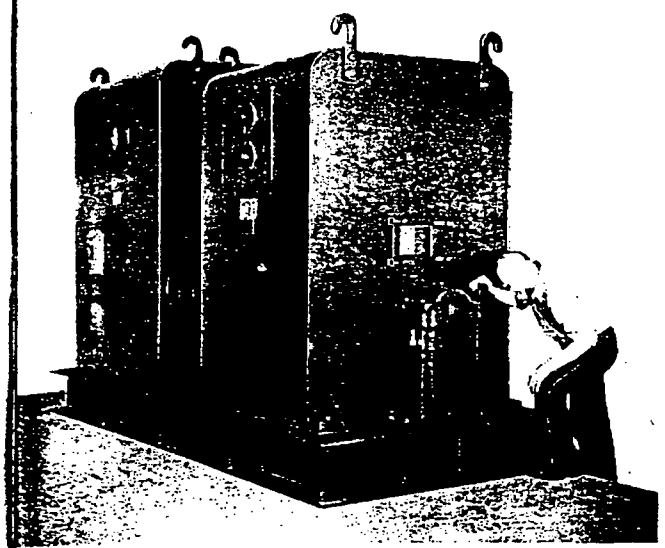
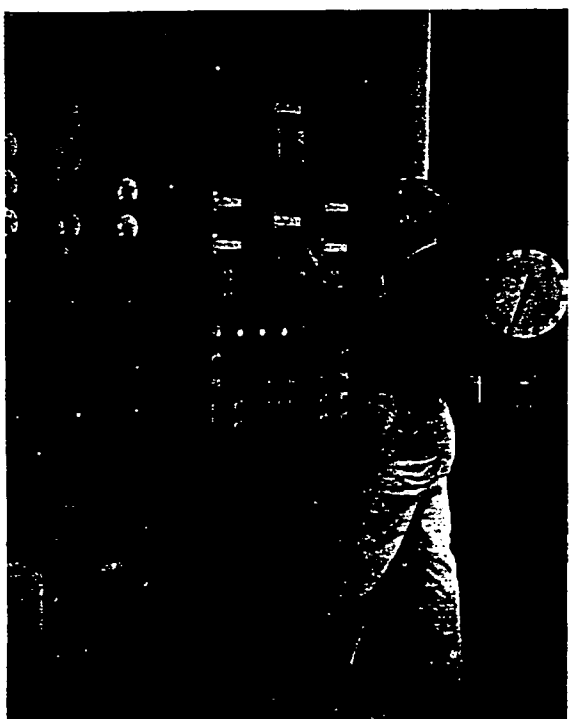


This is the special motor-generator set which powers the induction stirrer. The motor is a conventional 60-cycle machine. The generator is a special low-frequency, commutator-type, two-phase unit. Both are totally-enclosed units with air-to-water heat exchangers for protection of the motor windings from the inherently dirty mill atmosphere.

Here is the control panel from which the melt foreman controls operation of both furnace and stirrer. The operator is checking temperature between stirrer and furnace bottom at one of several check points. Temperature of the melt is kept more uniform by the stirring action.



In this 20-foot diameter Heroult-type furnace, the bottom is spherical with a 1¼-in. bottom plate of stainless steel, selected for its non-magnetic characteristics. The 25-ton stirrer, which was built by Elliott's Ridgway Division, conforms to the bottom of the furnace and is bolted to the rockers so that it moves with the furnace as it is tilted.

Because of the extremely low frequency with the correspondingly low core loss, it was not necessary to use thin laminations for the magnetic circuit of the stirrer. Actually, the core is made from ¾-in. carbon steel plates, bolted together, while the teeth are made from angle iron welded to the core. The conductors are formed from a hollow rectangular copper section, and each coil consists of several turns wound in pancake fashion and carefully formed to the required curvature.

Cooling of the stirrer winding is effected by circulating distilled water through the hollow copper conductors, and thence through a water-to-water heat exchanger in a closed system. The coils of each phase of the two-phase winding are all in series, electrically, but they are in parallel with respect to the cooling water circuit so as to decrease the pressure drop to a reasonable value. This necessitates the use of a hose connection at each coil end and adjusting valves to balance the water flow.

The stirrer is wound for two-phase power and consists of two magnetic poles. The power supply is of very low frequency so that the magnetic field travels over the surface of the melt at the most suitable speed and penetrates well into the molten metal in the furnace.

The winding is insulated with full Class B insulation and is well braced to withstand the magnetic forces occurring in the end windings. Brass plates cover the inner surface of the stator as a protection to the slot portion of the coils, while stainless steel covers protect the end windings.

It is interesting to compare this device with the familiar induction motor. The distances from the "stator" surface (which is the stirrer) to the melt, which becomes the "rotor," is about 30 in. Thus, we are dealing with a segment of a motor which has a 30-in. air gap. It is easy for electrical engineers to understand why the power factor of the stirrer is not particularly high, being less than 50 per cent.

Power for the stirrer is supplied by a 485-kva, 2-phase, 230-volt generator, driven by a synchronous motor. The generator is a commutator-type machine which obtains its excitation from a