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AUTOMATIC REVERBERATORY FURNACE CHARGING

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This invention relates to the feeding or charging of metallurgical furnaces, and more particularly it relates to a procedure and apparatus for automatically charging a furnace such, for example, as a reverberatory furnace used for producing copper matte.

Various devices and procedures have been used for feeding reverberatory furnaces. Such furnaces, generally, are operated continuously for long periods of time. That is, the furnace is not emptied between charges but a molten bath is maintained in the furnace at all times between the time of starting up the furnace and shutting it down for repairs or for some other reason. It is not uncommon for such a furnace to be operated continuously over a period of a year, or more, without a shutdown.

One method now in common use for charging a copper reverberatory furnace with the charge material to be smelted is known as side-charge smelting. In this method, it is conventional procedure for the material to be charged to the furnace to be conveyed from bins by means of drag chains, conveyor belts, vibrating conveyors, or by other devices, along each side of the furnace from a place adjacent the burner end, or bridgeway, for a distance of approximately two thirds of the furnace length. This distance may vary for different installations. Along the conveyor, at intervals, which in a typical installation may be approximately four feet, are drop chutes through which the feed may be selectively discharged into the furnace by operating one or more openable and closeable gates installed at each chute location.

Conventional charging is such that usually the charge chute gates on individual chutes must be operated manually to open and close them in order to direct the feed to a particular zone, or zones, within the furnace in order to have the charge where and when it is desired during the smelting operation. In conventional practice, when the chute gates of a chute are opened and a particular zone has been adequately charged, the gates of that chute are closed, also manually, and those of an adjacent chute are opened and that zone charged until the length of furnace served by the chutes, on each side, has been charged.

In addition to the manipulation of the gates, an operator engaged in charging will normally "rod" the material into the furnace as it enters the chute, in order to keep the chute from plugging and to gain increased tonnage. That is, the material is pushed through the chute by a manually operated rod.

A furnace is considered ready for another charging cycle when enough of the feed, which to a great extent reposes along the sidewalls of the furnace, has smelted away and melts into the molten bath maintained in the furnace. This smelting away of the feed charge leaves room for additional feed material to be introduced along the sidewalls of the furnace. This cycle of charging is continually repeated while the furnace is in operation.

In conventional charging, the charging cycles are usually set up to achieve a compromise between a maximum of copper matte tonnage output and a charging crew of a reasonable number of men.

Side-charging, which has been briefly described above and as conventionally practiced in the industry is subject to a number of drawbacks, some of which are as follows:

(a) Since heat transfer within a furnace is largely a function of the difference in temperature of the flame from the fuel burners and the charged feed, it follows that a frequently renewed layer of charge of limited thickness achieves greater fuel economy than that which results from less frequent charging, where the feed is piled to a greater depth along furnace sidewalls. Because charging frequency is limited by the practical considerations with respect to crew size, maximum utility of fuel for smelting is not attained.

(b) The manual rodding of feed into the furnace, an operation which almost invariably accompanies conventional side-charging, keeps certain furnace apertures open for extended periods. This causes infiltration of excessive amounts of cold air into the furnace, which retards the smelting rate.

(c) The men engaged in side-charging a reverberatory furnace normally work in close proximity to the furnace and are exposed for prolonged periods to the heat and fumes attendant to the smelting process.

This invention provides means and method for side-charging a reverberatory furnace which overcome the drawbacks mentioned above. Furthermore, use of the charging system provided by the invention results in an increase in furnace smelting capacity.

In accordance with the invention a line or row of spaced drop chutes are provided in the furnace roof, or arch, along each side of and adjacent the furnace sidewalls, each chute being equipped with an openable and closeable charge gate. Installed within each chute, below the charge gate, is a pivoted deflector plate counterweighted in such a manner as normally to close the chute but to open it a certain amount during charging so that feed passing through the charge chute impinges upon the deflector and at the cessation of charging of material through that chute, the counterbalanced deflector plate automatically moves to closed position. The deflector plate is preferably positioned so that it directs the feed passing through the charge chute further from the furnace sidewall than conventional side charging practice permitted, thus to cause the feed to be delivered at a place toward and nearer to the longitudinal center line of the furnace.

The charge gate of each chute in the preferred embodiment is provided with power driven means for opening and closing the gate automatically and in timed sequence, although these gates are such that they may be operated manually in certain instances, if desired.

The charge chutes in each row of chutes located along each side of the furnace, are fed from storage bins by a suitable conveyor device, which may be of known construction; such for example, as the drag chain type in which a power driven endless drag chain moves feed material through a feed channel by means of paddles attached to the endless chain; the bottom wall of the channel being provided with charge openings at the charge chutes. Other suitable conveyor devices, if desired, may be employed to carry the feed material to the chutes.

In accordance with a preferred embodiment of the invention, the charge gate of each charge chute is automatically operated by mechanical linkage connecting the gate and the piston rod of an air cylinder, which is operated in timed sequence by compressed air. This operation is controlled by electrically operated solenoid valves installed in the compressed air lines connected to the air cylinders. Each air cylinder, in the battery of air cylinders and chutes on each side of the furnace, is connected to a four-way electrically operated solenoid valve, which is connected to a compressed air line, which in turn is connected to a source of compressed air. One leg of the valve, when opened by electrical impulse, directs compressed air momentarily to its associated air cylinder;