

engine, and consequently during that corresponding to the taking of the diagram, the pulley revolves and carries along the drum. In the back stroke the pin, 8, slides over the notches of the pulley hub, and the cord winds around the pulley under the action of the spring.

It is necessary to place the apparatus in such a direction that the cord shall run at right angles with the shaft, 6, and that, having unwound, it shall again make two or three turns upon the pulley, 2. The spring should therefore have a tension just sufficient to wind the cord around the pulley. An excess of power would strain it uselessly.

Before taking a diagram, it is well to give the drum an initial movement forward, in order that at the end of the back stroke the stop, 4, of its spiral spring may not come into contact with the tappet (Fig. 2). In this way, a shock prejudicial to the apparatus is avoided, and the spring preserves a constant initial tension. To this effect, the operator with one hand turns the milled head, A, which is mounted loosely at the top of the axis of the drum and is provided underneath it with a pin that carries along another fixed to the drum itself. Then, with the other hand, the operator presses upon the head, 1. The throwing into gear having been effected, he allows the drum to follow the impulsion that is communicated to it mechanically.

The drum may be stopped instantaneously at any moment and the paper be removed from it. It suffices to pull upon the button, 1, in order to throw the pulley out of gear and cause the unwinding of the paper in turning the head, A, of the top. During this maneuver the pulley, 2, continues to revolve independently of the drum.

In Figs. 2 to 3 may be seen some of the details of the arrangement that permits of operating with a single hand for giving the necessary advance to the drum and for throwing the mechanism into gear. Upon the external face of the ring, 7, is screwed the ratchet, r, and opposite, but upon the milled head, 1, loose in the ring, is fixed the click, c. A spring, s, situated behind the head, 1, tends constantly to disengage the click and consequently to maintain an independence between the ring and the milled head.

For operating, we begin by exerting a slight pressure with the finger upon the click, c, which engages with the ratchet, r. Then, while preventing the coupling box, 7, from advancing, we revolve the head, 1, so as to give the drum the requisite initial advance. It then only remains to throw the mechanism into gear by giving the coupling box, 7, a slight push. At the moment at which the pin, 8, engages with the pulley 2, the click, c, becomes disengaged by reason of the rotary motion given the ratchet, r, and of the inclination of the latter's teeth.—*Revue Industrielle*.

AN IMPROVED FIELD GLASS.

THE accompanying illustrations represent a collapsible field and opera glass invented by Mr. Aitchinson, of Fleet Street, London. The spiral tubes are

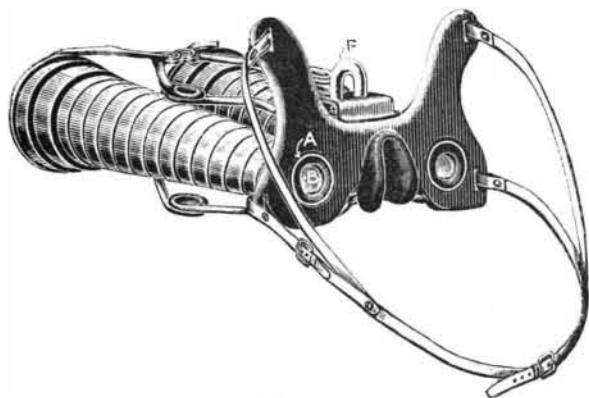


FIG. 3.

telescopic, and when closed up they occupy a very small space and may be readily slipped into the pocket. The inventor has also provided a separate attachment for the use of officers or others who have use for such glasses in the field, by means of which the glasses may be attached for permanent use, leaving both hands free for making notes or other purposes. The glasses, being made of aluminum, are extremely light. By fitting them with a special nose piece and a head strap,

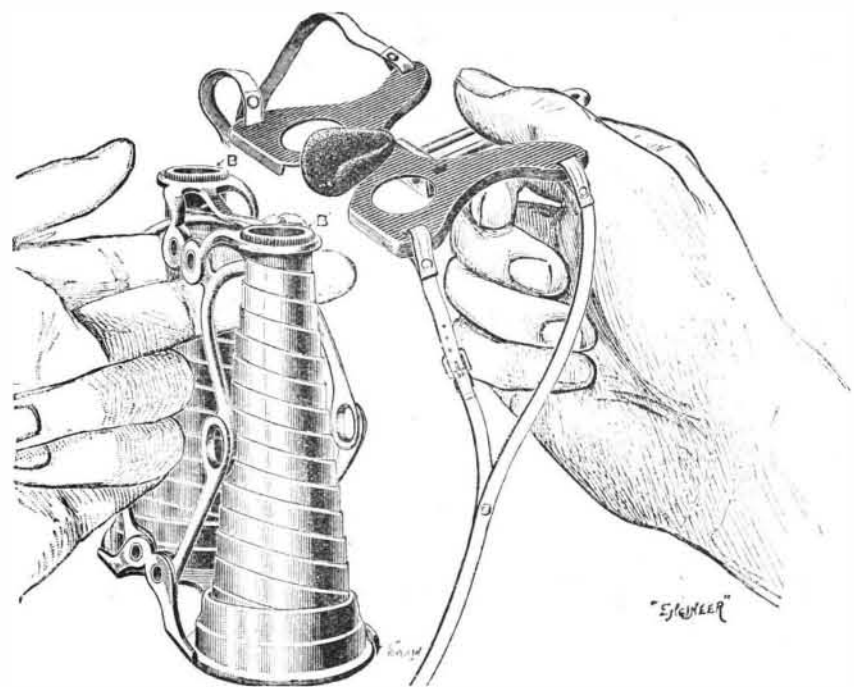


FIG. 1.

AN IMPROVED FIELD GLASS.

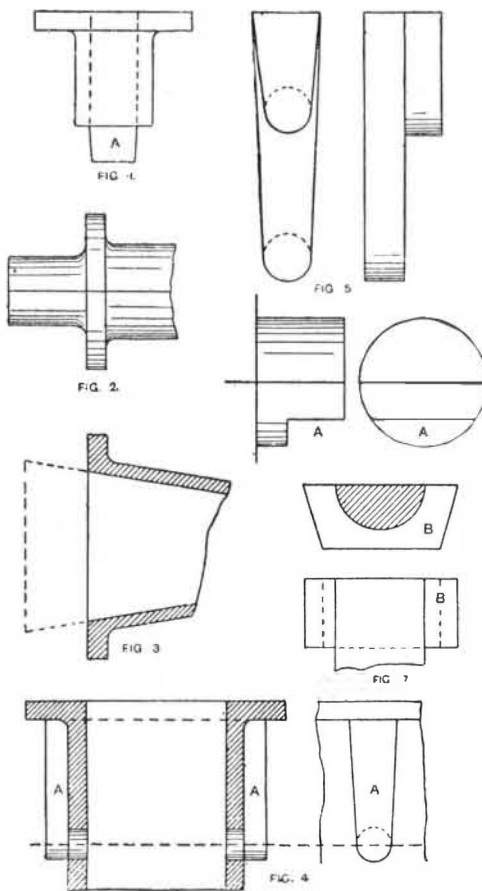
they may be worn as easily as a pair of spectacles, leaving both hands free.

Fig. 1 shows the method of attaching the nose piece, which is effected by slipping the plate on the eye pieces at B B, and then pushing in the staple-shaped key, F, in Fig. 3. The operation does not take four seconds. The straps are placed round the head and the glasses are then worn as shown in the diagram, Fig. 2. It is quite easy, while keeping the glasses in place, to see under them for the purpose of writing or sketching. The arrangement seems likely to be very useful to war correspondents at rifle ranges, and, in fact, under all circumstances where it is necessary to make observations and take notes at the same time. We are indebted to the London Engineer for the cuts.

CORE PRINTS.

By HERBERT AUGHTIE, in the Practical Engineer.

WHENEVER the internal parts of a casting have to be formed in the mould by means of sand cores, it is usually necessary to form seatings for the latter by

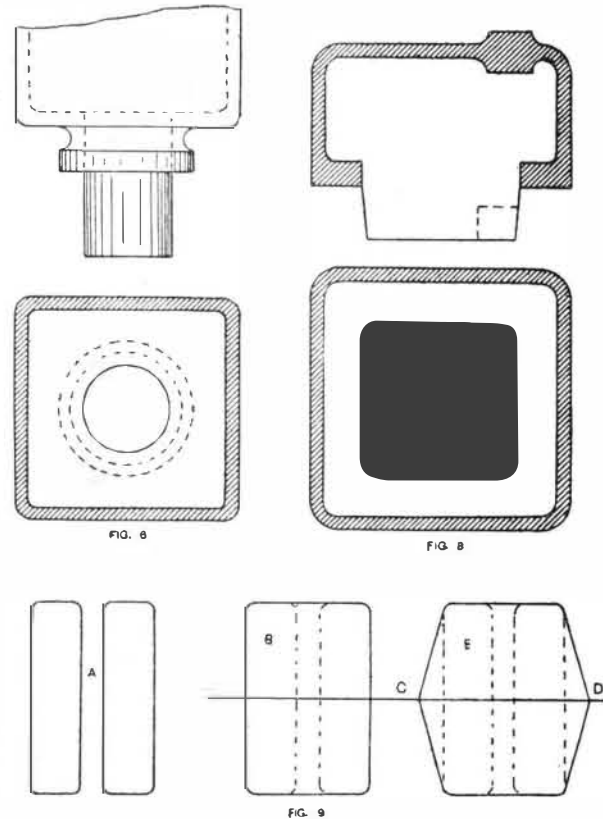


attaching core prints to the pattern. In Fig. 1 the lower part, A, is the core print on the pattern of a gland. It is circular in section and slightly tapering. When the pattern is withdrawn from the sand the depression it leaves serves to carry the circular core which forms the hole through the gland. If the depth of the pattern is not great, the core may be trusted to keep its position without a print at the top, but if the pouring of the metal is likely to disturb its position, another print is attached to the top of the pattern. Top prints differ materially from bottom prints, being very much shorter, and with a greater amount of taper. This is so because the top part of the mould has to be lowered upon it, and the shape described will render the core much less likely to be crushed or the mould broken than if it resembled the bottom print. If a core has considerable diameter and relatively small length—say, for instance, 12 in. by 12 in.—it is not only sufficient to have but one print, but that one may be of very small depth, say $\frac{1}{2}$ in. or $\frac{3}{4}$ in., for it is clear that the core will be able to stand firmly on its own base, the chief function of the print being to define the position of the core. In some cases no prints at all are used, the cores being set by rule or gage strips. In the case of Fig. 1,

the depth of the print is necessary to enable the core to maintain its position, as, even if a top print is used, it is not available until the mould is closed.

Fig. 2 shows one of the prints, A, of a flanged pipe, which is moulded horizontally. These are made parallel, and if they are slightly bell shaped (as B) where they join the pattern, an effect is produced similar to that of "finning" the joints of moulds. It simply insures that when the mould is closed there will be no pressure upon the weak edges of the mould, which would be likely to break them down. Sometimes (when by so doing work may be saved in making the core box) the print of a casting of tapering section may be made, as in the dotted lines of Fig. 3, to continue the taper of the hollow. Such a pattern would, of course, be drawn from the sand in a direction parallel to the plane of the flange.

If cores have to be inserted which do not lie in the plane of the joint, and cannot be inserted in the body of the mould, they may frequently be put in by the aid of a "drop" print. In Fig. 4 is shown a flanged box of rectangular section, in which circular holes, B, B, are required. The pattern is supposed to leave its own (main) core or "cod" in the green sand. Two flat circular cores, B, B, may be made, equal in thickness of metal, and pushed into place by a wooden



template, there to be retained by friction. This way would require no prints at all, but a far better method is to attach prints shaped like A, A. Into the impressions left in the sand may be placed cores which not only form the holes, but also fill up the cavities in the mould external to the form of the casting; or small cylinders of sand may be laid in the bottom, and the rest of the space filled up with green sand; this is prevented from falling into the mould by holding a small flat piece of wood in the space left by the pattern. Should two or more holes be required to be made in this way, the prints may be adapted (as in Fig. 5), by putting them in tiers; but the more holes there are the more desirable it is to make a core box to fill up the entire space, as not only will one plain print then be sufficient, but the time of the moulder is saved, and greater accuracy is attained.

In Fig. 6 is shown a pattern of a rectangular chamber having circular openings. If drawn from the sand in a line perpendicular to the plane of the section, the core may be carried by circular print impressions, and adjusted to give an even thickness of metal in the rectangular part by means of gage strips. To save the time taken in doing this, a flat surface parallel to the joint of the mould may be cut on the bottom of one of the prints for part of its length, as A, Fig. 7, or (and this is a much better method if the print be not of large size) the necessary flat surface may be formed by attaching a supplementary piece to the print (B, Fig. 7).

In Fig. 8 is shown a case in which a pattern is moulded with the core vertical, in which, although the shape of the print (here square with rounded corners) automatically regulates the thickness of metal, it is necessary to place the core in one of four possible positions, for in the present instance the internal eccentric boss would not match its external counterpart if placed in either of the three other ones. This end is secured by cutting away one corner of the print, as shown in the dotted lines. The corresponding corner of the core box made of course, have the part cut off fastened within it.

Although, generally speaking, the shape of the core represents the shape of the opening in the casting, yet there are some cases in which an advantage is secured by making them otherwise. Let Fig. 9 represent two openings made by separate cores, very near each other, in the face of a casting. If two prints are made, a very narrow and weak partition of sand, A, remains between the spaces left in the mould, and the integrity of which is not only threatened when the pattern is withdrawn, but again when the cores are placed. A much better plan is to fix one print (as B), in which case the two cores butt together, each being extended into the print space in order to fill it up.

For the same reason that the top prints of circular cores are considerably tapered (viz., to enable the mould to be closed without damage), the print, B, may with advantage be still further varied from the shape of the opening if the joint of the mould happens to come (as is likely) in the line, C D.

At E this is shown, and consists in tapering the print



FIG. 2.

away from the joint, forming four triangular extensions of the print space, which are filled up as before by making the core box to correspond. It is important that all prints should be plainly marked before the patterns are sent into the foundry by coloring them so that they contrast in appearance to the pattern itself, otherwise there is a danger than the moulder may treat them in some cases as bosses of metal. Although "checks" and other devices for adjustment, etc., are not always strictly necessary, yet the advantages of saving the moulder's time when a pattern has many castings made from it, and the lessening of his liability to error, will generally make it worth while to adopt them in the pattern shop.

[Continued from SUPPLEMENT, No. 1084, page 17331.]

ALTERNATE CURRENT TRANSFORMERS.*

By Dr. J. A. FLEMING, F.R.S.

LECTURE I. (Continued.)

THIS leads to the conclusion that in testing a high tension alternator for efficiency, it is quite sufficient to load up the machine on water resistance to measure the current going out of the machine as ordinarily measured on an alternating current ammeter, to measure the difference of potentials at the terminals of the machine, as measured on an alternating current voltmeter, and to multiply the values of the two readings together, and thus obtain the true power in watts being given out by the machine on the water load. There is no question of difference of phase in this case. If, however, the alternator is working upon an inductive load, such as a number of transformers lightly loaded, then the current curve lags behind the electro-

motive force curve, and it will be noticed how very different in form are those three curves. Generally speaking, in a machine like the Morley alternator with a very small armature reaction, there is very little change in the form of the electromotive force curve with the nature and amount of the load on the alternator, but in the

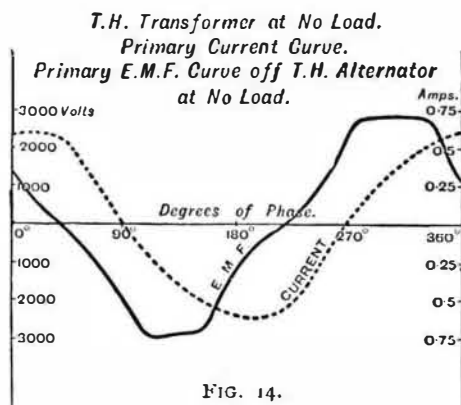


FIG. 14.

case of a machine like the Thomson-Houston or Westinghouse alternator with a large armature reaction there is a very considerable change in the form of the electromotive force curve which changes in the amount and nature of the load. In the above cases the forms of the electromotive force curves have been set out graphically in what are called wave diagrams, in which the horizontal ordinates represent time and the vertical ordinates represent the magnitude of the quantity,

Current and part of E.M.F. Curves of an A.20 Morley Alternator on Night Load of about 72 Amperes.

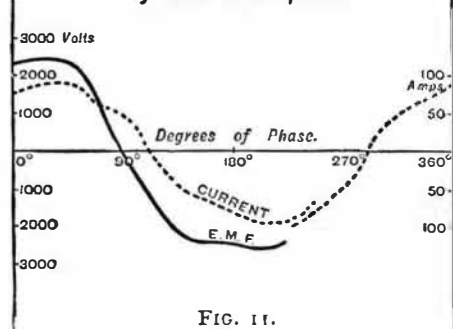


FIG. 11.

motive force curve by a definite amount at the zero value. This is shown in curves Figs. 11, 12 and 13, giving respectively the electromotive force and current curves of a Morley alternator and a Thomson-Houston alternator working on transformers lightly loaded. It will be seen that the difference of phase between the current and electromotive force curves is different at different parts of the curve; in the case of the Thomson-Houston alternator there is no difference of phase between the maximum values of the current and electromotive force, but a considerable difference between

E.M.F. and Current Curves of an A.20 Morley Alternator on Night Load of 70 Amperes.

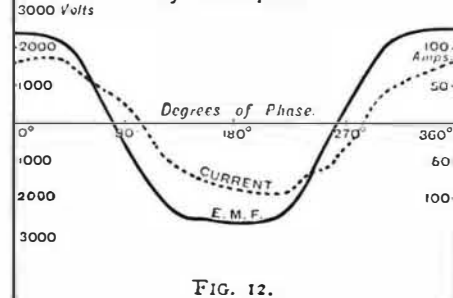


FIG. 12.

the zero values. In the diagram of the Thomson-Houston alternator the position of the field poles is shown by the square rectangles, which, therefore, indicate the manner in which the electromotive force curve is related to the field poles in the machine. It must not be supposed that the form of the current curve or of the electromotive force curve is a fixed attribute of the alternator; that is to say, we cannot speak of the electromotive force curve of an alternator as if it were something unchangeable and peculiar to that machine. It often largely depends upon the nature of the load.

E.M.F. and Current Curve of a T.H. Alternator on Night Load of 72 Amperes.

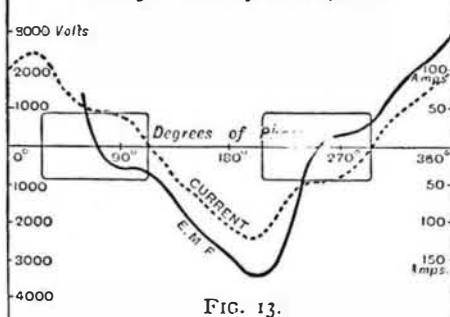


FIG. 13.

Thus, for instance, in Fig. 14 is shown the form of the electromotive force curve of a Thomson-Houston alternator when very lightly loaded, and in Fig. 15 is shown the electromotive force curve of the same machine when loaded on a non-inductive resistance to a fair proportion of its full load; while, on referring to Fig. 13, we see the form of the electromotive force curve of the same machine when working on an induc-

E.M.F. and part of Current Curves of T.H. Alternator on single Water Resistance Load of 70 Amperes.

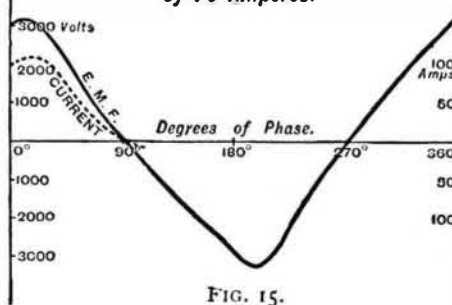


FIG. 15.

which is varying, whether electromotive force or current. For some purposes this method is not so convenient as that of setting out the curves in the form of polar diagrams.

The differences between these two methods—graphically delineated a periodic quantity—are shown in Figs. 16 and 17. In Fig. 16 part of the curve of the electromotive force of a Thomson-Houston alternator

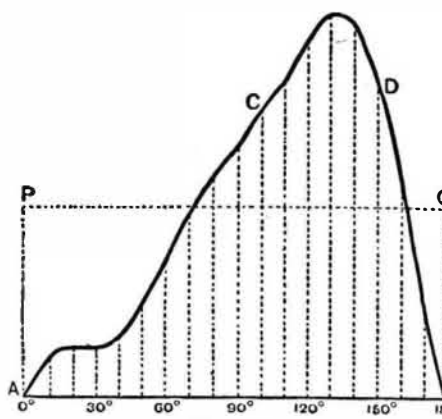


FIG. 16.

on an inductive load is shown. In Fig. 17 the same quantity is delineated in a polar curve. Instead of drawing vertical ordinates at equal distances to represent the instantaneous values of electromotive force, radii are drawn from a point, O, at equal angular intervals, the magnitudes of which are respectively proportional to the instantaneous values of the periodic quantity. A curve, BCD, is thus obtained, which is called a polar curve. It has this interesting property that if we find the area of the polar curve and describe a semicircle on a line, PQ, passing through the pole, O, the area of which is equal to the area included by the polar curve, BCD, it can easily be shown that the

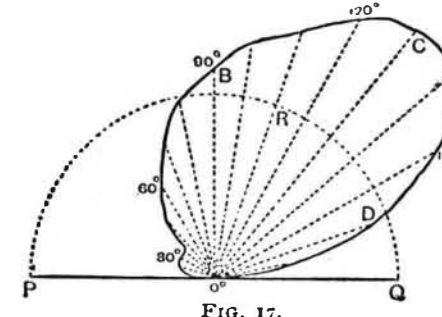


FIG. 17.

radius of this semicircle represents the square root of the mean of the squares of all the radii of the polar curve. This quantity is now generally called the R. M. S. value, or the root mean square value of the periodic quantity. By some writers it has been called the effective or virtual value. Ordinary alternating current ammeters and voltmeters give, as is well known, the R. M. S. value of the periodic quantity they are measuring.

Returning to Fig. 16, if we construct a rectangle,

A PQB, equal in area to the area included by the wave curve, ACDB, then it is easily seen that the height of this rectangle, namely, AP, represents the true mean value of the periodic quantity represented by the ordinates of the wave curve. In the case of any periodic quantity, such as a periodic electromotive force or current graphically delineated, it is found convenient to have a term to denote the ratio between the true mean value of the curve ordinate and the root mean square value, and this is called the form factor of the curve.* Having thus seen the manner in which we can experimentally determine the form of an electromotive force or current curve which represents the different instantaneous values of a periodic electromotive force or current, we can now proceed to discuss the manner in which these methods have been applied in the study of the alternate current transformer. Let us first suppose that the transformer to be studied is a constant potential transformer, having two windings, a primary and a secondary coil, both wound round an iron core forming a completely closed iron magnetic

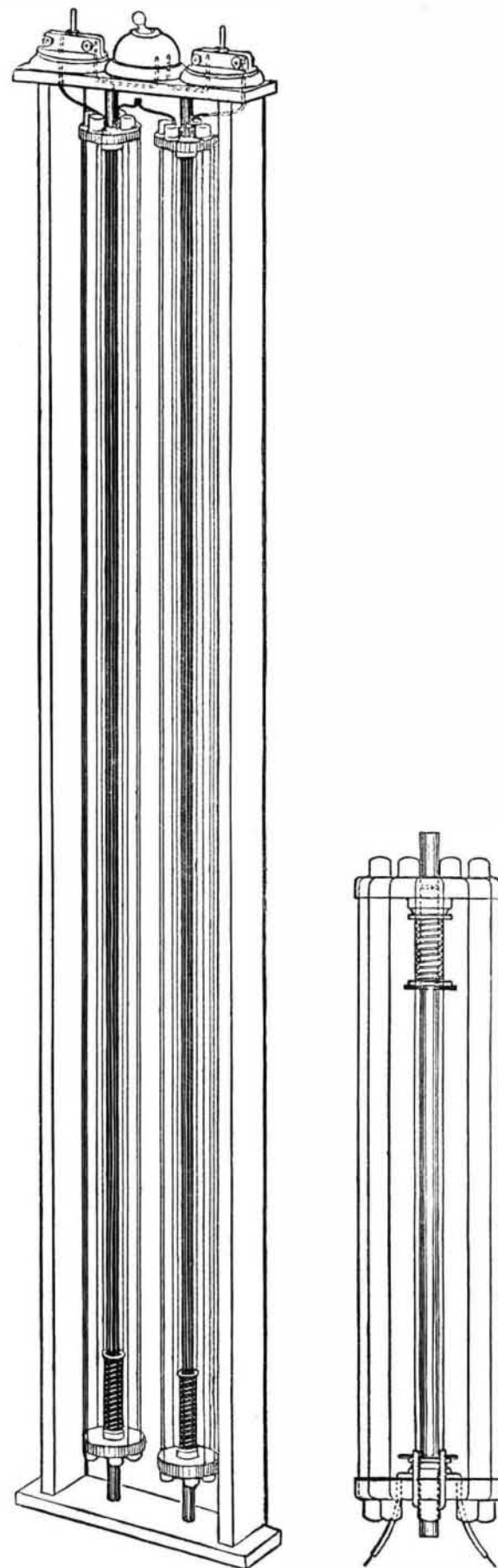


FIG. 18.—NON-INDUCTIVE RESISTANCES.

circuit. Let the primary coil be joined up through a non-inductive resistance, R^1 , as shown in Fig. 2, with a circuit of constant potentials, and let the contact breaker above described, denoted by C, and the electrostatic voltmeter, V, be applied to determine the form of the current curve flowing into the primary coil, P, of the transformer. In order to delineate the form of the curve of primary potential difference, it is necessary to put across the primary terminals of the transformer a non-inductive resistance, R^2 , which is divided in a definite ratio, so that by measuring a fraction, say $\frac{1}{n}$ of the whole difference of potentials between the terminals of the primary circuit of the transformer, we

* For further information on this point, see "The Alternate Current Transformer," Fleming, vol. i (new edition), p. 583, published by "The Electrician" Printing and Publishing Company, 7 Salisbury Court, Fleet Street, E. C.

* Lecture before the Society of Arts. - From the Journal of the Society.