

UNITED STATES PATENT OFFICE.

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PROCESS OF NODULIZING FINE ORES.

949,387.

Specification of Letters Patent.

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No Drawing.

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To all whom it may concern:

Be it known that I, JOSEPH WEATHERBY, Jr., a citizen of the United States, residing at New Cumberland, county of Cumberland, and State of Pennsylvania, have invented a certain new and useful Improvement in the Process of Nodulizing Fine Ores; and I do hereby declare the following to be a full, clear, and exact description of the same.

The present invention relates to processes of treating fine metallic ores, residues, flue dust or concentrates, whereby such fine materials are agglomerated or formed into nodules of appreciable size adapted for use in blast furnaces.

The objects of the invention are to provide an improved process whereby not only is a more effectual control of the furnace rendered possible and the danger and expense incident to the formation of rings and scaffolds overcome, but the nodules produced will be hard and porous, any oxygen present in the ore being partly eliminated.

A further object of the invention is to reduce the cost of the process of changing the physical form of the ore and to enable waste materials to be utilized in the production of a commercial product.

In carrying the invention into practice, known apparatus may be employed and various forms of such apparatus will at once suggest themselves, such, for instance, as a rotary kiln set at a slight inclination with a stack and ore entrance at the upper end and a nodule discharge and fuel supply or burner at the lower end.

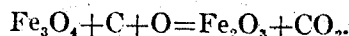
In the process of agglomerating or nodulizing as at present practiced, the fine material, usually previously mixed with a binding substance or agent, travels through the kiln and is agitated by the rotation of the latter so as to be thoroughly exposed to the action of the heat and gases, the rolling agitation and heat finally causing the fine particles to cohere in the form of nodules. The heat is such that the particles begin to form into nodules about midway of the length of the kiln and one of the serious difficulties encountered in practicing the process results from the formation of rings and scaffolds due to the adherence of the material to the walls of the kiln, this being especially liable to happen at or somewhat below the middle of the kiln where the ring

or scaffold cannot be removed without shutting down and cooling off the kiln.

In accordance with the present invention the fine material or ore is not heated to the point where agglomeration or nodulizing takes place until it reaches a point relatively near the discharge end of the kiln and at this point finely granulated carbonaceous material (coke or charcoal, for instance) is introduced and intimately mixed with the ore. The carbon particles becoming ignited consume oxygen from the ore and the ore particles adhere to the more highly heated carbonaceous material. Incipient fusion of the ore particles at once commences with the result that other particles adhere thereto and nodules are formed. The size of the nodules may be varied by varying the quantity of carbonaceous material introduced.

In practicing the invention it is preferable to introduce the fine carbonaceous material by blowing the same against or into the ore about six or eight feet from the discharge end where it will be thoroughly mixed with the ore as the latter is rolled or agitated by the rotation of the kiln.

The action at the nodulizing or agglomerating point is believed to be correctly indicated by the following formula:



The character of the resulting material is such that it does not take on oxygen in cooling and it, therefore, remains a stable product capable of being stored and handled economically. As the nodules are formed, the carbon particles contained therein continue to burn until they are wholly or partly consumed and the gases therefrom combine with the ore taking the place of the oxygen which is driven off and consumed in burning the carbon.

In practice the refuse coke dust discarded at the blast furnace has been successfully used and the economy of the process will be appreciated from the fact that good results have been obtained with the use of but one pound of coke to two hundred pounds of ore.

In the present process a lower temperature than heretofore, may be maintained to prevent the ore from fusing or sticking to the walls of the kiln and the increase in temperature due to the introduction and com-

bustion of the fine carbonaceous material takes place in the body of ore itself at the nodulizing point which point is so near the discharge end that, should clinkers or rings form, the same may be readily detached by a bar or instrument introduced through the discharge end without shutting down or cooling off the kiln.

Obviously, any desired means may be employed for introducing the fine carbonaceous material, but it is preferred that it be introduced in such manner that it is ignited from the ore or actually contacts with the ore before combustion has progressed to an appreciable degree. The fuel used in the burner may be either pulverized or gaseous, as in ordinary practice in nodulizing kilns or in cement burning kilns.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:—

1. The process of nodulizing or agglomerating fine metallic ores which consists in subjecting the ore to mechanical agitation and heat, then introducing and commingling carbonaceous combustible with the ore while still heated and in burning said combustible while in contact with the ore to raise the temperature of the ore particles to a higher degree.

2. The process of nodulizing or agglomerating fine metallic ores which consists in subjecting the ore to mechanical agitation and heat, then introducing carbonaceous

combustible into the ore while heated to a temperature sufficiently high to ignite the carbonaceous combustible and continuing the mechanical agitation during and subsequent to the introduction of the combustible.

3. The process of nodulizing or agglomerating fine ores which consists in subjecting the ore to mechanical agitation and heat, then introducing carbonaceous combustible into the ore while heated to a temperature insufficient to fuse the ore and in igniting said combustible and continuing the mechanical agitation during the combustion of the combustible.

4. The process of nodulizing or agglomerating fine ores which consists in subjecting the ore to agitation and heat insufficient to fuse the same, then while still heated and being agitated, introducing and commingling therewith a comminuted combustible substance which will effect the agglomeration of the fine particles.

5. The process of nodulizing or agglomerating fine metallic ores which consists in subjecting the ore to mechanical agitation and heat in a rotary kiln and in introducing comminuted carbonaceous combustible material into the ore in proximity to its point of discharge from the kiln.

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Witnesses:

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