Inasmuch as the electro-metallurgy of the reduction of iron ores had been established by the Canadian experiments, these Swedish inventors concentrated their entire efforts in an attempt to solve the practical, commercial problem, along the lines suggested in the official report. In carrying out their plans to a successful issue, they were ably assisted by the ironmasters of Sweden, who manifested great interest in this question. Special assistance was rendered by the able, and far-sighted director, E. J. Ljungberg, and the vice-director, Lars Yngström, of the largest and most influential industrial company in Sweden, the Stora Kopparbergs Bergslags Aktiebolag. The inventors made an agreement with this company, and the Trafikaktiebolaget Grangesberg-Oxelösund (owners of the largest iron ore deposits in Sweden), to carry on smelting experiments on a large scale at the Domnarfvet Ironworks.

In order to concentrate their individual attention on this problem, the inventors formed a company called the Aktiebolaget Electrometall, to which the patent rights were assigned.

Evolution of the Electric Shaft Furnace.

The construction of the specially designed electrical machinery, and the preliminary work necessary for the construction of the furnace, were commenced in April 1906; and

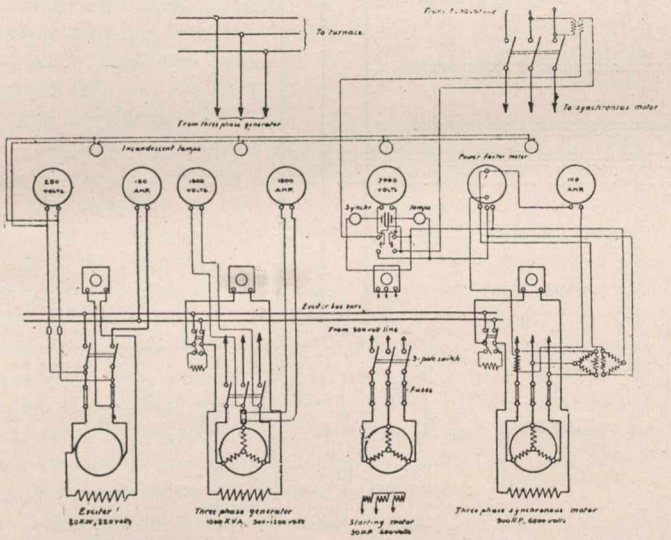

Fig. 2.—Diagram of Switchboard Connections in Generating Station.

towards the end of that year—when the installation of the electrical machinery and high-tension cables, etc., was completed the construction of the first electric shaft furnace was begun.

This furnace was put in operation April 1907, and from that time experiments were continuously carried on and improvements made; the daily experience thus gained being utilized in successive changes in design and reconstruction towards perfection. All experimentation was conducted along scientific lines, and has yielded a rich fund of usable knowledge and instructive data as follows:—(1) On the construction and operation of electrical furnaces; (2) on the conductivity and other characteristics exhibited by materials when subjected to high temperature; (3) on the qualities of the refractory lining materials; and (4) on the most suitable manner of designing and constructing the masonry of the furnaces. In addition to this, different methods of supplying the current and of various contact devices, etc., were tried and tested. In these initial steps the experimenters did not confine their entire attention to the practical side of electric smelting, but carried on laborious researches and investigations concerning the solution of purely theoretical problems; and the determinations made and data gathered will doubtless form an important contribution to the electro-metallurgy of iron and steel.

Taking into consideration the fact that the inventors have signified their intention of writing a detailed account of all the experiments conducted by the mduring the past three years, it will be unnecessary for me to enter into minute details; but to set forth only such facts as have a direct bearing on the experimental trials witnessed at Domnarfvet.

With a view of elucidating a number of disputed technical points involved in the smelting process itself, initial experiments were conducted at Ludvika during the summer of 1907, with a small furnace of 300 horse-power capacity. During these preliminary experiments many difficulties were encountered which had to be overcome; and it was not until the summer of 1908 that they succeeded in designing and constructing a furnace which, in their opinion, could be economically used in practice. Towards the end of the summer a number of experiments were made with this furnace, which demonstrated that the type evolved was durable, and that a good output could be obtained therefrom, notwithstanding the fact that the furnace was constructed with a relatively low shaft in order to reduce the building expense. On account of this low shaft, which was open at the top—as in the case of the furnace employed at Sault Ste. Marie—the consumption of charcoal was large, viz., 9 cwts. 6 lbs. per metric ton of pig iron produced. A considerable portion of this charcoal was consumed at the top of the open shaft, and the gas escaping from the furnace consisted almost wholly of carbon monoxide. Hence, notwithstanding the excellent results obtained with this furnace, the inventors conceived that by utilizing the waste gases, even more economic results could be attained; they consequently decided to construct a new one of larger capacity, with a higher and more rationally designed shaft.

The new furnace was completed early in December 1908, and the intention was to at once begin an extended trial run; but owing to a severe drought this extended trial had to be postponed. Some time previous to the completion of this furnace the inventors tendered the writer an invitation to witness a short trial test to take place early in December. Although little rain had fallen up to this time, hopes were entertained that by the middle of December there would be sufficient water to carry on the contemplated experimental trials.

Soon after receiving the invitation, I received official instructions to proceed to Sweden to investigate and report upon this new electric shaft furnace, and sailed for Europe via New York, on November 25, 1908. Immediately on my arrival in Stockholm, where I met Mr. Grönwall—one of the inventors of the furnace—it was arranged that we should go to Falun for the purpose of placing before Mr. Ljungberg, the general director of Stora Kopperbergs Bergslags Aktiebolaget—at whose works the furnace was erected—the great importance to Sweden, as well as other countries, of making, if possible, the contemplated special trials. As a result of this conference, he very generously allowed the use of power to operate the furnace for twelve days. The inventors informed me, however, that they did not expect entirely satisfactory results as regards the output of pig iron per electrical horse-power year, since a furnace of this size could not possibly arrive at its normal working condition in the short time allowed for the test inasmuch as the walls are so thick