THE ELECTRIC EXPOSITION.

THE ELECTRIC LIGHT.

THE GENERATORS.

The Palace of Industry offers to the world a unique collection of apparatus tor producing the electric light.

The problem seems to be solved, if we can judge by the multiplicity of the solutions proposed; we shall see in the sequel that it is not yet completely solved, but this same multiplicity sets out well in relief the incomparable elasticity of electricity applied to l ght, and shows that it is possible from this day to introduce the electric light in all applications; by giving to it, in each particular case, the special qualities which assure its superiority over other systems, under the limitation of two conditions which we shall treat separately: economy and the distribution of electricity.

We shall rapidly examine the processes of generating electricity tor the special purpose of light; a following article will be devoted to lights, regulators, and incandescent lamps.

Three methods are known of generating electricity in quantity sufficient for the electric light: hydro-electric piles, thermo-electric piles, and electro-dynamic machines.

In this Exposition there is no thermo-electric pile applied to light. Some years ago we had hoped that M. Clamond would have continued his work in thermo-electricity, but he has, unfortunately, done nothing, and we can only express our regrets in this respect.

The piles intended for the electric l ght are represented at the Exposition but by two types: the pile of M. Cloris Baudet and that of M. Tommasi.

The pile of M. Cloris Baudet is a pile with bichromate of potash; with five elements, of which, according to the inventor, only one a day needs to be replaced, the pile can sustain a voltaic arc, with carbons of three millimetres, whose power is about 15 Carcel burners.

The pile of M. Tommasi is a Bunsen pile. The improvements which have been applied to it do not appear fortunate to us, and we do not yet know of an application where it serves in a practical manner for domestic usage, as the prospectus pompously announces it. It is only necessary to approach for a moment the exposition of M. Tommasi, on the ground floor, in order to *feel*—in the proper and in the figurative sense—that the vapor of liberated hypoazotic acid makes the pile absolutely inapplicable to the usage for which it was primitively intended.

The instalment of this extensive apparatus and the manipulation which it requires, are, on the other hand, out of proportion with the result obtained.

Leaving aside these two separa e cases, and the electric accumulators, to which we shall return, we can say that the electric light of the Palace is exclusively obtained from mechanical generators of electricity.

The motors which drive the electric machines demand a special study. They are of two kinds: steam and gas.

The Exposition contains several interesting types of motors especially intended to drive the electro-dynamic machines; we will cite among others the Brotherhood motor and the Dolgoronki rotative system motor. In these systems of motors of great rapidity, the driving shaft of the electric machine forms the prolongation of that of the motor; thus all intermediate transmission is done away with, but simplicity is purchased, it must be admitted, by a greattr expenditure of steam.

The largest part of the motive force is produced by fixed, half-fixed, or movable machines varying from five to 150 horse-power. We do not say that the latter are most economic, because they consume, with equal power, much less of carbon, and because they have also a more regular motion—an essential condition for a good electric light.

We will notice more particularly two types of these powerful machines: one, exhibited by MM. Carels, is an expansion-engine, in a single cylinder; the other, exhibited by MM. Weyher and Richemond, belongs to the *compound* type, that is to say, with a compound cylinder; the expansion is made successively in the two cylinders. Figure 7 represents this motor driving the electric generators with alternate currents of Gramme and Lambotte-Lachaussée. The advantage of expansion-engines, either with one cylinder or with two conjugate cylinders, is great, for as soon as 100 horse-power is reached, less than a kilogramme of carbon is consumed each hour for every horse-power.

A large number of gas motors are also used to produce motive force. Most of them belong to the Otto type; they vary from 1 to 50 horse-power. The gas motors are practical enough, and also, up to a certain point, economical, when they serve to produce a light for a few hours each day, and in an intermittent manner.

For the same quantity of gas consumed, we can obtain 10 or 15 times more light by passing through the medium of the motor, the electric generator and the lamp, than by directly burning the gas in the ordinary burners, all in producing 100 or 150 times less heat in the light.

It is by an 8 horse-power gas motor that M. Jaspar drives the three Gramme machines which feed the three regulators placed in hall XV; a 50 horse-power gas motor also serves to light a part of the Palace.

We now come to the machines. We can first divide them, according to the generally admitted classification, into magneto-electric machines, of which the inductors are magnets, and into dynamo-electric machines, of which the inductors are electro-magnets.

The Exposition contains only two kinds of magneto-electric machines, the old type of Alliance and the machine of M. de Méritens. These machines are applied to beacon lights, and they also feed several Berjot regulators. Without wishing to condemn the electro-magnetic machines, it seems to be established, even by the Exposition, that their industrial reign has terminated. It must not be concluded by this that the electro-magnetic machines are worthless, but only that they are not industrial, in the practical sense of the word; that is to say, the power being equal, they are heavier, more expensive, and more encumbering than the electro-dynamic machines which are almost universally employed to-day.

In light-houses, where the question of capital engaged plays but a secondary role, the preference has been given to magneto-electric machines which, in consequence of the masses put in motion, give a greater relative regularity than electro-dynamic machines.

Magneto-electric machines, applied to light, are all with alternative currents.

Dynamo-electric machines are divided into two classes, according as they furnish alternative or continuous currents.

Machines with continuous currents.—The machines with continuous currents are suited to illumination by the voltaic arc and by incandescence. When they supply a single light they are mounted as represented in figure 1:

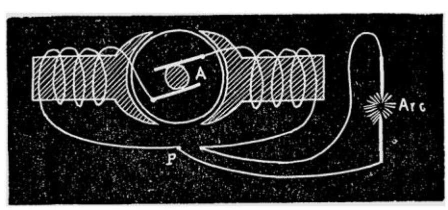

FIG. 1.—Diagram of the ordinary mounting of a dynamo-electric machine supplying a *monophote* light.

(A) an *inducted* Gramme ring, or Siemens bobbin turning between the two poles of an inductor II′, sustained

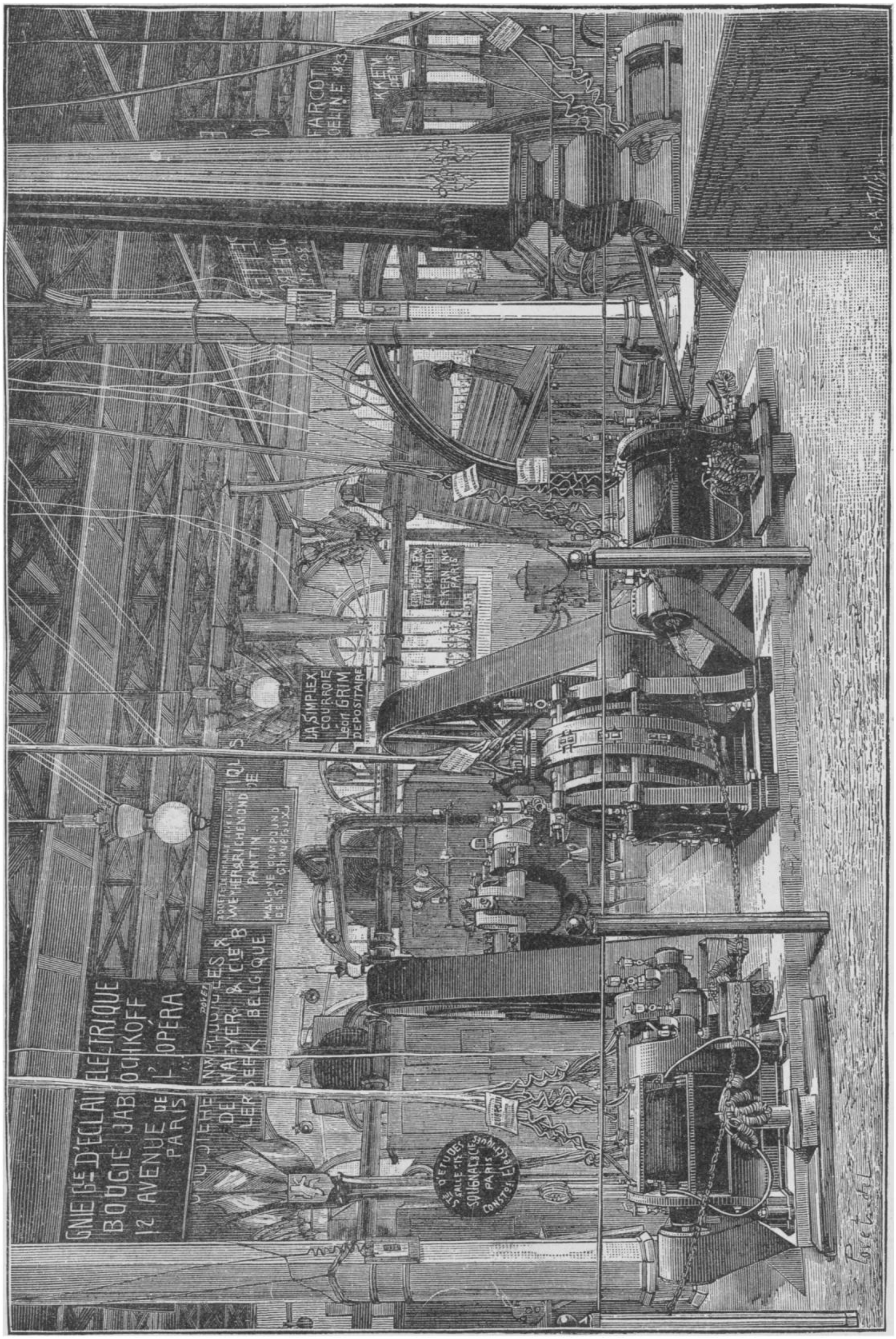

FIG. 7.—The Electric Generators of the Palace of Industry. International Exposition of Electricity. (After a photograph).

by the current from the bobbin, which also traverses the voltaic arc.

This is the mounting adopted to-day in most of the *monophote* regulators.

On examining this system a little closer, we see that it presents a serious inconvenience. When the arc is lengthened, the intensity of the current diminishes, for two reasons, first, in consequence of the increase of resistance of the current; second, because this enfeeblement corresponds to an enfeeblement in the same way of the power of the inductors, and, as a result, of the electro-motive force of the machine, since this electromotive force is itself a function of the power of the inductors. If the arc is made shorter, the reverse phenomenon results. This is a poor condition of regulation, since the increase of power of the machine corresponds to a shortening of the arc, and inversely, the diminution of the electro-motive force, corresponds to the lengthening of the arc. The production of the machine is, then in a contrary direction to the needs of the arc, and it is certainly one of the great reasons for which this mounting demands, in order to work well, sufficiently sensible regulators. They avoid this inconvenience by several methods.

The first consists of arranging the inductors *by derivation;* this arrangement, conceived by Wheatstone in 1866, has not yet received many practical applications. M. Siemens, of London, is studying it at the present time and we shall find, by and by, an application of it in Edison's machine.

The second method, universally employed in the machines with alternative currents and which is commencing to spread in somewhat important applications where the lights have continuous currents, consists of charging the inductors of a series of machines by a special machine. Diagram 2 represents this arrangement. The arcs 1, 2,

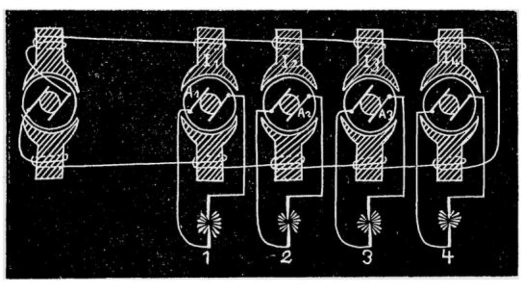

FIG. 2.—MACHINES charged by a special machine. Four machines with continuous currents supplying four regulators with a voltaic arc. The inductors are supplied by a separate generator.

3, 4 are bound to the brooms of the inducted bobbins A_1, A_2, A_3, &c., of the respective machines.

By this means a constant magnetic field is assured, whose power depends only on the velocity of the generator; as a result, the electro-motive force is then absolutely independent of the variations of resistance of the voltaic arc which it sustains. Thus is found the advantage of the magneto-electric machines whose magnetic field is constant, but we gain the additional advantage of having the most powerful machines, and of being able to vary the production of these machines by regulating at will the rapidity of the generator. There is in the French section a series of machines, arranged according to this principle.

Such are the arrangements employed with the *monophote* apparatus.

When a single machine is to supply several lights the arrangements change, and the lamps can be grouped in different ways.

When they are all branched over two general conductors starting from the limits of the machine, the lights are said to be established in *derivation*, in *multiple* or in *quantity* (fig. 3). When the lights are arranged, one

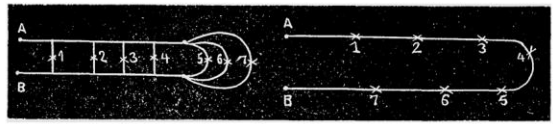

FIG. 3.—Mounting in derivation, in multiple arc, or in quantity.

following the other, on one and the same conductor, they are said to be mounted in *tension*, in *series*, or in *circuit* (fig. 4).

The mounting in multiple arc requires volume, that in circuit requires especially pressure or tension. The one or the other is applied according to the case.

Sometimes even several *derivations* are established, each carrying two, three, ten, etc., lamps in *circuit*. It is the case, for example, of the lamps of the Swan system of incandescence, fed by Brush machines.

The reasons of these multiple combinations are easy to comprehend. If the electric source of the machine we are arranging has more electro-motive force than that exacted by a single light, it would be an advantage to group several lights on the same circuit; when, on the contrary, the volume of current which the machine can produce is greater than that which is necessitated by a single light, we arrange them in *quantity* or in *derivation*. The Edison and Maxim systems of incandescence are monted in quantity over the source. They differ only, leaving on one side for a moment the lamp itself, in the manner of regulating the current.

In the Maxim system, the mounting of which is represented in figure 5, a separate generator supplies a series

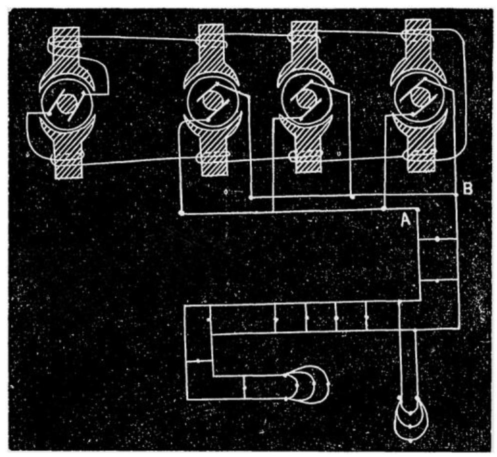

FIG. 5.—Mounting of the Maxim machines.

of machines, whose brooms are set between them in quantity, that is to say, by poles of the same name. All the lamps are branched over the conductors in derivation. The regulating obtains, by charging *automatically* the setting of the brooms of the generator, which reacts on the power of the current of the generator, and, consequently, on that of the inductor.

In the Edison system, the lamps are also mounted in derivation, but the inductors II^1 (fig. 6) are placed on a derived circuit led to the brooms of the machine in B and B^1. The power of the inductors is regulated, and consequently that of the machine, by manœuvring by hand a rheostat which serves to increase or diminish the resistance of the generating current, and consequently the electro-motive force of the machine. It is the Wheatstone mounting.

Machines with Alternative Currents.—The employment of alternative currents steps in with electric candles, because the two carbons must be equally consumed. Certain regulators also act with the alternative currents. The equal consuming of the carbon limits the displacement of the luminous point, which is often an advantage. All

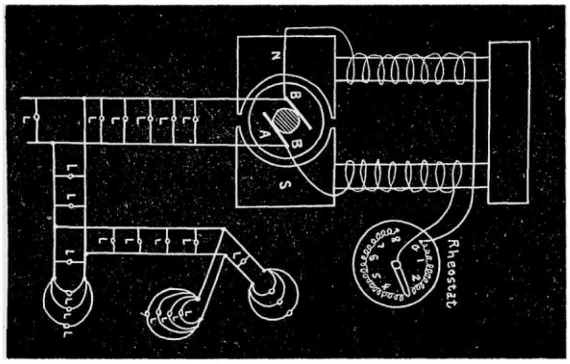

FIG. 6.—Mounting of the Edison machine.

the lights with alternate currents produce a peculiar humming owing to the nature of the currents which traverse them; this humming is often sufficient to forbid their use in places where it is necessary to have comparative silence.

The ensemble of a system of lighting by dynamo-electric machines, with alternative currents always includes two distinct machines: a machine with continuous currents or *generator*, and a machine with alternate currents, or *distributor*. This distributor consists of a variable number of circuits. Figure 8, simplified to show the

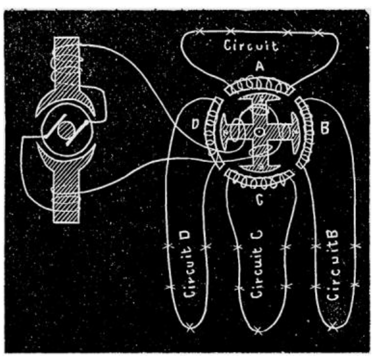

FIG. 8.—Mounting of a machine with alternate currents for candles.

principle, represents the mounting of a Gramme machine with alternative currents, supplying twenty Jablochkoff candles, arranged on four circuits of five candles each. The *movable* inductor bears eight poles, the successive ones with contrary names, in place of four. The generator can be of any system, whatever; it is only necessary to have a continuous current.

The power is regulated by the reciprocal velocities of the generator and the distributor. Sometimes the two machines mounted on the same axis turn with the same velocity, forming in reality but one. These machines are *self-generators*. In this case, we can no longer regulate the generator by its velocity, since this velocity is conjointly acting with the distributor; the regulating is then effected by the resistances introduced in the generating circuit. We have supposed the inducted, bobbins *fixed* and the inductors *movable*. It is the case with the Lontin, Gramme, and Lambotte-Lachaussée machines. At other times, as in the Wilde and Siemens machines with alternate currents, the inducted bobbin is movable and the inductors fixed, but nothing is changed for this in the general principle. We see from these several examples that the art of the engineer allied with the science of the experimentalist, offers some resources to convert mechanical energy into electric energy and then to distribute it to the lights which utilize it.

MICROSCOPISTS.

The first meeting of the State Microscopical Society of Illinois, for the present season was held at the rooms of the Society, in the Academy of Sciences, Friday evening October 14, the President, Dr. Lester Curtis in the chair.

After the transaction of routine business, Mr. Stuart described the microscopical structure of some vegetable drugs. The subject is not suitable for abstraction, and requires illustrations to be useful.

His paper was followed by one by Dr. Curtis, describing a new stand made for him by Bulloch. This stand presented some novel features, among the most striking was a mechanical stage of extreme thinness, admitting light at an angle of 160°. The movements were effected by a double pinion above the stage, an arrangement pronounced by those familiar with the operation of the contrivance, as exceedingly useful and convenient.

The stand excited considerable interest, as did also a right angled camera lucida of German manufacture which was adapted to it, the superiority of which over the ordinary form was so marked as to be unmistakable on trying it, even under the disadvantages of a crowded room and constant jar. After a discussion of the papers, the meeting adjourned. E. B. STUART.
Secretary pro tem.

PERMANGANATE OF POTASH USED AS AN ANTIDOTE TO THE POISON OF SERPENTS.

Very interesting experiments have been made in Brazil, by M. de Lacerda, which have established the fact that permanganate of potash is one of the most energetic antidotes to the venom of snakes. M. de Lacerda has addressed a memorial of his important works to the Academy of Sciences (meeting of the 12th of September, 1881).

The result of these researches is really astonishing; thus in a series of experiments, frequently renewed, of injecting the active venom of *boshrops*, diluted with distilled water, in the cellular tissues, or the veins of dogs, M. de Lacerda found that the permanganate of potash was able *to stop completely the manifestation of local injuries from the venom.* Yet the same poison, which had served for these experiments, being injected without antidote into other dogs, always produced great local tumefactions, with loss of substance and destruction of tissue.

These very remarkable results have been stated on various occasions, not only by the Emperor of Brazil, who assisted at these experiments, but also by physicians, professors of faculties, and members of the diplomatic corps.

MEANS OF DETECTING THE SOPHISTICATIONS OF OLIVE OIL WITH OTHER OILS.—The oils employed at Marseille for the adulteration of olive oil are the oils of colza, sesame, cotton, and earth-nuts, Colza oil is detected by means of the sulphur which it contains; 10 grms. of the sample are saponified in a glass capsule with an alcoholic solution of caustic alkali free from sulphides. The mixture is stirred with a silver spoon, and if this is blackened, colza, or at least some cruciferous, oil is present. For the detection of the oil of sesame a little sugar is added to hydrochloric acid at 30° (Baume?) which is then mixed with an equal bulk of the oil in question. The mixture is well shaken up, and the least traces of oil of sesame are indicated by a red coloration. For the detection ot cotton-seed oil there is added to the sample an equal volume of nitric acid at 40°. On stirring the mixture takes a coffee color. The detection of oil of earth-nuts is less simple. The sample is saponified with an alcoholic solution of potash, the soap separated as completely as possible, heated to expel the alcohol, and treated with enough hydrochloric acid to neutralize the alkali. The supernatant fatty acid—arachidic acid—is collected and dissolved in boiling alcohol, from which it separates in a characteristic white nacreous form.