LIPPMANN'S APPARATUS FOR ELECTRIC MEASUREMENTS.

Measurement of the intensity of electric currents is daily becoming an affair of more and more importance. Although there exists a large number of apparatus designed for this purpose, very few of them present all the qualities that are required for their practical employment. Most of these apparatus are based upon purely galvanometric actions. The type of the genus is the well known apparatus of Marcel Deprez, in which a soft iron needle is placed in the intense magnetic field formed by the two branches of a U-shaped magnet. The current to be measured traverses a bobbin and de-

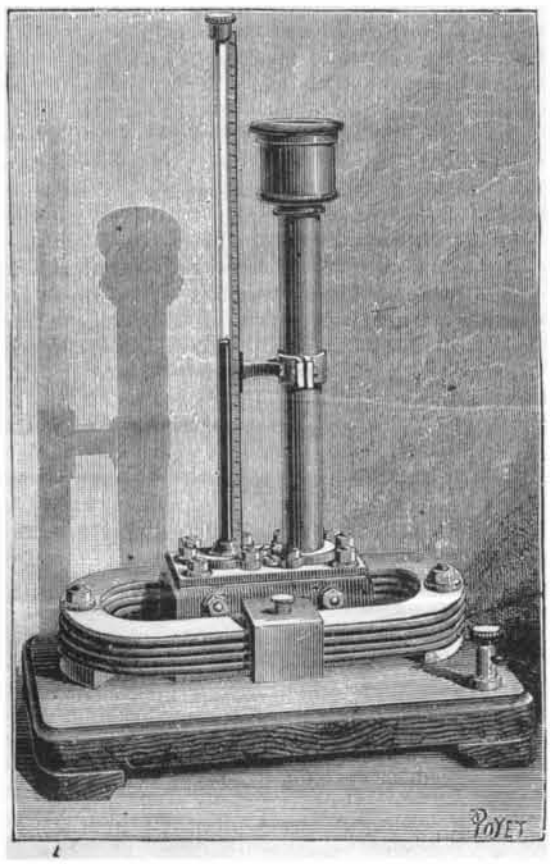


Fig. 1.—LIPPMANN'S AMPEREMETER.

velops a inagnetic field whose lines of force are directed at right angles with those of the magnet.

Under the action of these two fields the needle assumes an intermediate position that depends upon the intensity of the magnet's magnetization and the form of its polar pieces, upon the form and dimensions of the needle, upon the form, dimensions, and number of coils of the bobbins, and upon the intensity of the current.

There is, then, *a priori*, no simple relation between the deflections and the corresponding intensities, and it is only by artifices of construction that we succeed in obtaining a perceptible proportionality between these upon a certain fraction of the scale. In reality, each apparatus requires a particular graduation and a determination of a certain number of points, whence are deduced the rest through interpolation.

Lippmann's galvanometers, or amperemeters, present the peculiarity that their indications are indefinitely proportional on the entire length of the scale, and that it is only necessary to know the indication furnished by a given intensity in order to at once deduce therefrom all the rest.

The new principle applied by Mr. Lippmann in his apparatus consists in balancing the electro-magnetic action of the current to be measured by a hydrostatic stress which, at every instant, is proportional to the intensity of the current. It suffices to know one in order to at once know the other.

Fig. 1 gives a general view of Mr. Lippmann's amperemeter, and Figs. 2 and 3 are sections that will permit its principle and mode of operating to be understood.

A mercurial pressure gauge, A B C (Fig. 2), is placed between the branches of a permanent magnet in such a way that the two poles are on each side of the horizontal leg of the gauge. Pieces of iron, with ends in the form of truncated cones, serve as armatures to the magnets, and permit of concentrating the field at B, so as to render it as intense as possible at this point.

The current to be measured is led to the mercury from the horizontal leg of the gauge, and traverses it vertically. It comes in through the strip of platinum, D, and makes its exit through the second strip, E.

That portion of the mercurial column which is traversed by the current represents a movable current element, which, placed in the magnetic field constituted by the magnets, K, tends to move toward the right or the left. The stress exerted upon this current element is proportional to its intensity, and it therefore produces a hydrostatic action, which exhibits itself in a change of level of the mercury, which latter rises in one of the legs of the gauge until the hydrostatic pressure balances the electro-magnetic stress.

The theory of the apparatus shows that its sensitiveness is proportional to the intensity of the field, and inversely proportional to the thickness of the column of mercury. It is in order to obtain great sensitiveness that the chamber, B, is very thin and that the field is concentrated at this point by polar appendages of conical form.

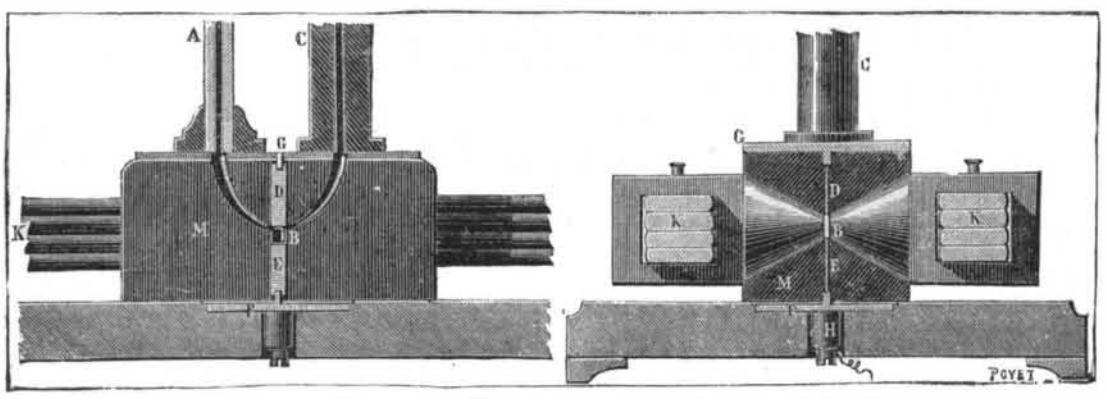
In order that the reading of differences in level may be dispensed with, there is arranged upon one of the legs a reservoir of wide surface in such a way that the level in this leg shall remain constant, whatever be the change in the other leg, which is of glass of small section. The constant level leg is given a certain height in order that all the readings may be made, whatever be the direction of the current. In practice, it is convenient to so arrange the magnets that a current ascending in the horizontal leg of the gauge shall produce an ascent of the mercury in the glass leg, and a descending current produce a depression of the mercury's level.

When still greater sensitiveness is desired, it suffices to incline the glass tube slightly, when a slight change of level will produce considerable of a movement in the column of mercury. Mr. Lippmann's amperemeter is aperiodic, in that it reaches its position of equilibrium slowly, and stops there without going beyond it. And it is reversible, too; that is to say, if the mercury be set in motion by means of an external mechanical force, and the two strips, D and E, be united by a circuit, the latter will be traversed by a continuous circuit that will last as long as the flow of the mercury does.

It is a true unipolar machine, that might perhaps some day be applied either as a mechanical generator of electricity, which should give little electro-motive force, but considerable intensity, on account of its feeble internal resistance, or as a standard of constant electro-motive force, in assuring of a constant flow, and a constant magnetic field that the unipolar machine would itself produce.

The principle of this apparatus has been applied by its inventor to several other apparatus, and, in particular, to an electro-dynamometer and a wattmeter, which figured at the Exhibition of Electricity at the Observatory last March, in the interesting collection of measures presented by Breguet. In the electro-dynamometer, a bobbin traversed by the current to be measured is substituted for the permanent magnet. Under such circumstances the magnetic field is no longer constant, but is proportional to the intensity. The result is that the changes of level in the mercury are proportional to the square of the intensity.

In the wattmeter a long, very fine-wired, and resistant bobbin is substituted for the coarse wire one, and is placed between those two points of the circuit at which it is desired to measure the expenditure of electric energy, while the mercury is, as usual, placed in the total circuit traversed by the current of intensity,



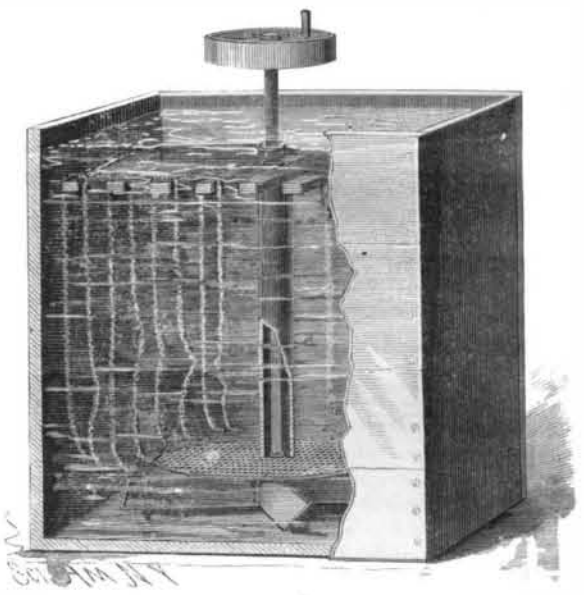
Figs. 2 and 3.—LONGITUDINAL AND TRANSVERSE SECTIONS.

I. The fine wire bobbin, mounted in derived circuit, produces a magnetic field that is at every instant proportional to the difference of potential, E, of the two points where it is fixed. The changes of level in the mercury are consequently proportional at every instant to the product, E I; that is to say, proportional at every instant to the number of watts expended in the part of the circuit considered.

Aside from the originality of the principle of Mr. Lippmann's apparatus, they all present the valuable feature of furnishing indications which are accurately proportional to the extents to be measured, and this obliges us to use them in a large number of cases in which we could not rely upon measuring by points, a method in which so many causes of error intervene to destroy accuracy.—*E. Hospitalier, in La Nature.*

IMPROVED LIMING VAT.

The accompanying engraving shows a vat in which hides may be evenly, thoroughly, and quickly limed, so that the hair can be easily and rapidly removed, and without damage to the hides by too long exposure in the liming liquid. The hides are hung from a rack formed of bars fitted across the tank. In the center of the middle rack timber is fitted the end of a tube which hangs nearly to the bottom of the tank, and has on its lower end a screen frame made of wire netting or wooden slats. In this timber and in a step bearing at the bottom of the tank is journaled an upright shaft, which passes inside of the tube and is rotated by means of a crank or pulley. Upon the lower end of the shaft, beneath the screen, are radial arms or paddles made with inclined blades, so as to induce



JOHNSTONBAUGH'S IMPROVED LIMING VAT.

strong upward currents in the liquid when the shaft is revolved, thus carrying the lime particles tending to settle at the bottom of the vat upward into contact with every part of each hide hung from the rack. Attached to the shaft at a point a little below the surface of the liquid is a paddle, which prevents the accumulation of lime at the surface and the undue settling of lime upon the hides at the rack. The screen frame prevents the shanks and tails of the hides from catching in the lower stirrer, and the tube prevents the entanglement of the hides with the shaft.

This invention has been patented by Mr. Thomas Johnstonbaugh, of Clearfield, Pa.

Meaning of Colors in Sealing Wax.

The language of flowers is supposed to be known by every educated person, at least those capable of blushing. But who knows the language of the colors in sealing wax? We are indebted to the Philadelphia *Times* for the following information: "Flirtations in sealing wax are the latest racket," said a stationer. "The ordinary red wax signifies business, and is supposed to be used only for business letters. Black is, of course, used for mourning and condolence. Blue means love, and as we make four or five tints of this color, each stage of the tender passion can be accurately portrayed. When pink is used, congratulation is intended. An invitation to a wedding or other festivity is sealed with white wax. Variegated colors are supposed to show conflicting emotions. Do you know that thimbles are being utilized to bear seals? Fact. The designs of that sort are mild just now, but are developing. We'll work the idea up, and think it will become fashionable. The odors used in the wax are ravishing in their delicacy—that is, the expensive sort. The cheaper grades are as bad as the pomatum of a five cent barber shop. The perfumery is the element of cost in the wax. A Paris firm makes the finest imported article. The perfume of burning wax fills an ordinary sized apartment, and lingers about the envelope for hours.

Sky Rocket Torpedo.

Recent experiments with an improved torpedo at the Washington Navy Yard, says a special from that city, have resulted in the attainment of a velocity of 100 feet in 10 seconds, the line of firing being almost perfectly straight across a current of over two knots an hour. This torpedo is discharged out of a tube, and is propelled by a rocket composition which is held in an iron tube sixteen inches in diameter and forty-two inches long. The explosive charge is so arranged as to be detached upon contact, and shot forward and downward for explosion underneath the armor of a vessel.