EXPERIMENTS WITH THREE-PHASE ELECTRIC ARCS.

Three-phase electric arcs have recently been produced and investigated by the Italian General Electric Edison Company, at Milan, on the one hand, and by an American, Mr. Richard Fleming, on the other. Quite independently of these researches (of which he was not aware until after his work was completed), Dr. P. L. Mercanton, of Lausanne, Switzerland, undertook a number of investigations in the same direction with a view of producing powerful illuminants in a rather condensed form, and of materially lowering the frequency necessary for maintaining the arc. The principal object of this work was, however, a possible increase in the luminous output of the electric lamp.

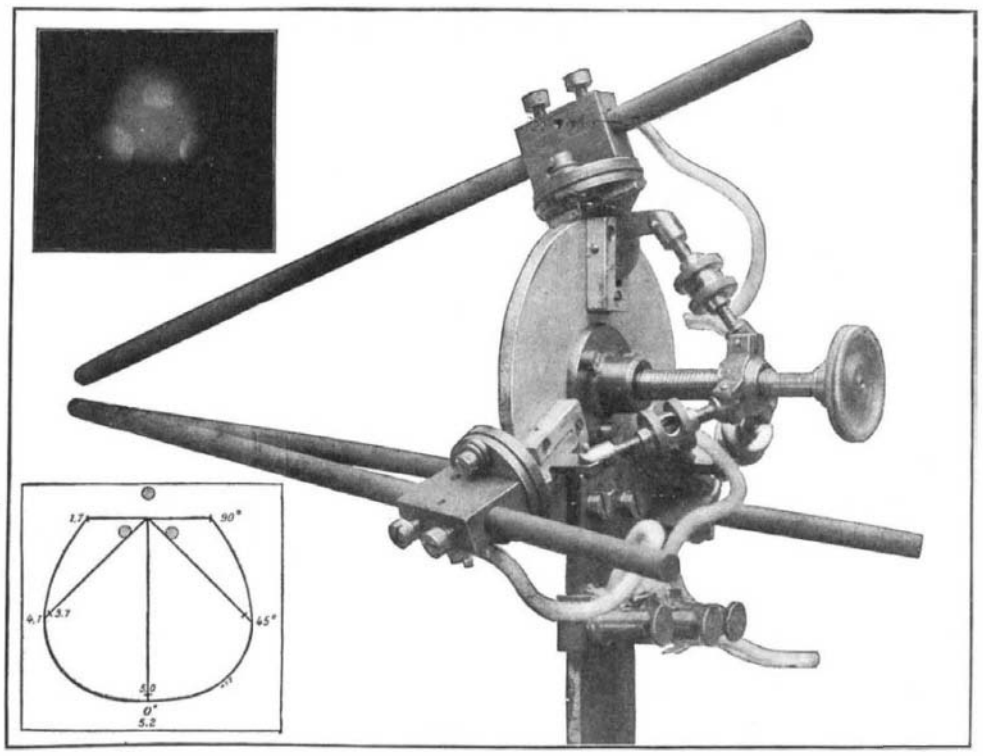
Three-phase arcs are constituted by three single-phase arcs burning successively between each pair of carbons, each being extinguished and lit again twice per period. As these are therefore at any time at least two arcs burning, the cooling effects are likely to be considerably reduced, and the consumption of energy required per candle materially lowered. These previsions were in fact fully borne out by experimenting with the lamp represented.

The lamp contains three carbons connected each to a phase of the current, and constituting a regular triangular pyramid, on the top of which the arc is produced by virtue of electrodynamic forces. Regulation is effected by hand, and consists in inclining the carbons with respect to the axis of the pyramids. For this purpose they are supported by three carbon holders which are pivoted at three points placed at angular distances of 120 deg. on the circumference of a circular metallic disk that serves as a base plate. To the middle of this disk, on the side opposite the arc, there is fixed a strong screw, the box of which is connected to a lever system controlling the mutual distance of the carbons. By a special arrangement, the levers may be lengthened or shortened.

The aspect of the luminous focus of this lamp depends to some degree on the kind of carbon used; the latter should be rich in volatile substances. As regards the length of the arc, on which its behavior will depend to a high degree, this is always upward of some millimeters, and in most cases superior to 10 millimeters. Under these conditions, the ends of the carbon appear to the eye placed on the axis of the lamp, like three luminous points of a high brilliancy (as represented); the common angle between the carbons varies between 30 deg. and 50 deg. The lowering in the frequency necessary to maintain the three-phase arc may be readily shown by adjusting the arc for the maximum of frequency and eventually withdrawing violently one of the carbons, when the arc ceases to pass between the two remaining points. The jumping of the single-phase arc from one pair of carbons to the other is visible by the flicker in the light given off from the edges of the crater in front of each other.

For a number of periods ranging between 38.5 and 51, the light is quite steady.

In order to determine the candle power of three-phase arcs, Dr. Mercanton undertook photometric measurements for various carbons and different directions of the light rays, by means of a Lummer and Brodhun photometer.



A THREE-PHASE ELECTRIC ARC.

From the results recorded, it is shown that three-phase arcs have a much better luminous output than monophase arcs between the same carbons.

While the previsions of the experimenter were thus borne out fully, Dr. Mercanton is however somewhat doubtful as to whether the saving afforded will warrant the difficulties inherent in the design of a regulating mechanism. On the other hand, there is the necessity of using three wires instead of two, and of replacing the single-phase lighting transformers by three-phase transformers. Wherever regulation by hand is practicable, and especially in connection with luminous projections, three-phase arcs seem however likely to render materal services, in virtue of the steadiness and brilliancy of the triple illuminant.

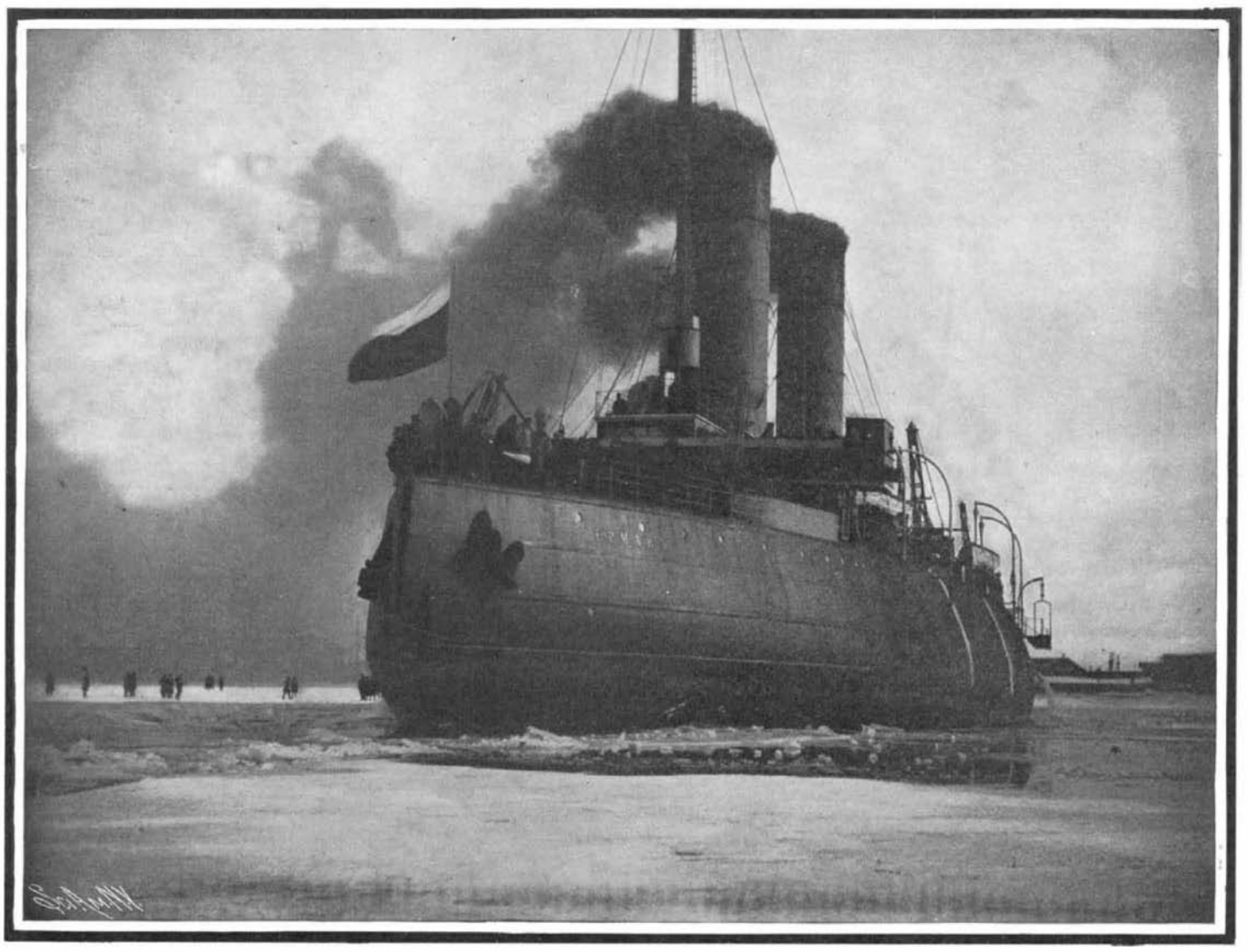
Thirty-five miles of roadway have been constructed within the World's Fair grounds.

THE RUSSIAN ICE-BREAKER "ERMACK."

To Admiral Makaroff, who went down with the ill-fated "Petropavlovsk," is due some belated tribute for his skill and enterprise in familiarizing the Russian marine with ice-breaking steamers of more pretentious size than the small craft of this type that had been used for thirty years in the harbor of Cronstadt. The "Ermack," if not actually designed by him, is at least a product of his energy and the embodiment of the best features of the American ice-breakers, which he had made the subject of an exhaustive study during a visit to America. She carries, moreover, many an appliance which Makaroff himself invented.

The problem of keeping open the ice-bound ports of the Baltic and of the Siberian Pacific coast is somewhat more difficult than the task that confronts the American engineer of the Sault Ste. Marie region. Russian ice is thicker; it lasts longer; and the longer it lasts, the more difficult it is to penetrate. For that reason Admiral Makaroff was compelled to design a vessel which, although in principle it did conform with the best American practice, still embodied features that would enable her to cope with the difficulties presented by the ice-bound harbor ice of Cronstadt and Vladivostock. What these features are will appear more fully from the following description:

The "Ermack" is 335 feet in length, 71 feet beam, and with her coal and stores on board has about 8,000 tons displacement. Her propelling machinery consists of four sets of triple-expansion engines of 2,500 horse-power each, steam being generated in six very large double-ended boilers built for 160 pounds pressure. She has three stern propellers and one bow propeller. Her speed with 8,000 horse-power is nearly 15¼ knots. The speed with the three after engines working ahead is about 15½ knots, and the speed with all the engines running ahead is about 16¼ knots, the power in each case being at the maximum. The highest indicated power developed is 12,000, corresponding with the speed of 16¼ knots.



THE RUSSIAN ICE-BREAKER "ERMACK." CAPABLE OF FORCING HER WAY THROUGH ICE TWENTY-FIVE FEET THICK.

Each propeller has a set of main engines of the triple-expansion type for driving it when the full power has to be exerted. At the side of the shafting of each screw is a pair of ordinary compound engines which drive the propeller by tooth gearing. The cylinders of the main engines are 25½ inches, 39½ inches, and 64 inches in diameter by 3 feet 6 inches stroke. The boilers are are double-ended, and six in number, 15 feet in diameter, and 20 feet 6 inches long. The grate area is 800 square feet, while the heating surface is 27,600 square feet total. The propellers are made with nickel-steel blades containing 3 per cent nickel, having a tensile strength of 40 tons; the stern propellers are 14 feet in diameter, the wing propellers being 14 feet 6 inches pitch, and the center propeller 14 feet pitch. The forward propeller is 13 feet in diameter and is 13 feet 6 inches pitch. The

(*Continued on page* 362.)