Patented Sept. 11, 1923. 1,467,797

UNITED STATES PATENT OFFICE.

BETHUNE GLASS KLUGH, OF ANNISTON, ALABAMA, ASSIGNOR TO SOUTHERN MANGANESE CORPORATION, OF ANNISTON, ALABAMA, A CORPORATION OF ALABAMA.

PRELIMINARY PREPARATION OF FURNACE CHARGES FOR ORE-SMELTING FURNACES.

No Drawing. Application filed June 7, 1918, Serial No. 238,691. Renewed February 15, 1923.

To all whom it may concern:

Be it known that I, BETHUNE GLASS KLUGH, a citizen of the United States, residing at Anniston, in the county of Calhoun, State of Alabama, have invented certain new and useful Improvements in Preliminary Preparation of Furnace Charges for Ore-Smelting Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to the preliminary preparation of furnace charges for ore smelting furnaces, and has for its principal object the obtaining of a preliminary product of such a character that it may be charged into the smelting or reduction furnace in such a condition as to constitute a practically uniform charge, wherein the constituent elements (that is to say the ore reducing material and such fluxes as are present) will be distributed throughout in the appropriate proportions for the smelting or reducing operation intended, and wherein, by reason of the preliminary preparation of the product, certain volatile constituents of the reducing agent employed and the gases capable of being driven off by calcination have been preliminarily expelled, so that they may not interfere with or delay the prompt beginning and regular progress of the smelting or reduction.

The invention is particularly appropriate for the preparation of furnace charges for electric smelting furnaces and especially for the preparation for such furnaces of furnace charges including a carbonate as the ore constituent, as, for instance, carbonate of manganese, whose admission as such into the electric furnace is accompanied with certain disadvantages hereinafter referred to. So also, as will hereinafter more fully appear, the invention supplies a means for minimizing the corroding effect of the manganese oxides (left after calcination) upon the furnace electrodes in that to a large extent the manner of distribution of the fuel content of the preliminarily prepared charge shields the electrodes by carbonaceous coating at those portions of the charge which are in contact with the electrode surfaces thereby correspondingly minimizing any tendency to excessive oxidation of the electrodes. Furthermore, the invention provides means for incorporating in the preliminarily prepared charge an appropriate amount of well disseminated coke or the like so as to correspondingly regulate the electric conductivity to suit particular exigencies of practice.

Broadly considered, the invention consists in intimately intermingling the ore and its constituent fluxes, in a finely crushed or ground condition, with carbonaceous material of such a character and in such a condition as to form with the ore a substantially homogeneous mixture, and then subjecting the mass (preferably in a closed retort or like chamber from which air is wholly or substantially excluded) to such a temperature as will coke or frit the mass, and which will incidentally drive off any constituents volatile at the temperature employed, which will be in the neighborhood of a low red heat; (say 500° C. to 575° C.). So also, any volatile products of calcination will be driven off from the ore, together with whatever moisture is contained in the mass. The product will be of a fritted or coke-like character, adapted for immediate use in the ore smelting or reducing furnace, or which may be stored or shipped for such use. As hereinbefore pointed out, there may be added to the mass, before it is inserted in the distilling and calcining retort or chamber such appropriate quantity of coke or the like as will determine its appropriate conductivity for electric furnace uses.

As the fuel constituent of the mass, I prefer to use pitch from the coal tar, wood tar, or petroleum distillation practice. Pitch from the coal tar distillation practice, in the form of heavy coal tar residues, still containing a percentage of bituminous material, is particularly advantageous, for the reason that it is solid at ordinary temperatures and can, therefore, be crushed or ground to the same mesh as the ore, thereby facilitating its homogeneous admixture with and distribution through the ore, and for the further reason that its melting point is not far removed from its solidification point, so that in the very early stages of the heating of the mixture in the distilling retort or chamber, an intimate adhesion of the coal tar pitch and the ore re-

sults, binding the mass together and insuring the production of a homogeneous coked product. These properties of coal tar pitch are in part present in pitch from the wood tar or petroleum distillation, and even in asphalt, which for some ores and for certain uses may be employed with advantage.

I find it desirable and appropriate to crush or grind the ore to such size that it will pass through a one-quarter inch mesh screen, and to similarly crush or grind the coal tar pitch or its equivalent. In some instances, however, instead of crushing or grinding the pitch employed, I may dissolve it in a suitable solvent, as, for instance, benzol; in such case, the distilling retort or chamber will be provided with connections to a suitable condensor wherein the solvent may be condensed and recovered for subsequent use.

The employment of the benzol or like solvent permits a particularly intimate and homogeneous distribution of the pitch (and consequently of the ultimate carbonaceous residue therefrom) within the mass and as a coating upon each individual particle of the ore.

I may also use, in substitution for, or in addition to the pitch, a rich coking coal of the bituminous variety, similarly crushed or ground and having the necessary binding qualities. The introduction of coal, instead of or in addition to the pitch has the the function of regulating the electric conductivity of the mass and may be employed for that purpose either with or without the introduction into the mass of coke per se.

The heating of the mass in the retorts or like chambers is proceeded with, under the conditions hereinbefore noted, until a coked or fritted mass is produced. At the termination of the operation, the retorts or chambers are drawn and the fritted or coke-like product, may be charged directly into the smelting or reduction furnace or, if it is to be used in the electric resistance furnace, of the type wherein the electrodes dip into the charge, it may be desirable to first crush or size the product for the electric furnace operation.

For the best results, it is desirable to so apply the heat to the retorts as to insure, as far as possible, uniformity of distribution of the heat over the top, bottom and sides of the retorts, thereby insuring a corresponding uniformity in the product. Any suitable form of retort or chamber may be employed, dependent upon the character of the ore and its associated fluxing constituents. In general, iron retorts will be found serviceable for the purpose.

In the practice of the invention, the operator will find it of advantage to employ that percentage of pitch or its equivalent which will yield the necessary proportion of carbon in the coked product for the smelting or reduction of the amount of ore present in the coked product. The invention permits the operator to very carefully adjust these relative percentages, so as to avoid waste of the reducing agent and, therefore, to insure corresponding economy of operation. In those instances where the electric conductivity of the furnace charge is to be regulated, the amount of addition and the electric conductivity of the addition for that purpose can likewise be carefully ascertained and predetermined.

Among the prominent advantages of the invention are that the predetermined proportioning of the several constituents of the furnace charge is accompanied further by the circumstance that these constituents are in close contact with each other and are homogeneously distributed throughout the mass, and that the mass itself is in a coherent form of such size and aggregate as is desirable in furnace operations, so that the furnace charge maintains its coherence until it is ultimately disintegrated by the chemical reactions incident to the reduction. The tendency of the materials of varying size and specific gravity to segregate in the furnace, which is a characteristic defect in the usual smelting furnace practice and which is productive of decreased output, lower recovery, and poorer quality of product, is to a large degree avoided in the use of the present invention. So also. as I have particularly pointed out, the diminution in the attack by the oxygen-bearing constituents of the charge upon the furnace electrodes, which diminution is a characteristic of the invention, permits the use of the electrode-resistance furnace in cases where the usual electrode consumption would otherwise make the operation commercially prohibitive.

I may say further that, in preparing the mixture of ore and pitch or its equivalent for the distilling retort or chamber, it may, in some instances, be desirable to wet the mixture, depending upon the kind and condition of the ore. So also, it is desirable that the entire charge be weighed and proportioned according to the desired ultimate furnace reactions and that the carbonaceous constituent be admixed in such amount as will produce the desired amount of residual carbon in the coked product for the required reactions to be consummated in the electric or other smelting or reducing furnace. In some cases, however, the particular local or commercial conditions prevailing may render it desirable that only a part of the smelting charge be treated in accordance with the process herein described. It will, of course, be understood, that to the extent to which such an operation involves the practice of the invention it is to be regarded

as included within the scope and intent thereof. Furthermore, it will be evident that the volatile products or by-products from the operation which progresses in the distilling retorts may be collected and saved as an adjunct to the general procedure.

As a particular exemplification of the practical employment of the process, I may specify its application to a form of manganese ores known mineralogically as rhodochrosite, which is, chemically, carbonate of manganese, approximating the chemical formula $MnCO_3$. The combined carbon dioxide in this ore is objectionable in smelting operations because the furnace energy is wasted in calcining the carbonate, excess of gases escaping through the charge, and the carbon dioxide, under the furnace conditions prevailing, attacks the carbon electrodes. It is, of course, possible to drive off the carbon dioxide by pre-calcination of the ore, but this is objectionable not only on account of the expense involved in so doing, but also on account of the disintegration of the ore down to excessive fines. The employment of the present invention, however, permits the carbon dioxide to be expelled simultaneously with the coking of the pitch or other carbonaceous material and the production of a coked agglomerate which, when properly sized, is particularly adapted to smelting or reduction in the electric furnace.

The invention is also of notable advantage in the preparation, for use in the electric reduction furnace, of native manganese oxide ores, manganese oxide ore concentrates, by-products consisting in whole or in part of manganese oxide, and the like, inasmuch as these materials by reason of their content of oxygen have, in the ordinary practice, a considerable corroding effect upon the electrodes, which corroding effect is greatly decreased by reason of the coating of carbon which the ore particles receive when coked or fritted in accordance with the process herein described. In fact, in the production of the coke-like mass from these materials, a portion of the oxygen combined with the manganese, is removed by partial reduction, thereby correspondingly relieving the amount of work imposed upon the electric furnace.

Having thus described my invention, what I claim is:

The method of facilitating the smelting of manganese carbonate ores, which comprises mixing the crushed ore with a proportion of carbonaceous coking material and simultaneously separating the carbon dioxide from the ore and the volatile constituents of the coking material by subjecting the mixture to a temperature in the neighborhood of a low red heat, whereby a homogeneous mass suitable for smelting is obtained.

In testimony whereof I affix my signature.

BETHUNE GLASS KLUGH.