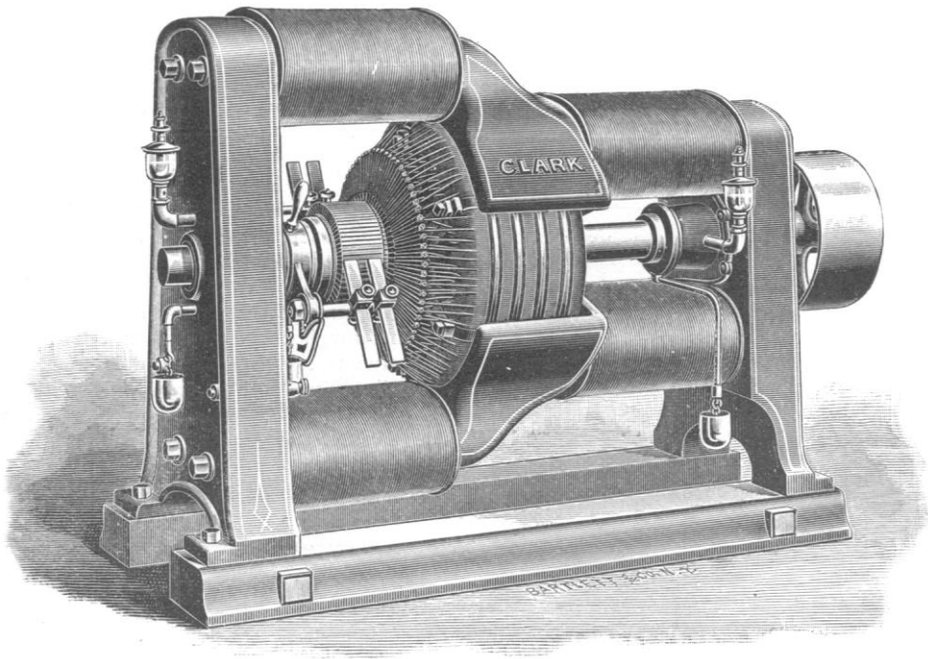
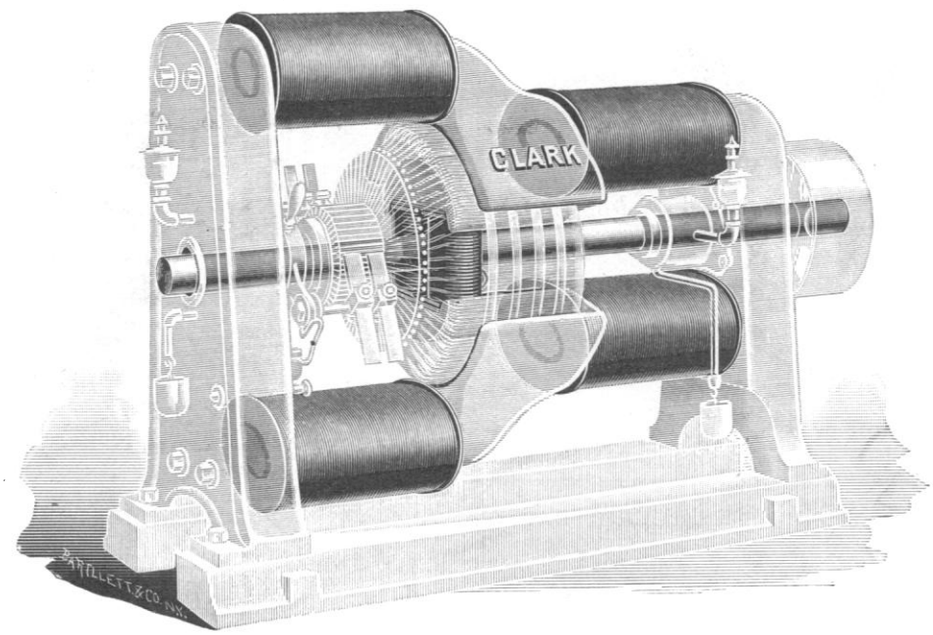
THE CLARK ELECTRIC COMPANY'S APPARATUS.

THE accompanying illustrations show the new apparatus of the Clark Electric Company. The dynamo shows some points of interest in details. It has an unusually long and deep commutator, provided with two independent brushes on each side, either one of which is able to carry the current, thus allowing the brushes to be changed or turned over while the machine is in operation. The shaft is very strong, being made of cast steel, and runs in gun-metal bearings. The armature cores are made of cotton-insulated iron wire wound into the proper form. A better division of the iron is thus obtained than by making the cores of sheet-iron rings with insulating material between them; but, as the core in this method of construction is laminated in both directions instead of only in one, its magnetic resistance is somewhat increased, which is a serious objection to such cores in most machines. In these machines, however, the pole-pieces of the field-magnets are presented not only to the outside of the armature, but to its inner surface as well; and by this means an enormous increase of the polar surface is secured, which is claimed to render the wire cores more effective than a sheet-iron core. The machines are shunt wound, and are claimed to be the only high-tension arc-light machines so constructed. They are calculated throughout to secure the highest possible efficiency, and it is stated that after a long run no portion of the machine is ever found uncomfortably warm to the hand.



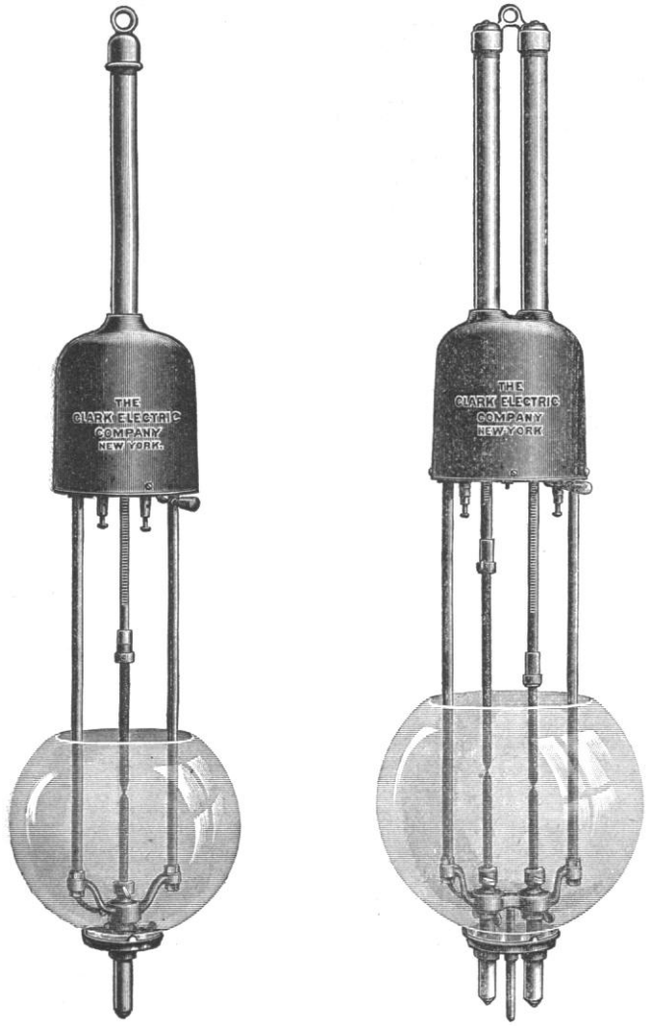
CLARK ELECTRIC COMPANY'S DYNAMO.

The principles on which the Clark automatic regulator works will need a word of explanation. The dynamos made by the Clark Company are shunt wound; and instead of using an adjustable rheostat in the field-magnet circuit, as is the usual practice with machines of this class, the exciting current is varied by means of an adjustable counter electro-motive force. This is accomplished as follows: the armature of the small regulating-machine shown in the cut is included, by means of its brushes and commutator, in the field-magnet circuit of the dynamo. This armature is of the Sie-



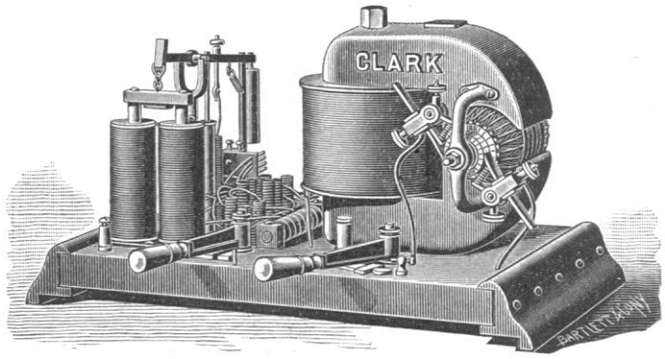
CLARK ELECTRIC COMPANY'S DYNAMO, SHOWING INTERIOR FIELD.

mens type, but wound with a large number of turns of fine wire, as the current passing through it is very small, in the arc machines never exceeding .4 of an ampère. When the current passes through the circuit, the armature revolves, and the machine becomes a motor, of course setting up a counter electro-motive force, the amount of which will depend upon the velocity of revolution of the armature, and the strength of the field in which it revolves. The speed of the armature is limited to a certain number of revolutions per minute by means of a small belt running from the pulley on the armature shaft to another one on the dynamo shaft, or on a line shaft, or some other revolving shaft whose speed is constant. As the speed of the armature cannot change, its counter electro-motive force can only change by reason of a change in the magnetic strength of its field-magnets. The main current, on its way to the



CLARK ELECTRIC COMPANY'S LAMPS.

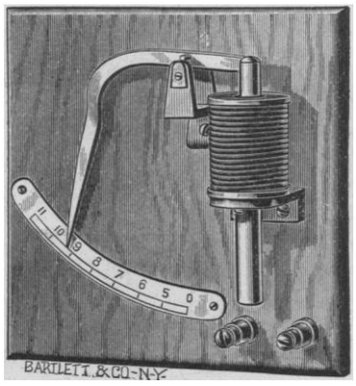
line, passes through the coils of the regulator field-magnets, and thus supplies the field in which the regulator armature revolves. If from any cause the main current should increase in strength, it will at once cause an increase in the power of the field of the regulator, and an increase in the counter electro-motive force of its armature, which, being opposed to the exciting current of the dynamo field, reduces that current at once, and with it the strength of the magnetic field of the dynamo. This at once reduces the generating power of the dynamo, and brings the current back once more to its standard strength. If the strength of the main current should decrease for any reason, the opposite action will take place, the regulator field-magnet decreasing in strength, the counter electro-motive force of its armature diminishing, and the current through it and the field-magnets of the dynamo increasing, thus restoring the strength of the main current. There is another piece of apparatus included in the regulator, and shown at the back of the cut. It consists of a solenoid, located in the main circuit, whose armature is attached to a lever. The other end of this lever carries a sliding contact piece, which slides over a number of sections or contacts of copper. A number of small spirals of german-silver wire are connected to these contacts, and arranged so as to form an adjustable shunt for the field-coil of the regulator, whose resistance in the 30-light regulator is only .15 of an ohm. By means of this arrangement, when the main current falls a trifle, the resistance of the german-silver coils is diminished, and a greater portion of the main current is shunted through them, instead of pass-



CLARK ELECTRIC COMPANY'S AUTOMATIC REGULATOR.

ing through the field-magnet coils. This, of course, causes a further reduction of the magnetism of the regulator field-magnets, the reverse action taking place when the current rises. It will be seen by this description that the regulating power depends upon the disturbance which is to be corrected; and the greater the disturbance, the greater is the regulating power; and, as it is not necessary that any thing should move, the regulating influence can be exercised to a great extent instantaneously, while the entire power of the regulator can be exerted in the fraction of a second that is required for the lever of the solenoid armature to move.

It is stated that the 30-light regulator exerts a counter electro-motive force under extreme variations of the main current, ranging from three or four volts to seven hundred volts, which is enough to control the dynamo under the most violent changes of load; and, as there is no train of gears nor ratchet movements to be put in



CLARK ELECTRIC COMPANY'S AMMETER.

motion, the regulation is accomplished in much less time than with any other device in use. The simple form of ammeter shown is supplied with each plant.

The arc-lamps shown in the illustrations are storm-proof, and do not require any hoods or other devices to protect them. The binding-posts are on the under side of the case, and will not become short-circuited by sleet or snow. The switch is also on the under side of the case, where it can be seen by the person operating it. These lamps have been exposed to the worst storms of the past winter; and, although at times completely covered with ice and snow, they have never failed to start when the current was turned on. The movement is claimed to be the most powerful ever put into a lamp. The moving parts are heavy in proportion, the carbon-holding rod alone weighing sixteen ounces.