1931

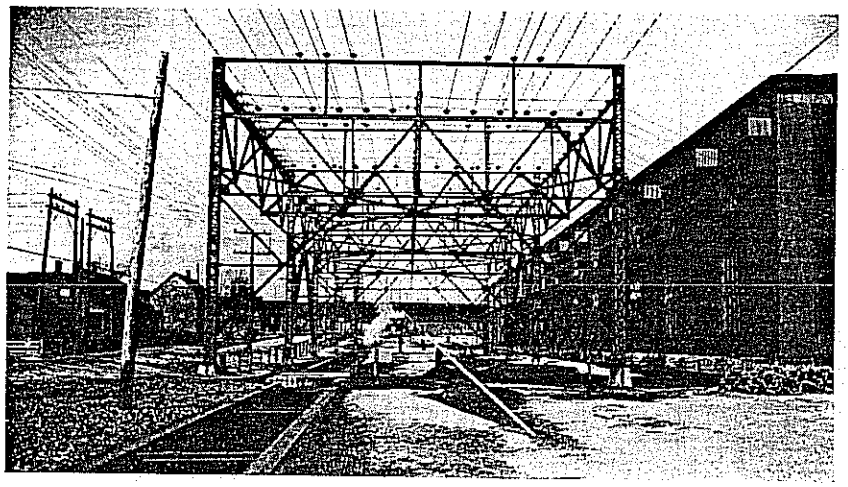

Figure 1. Lake Linden power plant arbor

Electric POWER DISTRIBUTION

By Frederick N. Bosson*

THE first lighting plant installed by the Calumet and Hecla Company was located in the Calumet mill at Lake Linden, and went into commission in May, 1878. It consisted of a Siemens a. c. generator and exciter and 24 arc lamps. This apparatus is now in the Engineering Museum in New York.

In 1881 a Brush arc dynamo, serial No. 26, and eight 4,000-c. p. lamps were installed at the mine for surface lighting. They were mounted on two tall masts and were put in commission on the night of July 4 as part of the day's celebration. Following this, two arc-lighting dynamos of 35 2,000-c. p. lamp capacity were installed and were used in the interior lighting of buildings. In 1892 the electric station at the mine was put in commission, which included incandescent machines and power for pumps, as noted in the article on underground power distribution.

In 1895 an electric plant was started at the Calumet and Hecla mills, which consisted of 3 a. c. lighting machines and three Brush arc machines. In 1901 a 300-kw., 25-cycle generator was purchased for the operation of the pumps that were installed in No. 7 shaft; but the real beginning of the present power system dates from 1902 when two 1,000-kw. generators, engine-driven, generating at 440 volts, three-phase, 25-cycles, were started for the mill electrification. the mine and mills were connected with transmission lines in 1906 after three 2,000-kw., 13,200-volt, engine-driven generators were installed.

At present there are two main generating stations, one at the Calumet and Hecla mills at Lake Linden and the other at the Ahmeek mill at Hubbell. These two stations operate in parallel, the two 13,600-volt buses being tied together by two 250,000 c. m. tie lines. The other turbo generators feed into the 13,600-volt system through transformers and feeders, making up the total generating capacity of 40,000 kva. At the Lake Linden plant there are eight outgoing feeders, including the two tie lines between the two generating stations. These feeders go out of the building overhead into an arbor from which they diverge. (See *Figure 1.*) The arbor is laid out so that circuits can be easily interchanged. At the Ahmeek station there are two incoming tie lines and two outgoing feeders. These are carried underground by three-conductor cables from a distributing tower located about 200 ft. from the station.

All power from the main stations is distributed at 13,600 volts, 25 cycles, three-phase, with the exception of a small amount of power for auxiliary use and the original 440-volt zone at the Calumet and Hecla mills. The 13,600-volt distribution is carried on wood poles and cross arms. Pin-type insulators of 23,000-volt working pressure are used to carry the wire on a 3-ft. delta and deliver power to 13 substations located at load centers. (See the diagram, *Figure 2.*)

Secondary distribution is done at 2,300 volts from all substations with the exception of No. 5 Tamarack substation, which delivers at 4,000 Y, and the regrinding plant and Tamarack reclamation substations where both 2,300 and 440 volts are distributed. The transformer capacity at the distributing centers aggregates 45,150 kva., and the total connected a. c. motor load is 53,365 hp. with a total of 895 a. c. motors, the largest being 1,250 hp. With a few exceptions, all surface motors of 50 hp. and above are 2,300 volts; those below 50 hp. are 440 volts. All motors used underground are 440 volts with the exception of the 5 hp. and smaller motors, which are usually wound for 110 volts. The company also has a total of 87 d. c. generators aggregating 4,150 kw. that furnish power to 260 direct current motors of 4,375 hp. capacity.

Lighting throughout the mill and the main circuit at the mine is done at 60 cycles. This current is obtained by frequency changers of a combined capacity of 1,500 kw. The balance of the lighting is 25 cycles.

On the opposite page are three circle diagrams showing the total power generated and distributed for the year 1929. (*Figure 3.*)

* Electrical Engineer.

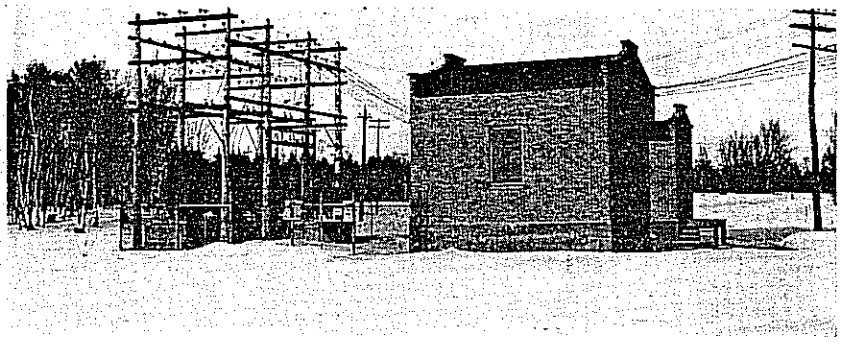

Figure 4. Typical substation for power distribution, at Ahmeek Mine

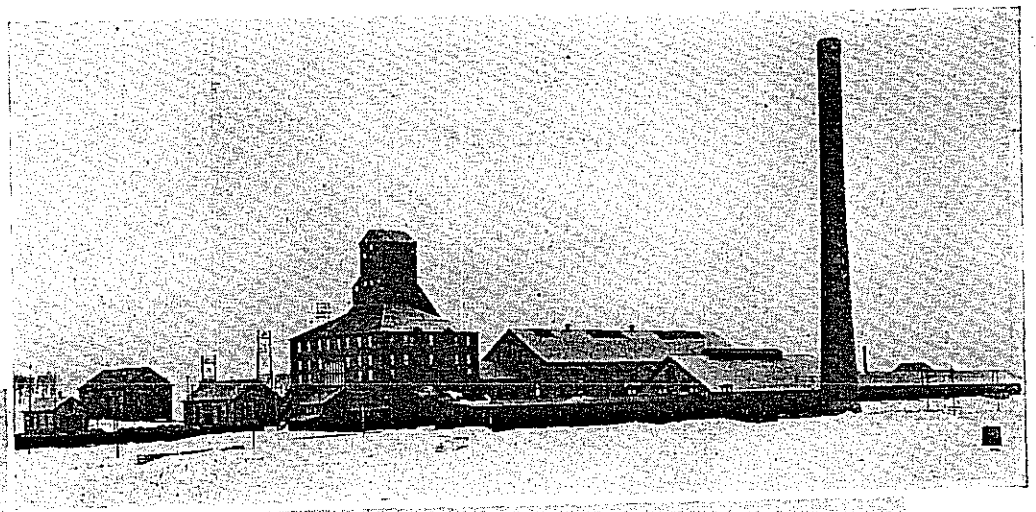

Figure 1. Plant at Red Jacket shaft.

Figure 2 (above) Plant at North Ahmeek, No. 3 and 4 shaft

Figure 3. Rock house at Ahmeek No. 2 shaft

Figure 4 (below) Pattern shop, foundry and smith shop at Calumet

CALUMET AND HECLA CONSOLIDATED COPPER COMPANY