

# UNITED STATES PATENT OFFICE

2,657,990

## FEEDING FURNACES

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Application March 29, 1949, Serial No. 84,166

9 Claims. (Cl. 75-74)

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This invention relates to a method of feeding or charging metallurgical furnaces, and more particularly is concerned with a procedure for introducing the raw materials to be smelted into a reverberatory furnace used for producing copper matte.

Various devices and procedures have been used heretofore for feeding reverberatory furnaces. Generally, such furnaces are operated continuously in that 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 some other reason.

One method of feeding such a furnace that has been used was the introduction of the charge through holes or ports in the center of the furnace roof or arch, allowing the charge to fall by gravity down into the bath. This center feed method could be used only for dry material however, and in more recent years has been largely superseded by the side feeding furnace.

The charging openings in the side feed furnaces are located at the edge of the arch along the skewback so that the charge piles up in sloping heaps along the interior side walls of the furnace. This was adopted with a view to protecting the side walls of the furnace and in an effort to approach continuous feeding and smelting. However, this method has the disadvantage of producing accumulations of solidified material on the floor or hearth of the furnace which gradually build up and reduce the size of the molten bath. Such solid accumulations include charged material that has never been melted but that has been forced down through the bath to a point where the temperatures are too low for melting, and other material which has separated out of the bath as a refractory substance.

The so-called gun-feed bath furnace has also been used with hot dry raw materials, and in this case the hot dry feed is introduced by gravity through retractable inclined conduits or pipes inserted through the side walls of the furnace so that they discharge at an elevation only a few inches above the surface of the bath and cause the calcine to spread over the surface of the bath. Such a feeding method, however, could not be used for moist or wet material.

In recent years, there has been considerable use of the reverberatory furnace to melt down concentrates from copper ore, these concentrates being unroasted and often moist, and in some cases even wet. This development was brought about by progress in the ore dressing

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field and the upgrading of concentrates from copper ore to such an extent that it became no longer necessary to roast the concentrates preliminary to smelting in order to make a copper matte of the desired high copper content for converting directly to blister copper.

By this procedure the three-step process of roasting, melting and converting has been reduced to a two-step process of melting and converting. However, because wet materials in contact with molten matte produce violent explosions it has been apparent that the old center feed or gun feed type of furnace could not be used, and the charging of such material has had to be confined to the side feed furnace with its attendant disadvantages. However, even with this method of feeding, operators are troubled by the fact that explosions do occur unless the greatest of care is exercised to prevent any substantial quantity of wet material from slipping down or rolling off the inclined heap of charge along the sides of the furnace and plunging into the bath.

Also, such moist or wet unroasted concentrates are not provided with adequate flux for the silicious matter, such as the iron oxide which is present in a roasted ore or concentrate, and this necessarily makes difficult the practice of smelting raw or wet sulfide concentrates in the reverberatory furnace. The fluxing of the non-sulfide or silicious portion of the charge is very haphazard with the side feeding method. In the two-stage melting-converting process all of the iron sulfide in the reverberatory furnace charge must be oxidized in the final or converting step and all of the iron oxide produced in the converter is returned at infrequent intervals to the reverberatory furnace in the form of molten converter slag.

For the best metallurgical results, such converter slag must not only be combined with additional silicious material to increase its silicate content to the point where it can be economically disposed of as reverberatory furnace slag, but also the condition of super-oxidation in which it arrives at the reverberatory furnace must be reduced by proper high temperature contact with sulphide or other reducing agent. These results are not properly accomplished in the side feed reverberatory furnace and the converter slag is likely to flow forwardly in the furnace more or less along the center line thereof and thus pick up only in a haphazard fashion the needed silica and sulfide material with which it should react. Another difficulty inherent in the side feed fur-