alone is effective in producing the first movements of the armature. The latter in moving away from the pole momentarily separates the hammer at the end of the lever from the buttress or rigid obstacle. This repulsion is succeeded by the attraction of the armature caused by the following current, and the armature is then pulled back to its original position, and tends to pass beyond this position by reason of the attraction and its own *vis viva* or momentum, but is stopped in this direction by the rigid piece or obstacle against which the hammer strikes. The intensity of the blow or shock consequently results from the combined effect of these two actions, and is in direct ratio to the electro-magnetic forces which produce the repulsion and attraction of the armature. The number of shocks is equal to the number of electrical charges produced in the telephonic circuit.--*Engineering.*

PILES AND ACCUMULATORS AT THE MUNICH EXHIBITION OF ELECTRICITY.

PILES designed for general application were slimly represented at the Munich Exhibition, and the majority of those that were exhibited formed part of electro medical apparatus.

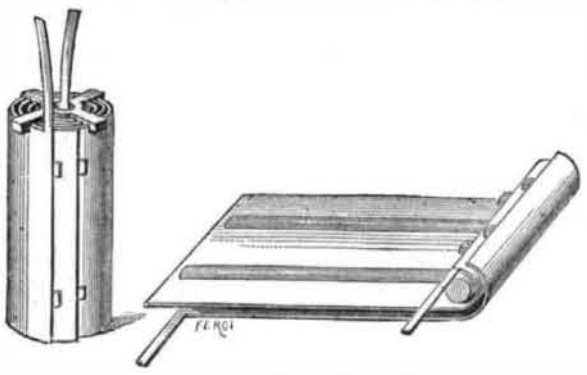


FIG. 1.

We may cite, however, the well known bichromate pile that accompanied the Griscom motor, the plunging piles of Fein, of Stuttgart, and a lime pile, of the Gandini system, exhibited by the Societa Industriale Franco-Italiana of Milan. This last named apparatus, whose elements are inclosed in varnished sheet-tin vessels, is not practical. Various houses likewise exhibited Leclanche elements or parts of

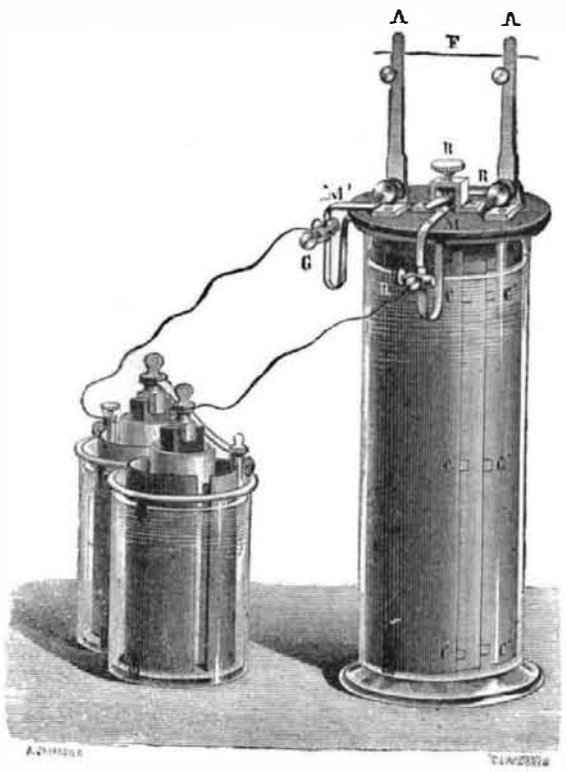


FIG. 2.—PLANTE'S SECONDARY PILE.

such. Mr. J. Bendl exhibited different kinds of carbons, the house of Gerzabeck & Co. presented carbons in plates and prisms for Bunsen, Leclanché, and Stoehrer piles. Dr. Lessing exhibited Hipp's manganese briquette and carbon and manganese cylinder elements, and Mr. Minner had on exhibition crystallized and crushed manganese for Leclanché elements.

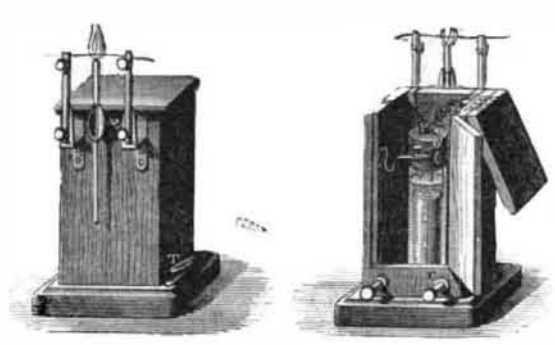


FIG. 3.—PLANTE'S ELECTRIC LIGHTER.

But if this section of piles, properly so called, presented nothing peculiar, it was not so with the secondary ones, or accumulators. The principal known types of such apparatus were represented, and, in addition thereto, some others were shown that had not before made their appearance.

Among the former it is proper to mention, in the first place, Mr. Planté's secondary piles. This gentleman exhibited a group of apparatus and pictures which formed, so to speak, a resume of his labors. First, there was his insulated element formed of two leaden plates rolled together, with bands of rubber to separate them (Figs. 1 and 2), and immersed in a vessel of acidulated water. Two Bunsen elements (Fig. 2) are sufficient for charging this element and covering one of its plates with peroxide of lead, while the other remains in a free metallic state. It was these insulated elements that Mr. Planté first made use of and put to a certain number of applications. For example, the model shown in Fig. 2 was arranged by him for exhibiting, during courses of lectures, the incandescence of a platinum wire under the

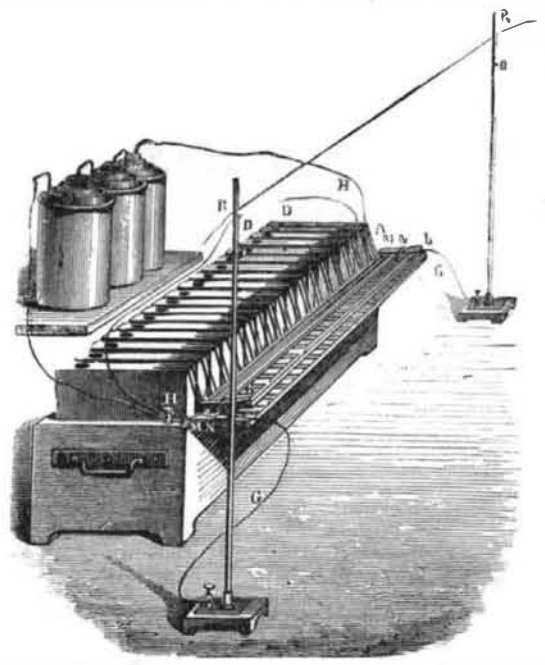


FIG 4.--PLANTE'S COUPLE IN BATTERY FORM.

influence of a powerful current. The two small Bunsen elements, which of themselves would have been incapable of producing such incandescence in the wire employed, were capable of effecting it through the intermedium of the secondary pile. The same type of element is the one which, slightly modified a little later on, has become the base of Mr. Trouve's polyscope.

Another application of his insulated pile that was made by Mr. Planté was the "Briquet de Saturne"—a small lighter shown in Fig. 3. Here a small mahogany box supports in front a small aluminum candle, and above this there is held between two binding screws a platinum wire.

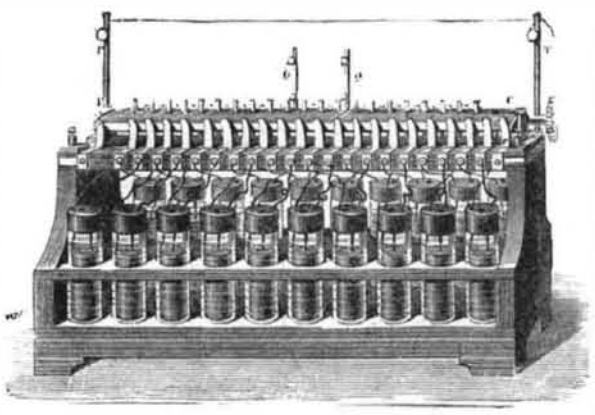


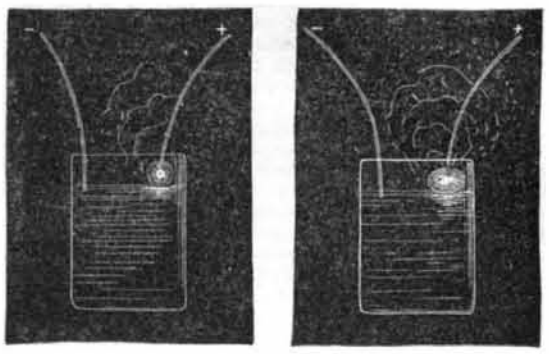
FIG. 5.—PLANTE'S COUPLE IN BATTERY FORM.

The box contains a secondary pile which is kept charged through the contact of its two terminals, C, with a Daniell pile of three elements. When the spring, T, is pressed, a current is caused to pass into the platinum wire, and the incandescence that is produced lights the candle.

Although the Planté couple of itself afforded material for but few applications, it presented especial interest in the form of a battery. In this shape, all the elements could, in the first place, be associated in quantity and charged with a pile of feeble tension—with two Bunsen elements, for example; and, then, their grouping being changed, they could be reunited in series for the discharge, in such a way as to have at one's disposal for a few instants a source of very great tension.

The first arrangement employed by Mr. Plante for this purpose is shown in Fig. 4. The couples, forty in number, were aranged in rectangular troughs.

Each of the leaden plates terminated, through its prolongation, at a strip of copper whose extremities carried springs,



FIGS. 7 AND 8.

which were capable of being pressed either by metallic bars, MM', NN', or by an insulating bar, BB', whose under side was of metal. These bars were connected together in such a way as to form a frame which could be tilted. In the position shown in the figure, all the springs of the plates belonging to every other row are pressed by the rod, MM', and all the springs of the other rows by the rod, NN'. The couples are thus united in quantity. When the insulating bar is depressed, its metallic parts unite the springs in tension, and consequently the corresponding couples also.

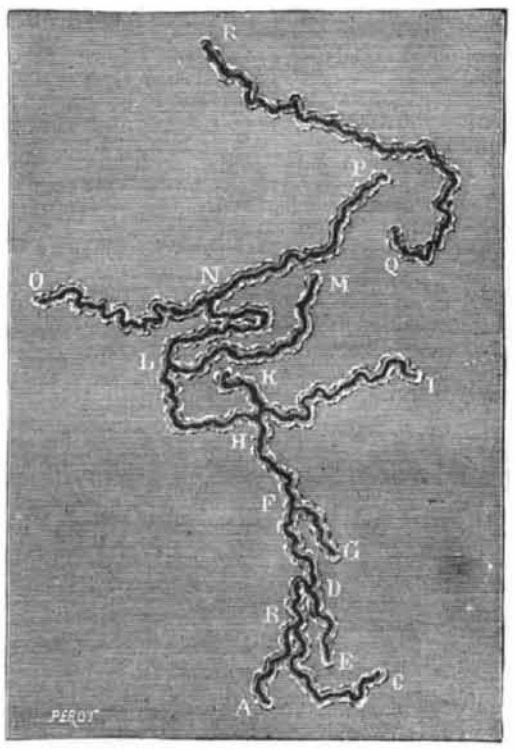


FIG. 9.

This arrangement was soon replaced by the one shown in Fig. 5. Here the couples are arranged in two rows, and above them there is a wooden bar that carries two rows of vertical springs. All the poles of the same name are connected with one of these rows, and all those of contrary name with the other. An insulating bar, CC', that carries a metallic one on each side, connects all these springs in quantity for the charge. If it be turned 90°, it presents to the springs a series of pins that connect them in pairs and

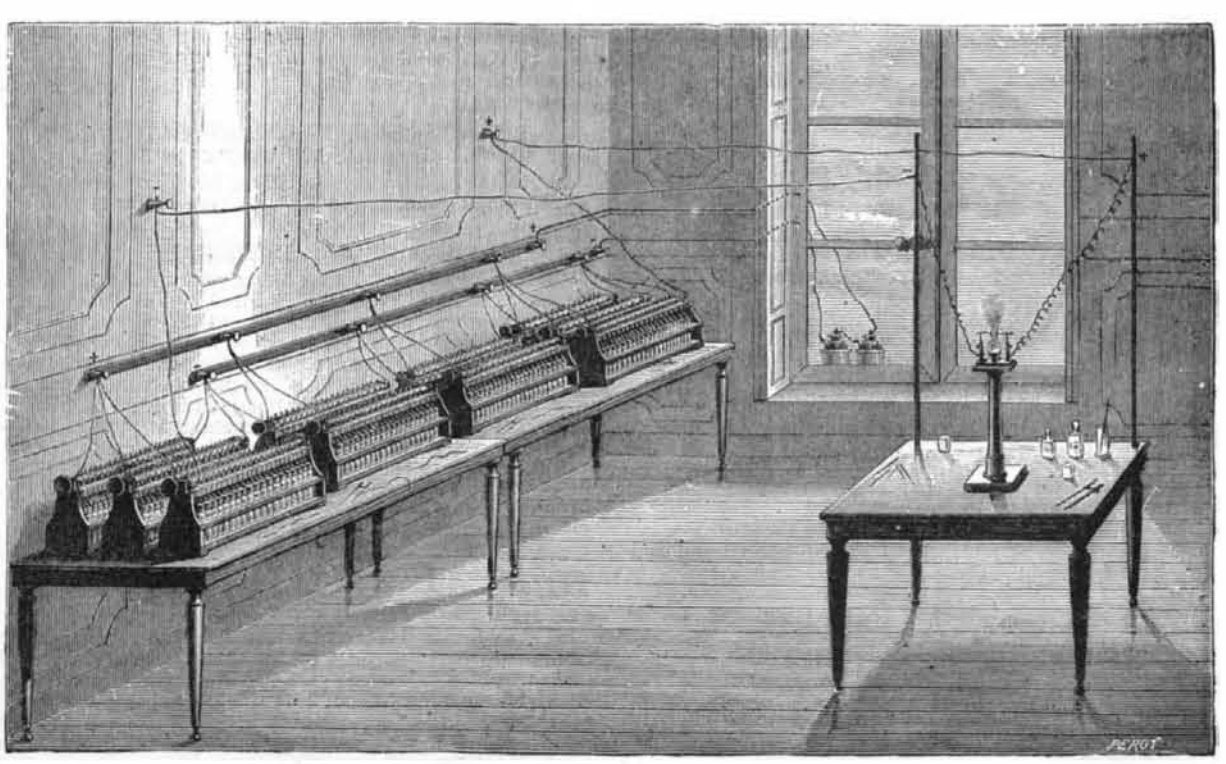


FIG. 6.—PLANTE'S BATTERIES UNITED FOR EXPERIMENTAL PURPOSES.

unite the elements in tension. It requires a few hours to charge an apparatus that has been already formed.

With these batteries, Mr. Plante in starting with a charge of two Bunsen elements, was enabled to produce effects that usually require a powerful current source. He succeeded, for example, in producing an arc electric light for

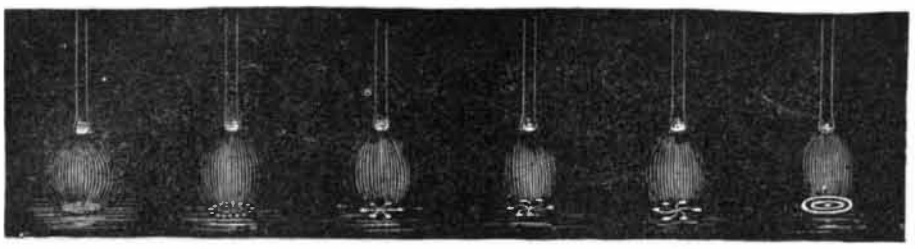


FIG. 10

a few instants, and in raising a very long platinum wire to incandescence, etc. But it was especially by uniting together, as shown in Fig. 6, several of these batteries so as to raise the number of elements to 200, 400, 600, and 800, that he was enabled to obtain remarkable effects and study those peculiar phenomena that are due to currents of high tension. His battery had even the advantage that while it produced a high tension it did not have a great resistance.

With his apparatus he found it possible, with an acidulated water and platinum wire galvanometer, to observe that

FIG. 11

luminous sheath that surrounds the magnetic electrode when the current is sufficiently powerful (40 secondary elements).

With 200 couples he was enabled to produce what appeared like globular lightning. If, into a salt or acidulated water voltameter, we first plunge the positive electrode, and then bring the negative one near to the surface, we will obtain sparks at its extremity; but, if we plunge the negative electrode first, the positive one will give rise to

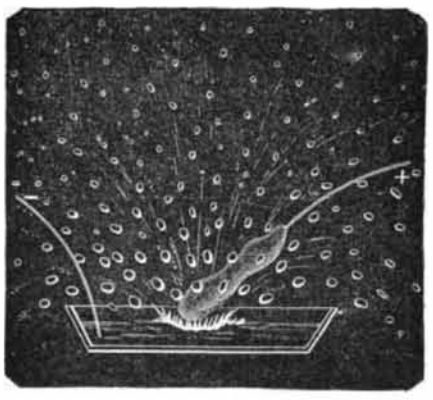


FIG. 12.

a luminous globule of vaporized matter (Fig. 7) which soon takes on a gyratory motion and assumes a flattened form (Fig. 8). This phenomenon is accompanied with a sound that appears to proceed from successive condensations of the material.

With distilled water and 800 couples, when the positive electrode is plunged in in advance, the negative one gives rise to a yellow flame which, by a little separation, becomes converted into an ovoid globule. The sparks that are then produced on the surface of the water give rise to the different effects that are shown in Fig. 10.

FIG. 13.

An experiment that gives effects that still further simulate ball lightning as we observe it in nature may also be performed with the 800 couples, in using a mica condenser for charging. If the sheet of mica presents a small point, it becomes pierced at that spot like a too highly charged Leyden jar, and the spark will be observed to persist in the form of a globule, which, melting the tin, plows up the surface of the plate as shown in Fig. 9.

When 400 couples, instead of 200, are employed along with a salt or acidulated water galvanometer, the phenomenon changes, and instead of a globule we obtain a spray of globules as shown in Fig. 11. This phenomenon is again produced when the extremity of the positive pole is surrounded with bibulous paper soaked in salt water (Fig. 12). But, when the quantity of salt water in the voltameter is small, it becomes heated, and the globules are replaced by a disengagement of steam (Fig. 13). We may also cite the electric "Mascaret" (Fig. 14), a sort of wave obtained by resting the positive electrode against the edge of a vessel of water, while the liquid is in communication with the negative pole.

With a current from about 300 couples, if the positive electrode is a Wollaston one, and we introduce it into the liquid as shown in Fig. 15, the glass and platinum will be observed to melt in the center of the mass and give out a bright light.

This vitreous light can also be produced by resting the positive wire against a plate of glass a little above the surface of the liquid (Fig. 16); and, finally, an analogous phenomenon may be obtained with quartz (Fig. 17).

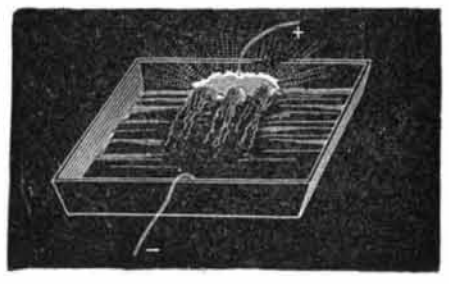


FIG. 14.

Upon putting the negative electrode into the liquid, and placing the positive against the moist sides of the vessel, we obtain, according to the electrode's position, one of the several phenomena shown in Figs. 18, 19, and 20, that is to say, a luminous crown, an arc edged with brilliant rays, or a sinuous line having a rapid undulatory motion.

Another experiment that Mr. Plante has classed among

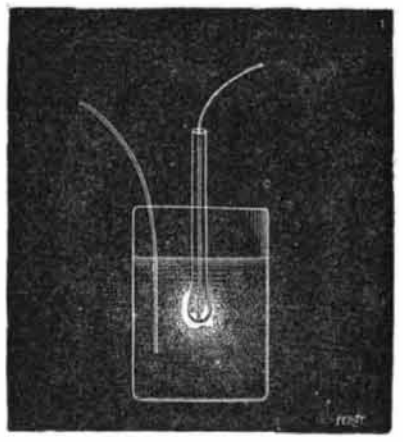


FIG. 15.

the effects of high tension, although it may be performed with ten or twenty couples, is the following:

When the liquid in the voltameter is acidulated water, and the positive electrode is of copper, for such tension of current, the seat of oxidation is at the extremity of the wire, and the latter makes a hissing noise and gives rise to a prolonged jet of oxygen. If the vessel be placed over an electro-

FIG. 16.

magnet, the cloud of oxygen will be seen to take on a gyratory motion (Fig. 21), and the oxide that is carried along on the other pole will move in an opposite direction.

Such are the principal phenomena which have been obtained by Mr. Plante by means of his powerful apparatus, and which have served as a basis for the very ingenious views that he has put forth upon analogous atmospheric ones, and which have led him to a few applications.

Thus, for instance, he has devised a process of electric engraving upon glass, utilizing for this purpose those corrosions that occur in the phenomenon of vitreous light. The plate to be engraved (Fig. 22) is placed in a pan, and the positive wire is run along its edge. The negative wire, inclosed in a glass tude, is moved by hand through a thin stratum of a concentrated solution of nitrate of potash. A lumi-

FIG. 17.

nous furrow follows the course of the wire, and the glass is at the same time engraved. But one of the finest applications that Mr. Plante has made of his apparatus is their use for charging his rheostatic machine. The secondary battery

FIG. 18.

transforms the work of the voltaic pile in such a way as to give temporary effects of quantity or tension that are much superior to those from any given pile. The object of the rheostatic machine is to transform the work of the pile in

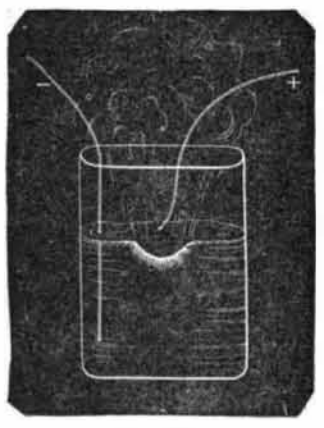


FIG. 19.

such a way as to have a tension comparable with that of static machines. This apparatus (Fig. 23) resembles a secondary battery in its arrangement, save that the elements are here replaced by mica and tin condensers, and that a winch permits of revolving the commutator that unites them now in tension and now in quantity. The two extreme poles have the form of an exciter.

The apparatus is connected with 600 or 800 secondary elements that charge the condensers in quantity. Then, the

FIG. 20.

commutator being revolved, the pile becomes excluded and the condensers are discharged in tension. The effects are then analogous to those of a very powerful static machine.

It will be seen from this to what extent Mr. Plante has carried a scientific study of his apparatus. This latter has even begun to enter into practice in connection with Achard's electric brakes and various electro-medical apparatus.

Mr. Faure has endeavored to render it better adapted for the industries by replacing the natural formation by an arti-

ficial one. Mr. De Kabath and others have done the same. The piles of these two inventors were represented at Munich by a single specimen only.

In addition to apparatus already known, we have to call attention to those of Messrs. Schulze & Boettcher. Fig. 25

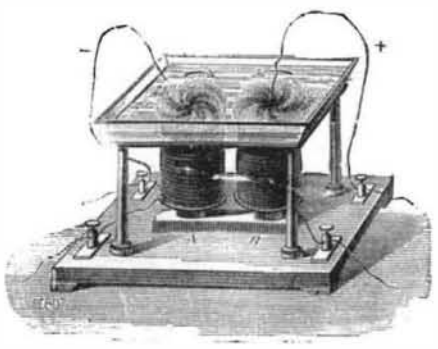


FIG. 21.

represents one element of the Schulze pile, and Fig. 24 shows a battery composed of such elements

Mr. Schulze covers the parallel leaden plates that form his accumulator with a paste of flowers of sulphur, and, by heating these, he forms upon them a layer of sulphuret of lead. If these plates be put into water acidulated with one-tenth part of sulphuric acid, and the current be made to pass, the sulphur separates, and the plates assume the requisite spongy condition.

At the Munich Exhibition a Schulze secondary battery of thirty elements operated eight Edison lamps, or one arc lamp, and served for the transmission of power.

The machine employed for charging these accumulators was the Schuckert, situated near the falls of Hirchau, at 5 kilometers from Munich, and this served at the same time to run two lathes.

Mr. Boettcher's accumulater is not, like that of Schulze and its predecessors, composed solely of leaden plates, but contains, as a negative electrode, a zinc plate instead of a lead one, and the element itself is filled with sulphate of zinc. His apparatus has the form of a plunge pile, as shown in Figs. 26 and 27. The zinc plates, Z, which are U-shaped, surround the lead, *p*, which is of undulatory form, and are

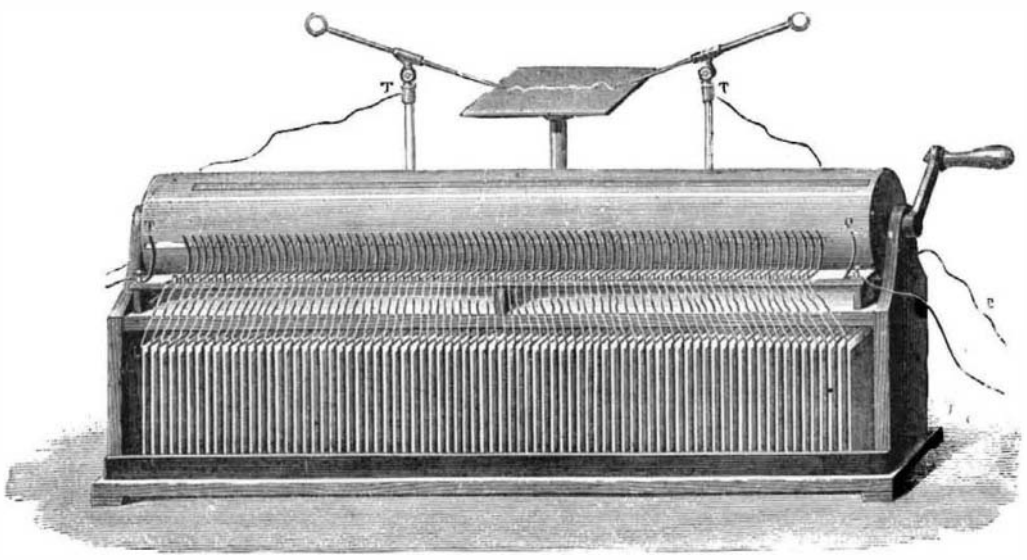


FIG. 23.—PLANTE'S RHEOSTATIC MACHINE.

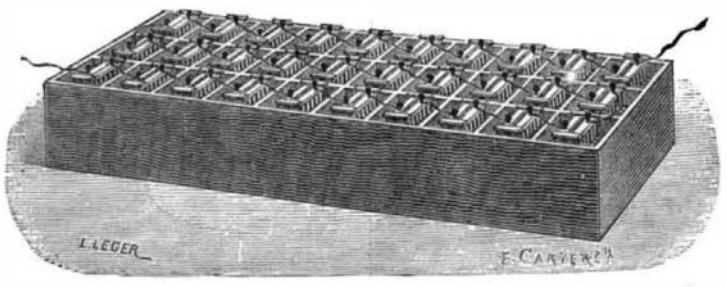


FIG. 24.—SCHULZE'S BATTERY.

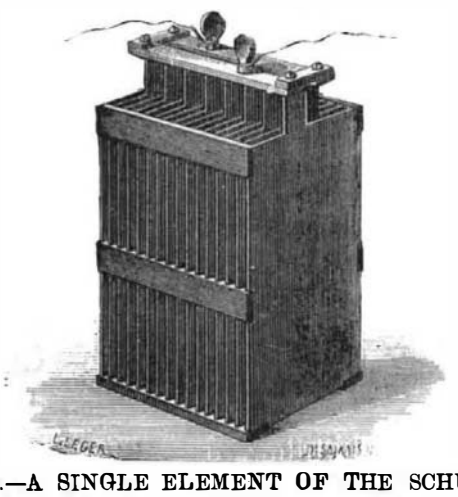


FIG. 25.—A SINGLE ELEMENT OF THE SCHULZE BATTERY.

separated from it by parchment paper, F. The whole thing has a general resemblance to the Wollaston pile.

When the accumulator is charged, there is formed peroxide of lead, which, at the discharge, is converted into protoxide. But, as soon as such conversion is at an end, the protoxide of lead, the zinc, and the zinc sulphate form a new couple which prolongs the duration of the current.

This accumulator should have a greater storage capacity than those using lead only; but exact calculations have not as yet been made in regard to this.

If experience should confirm the inventor's provisions and a greater effective duty be obtained, the apparatus at all events would have to be given a more practical form and not be allowed to preserve the laboratory arrangement that it now has. The transformation, however, would be easy to effect.

The two accumulators that we have just mentioned present a certain interest in that they are not, like the majority of those that have been brought out in recent times, simple modifications in form of the Plante or Faure pile.

The first is distinguished by an original mode of formation, and that is the preliminary conversion of the surface of the lead into a sulphuret. It must be said, however, that this process, although it allows the metal to be obtained in a suitable spongy state, has at least the draw back of disengaging sulphureted hydrogen—a gas that is injurious as much through its bad odor as through the action that it exerts upon metals in blackening them.

FIG. 26.—ARRANGEMENT OF THE PLATES IN THE BŒTTCHER ACCUMULATOR.

The second presents as a peculiarity the use of zinc, and it is possible that we may have here a reason for the increase in the storage power of the couple.

There was likewise shown at the Munich Exhibition a peculiar accumulator which was based upon the use of bromine, and which was due to Prof. Zenger of Prague. As the inventor has not as yet taken out all his patents, he was not able to give us an exact description of it, and we shall therefore have to describe the apparatus to our readers at some future date.—*A. Guerout, in La Lumiere Electrique.*

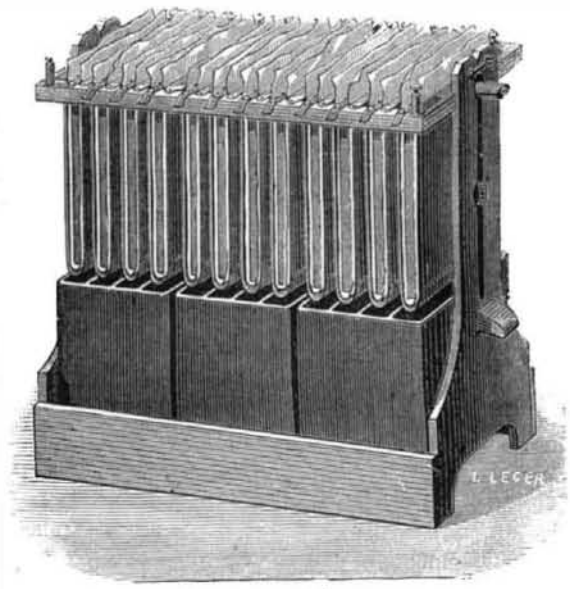
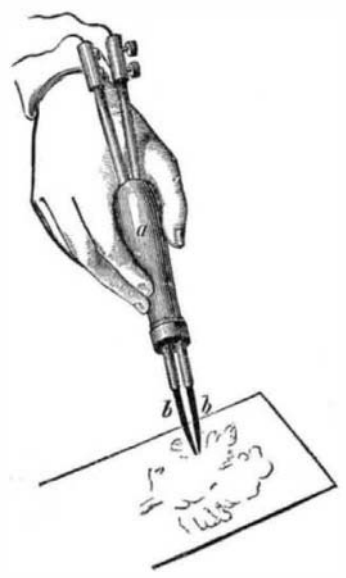


FIG. 27.—THE BŒTTCHER ACCUMULATOR.

IMPROVED ELECTRIC PEN.

THE annexed cut represents a new and improved electric pen for burning ornaments in wood surfaces. It consists of a handle, *a*, through which two conductors pass, the ends of which are provided with platinum points, *b*, which are held close to each other. The two conductors are connected by wires with a secondary battery, an electric machine, or with an ordinary battery, provided with a switch by means of which the current can be regulated. If the current passes through the electric pen, the platinum points become



incandescent, and when drawn over or held in contact with the wooden surface to be ornamented, burn lines, etc., into the same. With some skill very elegant designs and novel and beautiful effects can be produced on wood surfaces by means of this pen. The pen is known as the electric or pyrograph pen.—*Illustrirte Zeitung.*

IMPROVED INCANDESCENT ELECTRIC LAMP FOR MINERS.

MR. GASTON PLANTÉ has exhibited an incandescent electric lamp for miners, at the Vienna electrical exhibition, an illustration of which lamp is given herewith. It consists of a small box containing two Plante secondary batteries, A A, and a small Swan incandescent lamp, B, of three volts. The box is provided with a suitable handle for carrying it and with suitable contact buttons for making the connections