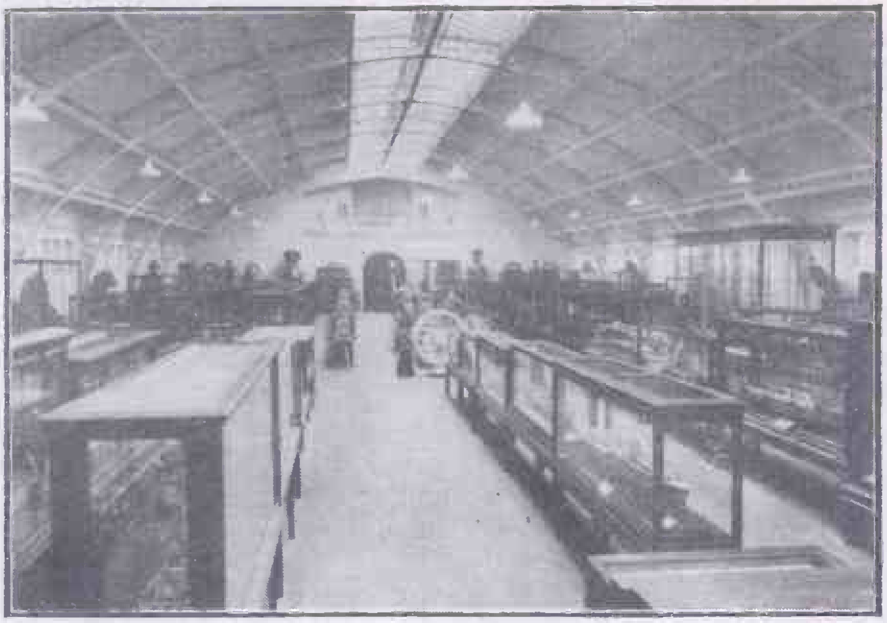


Fig. 6.—Neptune's Hall, formerly the gymnasium of the Royal Hospital School, which now contains a huge collection of many types of ship models of all periods and in various scales.

Tiny Model Cannon

Before leaving Neptune's Hall, Mr. Carr asked me to look through a magnifying glass at the smallest exhibit in the Museum—a model cannon, weighing less than a grain and no more than a speck when seen with the naked eye. This tiny novelty was originally made for the Great Exhibition, held in Hyde Park, 1851.

It is impossible, within the space allotted to this feature, to give you more than just a microscopic impression of the fascinating things that await the visitor to this Museum, either "in the world of models" or in the worlds of art, history and shipping. Facilities for reaching the Museum from London are not at present as good as they should be, especially when the boat services on the Thames are not running, but there are several ways of getting there by road and rail and a visit is well worth while. The most frequent train service is from London Bridge to New Cross and then by tram to the Museum. Alternatively, you can take the train to Maze Hill, which is within walking distance of the Museum, but trains that stop there are infrequent. During the spring and summer, the ideal way of approaching Greenwich is by river steamer from Westminster Bridge, which takes about three-quarters of an hour—time that passes all too quickly when you are watching the busy life of London River and identifying the places that you pass en route. Here is an idea for a day's vacation in a part of London teeming with historical interest, and if you are a ship model enthusiast, you have at the same time a fine chance of increasing your knowledge of the development of ship modelling in this country.

[*Note: All the illustrations in this article are by the courtesy of the National Maritime Museum, Greenwich.*]

Letters from Readers

"Institution of Mechanics"

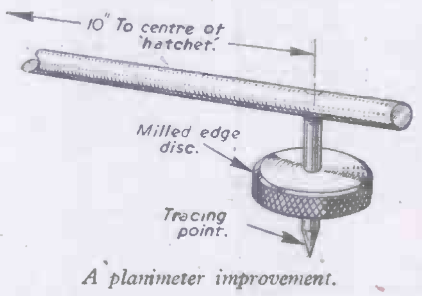
SIR,—A small group of skilled mechanics have banded together to form an "Institution of Mechanics," to raise the status of the skilled mechanic, assist in the interchange of ideas, experience and mutual help. We wish to raise the quality of craftsmanship and provide employers with a pool from which they can choose a really skilled man for any job. By encouraging members to study foremanship or industrial psychology to certificate standard, we hope to ensure that members get a chance of promotion when promotion is going.

We have the backing and help of a Member of Parliament, the good wishes and future help of the Minister of Labour, and individual interest of mechanics as far off as the occupation forces in Germany.

Would any readers interested in the aims set out above, or in any way interested in the cause of the skilled mechanic and the furthering of craftsmanship, even those not engaged professionally but are skilled amateurs, drop me a postcard. I will try to put readers into touch with others in their locality so that they may form local branches.—A. L. JACKSON, Acting Secretary, 118, Westwood Park, London, S.E.23.

"Hatchet" Planimeter

SIR,—In reference to the article on the "Hatchet" planimeter in the October, 1947, issue, here are one or two additional details which readers may easily add to the instrument. They are not original, but could at one time be seen exhibited on those types displayed in the South Kensington Science Museum. In one form the tracer piece carried a milled-edged disc, which could turn freely about the tracing point so as to serve as a convenient handle.



A planimeter improvement.

Also, this tracing point was made separately and screwed to the 10in. bar, as shown in the accompanying sketch.

In another form the horizontal 10in. bar was graduated so that areas could be read off directly, i.e., distances were marked corresponding to the marks made on the paper, and numbers set against them equal to the computed areas.—G. ELLIS (Sheerness).

Model Aeroplane Lubrication

SIR,—The following note might be interesting to model aero enthusiasts. The most successful oil for model aeroplane lubrication, both diesel and coil ignition engines, is Thelson motor oil H.C50, manufactured by Kenneth Thelwall, Ltd., Churchill Road, Doncaster.

This is a castor-based oil containing a very efficient inhibitor which prevents piston ring sticking, and this is one of the drawbacks associated with this type of oil.

There are at present only limited supplies of this oil available, but I am sure that the firm would do their best to supply orders from model aero clubs.—P. W. HALDRICH (Hungerford).

String Washers

SIR,—In the issue of PRACTICAL MECHANICS for December, 1947, you published a very interesting leading article about inventions. What interested me most was your remarks about the various kinds of spring washers that had been invented and that they had not been very successful.

I may state that I have had 40 years' experience in driving and repairing traction engines, road rollers and steam wagons in many parts of the country between the Moray Firth and the English Channel. When I first started in 1892 there were no fine tar macadam roads, but only rough, uneven roads, and traction engines were very hard to stand on owing to the vibration, which made the driver's teeth chatter at times. There was plenty of strain on bolts, and very often nuts and lock-nuts had to be tightened up. Lock-nuts were not improved by any of the types of spring washers. After trying many ways of keeping nuts from getting loose I found out a way by chance which proved so successful that I used it as long as I carried on driving.

I simply used a piece of ordinary thick string as a washer.

I screwed up the nut till there was just room to get the string between the nut and the plate or bearing cover, then twisted the string round the bolt or stud till it filled the space to the outer edge of the nut, and tightened the nut as hard as I could. I did the same with the lock-nut, and when the string was cut off close to the edge of the nuts there was nothing to be seen.

A piece of thick string was quite suitable for bolts from 1in. upwards, and for smaller size bolts I untwisted two or three strands to suit the size of bolt.

I have not driven any steam road engine for several years, but I still keep my faith in the string washer.

I look forward for my PRACTICAL MECHANICS every month as it is the best paper I get.—W. JOHNSTON (Aberdeen).

Crystallisation Experiment

SIR,—I read with interest, in your January issue, the answer to Mr. A. Casser's question regarding the production of crystal growths on coal. No doubt the method suggested would produce the desired effect up to a point, but I cannot help thinking that the whole process is rather ponderous. I would humbly suggest the following method:

Mix a small bottle of red ink with three tablespoonfuls of household ammonia, two tablespoonfuls of common salt, two squares of washing blue and three tablespoonfuls of cold water. Place four or five lumps of coal about the size of tangerine oranges in a glass bowl and pour the mixture over them. Stand in a warm place. Every second day pour over the coal a tablespoonful of water in which has been dissolved a teaspoonful of salt. In a short time there will be a bowlful of crystal growths which will be both interesting and decorative.—H. H. MIDDLETON (Twickenham).

Trade Notes

D.P. Kathanode Batteries

THE first main-line diesel electric traction locomotive for passenger service in this country has been undergoing final trials and a duplicate locomotive—No. 10,001—will later be brought into service.

The giant 16-cylinder, 1,600 h.p. "English Electric" diesel engines are electrically started by means of 120-volt, 236 ampere-hour D.P. Kathanode diesel traction batteries, manufactured by the D.P. Battery Co., Ltd., Bakewell, Derbyshire. This type of battery has been exhaustively tested out in actual service on diesel-electric locomotives used mainly for shunting operation by the London, Midland and Scottish, London and North Eastern and Southern Railways. The battery is designed to operate with a generous safety margin under conditions much more severe than are likely to be actually encountered, as, for example, with a temperature at freezing point and in a half-discharged state.

The cells are assembled in specially treated wood trays, these being fitted with porcelain insulators on the sides and ends. As headroom is somewhat restricted the cell-containing trays are mounted on steel-faced ebonite runners sliding in channels to facilitate easy withdrawal for periodical inspection. Handles are fitted on the ends of the trays for this purpose, and each cell is provided with a float to enable the acid level to be readily observed.

D.P. Kathanode traction battery.

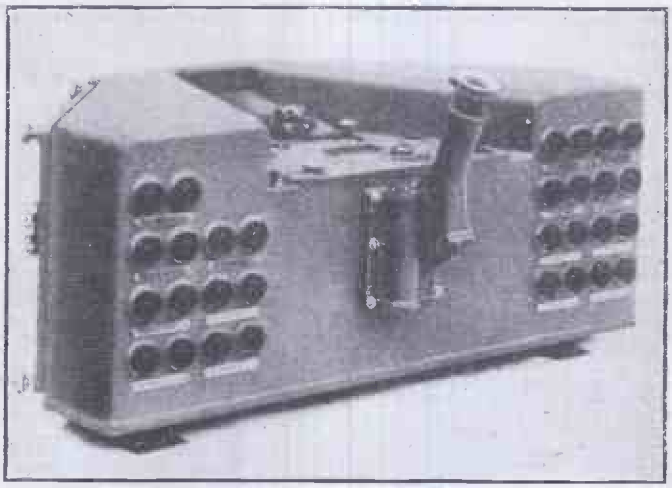
Batteries of the type referred to above are being manufactured for 12 main-line diesel-electric locomotives for the Egyptian State Railways.

D. P. Kathanode diesel traction batteries of somewhat smaller capacity are in use on many diesel-electric shunting locomotives at the present time, amongst these being 37 operated by the ex-L.M.S., L. & N.E. and Southern Railways.

New Recorder of Oscillograph Traces

IT is well known that high-speed mechanical or electrical variations can be translated by a standard commercial oscillograph into visible traces on a fluorescent screen. The impermanence of the traces, however, makes difficult any accurate study of the inter-relationship of several phenomena and makes impossible any subsequent checking; and attempts have been made with varying success to photograph these traces by means of standard cameras.

During the late war Messrs. Avimo, Ltd., designed special cameras which gave much more satisfactory results and recorded, side by side, on continuous film or paper, traces from any standard type of oscillograph. The number of traces which could be so recorded was, however, limited in practice by the fact that the space between the screens necessitated moving the camera back so far that the traces were reduced eventually to an impracticable scale. To provide a record on a practical scale where a number of traces are required to be shown side by side Avimo now have in production a series of recording cameras with built-in cathode-ray tubes—the latter so arranged that their traces are photographed through a mirror. In this way as many as 15 traces, plus a timing interval, may be recorded on a scale adequate for practical purposes.



The Avimo Fifteen Channel Camera which records 15 oscillograph traces side by side.

Club Notes

Wallasey Society of Model and Experimental Engineers

AN exhibition will be held from April 8th to 10th at Church Street Schools, Church Street, Wallasey, and will open as follows: Thursday and Friday, 5-9 p.m.; Saturday, 12 noon to 8 p.m. There will be steam locomotives on a passenger-carrying track, a working "oo" railway layout and other models working on compressed air. —Hon. Sec., W. K. NICHOLAS, 12, Rose Mount Drive, Wallasey.

The Beverley Model Club

THIS club now meets at "Cross Keys Hotel," Lairgate, Beverley. The times are as before, viz., 7.30 on second and fourth Mondays. At the first annual general meeting held on January 26th it was agreed that the club was firmly on its feet in spite of only five months' existence. Plans of the model car section are going ahead, and on February 5th the first public demonstration was given to the people of Beverley. Mr. Turner's "Kitten" showed the possibilities of this branch of modelling, and on one run lapped at 25 m.p.h. on a 12ft. line. Mr. Jackson's "Kitten" and Mr. Ward's free-lance model, although only partly finished, showed their paces. The meeting was rounded off with an R.T.P. flying competition which was won by Mr. Harrison's "Thistledown." His encore flight lasted 66 seconds and was warmly applauded.—Hon. Sec., F. H. PLASTER, "Virginia House," Cartwright Lane, Beverley, E. Yorks.

Society of Model and Experimental Engineers

THE above club will hold its fifth exhibition during Easter week.

The exhibition will be held from Wednesday, March 31st, to Saturday, April 3rd (inclusive) at the Central Technical School, Leopold and West Streets, Sheffield. Entries of all kinds will be welcomed from "lone hands" and from other societies; all such entries will be eligible for awards, and judging will be independent and anonymous. All exhibits will be insured.

As in former years, it is hoped to have the valued co-operation of the Sheffield Ship Model Society, the Sheffield Society of Aeromodellers, and the Sheffield Model Yacht Club.—W. J. HUGHES, 87, Hopedale Road, Frecheville, Sheffield.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page S6 (THE CYCLIST), must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Making Leathercloth

WILL you please supply me with a formula for the paint used in making rexine or leathercloth and the method of applying it. Can it be sprayed? How are the antique and hide effects obtained?

I should also like to know if the paint can be bought.—L. G. Roberts (Bexley Heath).

LEATHERCLOTH of various trade names is essentially a closely woven fine canvas material, the fibres of which have been impregnated with a cellulose compound and the surface of which has afterwards been treated with a pigmented cellulose paint, with or without a subsequent pressure and/or heat treatment for the purpose of obtaining special types of embossing effects. It is in this manner that the various "hide" and "antique" effects are obtained, the treated cloth being passed through heavy calender rollers.

You cannot hope to make a close imitation of leathercloth by merely using home methods, but you will be able to make some such type of material. The basic cellulose solution is made by dissolving scrap celluloid either in "cellusolve" or in a mixture of approximately equal parts (by volume) of acetone and amyl acetate Unfortunately, these solvents are extremely hard to get at the present time, but you may possibly obtain a small quantity by going the rounds of the London chemical supply houses. The solution of the celluloid is effected by shaking, not by heat, since the solution is very inflammable.

The cloth is stretched on a frame, and the solution is well rubbed into the upper side of the material, this operation being done twice. For this purpose, the solution should have a thin varnish consistency. After drying (12 hours in the cold) a cellulose paint or varnish is applied to the treated surface. One coating is usually sufficient to give a smooth, pleasing effect, and one coating of the paint is less liable to crack than two coats. The paint may be either sprayed or brushed.

The precise paint and cellusolve solution used by the leathercloth manufacturers is maintained a close secret and of course you will not be able to obtain their results. Nevertheless, with careful and patient working, you should be able to produce some reasonable imitations of the commercial article. The only trouble is the present-day excessive and continual shortage of materials, so far as the average individual is concerned.

Electrical Indicator for Storage Tanks

I HAVE recently installed two storage tanks for fuel oil of 12,000 and 6,000 gallons capacity above ground level and I would much like to instal inside an office some 60ft. from the above tanks an accurate indicator so as to check daily the amount of fuel in storage. Would a hydrostatic gauge be suitable with, say, a ⅜in. bore pipeline from each tank suitably connected with a tee at the U-tube end so that each tank reading could be taken in turn?

I would be pleased to have your observations on this or any other method it would be possible to employ.—T. Guerden (Blackburn).

IN principle, a hydrostatic petrol-level indicator would answer your purpose, but in actual practice it would possibly give rise to many difficulties, thereby giving inaccurate and unsatisfactory results, mainly owing to the long connecting line (60ft.) which would be interposed between the tanks themselves and your own office.

A much better method, we think, would be an electrical one, a modification of which has been put into practice for car use by Messrs. Smiths, and by other people.

Essentially, with the electrical method a suitable float is provided, which float operates an arm working up and down an electrical resistance of the rheostat type. A galvanometer instrument (at any reasonable distance) is wired up in circuit with the rheostat and a source of current (battery, accumulator or D.C. transformer), so that as the float arm moves up and down the rheostat in accordance with the variance of liquid level in the tank the resistance of the circuit continually varies. This variation is manifested by the movement of the needle on the galvanometer dial, the latter being, of course, carefully calibrated in terms of the capacity of the tank in question.

It will be realised that the current need not continually flow through the circuit. It need merely be switched on at the moment at which it is desired to take a reading, a switch being provided near the dial for this purpose.

The rheostat itself must be mounted and secured well out of the reach of the liquid in the tank, otherwise it would become oil splashed and thereby refuse to function.

A system operating on these lines will, we think, give you a much more accurate indication than would a hydrostatic level with its long liquid-containing pipeline, which would be subject to all sorts of temperature and barometric changes.

Potash Manufacture

CAN you suggest any method by which dry waste wood and fresh forest timber waste can be utilised in the manufacture of potash on a small commercial scale? If the project is feasible, I should appreciate details of plant, process, etc.—H. J. Lucas (Southampton).

POTASH (potassium carbonate) was formerly obtained very largely from the ashes of plants and wood which were burnt in iron pots; hence the name "pot-ash."

In some parts of Canada and the United States the process is still, we believe, carried out in a very small way. Briefly, this process is as follows:

The wood chippings, etc., are burnt completely in smooth-walled pits. The ashes are collected, mixed with a small quantity of lime, and then extracted with boiling water in open tanks or boilers. The liquid is drawn off, roughly filtered, and then evaporated to dryness. The dry matter is then heated to red heat in order to calcine and burn away any remaining organic matter. The material which remains is of a creamy colour and was at one time known as "American potash." It contains varying quantities of caustic potash, from which substance various potassium compounds can be prepared by the appropriate chemical processes.

Such is an outline of the basic process, which is simple enough. But whether you can, without prior experience, work the process for yourself and make it an economic success against the prevailing restrictions is more than we should like to say. The chemical plant required is very simple and your needs in this respect are well catered for by the many firms of chemical plant makers in this country. They, however, are working under restrictions and, as you know, steel and allied products all come heavily within the restrictive influence.

Your best plan, we think, is to try the process out in a small way first of all, using a few clean iron or steel drums. From these beginnings you will obtain a knowledge of the various difficulties inherent in the process, and this will enable you to decide whether to proceed in the matter or not. Always, of course, bear in mind the fact that your final product is not a pure one. To produce pure potassium salts would necessitate the equipment of a small chemical works in itself, the employment of at least one skilled chemist and various ancilliary workers. Moreover, you have also to remember that in thus entering into potash production you would be up against powerful interests which would not be inclined to treat your competition lightly.

We think, therefore, that even before commencing small-scale experiments, you should consult authentic chemical literature on the subject in a good and up-to-date reference library. Only then will you be equipped with the means of sizing up the various problems, technical and economic, involved.

Tanks for Hydrochloric Acid

CAN you please advise me as to the best and most economical method of maintaining a solution of 500 gallons of "cold" hydrochloric acid, in bitumen-lined tanks, at a temperature of approximately 60 deg. F.?

The tanks are used for pickling wire rods prior to wiredrawing. Any immersion system should provide for protection of equipment against the acid.—K. O. Leach (Sheffield).

YOU do not tell us at what strength the hydrochloric acid is to be used, nor whether the acid is of the "pure" or "commercial" variety. In any case, a bitumen-lined tank will not withstand any liquid, let alone an acid liquor, at 60 degrees, for the simple reason that the bitumen will soften at this temperature and will slowly "creep" down to the bottom of the tank.

We think, therefore, that, instead of bitumen, you must really mean *asphalt*, which is essentially a product manufactured from bitumen, but being very much harder than the latter.

Very many industrial chemical tanks are asphalt-lined, the asphalt used for the purpose being of a special variety known as "acid-resisting asphalt mastic." For tank-lining purposes this type of asphalt must be used. Two ⅝in. thick layers of this asphalt would resist hydrochloric acid up to a 50 : 50 dilution with water at a temperature of 60 deg. F., provided that there was not much mechanical agitation of the liquid in the tank. But this concentration and temperature of acid is very near the borderline, and hence you would have to be prepared for a slow deterioration of the surface of the asphalt tank-lining, so much so that a resurfacing might be necessary after two or three years of usage.

As an alternative to an asphalt-lined tank, have you ever considered a strong wooden tank, glass lined, and with the joints of the glass made up with a good acid-resisting cement? If its joints are good, such a tank will last almost indefinitely, and at any reasonable temperature, always provided that its glass linings do not become mechanically damaged.

An electrical heating immersion unit can be used in either case, but with a bitumen-lined tank steam heating should not be used unless the steam coil is kept at a good distance from the asphalt lining, for, with steam heating, it is very easy for a development of excess local heat so to soften an adjacent area of asphalt that it slides down to the bottom of the tank and thus leaves a "weakness" in the asphalt lining which is steadily (and usually rapidly) progressive, and thus results in the entire disintegration of the tank lining.

Renovating Canvas of Oil Painting

I HAVE recently framed a valuable oil painting and after varnishing it with gum mastic I find that the canvas has become slack and has wrinkled slightly. Can you advise me of a suitable solution which I could apply on the back of the painting, thereby shrinking the canvas to make it taut in the frame?—W. Henderson (South Shields).

TO be perfectly candid, it is quite impossible for us to diagnose just where you have gone wrong in varnishing your picture. The whole art and technique of varnishing an oil painting on canvas is a very tricky one. Its success depends on so many different factors, as, for example, the age of the picture, the type of paint used, the nature of the "ground" on which the picture has been painted, the precise composition of the applied varnish and the state of humidity of the surroundings and materials. All these factors—and others—sum up and determine whether or not the varnishing is to be successful.

Gum mastic is certainly the best material for varnishing an oil painting, but it must be the pure and unadulterated gum dissolved in the purest turpentine to make a medium-strength solution. We presume that you have attended to these requirements. If, however, the solution is too dilute (i.e. contains too much turpentine) the latter will soak through to the back of the canvas (particularly if the picture is old and contains numerous cracks) thereby causing the individual fibres of the canvas to relax and slacken. The same effect obtains if the correct strength mastic varnish is applied too liberally. Again, a similar thing happens if the varnishing is done under damp conditions, for a canvas may absorb and hold a good deal of water vapour.

The picture should be bone dry to begin with. The surface should be given the thinnest possible layer of varnish, applying it with a small, flat brush (preferably of hogs' hair). This coating should be allowed to dry before a second (and thicker) coat of varnish is applied.

Possibly, therefore, in the light of the above information, you will be able to find out just where you have gone wrong in the varnishing process.

We assume that the canvas is perfectly sound although very frequently many of these old pictures are on canvases which are anything but sound, and which require renewing—a very difficult and expert task.

If such is the case, your best plan is to remove the canvas from its frame and very carefully to renail it in position. This is a job for two people, one doing the necessary stretching and the other the nailing

It is easier to do this in the case of a small canvas than of a large one. Again, you might insert the usual wooden wedges at the corners of the canvas frame and drive them into position. This procedure is often sufficient to take up any stretch in the canvas.

On no account apply any chemical substance, oil, glue, etc., to the back of the canvas. If you do, the picture will gradually deteriorate. There is nothing like oil for slowly rotting the fibres of a canvas.

If the picture is particularly valuable, we should advise you strongly not to tamper with it further but to place it in the hands of a good local picture restorer. His charge should not be excessive for the work entailed.

Paper-making

I AM very interested in making paper and putting in the watermark, and wish to know if you can give me a recipe for the making of paper (writing paper) and tell me how to incorporate the watermark?

I am told that old papers, as well as rags, have to be "cooked" and stirred up in a vat.

You might be able to recommend a good book on the subject.—K. Morgan (Melbourne, Australia).

PAPER-MAKING as an amateur pursuit is a very difficult job, and there are very few who ever attempt it. Simple enough in theory, the procedure is difficult in practice, and it calls for the utmost degree of skill and experience. Given this, however, and using good materials, there is, for most purposes, no better paper in the world than that of the "handmade" variety, a commodity of the very highest quality which even this present machine age has been unable to displace.

The paper is, of course, made by dipping a fine wire mesh, wooden framed, into a vat of the liquid paper pulp, which latter is obtained by the breaking down of clean rags and other fibrous materials in water. This has to be done mechanically by means of a "beating engine," which literally tears the rags asunder. To some extent you can get a similar effect by the prolonged boiling of scrap paper in water. The usable paper pulp should have the appearance of milk.

When taken up in the wire-bottomed shallow tray the water drains through the wire mesh, leaving behind a wad of fibre. This wad is tapped off the mesh on to a wet pad of hair felt, on which it is allowed to dry. The resultant mass of formed paper is, of course, highly absorbent, like blotting-paper. It is then "tub-sized," in which process it is passed through a 3 per cent. solution of gelatine (3 parts gelatine dissolved in 97 parts of water) containing also a little soap and a little common alum to increase the smoothness and toughness of the paper. It is again dried and is then ready for use.

The watermark (if any) is obtained simply by weaving the required design of the watermark into the wire mesh of the paper-making frame. In this manner, the design, in woven wire, is raised above the level of the wire mesh to a very slight extent, and it is this which produces the required watermark, the watermarked area of the paper being slightly thinner than the remainder of the paper.

There are no books on papermaking from an amateur viewpoint. Below, we give a list of technical works on industrial papermaking. After each title we append the pre-war publishers' price. Such books may be obtained from any good bookseller, such as Messrs. Ed. Bryce, Ltd., 54, Lothian Street, Edinburgh, or Messrs. W. & G. Foyle, Ltd., Charing Cross Road, London, W.C.2, from both of which firms also secondhand copies may possibly be obtained:

- R. H. Clapperton: "Practical Paper Making" (7s. 6d.).
- R. H. Clapperton and W. Henderson: "Modern Paper Making" (21s.).
- A. Watt: "Paper Making" (8s. 6d.).
- H. A. Maddox: "Paper" (3s.).
- R. W. Sindall: "Paper Technology" (21s.).
- Cross and Bevan: "Textbook of Paper Making," 5th ed., revised (30s.).
- J. Beveridge: "Paper Maker's Pocket Book" (21s.)

Water Softener Details

I WAS very interested in the constructional details for making a water softener. Will you please let me know if the following would be suitable for making the body?

I have two brass shell cases 20in. by 4in., relics of the 1914 war. Would brass have any harmful effects on the water or the basic material and salt?

I cannot get the softening medium in Guildford, so will you also let me have an address where it can be purchased?—G. F. Hall (Guildford).

COPPER and brass are definitely unsuitable for any type of water-softening apparatus, since both of these metals are liable to be attacked by water-softening chemicals and particularly by salt or brine solutions. For ordinary purposes, iron is the best metal to use, and if the softened water is required for human consumption the iron should not be galvanised, that is to say, zinc-coated.

A vessel of dimensions approximately 2ft. by 9in. would, we think, be suitable for your purpose. After cleaning out, this should be filled at the bottom with clean broken glass, then clean coarse rock or flint fragments, then a 1in. layer of coarse sand mixed with broken charcoal fragments. On top of this place a 12in. or 18in. layer of the softening material, with a layer of well washed coarse sand above.

The vessel must, of course, be provided with a suitable tap near the bottom.

Water-softening materials of this class are as yet not easy to obtain.

Your best places of inquiry are: Messrs. Albright and Wilson, Ltd., Water Treatment Department, 49, Park Lane, London, W.1; Sofnol, Ltd., Greenwich, London, S.E.; and Burgess Zeolite Co., Ltd., 68-72, Horseferry Road, London, S.W.1.

In smaller quantities, you might possibly be able to obtain water-softening zeolite material from one or other of the London wholesale chemical supply houses, as, for instance, Messrs. A. Gallenkamp & Co., Ltd., 17-29, Sun Street, Finsbury Square, London, E.C.2, or Messrs. Hopkin and Williams, Ltd., 16-17, St. Cross Street, Hatton Garden, London, E.C.1.

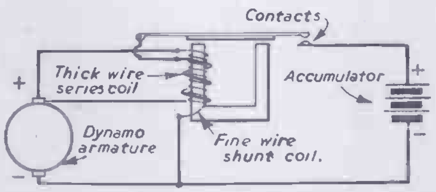
Cut-out for Charging Circuit

COULD you tell me how to make a small dry accumulator which will pack into a small cylinder 2in. diameter and 6in. long? I want it to be charged by a 6-volt dynamo and to operate two 6-volt lamps of .3 amps and .04 amps.

Also, could you tell me how to make a cut-out device so that the accumulator will be charged at the correct rate and length of time, and how to make the connections to dynamo, accumulator and lamps?—L. Starkey (Manchester).

WE cannot hold out much hopes of successful home construction of the type of accumulator you mention, and consider that you would be well advised to purchase one of the manufactured articles, such as the Varley.

We know of no type of automatic cut-out which will ensure the accumulator is automatically charged at



Arrangement of cut-out in a charging circuit. (L. Starkey.)

the correct rate and for the correct length of time. A certain amount of supervision is always advisable.

A cut-out, which would break circuit when the dynamo voltage is too low for charging, and would close the circuit when the dynamo voltage is correct for charging, could consist of spring-loaded contacts carried on an armature of soft iron, the contacts being connected in series with the accumulator. Opposite the armature should be fitted a soft iron pole piece wound with a coil of fine wire connected across the dynamo; when the dynamo voltage reaches the required value the current and magnetism created by this coil are sufficient to attract the armature and connect the dynamo to the accumulator. On the top of the fine wire coil are wound a few turns of thicker wire which are connected in series with the contacts; this coil carries the charging current so that when current flows to charge the accumulator the series coil assists the fine wire shunt coil in keeping the contacts closed. If the dynamo voltage falls so the accumulator tends to return current to the dynamo this current in the series coil will create magnetism of opposite polarity to that of the shunt coil, the total magnetism will be reduced and the spring will open the contacts.

Solid Methylated Fuel

CAN you please supply me with the recipe for making solid methylated fuel? Small quantities only will be needed.—W. J. Grove (Portsmouth).

TO make "solidified spirit" proceed according to the following formula:

Spirit, 1,000 ccs.; stearic acid, 60 grams.; caustic soda, 13.5 grams.

Dissolve the stearic acid in 500 ccs. of the spirit. Dissolve the caustic soda in 500 ccs. of spirit. Warm both solutions to about 60 deg. C. Then mix them, stir well and allow to solidify.

If you cannot obtain stearic acid, the following is an alternative formula, but it is not as good as the previous one:

Spirit, 1,000 ccs.; soap chips, 30 grams.; shellac 2 grams.

Heat the alcohol to 60 deg. C. (140 deg. F.). Add the soap and shellac. Stir well until dissolved. Then allow to cool.

White Spirit Varnish

WILL you please supply me with a recipe for making a white hard varnish "spirit" as used for tennis rackets?—E. Gent (Surbiton).

A SPIRIT varnish of the type you require can readily be made by dissolving bleached shellac powder in about an equal quantity of warm methylated spirit. The spirit should be placed, together with the shellac, in an uncorked bottle, the bottle being allowed to stand in a vessel of warm water. Shake up the mass very frequently until it has all dissolved. The consistency of the varnish should be that of thin syrup. If it is too thick, add more spirit; if too thin, add more shellac. Finally, before use, filter the varnish through fine cloth (muslin), and apply with a soft, flat brush.

A solution of gum dammar in turpentine also makes a very good clear varnish. Unless, however, applied very thinly, it will take a couple of weeks to dry and a further week to harden.

Finishing French Polish: Bleaching Ivory

THERE is a method of finishing french polishing with dilute vitriol and some kind of chalk instead of the alternative method of spiriting out. Could you give me any information on the subject?

Also, is there any method of bleaching discoloured ivory back to its original whiteness without the tedious process of scraping and glass papering?—W. Picton (Barrow-in-Furness).

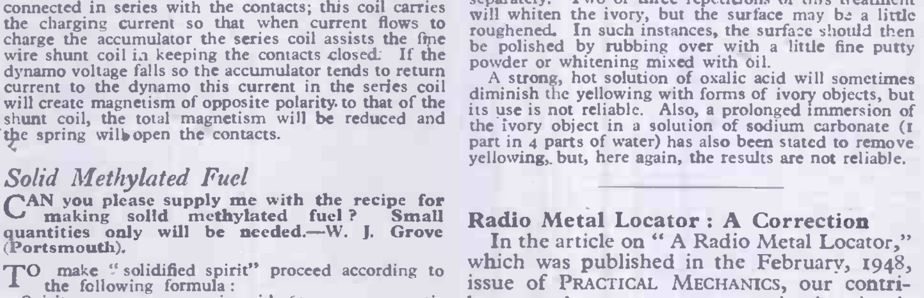
SOME polishers have a practice of going over the polished surface with a dilute solution of sulphuric acid (vitriol) and then neutralising the acid-treated surface with precipitated chalk, finally wiping away and giving the surface a final rub over with a soft polishing wad. The sulphuric acid strength is about 1 in 6, i.e., 1 part of sulphuric acid in 6 parts of water. We see no advantage in the process, however, which is said to toughen the polish film, nor do we recommend it.

Ivory is best bleached by continually wetting with water and placing in strong sunshine for a prolonged time, but it is obvious that this method cannot be undertaken in very many instances. We observe, too, that you do not state what kind of ivory objects you desire to bleach. If, however, you refer to pianoforte keys, the best method (apart from the sunlight bleach) is to make up a paste of chloride of lime and water. Acidify this with a few drops of sulphuric or hydrochloric acid (dilute) and spread the paste on the ivory surface, treating each key (removed from the piano) separately. Two or three repetitions of this treatment will whiten the ivory, but the surface may be a little roughened. In such instances, the surface should then be polished by rubbing over with a little fine putty powder or whitening mixed with oil.

A strong, hot solution of oxalic acid will sometimes diminish the yellowing with forms of ivory objects, but its use is not reliable. Also, a prolonged immersion of the ivory object in a solution of sodium carbonate (1 part in 4 parts of water) has also been stated to remove yellowing, but, here again, the results are not reliable.

Radio Metal Locator: A Correction

In the article on "A Radio Metal Locator," which was published in the February, 1948, issue of PRACTICAL MECHANICS, our contributor made one or two errors in the circuit diagram. The corrected diagram is given below.



Corrected circuit diagram for the radio metal locator published in the February issue of "Practical Mechanics."

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408, HIGH STREET, LEWISHAM,
LONDON, S.E.13
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(Near Lewisham Hospital).

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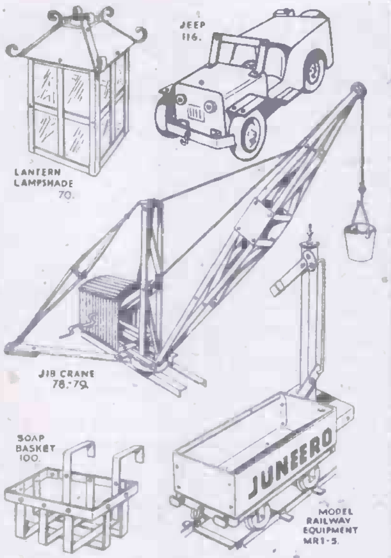

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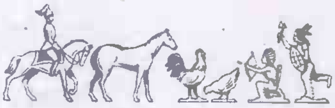

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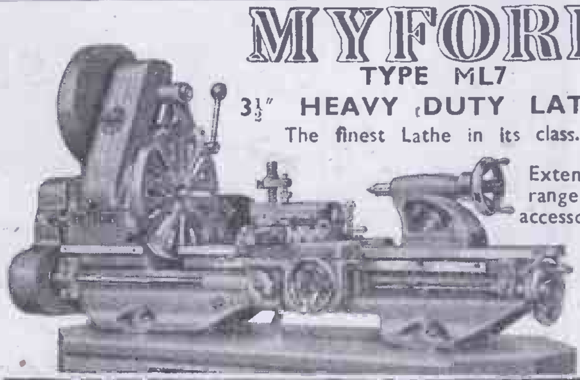

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B.T.H. TRANSFORMERS. 200/230/250 volts, 50 cy. input, 2 volts 20 amps, 75 volts 6 amps., with 15 taps output, 70/-. Carriage paid England and Wales.

METAL RECTIFIERS. 12 volts, 1 amp., 12/6; 12 volts, 15 amp., 40/-; 36 volts, 10 amp., 55/-; 60 volts, 1 amp., 30/-; 75 volts, 6 amp., £4.

SOLENOIDS. 12 volt Rotax, will pull ½oz. ½in., 6/6; heavy Solenoids, 24 volts, to lift 14lbs., 15/-.

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THE Cyclist

Editor: F. J. CAMM

VOL. XVI APRIL, 1948 No. 313

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

Phone: Temple Bar 4363
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Comments of the Month

By F. J. C.

Diamond Jubilee of the Pneumatic Tyre

NO invention has made such a profound impression upon civilisation nor been responsible for such change in the habit of the people of the world than the pneumatic tyre. It paved the way for the perfection of the bicycle, the motor cycle, the motor car, the aeroplane, and all vehicles which run on wheels.

Its invention was as momentous as that of the wheel itself. This year the pneumatic tyre celebrated its Diamond Jubilee, for it was on February 28th, 1888, that pneumatic tyres were first used. Although there had been a previous patent for pneumatic tyres by Thompson, it was John Boyd Dunlop who diligently applied himself to the task of fitting pneumatic tyres to the wheels of bicycles and tricycles. The jubilee has been fittingly celebrated at the premises in May Street, Belfast, where the tyres were invented and made, and at Fort Dunlop.

The Lord Mayor of Belfast laid a wreath on the May Street Memorial to John Boyd Dunlop, and in a speech paid tribute to his work and the pride with which Belfast claimed Dunlop as a citizen.

Tyre manufacture to-day gives employment to millions of people and comfortable and enjoyable travel to many more millions.

Robert Carlisle, now 84 years old, who helped Dunlop to make the first pneumatic tyre, placed a wreath on the Fort Dunlop Memorial. Mr. Carlisle is the oldest Dunlop employee.

In our issue dated July 20th, 1938, we devoted the whole of that issue to the history and development of the pneumatic tyre, for it was, of course, in that year that it celebrated its jubilee. In that issue we said, and we now repeat, that Dunlop has indelibly inscribed his name on the walls of Valhalla, among those immortals who have benefited civilisation, for the pneumatic tyre supplied the missing link in what was in itself a great invention—the bicycle. The bicycle introduced a new form of transport readily available to and within the means of all. It has done more than anything else to improve the fitness of the human race, and to increase its longevity.

Dunlop's patent is dated July 23rd, 1888, and, of course, it amused the technicians of the period, who still believed that nothing would oust the solid tyre. Famous cyclists, such as George Lacy Hillier (aptly termed the apostle of lost causes because of his opposition to the safety bicycle, and other improvements to the Ordinary) vigorously opposed the pneumatic tyre in speeches and in print, whilst many others endeavoured to get it suppressed in racing circles. In this latter they, for a time, succeeded. Others, of course, contributed to the success of the pneumatic tyre.

We must not forget Harvey Du Cros, the financial genius behind the formation of the Dunlop Rubber Co.; Charles Kingston Welch, whose patent for the method of fixing the cover to the rim by means of endless wires improved the design and fortified the position of the Dunlop patent; nor Woods the inventor of the tyre valve, that simple device which enables the tyre to be quickly inflated, and is practically the same to-day as it was when first originated.

Dunlop was born at Dreghorn in Ayrshire (appropriate name!) in 1840, and was educated at the Irwin Academy under Dr. White, from whom he acquired his knowledge of mathematics. He entered the Veterinary profession as quite a young man, qualifying when he was 19. On obtaining his degree he went to Ireland, where he settled in Belfast, in which city he invented the tyre.

When he invented and made the first pneumatic tyre he had never ridden a bicycle and there was not a rubber factory in Ireland, yet he made the first practical air tyre for his son Johnny's tricycle. He made it out of ordinary sheet rubber and canvas, his only too' being a pair of scissors.

Robert Carlisle, now 84 years old, who helped John Boyd Dunlop to make the first pneumatic tyre, places a wreath on the memorial to him at Fort Dunlop.

First Success in Racing

THE pneumatic tyre achieved its first success in racing before a sneering crowd at the Queen's College Sports Meeting at Belfast, held at the North of Ireland Cricket Club's grounds on May 18th, 1889, when William Hume won the first race ever to be ridden on pneumatic tyres.

There were four cycle races, and after winning the first two, Dunlop congratulated him and suggested that he had done very well for the day. Hume then went on to win the third and fourth races! The results obtained by Hume so impressed Harvey Du Cros that he left the meeting after the first two races and got to work on schemes for exploiting the idea. Shortly afterwards Hume went to Liverpool and entered a scratch mile event, but in this he failed, but he succeeded in winning all the remaining cycle events.

Notwithstanding the claims of a so-called historian who, for years, exhibited a machine in his so-called museum with the specious and quite fictitious claim that it was the bicycle on which Hume won the first race, we have Hume's authority for saying that the machine was destroyed. As this spurious machine has been bequeathed to the City of Coventry, we made it our business to inform the appropriate authorities there of the facts. It is unlikely that the machine will be exhibited as Hume's bicycle. Hume took shares in the Dunlop Company's original issue.

An amusing aspect of the history of the pneumatic tyre is, as can be expected, the stupid attitude of the National Cyclists' Union at the time. Dunlop was declared by that body to be a professional cyclist, and so were the remainder of the directors of the Dunlop Company. Dunlop could not ride a bicycle at that time!

The first advertisement for Dunlop's great invention appeared in an Irish journal dated December 19th, 1888. It said:

"Look out for the new pneumatic safety. Vibration impossible. Sole Makers, W. Edlin & Co., Belfast."

First Appearance in the South

THE first appearance of pneumatic tyres in the south of England was at the Spring Sports of the Surrey Bicycle Club at Kennington Oval in April, 1890, when two machines so fitted were used. Frank Shoreland, heavily handicapped and riding a geared Facile, won from a short mark with such ease that the merits of the pneumatic tyre were quickly recognised.

Tyres in those days were costly, and the competitor to the pneumatic was the cushion tyre. It was found, however, that this punctured more easily than the pneumatic. There were also stuffed cushion tyres.

A pair of pneumatic tyres in 1888 cost £3. The reduction in vibration enabled much lighter machines to be built, and the weight of a bicycle gradually fell from about 70lb. to 26lb. The first repair outfit was marketed in 1891 by A. J. Wilson, who was closely associated with the early days of the pneumatic tyre. Wired-on tyres were first produced in 1893 under the Welch Patents and they rapidly replaced the beaded edge tyres.

Early Pneumatic Tyres

IN the early pneumatic tyre it was necessary to lift the strip of canvas which covered the edges of the outer cover, unstick one edge for about 1ft., using naphtha as a solvent, cut a slit in the wall of the canvas bag and so gain access to the inner tube before a puncture could be repaired.

The early pneumatics as sold up to 1893 consisted of an air tube completely enclosed in a canvas bag which was wrapped round the rim, the whole being covered by an endless strip of vulcanised rubber, thickened on the

(*Continued on page 52.*)

PARAGRAMS

The King and Queen as Patrons

THE King and Queen have granted their patronage to the Cycle and Motor Cycle Show to be held at Earl's Court from November 18 to 24.

Large Scale Operations

A BEDFORD man who was sentenced at the Borough Police Court to six months' imprisonment on each of two charges of cycle-stealing, asked for 21 other cases to be taken into consideration and it appeared that he had been stealing cycles at the rate of approximately one every fortnight. The man told the police that he stole the cycles to get money, generally while he was "in drink." Up to the date of the hearing only six of the stolen machines had been recovered.

Celebrations in 1948

ANOTHER Yorkshire club, Brodsworth Racing Club, will celebrate its twenty-first birthday in 1948 and plans are being made to mark the event and to make the coming season a special one in the club's history. This year the club is introducing youth championships of 880yds. and 10 miles and a "best-all-rounder" competition for junior members. Other events planned include track championships of 880yds. and five miles, time trials of 10 and 25 miles and a rough-riders' trial.

New Yorkshire Club

A NUMBER of cyclists in the Rossington district of Yorkshire, some of whom have previously been members of Doncaster Clarion C.C., have formed their own cycling club. It has been named The Rossington Road and Path Club and plans are being made for its first year of life.

Miracle Operation on Cyclist

MR. HAROLD BLAKE, of Kettering, chief reporter on the staff of the *Kettering Evening Telegraph* and formerly a prominent member of Peterborough Cycling Club, is reported to be making good progress following a miracle operation in a hospital at St. Louis, Missouri. Mr. Blake, a sufferer from Parkinson's disease, had become so affected that he could neither walk nor use his right arm, and he was told by the specialists that he could not be cured. However, he read in a magazine of the new operation evolved by an American surgeon, on a part of the brain to break up the paralysis, and he decided to make the trip to America. He is now gradually learning to walk again and to use his right arm and if all goes well he may even be cycling once more. He is the first Englishman to undergo this operation.

Paid for Pleasure

MIDDLESEX county education authority has decided that an allowance of fifteen shillings a term shall be paid to all schoolchildren in the county over 11 years old who cycle to school and live more than two and a half miles from school. Normally such children are entitled to free travel, and it is felt that if such children prefer to cycle instead they should receive some allowance for the upkeep of their machines.

Powered Cycle

AN American doctor, who is an amateur mechanic in his spare time, has converted his bicycle to power propulsion. It looks rather like a tradesman's cycle, having a box about 18in. square fixed above the front wheel. The box contains a 2 h.p. petrol engine and a one gallon tank and the drive is by belt and pulleys to a chain on to a sprocket on the front wheel. The doctor claims that his cycle can now do 120 miles to the gallon and has a range of speeds from six to 42 m.p.h. Although having the engine over the front wheel would appear to make the machine rather unmanageable, the inventor claims that it can be ridden perfectly at all speeds.

Any Older Club?

PETERBOROUGH Cycling Club, which has just celebrated the seventy-third anniversary of its foundation, is claimed by members to be practically the oldest cycling club in the world. Towards the end of last century club members used to ride more or less sedately along the bumpy roads wearing tight-fitting uniforms and pill-box caps like a kind of Boys' Brigade. The Peterborough Club, in 1881, was presented with a bugle as winners in a competition for the most smartly turned out club and members also took part in Queen Victoria's Jubilee procession. During 1947, club membership increased by 50 to 142 and 23 club records were broken during the season.

Fold It Up

A FOLDING bicycle, which, it is claimed, can even be sent by rail without finishing its journey as a complete wreck, is being produced in quantity by a firm of cycle manufacturers at Westfield, Mass. It is called the Columbia Compax and is designed on the lines of those folding bicycles used by paratroopers during the war. The handlebars fold downwards and the frame folds back upon itself so that both front and rear wheels lie together. The folding-up operation takes only a few minutes and no tools are required.

Not So Good

MONMOUTHSHIRE Police recently carried out a check of 181 cycles used by scholars at the Monmouth Grammar School, but out of the total number inspected they were only able to pass 27 as being fit for the children to ride in safety.

Learn from the Young

URMSTON (Lancs) Road Safety Committee is suggesting that grown-up cyclists ought to watch the way in which the local children manage their cycles if they want to learn good road sense. Altogether, Urmston child cyclists have received 15 out of the 35 proficiency certificates awarded in a competition organised by the National Safety First Association. Special instructors examine the children's bicycles and give short lectures on maintenance and road sense.

Well-earned Retirement

MR. A. FOSTER, senior partner in the firm of Messrs. A. Foster and Son, cycle dealers, 26, Wood Street, Earl Shilton, Leics, has retired after 50 years in the business. His two sons, Mr. C. A. Foster and Mr. H. Foster, will carry on the family business.

Can He Prove It?

DURING the war a glib explanation of the increase in cycle-stealing was that Servicemen took them temporarily so that they could get back to camp. Now that the war is over and many men out of uniform, it is being suggested by the Chief Constable of the Holland division of Lincolnshire that the habit continues. He told Holland County Council, in his annual report on the year's crime: "During the war, when there were a lot of troops in the area, it was expected that cycle thefts would increase. This, in fact, did happen. Then there was a lull and now it looks as if those men coming from the Forces are looking for cycles once more." He added that the abolition of basic petrol may also have had some effect.

High Hopes

MR. JOHN DRAPER, secretary of Kettering Friendly Cycling Club, forecast at the club's annual dinner and prize-giving: "It is not an idle boast, but within the next two years we hope to have somebody worthy of representing Britain." Although the club only came into being in 1945, much progress has already been made. Practically all the members are under 25 years of age and they are showing the greatest keenness, especially the 17-year-old rider who, by mistake, covered 10 miles more than he need have done in the race to decide the club championship. This rider did not win the championship, but he did collect five other awards during the season.

New Members for Doncaster Club

ALF MARTIN, the well-known Yorkshire Road Club rider, with his wife, Mary Martin, a national title holder, have both become members of Doncaster Wheelers' Club, and will take part in racing events for the club next season. At the end of 1947 the club membership had increased to 111 and a successful season is anticipated.

Ride Him, Copper!

A PETERBOROUGH policeman, cycling sedately along, and keeping a sharp look out for any law-breakers, suddenly sprang into action and gave a five-minute rodeo exhibition when a milkman's horse ran away with its car. Pedalling furiously, he chased and overtook the runaway and then, riding with one hand on the handlebars he managed to grasp the dangling reins. He was dragged for a considerable distance, but he kept his balance and eventually managed to force the excited animal to a standstill.

His Work Appreciated

AT the annual general meeting of St. Neots and District Cycling Club, held at St. Neots, Hunts, the club handicapper, Mr. C. H. Paget, was made an honorary life president of the club in recognition of his services. Arrangements are also being made to present him with an illuminated address and reference was made at the meeting to his good work for the club over a long period.

Fifty Years In Business

AFTER carrying on business as a cycle dealer for some 50 years in Coney Court and Bridge Street, Brigg, Lincs, Mr. Frank E. Lee, of Scawby Road, Brigg, has died at the age of 78. He was born in Birmingham and moved to Brigg to commence business on his own account in the early days of cycling.

Above the Law?

AS quite a number of cyclists have discovered, Halt signs are put in the streets to be observed, but a St. Ives (Hunts) Rural District Councillor evidently has other ideas. He was motoring in Peterborough when, according to a policeman, he passed a Halt sign at 15 miles an hour. He duly appeared before the Peterborough Bench, and told them: "I worked with the police through the war years. This would not have happened in my own county. They all know me and I am sure my word would have been taken." The chairman told him he had better be careful what he said and must not regard himself as having in Peterborough the immunity which he claimed to have in Huntingdonshire.

Started Well

RON MEADWELL, of Melton Mowbray, member of the East Midlands Clarion Club who is with the British Olympic Games team in South Africa, began in fine style by winning the half-mile handicap from scratch and setting up a new South African record of 56.7 secs. The event took place on an asphalt track at Bulawayo, Rhodesia.

Fairies About?

A CAMBRIDGESHIRE cyclist evidently believes that fairies are on the road now and again, apart from those who accompany male club members on their runs and, at the same time, add a little brightness to the countryside. He said he left his cycle outside a public house without a lamp on it but when he came out again there was a nice new lamp which had materialised from somewhere. He made no enquiries but rode away and a week or so afterwards he was charged with stealing the lamp and was fined £2, together with 12s. costs.

Doncaster's Biggest

AT a meeting between officials of the South Yorkshire N.C.U. and Mr. Rupert Todd, manager of the Gaumont Cinema, Doncaster, arrangements have been made for holding Doncaster's biggest roller-racing competition. It is planned to hold the event on the stage of the Gaumont during the period from April 19 to April 23, and good support is expected.

In Business 37 Years

THE death has occurred at his home, 95, London Road, Boston, at the age of 62, of Mr. Frederick Victor Walker, for 37 years a cycle dealer in business in High Street, Boston. After serving an apprenticeship with a Lincoln cycle dealer he went to Boston in 1903 and later established the present business in High Street. Mr. Walker took a great interest in local activities until his health began to fail about twelve months before his death.

Quarter of a Century with J. A. Phillips

TWENTY-EIGHT employees of J. A. Phillips and Co., Ltd., of Smethwick, Birmingham, received gold wristlet watches in recognition of 25 years service with the firm at a dinner held in their honour on Monday, February 16.

Altogether, over 60 watches have been awarded since the firm's inception to employees with a quarter of a century's service. Thirty-eight of the previous watch-holders still work at Phillips', representing 1,100 years service between them. The male employee with the longest service is Mr. W. J. Underwood who has done over 49 years, while Miss G. A. Williams with 33 years is the longest serving female employee.

Around the Wheelworld

By ICARUS

Bidlake Memorial Plaque

MY congratulations to R. H. Harris on being awarded, by the Bidlake Memorial Trust, the Bidlake Memorial Plaque for 1947 for his victory in the Amateur Sprint Cycling Championship of the World at Paris on July 27th, 1947. Hitherto I have quarrelled with the decision of the Trust in awarding the Plaque for events or for reasons which I do not consider meritorious. I maintain that if nothing worthy of perpetuating Bidlake's memory has occurred during the year the Plaque should not be awarded for that year. To fish round and find some flimsy pretext for awarding it, such as for the invention of a split pin, is to besmirch the honour of those who have justifiably merited the award. Harris has certainly done that, and I shall be present to congratulate him in person long before the next issue appears.

Chiltern Road Club

J. W. GRIFFIN, 9, Lime Avenue, High Wycombe, is the secretary of the Chiltern Road Club, newly formed and affiliated to the British League of Racing Cyclists. Interested cyclists are asked to get into touch with him at that address.

Welsh Cycling Union

MR. J. P. THOMAS, secretary of the Rhos-on-Lea C.C., 15, Tan-Lan Road, Old Colwyn, N. Wales, would like to see a Welsh Cycling Union formed, which would enable Welsh riders to compete in the large programme of international events organised by the B.L.R.C.-S.C.U.-F.S.S.T. combination. At present the Rhos-on-Lea C.C. is the only body in Wales recognised by these progressive bodies. He appeals to all interested Welshmen to write to him with a view to furthering this project.

New Hudson Silver Arrow

AN attractive sports model has now been added to the New Hudson range. The 21in. or 23in. frame has double-taper seat and chainstays brazed-up, with cutaway lugs and forward drop-out fork-ends. The front fork is D to round with chromium-plated crown; wheels are 26in. by 1¼in. Endrick, with lightweight hubs. The handlebar is Continental pattern, chromium plated on adjustable stem, and brakes are side-pull caliper. Celluloid mudguards are fitted and the brake cables are silvered. The finish is attractive in carmine red with silver band on seat tube, and silver head. Price with fixed and free wheel (model G18), £13 14s. 5d. (including £2 11s. 11d. tax). Model G18D is fitted with B.S.A. 3-speed hub, and costs £15 11s. 6d. (including £2 18s. 9d. tax), and model G18T, with Cyclo gear, costs £15 17s. 7d. (including £3 0s. 1d. tax). A ladies' model, 21in. or 22in., is available with free wheel (model L16), or B.S.A. 3-speed hub (model L16D), at the same prices as the men's models.

Presentation to Arthur Whinnett

The high spot of the annual dinner of the Southern Road Records Association which was held at the Windsor Castle, Victoria, on February 19th, was a presentation to Arthur Whinnett for his valued services to the Association for 20 years. The chief guest of the evening was W. H. Townsend, secretary of the R.R.A. The presentation took the form of a small record Plaque of the Association, an inscribed testimonial and a cheque. The Plaque was inscribed with the S.R.R.A.'s thanks for devoted services. The President of the Association, J. Dudley Daymond, was in the chair.

The toast of the Association was proposed by W. H. Townsend, who paid fitting tribute to its work. The number of affiliated clubs, said Percy Hugget, the secretary, was now 42, nearly double the 1947 total. Present at the dinner were members of the Norwood Paragon, the Addiscombe, Kentish Wheelers, Vegetarian, Belle Vue, Polytechnic, Dulwich Hamlet, Catford, Balham, Kent Road, Redhill and Southern Road Cycling Clubs. I noted also Arthur Slade, Charles Lawton, Stan Butler, Alan Gordon, Monty Southall, Charlie Davy, W. G. Paul, J. Brereton Summers, Tommy Hall, E. Coles-Webb, H. H. England, R. B. Coley, Harry Miles, Frank Southall, S. Amey, W. Gibson, and J. H. Wallis. An excellent evening.

Reg. Harris, of the Manchester Wheelers, who has just been awarded the Bidlake Memorial Plaque for 1947.

W. S. Gilbert–Cyclist

IT is not generally known that W. S. Gilbert, who wrote the famous series of comic operas, came from a cycling family, and himself was a keen cyclist. So also was his wife. They even kept spare cycles in the house for the use of their friends, and all of the servants rode bicycles. He had a special stable for bicycles built in the grounds of his country house, Grim's Dyke, in the Harrow Weald. The *Birmingham Post* drew attention to this in a recent issue.

Southern Counties Cycling Union

THE list of road events has been altered slightly to the following :—

	Course
April 4th—25 miles, 1st class	G 2
April 11th—25 miles, Women	G 2
April 18th—25 miles, 2nd class	G 3
May 2nd—50 miles	G 7
June 13th—100 miles	G 9
July 18th—50 miles	G 7

The Duke of Windsor on Cycling

THE Duke of Windsor, in his memoirs, recently published in America and serialised in the *Sunday Express*, has the following to say on the subject of cycling:

"I learned about war chiefly on a bicycle. I was constantly back and forth between various headquarters, and although entitled to a staff car, I seldom used one within our area.

"The motor-cars of the brass-hats honked infantrymen off the road into ditches, splashed mud, and, even under the best of circumstances, were an irritating reminder of the relative comforts of staff life.

"My green Army bicycle was a heavy, cumbersome machine, which was tough to trundle through the mud.

"But on it I pedalled hundreds, even thousands, of miles collecting material for reports, inspecting camps, and meeting thousands of people.

"My brother officers laughed at me for preferring this hard way of getting around, but they missed the point. Just as had my first bicycle at Sandringham, my Army bicycle opened up for me an unexpected new world.

"Even now, after three decades, I still meet men who will suddenly say: 'The last time I saw you, you were on your bicycle on the road to Poperinghe,' or Montauban, or any one of a hundred French villages.

"I am amazed when I hear the young veterans of this last war talk so casually about global war, with its whirlwind sweeps and rushes across oceans and continents."

Thiefproof Cycles

MR. J. G. SIMPSON, of Durham, apropos my paragraph on thiefproof devices writes:

"Your remarks regarding thiefproof cycles prompts me to pen the following (but no claim is made that the problem is solved). The suggestions, suitably modified, may assist in reducing the number stolen.

"(1) 'Bulky' cycles are not easily 'taken away.' Locking the front wheel at full lock can make for 'bulkiness.' With the wheel locked in the ahead position only a little wrist-work is necessary to get through a crowd. A broadside wheel also attracts attention! Thieves don't like that.

"The above presents a parking problem, so as an alternative, how about a form of street stand, lockable in the 'stand' position, and for the sake of safety in the 'up' position. (It might fall during riding.)

"It would serve the same purpose because of its protruding at the side.

"(2) More trouble, this! '*This*' being an unattended indicator (again lockable and for increased safety of cycle inter-connected with the steering-head or other lock). Maybe a handlebar fixture, erectable and capable of being illuminated at night—something tubular, perhaps. Red being best avoided. It might be mistaken for a rear light.

"(3) One to be frowned upon, but here it is. More rules and regs.!

"On sale of a cycle the frame number, an additional number given by the manufacturer and the name and address of the buyer would be recorded by the agent (suitably approved, by the manufacturer) and also lodged with the police, latter also approving agents.

"Now in case of a stolen cycle the police would have something to work upon. Three things must tally. That is complicated enough.

"The 'gift' number and usual name, etc., would be carried by the cyclist when using machine and not fixed to the cycle.

"Changed frame numbers wouldn't tally with the police records.

"Used machines could be dealt with in the same way through suitably approved agents (or dealers, if you prefer that name).

"(4) This final suggestion is perhaps the simplest and most effective. Give all 'regular' cycle thieves one sentence—imprisonment. Some of the profits couldn't be set aside for that!"

G. H. S. and Brick Walls

G. H. S. is still at it. In a contemporary he says that there is no purpose in continually butting our heads against a brick wall. It is almost unnecessary to tell you that he is riding his hobby-horse and decrying massed-start racing. No one is knocking their heads against brick walls except G. H. S. His attitude is, as I have pointed out before, that he does not like massed-start racing, and therefore how *dare* you like it! In spite of what he writes the Government attitude towards massed-start racing, or at least its spoken opposition to it (subtle distinction), has been entirely inspired by the N.C.U. and the R.T.T.C., and by other critics.

The statement by Scotland Yard as long ago as June 22nd, 1922, to which he refers, has no relation whatever to massed-start racing. It referred to time trials and motoring events.

New Tyre for Cars

TO improve radio reception on motor-cars Fort Dunlop is at present experimenting with a new tyre, developed from one used by the R.A.F. during the war, which removes the static electricity generated by the movement between tyre tread and road surface.

Tyres Have Four Lives

CARBON black increases by 400 per cent. the resistance of tyre treads to wear, Dr. D. Parkinson, of Fort Dunlop's research department, told Birmingham University Chemical Engineering Society in a lecture on "Carbon Black in the Rubber Industry" recently. This, he said, was primarily a consequence of the exceedingly small size of the carbon particles which the electron microscope had shown to be of the order of one millionth of an inch in diameter. Next to rubber itself, carbon black was the most largely used material in the world's rubber industry, more than half a million tons being consumed annually.

All-time Cycle Record

THE number and value of British bicycles exported during 1947 set up an all-time record—1,449,662, bringing £10,040,338 to Britain, as against the previous record of 1,073,391 machines, bringing in £6,442,826 the year before.

Diamond Jubilee of the Pneumatic Tyre

(*Continued from page* 49)

tread. From the 2in. and 2½in. solids of 1871 to 1873, tyres gradually decreased in size as wheels increased in diameter, until a ¾in. tyre was considered the correct thing for racing, despite the fact that it ploughed into the grass on turf tracks and dug into cinder paths.

In 1888 the tyres in use may be summarised as follows:

The inflated or single tube in which there was one case to contain the air. This class included the tubeless tyres such as the Fleuss.

Cushion tyres either round or oval in form with a small hole central or eccentric, but not inflated.

Stuffed cushion tyres which had larger holes than the cushion tyres stuffed with some light substance such as felt or cork.

Solid rubber tyres, including tyres as used for carriages and having a small central hole for wiring on.

Spring tyres.

From small beginnings the Dunlop Rubber Company has developed to an enormous world-wide organisation, and it has achieved a remarkable transformation in tyre production and methods of manufacture. Famous names flash across the Dunlop stage—Zimmerman, G. P. Mills, J. W. Stocks, Dick Palmer, Harry Green, F. C. Armstrong, A. J. Wilson, Arthur Du Cros. . . .

Dunlop himself wrote the "History of the Pneumatic Tyre," and it was published after his death. Sir Arthur Du Cros has also written a fascinating book entitled the "Wheels of Fortune," which deals very fully with the history and development of the pneumatic tyre, of the early problems, the litigation, the competition, and the struggle to change popular beliefs in the solid tyres.

It was 60 years ago when Johnny Dunlop rode off in the moonlight on the first pneumatic tyres. Dunlop died on the 23rd October, 1921, and thus did not live to see the Jubilee or the Diamond Jubilee of his invention.

His daughter, however, Mrs. Jean McClintock, is still alive, and acts as an historical link between those days and the present. She is, indeed, an authority on Dunlop and his work, and we have been privileged to publish many articles in this journal from her pen.

Our regret is that paper shortage has prevented us from signalising in the manner we should have liked the Diamond Jubilee of one of the world's greatest inventions, and on lines comparable to that with which we spread ourselves in our issue dated July 20th, 1938, which remains a souvenir of the pneumatic tyre and a history of it.

PARAGRAMS

(*Continued from page* 50).

Under New Management

CHARLES GALLACHER, 36-years-old racing cyclist with a fine record in Scotland and the Midlands over the past 18 years, has taken over the post of team manager to the racing riders of Kettering Friendly Cycling Club. In 1939 he left the Lanarkshire Road Club and went south to Northamptonshire, but during the war he had little time for the sport, being too busy with other things. He will work on a voluntary basis and is planning a course of intensive training for track work and time trials with a view to club members competing in open events. His greatest achievement during his career was, he says, when he was 17 years old and came second in the National Scottish Cycling Championship, completing the 25-mile course in a snowstorm in 1 hr. 9 mins.

Pushed Bike!

WILLIAM LUSH, of Cicero, in Illinois, has built himself a box of tricks on wheels which he attaches to the rear of his cycle to push himself along. On a light framework on two small balloon-tyred wheels he has mounted a 1½ h.p. petrol engine which drives the wheels through a system of Vee-pulleys and belts, covered with an aluminium top for neatness. This engine-trailer is clamped to the frame of the cycle on either side of the rear wheel and can propel the cycle at a speed of 25 m.p.h. Clutch and throttle cables are taken to controls on the cycle handlebars. Mr. Lush has also used the unit for towing a lawn mower when he has not felt too energetic.

Big Business

WHEN three boys appeared at Peterborough Juvenile Court charged with cycle stealing, it was disclosed that they had gone into business in a big way. The ringleader, who was 16 years old, had arranged with his two 15-years-old "partners" to steal cycles which were left unattended, alter the cycles by changing round the accessories and repainting them, and enter them in local auctions under an assumed name. When they were caught the boys had already stolen six cycles valued at £48 10s. and were evidently working up what was, to them, a profitable business.

Making Good Progress

AT the dinner and prize-giving of the East Midlands Clarion Club, held at the Victory Hotel, Leicester, on February 5, it was stated that the past season was the most successful in the Club's history. Four Club members, R. Meadwell, R. Cassy, W. Pratt and R. Herbert are in the short list for the Olympic Games. The Club is anxious to have a cement track at Leicester, and one speaker commented that many riders do not know what it is like to race on a track until they are actually on the point of taking part in an important event. The Club now has a new award, the Whitworth Memorial Rose Bowl, which was won by Mr. and Mrs. Sid Mottram. Sid Mottram had been Club secretary for 14 years until his recent resignation.

Tudor Cycle Shop

MR. H. BERWICK, cycle dealer, of Sheaf Street, Daventry, has discovered during repair work at the premises in Sheaf Street, which he recently acquired for an extension of his business, certain building work dating from Tudor times. A beautiful carved oak staircase has been found hidden beneath many coats of paint, a number of oak beams came to light when matchboarding was stripped from the ceilings and four Tudor fireplaces were found to have been bricked up. The premises are some of the oldest in the town, although during the Victorian period an addition was made at the rear.

No More Punctures!

ONE of the exhibits at a recent Trade Fair in Paris was a substitute for bicycle tyres, consisting of a series of coiled steel springs attached to the rim. The springs formed a "tyre" about the size of the normal cycle tyre and it is claimed that they give easy riding and are long wearing. The shortage of cycle and other tyres has existed for a considerable time, it being quite usual to see a cycle offered for sale in a shop minus the tyres, and probably the new idea will become popular until tyres are more easily obtainable.

Midhurst
The main street of this lovely Sussex town

APEX 'SUPERLITE' CELLULOID PUMP

15 × ⅞" BLACK

Thick Celluloid Beautifully Polished

Light of Weight but of robust construction

'SUPERLITE' 15in. CELLULOID (with solid drawn brass plunger tube) each **5/-**

'LASTWEL' CELLULOID (with steel split plunger tube) 15in. each **4/6**

The World Famous

BAILEY'S 'SUPER' PUMP

15 × ⅞" BLACK

Steel Lined Celluloid Covered

Lining is Solid drawn cartridge fashion, the ends being solid with the barrel

Cannot warp nor leak.

BAILEY'S 'SUPER' (Steel lined and Celluloid covered) 15in. each **5/6**

BRASS PUMP, Nickel Plated or Black enamelled (with steel split plunger tube) each **4/-**

APEX PRODUCTS

Are in use in every Country in the world.

They are known and appreciated for their reliability, long service and efficiency in their job of inflating tyres.

Labour and materials are still very much restricted ; consequently supplies of pumps are scarce ! If you are lucky in owning an Apex Pump, treasure it.

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THE "FLUXITE QUINS" AT WORK

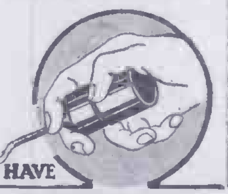
" Don't worry ! We'll soon be all right !
" I've borrowed this tin of FLUXITE."
Yelled EH, "You're a dud;
Our burst is a flood,
" And now we're afloat for the night."

For all SOLDERING work—you need FLUXITE—the paste flux—with which even dirty metals are soldered and "tinned." For the jointing of lead—without solder ; and the "running" of white metal bearings—without "tinning" the bearing. It is suitable for ALL METALS—excepting ALUMINIUM—and can be used with safety on ELECTRICAL and other sensitive apparatus.

With Fluxite joints can be "wiped" successfully that are impossible by any other method

Used for over 40 years in Government works and by leading engineers and manufacturers. Of all Ironmongers—in tins, 10d., 1/6 and 3/-.

● TO CYCLISTS! For stronger wheels that will remain round and true, here's a time-tested tip. Tie the spokes where they cross with fine wire AND SOLDER. It's simple—with FLUXITE—but IMPORTANT.



THE "FLUXITE" GUN puts "FLUXITE" where you want it by a simple pressure.
Price 1/6 or filled 2/6.

ALL MECHANICS *WILL* HAVE

FLUXITE

IT SIMPLIFIES *ALL* SOLDERING

Write for Book on the ART OF "SOFT" SOLDERING and for Leaflets on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE. Also on "WIPED JOINTS." Price 1d. Each.

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"No other tyre will really satisfy me now"

Rubber dipped insulated cord body with deep tread for long life and safe riding. Tubes are circular-moulded — tailor made to fit without wrinkling—rubber-base valve prevents air leaks.

Firestone

BEST TODAY ★ STILL BETTER TOMORROW

Wayside Thoughts

By F. J. URRY

Finchingfield, Essex.

A picturesque village of North Essex, with its pond and green, gabled houses and old church. . . .

The Cut!

THE ways are quiet again and the wartime loneliness of them is now greater, for the military traffic has almost disappeared. I am not glorying in this condition, but simply taking advantage of it, and—let me be candid—enjoying the changed circumstances of spring cycling. I am indeed sorry for many people who found a quiet pleasure in travel now robbed of that enjoyment, and because of their age and inactivity cannot take to the game you and I enjoy. To the active and the healthy, I say it is their own fault if they do not take to cycling, get and keep fit, improve their local knowledge, and wake up one morning to discover they are capable of eighty miles in a day and can enjoy the performance. A famous newspaper said the petrol ban hit the comparatively few and those who could best afford it. Like every general statement, that is not entirely true, simply because the car had brought amenities to many people who are too old to find delight in the exercise which cycling entails. These changed circumstances on the road will mean a very great increase in the use, and I hope the enjoyment, of cycling, and if only the story of the pastime could be told in temperate language by the folk who have long enjoyed it, and the trade could supply us with the best class of goods, I am certain the pastime would enter a novel condition of enthusiasm which has been too long restricted to the type known as club cyclists. Alas! the story is not told and the industry, by and large, is not in a position, apparently, to give us the goods we want and encourage those amongst us who love the game to tender advice on the way to play it and the kind of instrument with which to enjoy it. It is, of course, one of the austerity impositions that make for inhibition and keep us chained inside the circle of frustration. And there is another important hangover in thought that makes the erstwhile motorist buy cheaply when he takes to what, in his opinion, is the next best thing. His mind recollects bicycles at £3 19s. 9d., and he thinks £11 should still purchase the best or the near best. He has forgotten the rise in costs and the P.T., yet curiously enough he remembers both when the prices of new cars are discussed. I have met this tangle of values over and over again when mention has been made of a first-class mount—when obtainable—costing a figure in the region of £30.

The Values Remain

THE old prices have gone for ever, but not the old values. The best you can afford is still safe advice on bicycle purchase, where the value in the article is reflected in the ease of its running and its comfort accommodation. That fact is always worth remembering; yet how comparatively many folk fall for the seemingly similar article at a lower price. This oft-debated question is not one of salesmanship so much as of sense, for on analysis who would create for himself an unnecessary task for the purpose of saving a few pounds? Yet this error is often committed deliberately, and it is nearly certain to bring disappointment. Unfortunately, we do it in so many ways of life, seeking for the things that never existed when the worthwhile is so near to us that we fail to recognise it. I often think along these lines when on my evening jaunts, and am passed by people hurrying fiercely on their way, oblivious to the beauty of the closing day and the loveliness of a land preparing for sleep, bathed in the splendour of light with one bright star high in the zenith. Such moments—and they are many in a year—always remind me of Wordsworth's sonnet:

> " The world is too much with us, late and soon:
> Getting and spending we lay waste our powers;
> Little we see in Nature that is ours;
> We have given our hearts away; a sordid boon!"

And how true that is in a people that seem to hurry on and have no time to look. Actually, we are better beings if we save an hour or two a week for the quietude that makes our blessings a realisation, and rest awhile the driving spur of ambition. And I know nothing so efficient in the way of healthy contemplation than a couple of hours aboard a bicycle, when the familiar ways are etherealised under a sky radiant with the richness of sunset. Yes, there is more quiet joy in cycling on a good bicycle than can be given you in the racing game or the broader pleasures of club riding; and literally there are millions still to make this discovery.

Variable Joys

THAT, however, is only one phase of a greatly varied pastime. I have enjoyed and still enjoy the others, albeit the sternly strenuous exercises by proxy. Right at the end of last season I was out all day helping my younger friends in a 12 hours' ride, and it was a joy to meet so many of the old boys on the roads, inflamed with the spirit of the ancient days. But, alas! most of them were using up their last few gallons of petrol, and for the main part the bicycle was a memory—albeit a happy one—to them. I wonder if they will return to the old love and get reasonably fit now that the spirit that moves the horses is denied to them? From their point of view in the physical sense it might be a good thing; for it is true that the man who once rode a bicycle superbly knows how to "train on" and conserve his powers in order to enjoy them. The pity is he ever allowed them to lapse, that great error in neglect which has robbed thousands of men of a pleasure so physically splendid that I frequently wonder how such unwisdom became associated with the old racing man, the worst example in neglect of cycling continuance in any type of rider. And this question of help on big racing fixtures raises the many difficulties of organisation to be faced by club officials now that petrol has dried up. In these modern days racing men have been more dependent on car aid than they recognise, and the withdrawal of that useful carrier of helpers, and particularly of food and drink, will create a problem. In the old days when cars were not on the road, we used a pub or a cottage; food and drink was plentiful and cheap; but to-day the difficulties of provender are enormously multiplied, and the people of the pub or the cottage do not want you. It is a fact to be faced if the basic ration is missing from our scheme of life for the couple of years which some of my knowledgeable friends predict. Well, I shall go on along the lonelier roads, and I and my like will rejoice that we are still cyclists, happy in our freedom, and thankful, I hope, for our health and activity, and tolerant to the disappointed people who envy us.

Luck of Ownership

I HAD a new bicycle in May, luckily shod with Sprites, stainless rims, spokes, bar, and seat pillar, a large sofa-like saddle of hide, and a four-speed "gear" of the wide ratio type. I was touring with it within a few days of its home-coming, and since then it has covered just over 2,000 miles without a creak unless you count the rather comforting protest of the saddle when I put my weight on the cantle plate to ride up stiff slopes. But I must mention both the cable wires of the brakes shed their stops at the lever ends, a bit of careless work on the part of brake makers, the kind of thing that never should happen. It is a beautiful bicycle to ride, although its blackness calls forth the derision of my younger friends with their lustre-finished machines. I tell them, and it is true, that in a year or so my mount will look respectable still when theirs is wearing the shabbiness of a couple of winters. Still, that is all a question of personal preference; I like 'em black, with a decade of decent appearance to please me along the road. My normal gear is the usual 60in., very comfortable for pottering around up to 12 miles an hour; but I have a 74in. when I feel frisky and the wind is fresh and my way. Also, I can go as low as 40in., to trundle which is a good deal easier than walking when a long slope needs climbing. Yes, it is a beautiful bicycle, easy steering with its 68 deg. angles, easy riding and comfortable to the postured fellow in the saddle. It is the first I hope of several to come home when their makers can give me the small elegances I desire, for not counting this May-time purchase, all my bicycles are of pre-war vintage except one, and are showing signs of their years of service. At this moment I am riding a 13 years-old model on which I must have travelled 30,000 miles, and I am delighted with its running qualities, and, indeed, its general up-to-dateness except in the matter of enamel. That machine has only needed a new chain-wheel and rear sprocket, and a pair of new pedals, beyond, of course, many tyres and brake blocks. The rims, pre-war Italian Fiume alloy, have stood up remarkably; I would have expected them to wear through on the brake paths, as other alloy rims in my possession have done, but they look good enough for thousands of miles yet. For the moment I am keeping the new bicycle for special journeys because the tyres are sound, and this cannot be said for most of my mounts, nor will it be possible to repair that fault until I can buy good open-sided tyres, not in ones or twos, but in half dozen pairs. My tyres are such rags and patches that the like of them I have not seen since I was 18, with that delightful age's impecuniosity.

The Quiet Way

THE pleasant anticipation of a quiet night ride makes me forget the dull days of work, and the still worse ones when the hum and rattle of the machinery has ceased during those times when the works are idle for lack of power. But the clack of the typewriter dots dismal thoughts with capital I's and dominant full-points. Then I go out into the darkened night and in half an hour leave the line of frustrated lamps along the last suburban street and move silently and more contentedly under the stars between the black hedge-rows. Only a few lorries meet or overtake me, a pool of white floodlight, a growing and dwindling roar, and again I am almost the sole occupant of the road. Who would have thought so great a change as this could happen to our hard hammered roads in peacetime? Yet here it is, and the winter night prowler has time to look and listen, to muse and remember as he passes over familiar ways he has known since his years entered into double figures. They are grand hours, these quiet rides home over the long route, and I am lucky to be so situated that I can enjoy them and count the blessings cycling has given me. Usually I prefer company on my excursions, the chatter and change of words, the coinage of the mind, but on these occasions it is very pleasant to feel self-sufficient, to see the orange glow of a bedroom window where children are preparing for rest and to hear a couple of old owls hold a one note conversation with each other across the meadows. They are a refreshment, and I wish many more people could taste of their goodness, for the essence from which they derive is the quiet activity of cycling.

Dunlop's Annual Donation

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My Point of View

By "WAYFARER"

On the edge of the Plain—Erlestoke, looking towards Lavington.

Not To Be Answered

THE writer of an open-air article in one of the daily newspapers recently inquired whether there was a nobler prospect of sea and mountain, south of Skye, than the view one gets from a boat midway between Port Meirion and Borth-y-gest, North Wales. There is no answer to such a question; nor, I imagine, was any answer expected. It is beyond the wit of poor feeble man to say which is the best view anywhere, so much depending on circumstances over which there is no control—and also on the mood of the onlooker.

I have never seen the view which is the subject of this unanswerable inquiry, though I have gazed at the scene in amazement, from many land points, and I therefore turn to "The Cruise of the 'Nona,'" by Hilaire Belloc, for something in the nature of confirmation of what is implicit in the question. This is what Belloc says: "Therefore did we lie thus in Harlech Bay, gazing at the great hills of Wales. There is no corner of Europe that I know, not even the splendid amphitheatre standing in tiers of high Alpine walls around Udine, which so moves me with the awe and majesty of great things as does this mass of northern Welsh mountains seen from this corner of their silent sea."

Those "Drear" Days

IF it had been suggested to me during my early cycling career that the time would come when a ride of 70-odd miles on a "drear" day in December would be commonplace, I am sure that surprise would have been registered. And yet that unspoken prophecy has come to pass! At the time of which I speak it was my habit—and the habit of many other cyclists—to have done with cycling at the end of September, the pastime to be resumed in the following spring. This is hardly the occasion to dwell on the supreme folly of such a course (still practised by a small selection of wheel-folk), with the cutting out of one of the best months of the year from the open-air standpoint; and, whatever may be said in support of the policy of refraining from active cycling when the conditions are really difficult, October is essentially a grand month for "the living out of doors." A good October can be very good indeed; indeed, magnificent. That is by the way. For many years now I have looked upon every month as a cycling month, maintaining that our pastime is just as good in February as in May—just as thrilling in November as in July. That is the voice of experience.

On an early Sunday last December—"drear" December—I set forth for my usual jaunt, which, in the event, totted up to 73 miles. It was certainly a forbidding morning, with a definite threat of fog. But, after a while, I rode in splendid sunshine, which put paid to the opaque atmosphere and touched the glowing countryside into life. The low temperature suggested the desirability of steady movement in order that personal warmth might be maintained. So, in pleasant conditions, lunch and tea went by, and lamps were lighted for the evening run home, this part of the day's programme being shared with two companions. Nearly half of the final stage of the ride had been accomplished when, without a word of warning, we found ourselves enveloped in a thick fog—and not a valley fog, either, for we had just topped a line of hills when this change occurred. With white blankets hanging in front of our noses, flop went our pace, and we moved cautiously forward and downward in a world of silence. It must be admitted that I harbour no kindly feelings towards fog, which always makes it difficult for one to ride fast enough to keep warm, and which (in my case) tends to produce a headache. But the nettle had to be grasped; where fog is concerned there is no "escape clause." On the main road a mile below the ridge, ghostly traffic, in small quantities, was moving gingerly onward. We joined in the procession, finding, to our joy, a gradual thinning of the fog. So our pace quickened, and our day's journey was completed in something like normal time.

A far better day—again in "drear" December—occurred a fortnight later, yielding me 76 miles. The joys of the afternoon transcended those of the morning and evening, and our little party of three paused time and again to look over a lovely countryside to those distant hills we know so well. What beauty; what colouring! "The soul of winter!" ejaculated the schoolmaster, as we lingered at one point, grateful to the farmer who, having cut down his hedge, had provided us with an opportunity for such grand views. The scene was indeed an enchanting one, the layers of grey clouds in the sky being beautified with streaks of salmon-pink, and the rolling land telling out part of its endless story. It was a picture of great inspiration, something to take away with us, in the storehouse of the mind, for use on future occasions when, owing to the exigencies of work, these rural scenes were not quite so near at hand.

Thus we went on our way, preferring a roundabout route to the direct road. Night closed down upon us, but not before we had been favoured with a second joyous glimpse of the distant hills (in another direction); and rather belatedly—an hour after lighting-up time—we came to the cottage of our choice, there to be welcomed by a grand fire and a first class tea. And so home—in the cool of the evening! A week later—the last Sunday of the year—I partook of "the mixture as before" with a total of 72 miles. Not bad for three Sundays in "drear" December!

Supporting Evidence

IT may be fitting, at this juncture, to summarise a letter which appeared in *The Times* immediately following compilation of the preceding paragraphs. Actually, the letter was written (by a Glasgow lady) to complain of the alleged inaccuracy of the official weather forecasts, and it gave a fine picture of Saturday, December 20th ("drear" December again!)—"a day (she said) of such exquisite loveliness that people noticeably took a more optimistic view of the world in general and Britain in particular." The dawn, she heard, was remarkably beautiful. As to the dusk, of which she was an observer: "Imagine the semi-circle of the sky from east to west; the east already in grey-blue darkness with high in the heavens a silver half-moon set in a hazy gold aureole. From this point westwards a dome of turquoise was suffused in an after-sunset light ranging from coral to deep orange, in which light clouds, some rosy, one dark indigo, were suspended. And the air soft and calm." And the connection between this glorious picture and our pastime? Well, here is one of the rewards for cycling in the "drear" month of December—a reward piled on top of all the other advantages which accrue from active participation in the road-game of road-games, whatever the time of the year or the day (or night), and whether for short journeys or long. Further, when Easter approaches, we who practise cycling as well as preach it will find an additional reward—for we shall be ready for the longer jaunts which the first holiday of the year presents to us.

The Contrary Way

USUALLY at this time of the year I provide myself with two front lamps—a gas lamp for the serious evening journey and an electric battery lamp for the brief period before tea when darkness is falling. This latter avoids my having to "wet the carbide," which it is not worth while to do for an odd half-hour in the dusk. But how contrary these battery lamps can be! It so happened that, on the last Saturday in 1947, my gas lamp refused to operate properly, whereupon, a mile or two from home, I turned off the water, blew out the feeble light, and switched on the electric lamp. At least, I went through the motions of switching it on, but the battery had run down and there was no response. So I had to revert to the gas lamp and put up with the miserable glim it was providing. Next morning I set forth for my usual day's journey and a passer-by called my attention to the fact that my battery lamp was functioning. The contrary way! I switched off, and at the first opportunity I bought a new battery, being tired of this humbug.

That night the gas lamp let me down again (trouble now diagnosed) and I had to revert to the battery lamp. A broken reed! Owing to a faulty contact there were no results and it was necessary for me to relight the carbide. The resultant light was so dim that at one point a policeman was constrained to cry aloud (twice), "Hey!" indicating, I fancy, that he desired to converse with me. I suddenly became deaf in both ears, and there was a marked increase in my speed. Later on I was able to borrow an electric lamp and thus returned to the status of a law-abiding citizen. With the aid of a meat skewer my erring battery lamp was brought to heel, and it is hoped that there will be no more trouble. But these batteries are indeed contrary things . . . . my rear lamp battery excepted. That, at the moment, is behaving marvellously.

Unrivalled Pictures

THERE are those who think that I hold a prejudice against that type of entertainment which people, with sublime effrontery, speak of as "the pictures." Not for worlds would I desire to deprive the public of their right to think just what they fancy with regard to myself and my views, but let it be said, in a thoroughly forthright manner, that my prejudice (if any) is directed at those who make a fetish of going with habitual regularity and frequency to "the pictures" (with their occasional concomitant of a chewing-gum atmosphere and a torrent of gangster English), while completely neglecting the beauty and the majesty which reside all around them—the undying loveliness of our countryside, with its variegated colour scheme, its moors and woods and rivers and valleys and lakes and high hills, and with its ever fascinating network of roads and lanes wandering hither and thither. To my way of thinking, those are the pictures which are worth patronising, day by day and week by week, as opportunity offers.

Having thrown that off my chest, I et me now frankly admit that during 1947 I went to "the pictures" twice. The attraction of "the pictures" was the scenery, and the scenery alone. A friend who was holiday-making in the Isle of Skye while "The Brothers" was being created ("shot," I fancy, is the term to use) wondered to me "what sort of a mess they would make of it." I went and saw, but am not in the least degree competent to express an opinion on the technique of the film. Later on the possibility of looking at some Irish scenery sent me post-haste on a visit to "Captain Boycott." Each of these films provided me with snippets—and nothing but snippets—of lovely (indeed, adorable) scenery, whetting my appetite for more and more of the real thing. My complaint against the cinema is that what it presents to the public lacks continuity and endurance, and I am bound to say that my preference is for still pictures.

In this latter connection I recall a little controversy which raged a few years ago as to the relative merits of static and moving pictures as regards cycling lectures. I voted—perhaps rather vehemently (as is occasionally my wont)—for the "out-of-date" magic lantern. My vote still goes in the same direction, and is all the firmer now because the opportunity for seeing "the pictures" has been multiplied many times over, and because it is a change and a relief—to put the thing on no higher plane—to be able to view still pictures, without dithering or clamour. Moreover, after some 25 years of lecturing for cyclists and others, I find that the product of the well-named magic lantern is still received with complete acceptance by my audiences whether of the wheeling or the walking variety.

Yet, when all is said and done, we must return to the basic fact that the best pictures of all—the unrivalled pictures—are those which we travellers obtain during our journeyings; and those pictures are all the more appreciated when they are earned by "the sweat of the brow."

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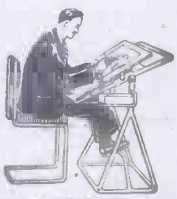

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