

it into a stream of water flowing rapidly in front of the settler and is carried by the water through a launder to the slag dump in the lake.

Quincy Smelting Works.

Next in geographical order and in time of erection are the Quincy Smelting Works, built in 1898 on the north shore of Portage lake, opposite Houghton. There is one main refinery building containing four separate reverberatory furnaces, in each of which the mineral is melted and the resulting copper refined. The mineral comes from the stamp mill in 60,000-lb. capacity steel hopper cars having separate compartments for the different grades, and is unloaded into storage bins from an overhead trestle. Small steel charging cars pushed by hand are used to transport the mineral from the bins to the furnaces where the cars are lifted by electric jib cranes and emptied into the hoppers above the furnaces. The furnaces are charged each afternoon, the melting and skimming going on during the night and the copper is refined and dipped out the next morning. These furnaces have fixed boshes on which the molds are placed, and contain water into which the copper drops when the molds are overturned. The dipping is performed with ladles swung on trolleys travelling on I beams which run over the front door of the furnace and over the molds. The copper is fished by hand from the water when cool and piled on hand trucks for weighing and removal to the shipping dock.

The blast furnace is charged with 2-wheeled buggies from bins. The waste slag runs from the settler into a large slag car holding 3,000 lbs., mounted on four wheels. When this car is full it is run to an elevator and lifted about 30 ft. above the ground level to the slag tramway, along which it is propelled by a Baldwin-Westinghouse locomotive to the slag dump, which forms a broad solid deposit on low ground.

There is a briquetting plant for making briquettes of the very fine slimes that form part of the concentrates. These are mixed with fine lime and pressed into form in a White briquet machine; then the briquettes are piled on tram cars and placed in a steel cylinder in which they are hermetically sealed and subjected to intense heat in an atmosphere of superheated steam. This puts them in condition suitable for smelting in the blast furnace without excessive loss in flue dust.

Lake Superior Smelteries.

The Lake Superior Smelting Works at Dollar bay, some 3 miles east of Houghton, on the north side of Portage lake, were built in 1888. As originally planned there were two refinery buildings, each intended to contain four furnaces. After being remodeled twice the plant now comprises three large reverberatory furnaces and four small furnaces, the latter soon to be superseded by the fourth large furnace, now under construction. Each furnace is used for both melting and refining. The large furnaces, 17 ft. wide by 30 ft. long, are equipped with mechanical pouring devices and have a capacity of 200,000 lbs. of refined copper to the charge. The casting machine consists of a series of cast-iron plates connected on each side by an endless chain which passes over sprocket wheels at each end, carrying copper molds and bringing them successively in front of a hydraulically operated ladle kept constantly filled with copper flowing from the furnace. The ladle, in addition to the tilting motion, has a reciprocating motion alongside the table and is centred and carried along with the mold during the pouring by a lug which engages with one of the links of the chain and on being released at the end of the stroke is re-

turned to the initial position by means of a hydraulic cylinder. This permits the continuous motion of the molds without having to stop them at the ladle. The ladle is controlled by one operator seated opposite the tap hole. As the molds pass down over the end wheels the solidified copper drops from them into the water of the cooling tank on to a moving conveyor which carries it along in the water until thoroughly cooled and then up to the loading table. From this it is lifted over to 4-wheeled trucks that carry between 5,000 and 6,000 lbs., which are pulled by a gasoline motor truck to the scales, two in number, and thence to the dock or platform, where it is piled in regular order ready for shipment. One of the scales has an ordinary beam which is read in the usual manner, while the other has a type-registering beam which makes a printed record when the load is balanced, thus affording an absolutely reliable check on the reading of the first scale.

The mineral is brought to the works in steel hopper cars of 100,000 lbs. capacity, which are run up a trestle over the bins, these, however, being little used, as the mineral is ordinarily dropped into hoppers leading to belt conveyors, which carry it direct to the furnace hoppers—the cars being weighed, both loaded and empty, on a railroad track scale provided with a type-registering beam.

An electric overhead monorail crane traversing the works and yard serves to handle cupola blocks, mass copper, supplies and other materials, delivers coal to the furnaces by means of a detachable shovel of the clam-shell type provided for that purpose, which can be removed when not in use, and hauls the slag pots containing the reverberatory slag to the blast-furnace charging floor.

Steam for running the power plant is obtained from vertical water-tube boilers which utilize the waste heat from the furnaces. Each furnace also has a stack through which the gases may be diverted in case repairs to the boilers are necessary. Recording pyrometers and draft gauges making 24-hour graphical records indicate the working of the furnaces and guide the furnace men in their work.

At the blast furnace the slag, fuel and fluxes are shoveled into small steel tram cars which are pushed by hand to the charging doors and up-ended by a steam-cylinder hoist so that the contents are slid into the furnace. The waste slag is granulated by falling into a stream of water and elevated by a link belt elevator into a storage tower from which it is hauled away by teams to the dumping ground. A recording blast gauge makes a continuous record of the blast pressure, which, together with the daily analyses of the waste slag, gives a check on the running of the furnace.

Calumet & Hecla Smelteries.

The Calumet & Hecla Smelting Works, built in 1885, are situated on the shore of Torch lake, 9 miles from Houghton, and contain 12 reverberatory furnaces. The mineral at these works is stored for a time in bins to allow the water to drain out, after which it is drawn to the furnaces in 2-wheeled buggies. These are lifted over the charging hoppers above the furnace by electric cranes. At the last blast furnace the slag, fluxes and fuel are lifted in the tram cars by an electric monorail crane and discharged into steel bins arranged around the sides of the building high enough above the charging floor to permit steel buggies to be loaded through shore chutes; the buggies are then wheeled to the furnace doors and the contents dumped into the furnace. The waste slag escapes through a trapped spot into slag pots mounted on wheels, from which it is dumped when chilled on the ground, broken and lifted by a derrick to railroad cars for transportation to the dumping ground.