UNITED STATES PATENT OFFICE.

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PROCESS OF AGGLOMERATING FINE ORES.

1,114,030. Specification of Letters Patent. Patented Oct. 20, 1914.

No Drawing. Application filed April 10, 1913. Serial No. 760,260.

To all whom it may concern:

Be it known that I, JAMES H. PAYNE, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented or discovered certain new and useful Improvements in Processes of Agglomerating Fine Ores, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to the treatment of fine ores and other comminuted metal bearing materials, such for example as "flue dust", and more particularly to the treatment of materials of this character containing a relatively high proportion of sulfur, for the purpose of making the same available for use in the blast furnace or other reducing operations. In order to make such finely divided or comminuted materials capable of commercial utilization it is necessary to convert the same into definite masses of appreciable size. This, in the case of iron and other metal bearing ores relatively low in sulfur, has been successfully accomplished by agglomeration or nodulization in accordance with a well known process described, for example, in the patents to Whitman, No. 978,971, Dec. 20, 1910; Dicke, No. 986,271, March 7, 1911; and King, No. 995,542, June 20, 1911. In accordance with this process the finely divided material is introduced into the upper end of an inclined, rotating kiln or furnace to the lower end of which heat is applied, usually by means of a suitable oil or other burner projecting into said lower end. The rotation of the kiln or furnace causes the material to travel downwardly therein, the heat first driving off the volatile matter in the material and finally, as such material approaches the lower end of the kiln, raising the temperature thereof to the point of incipient fusion, thus causing said material to become semi-plastic, so that, when agitated by rolling upon the interior of the rotating kiln, nodules, well adapted for further metallurgical operations, are produced and discharged from the lower end of the kiln. When, however, attempt is made to employ this process for the agglomeration of ores or materials containing a relatively high proportion of sulfur (by which is meant approximately 5% or over) such, for example, as sulfid ores of copper, certain difficulties are encountered. The process depends for its successful practice upon the fact that the material to be agglomerated is raised merely to its sintering temperature, or to the point of incipient fusion, so as to become semi-plastic, in which condition it may be readily rolled into nodules. If, however, the material be heated to a temperature considerably above this point, it will fuse completely, becoming too fluid to nodulize and adhering to the inner wall of the kiln. When copper and other ores containing a considerable proportion of sulfur are subjected to heat, the sulfur is expelled and ignited, and the heat generated by the combustion or oxidization thereof raises the temperature of the ore or other material to a point considerably above that of incipient fusion, so that successful agglomeration cannot be effected. In order to overcome these difficulties and to permit the agglomeration of copper and other sulfur-bearing ores or materials by means of the process above described, the present invention contemplates subjecting the material to be agglomerated to a treatment which will prevent the complete fusion thereof under the temperature generated by the oxidization of the sulfur. Preferably this is accomplished by mixing with said material a substance which produces a mixture, of which the melting point (that is the temperature at which more melting would occur, than is required for proper nodulization) will lie above the temperature thus generated. The substance employed for this purpose will depend upon the nature of the ore or material treated. The melting point of a material being at a minimum when said material is in a neutral condition, the substance added to raise the melting point of the mixture to be nodulized should be of a less nearly neutral character than that of the ore treated, being basic or acid according as the ore is of a basic or acid character. Thus, in operating upon a basic ore, lime or oxid of iron will preferably be added, whereas in operating upon an acid ore, silica or a silicious material is preferably mixed therewith. By so adding to the material to be agglomerated a substance which will cause the fusing point of the resultant mixture to be above the temperature generated by the oxidization of the sulfur, and then passing the same through the usual rotary kiln and applying heat thereto, preferably in the form of a short, fan-shaped flame at the lower end of the kiln, it

is found that the copper or other sulfur bearing ore may be successfully nodulized.

The admixture of the temperature raising material may be made prior to the introduction of the ore into the kiln or this material may be introduced into the kiln directly while the process is being carried on. In cases of ores or materials having a small proportion of sulfur, but sufficient to cause the difficulties above referred to, the latter course would preferably be followed. Thus the material to be agglomerated may first be introduced into the kiln in its natural condition, and the process carried on until the material begins to stick to the kiln wall, whereupon the introduction of a small quantity of lime or silica, as the case may be, into the kiln will cause the material at once to separate from the kiln walls and agglomerate. By this method the amount of foreign material added may be reduced to a minimum. In ordinary cases, however, as, for example, in treating sulfid copper ores which contain approximately 15% of sulfur, the silica or lime is preferably added before the material is introduced into the kiln. Should accretions at any time begin to accumulate so as to hinder the proper working of the kiln, a quantity of material or mixture of an essentially higher melting point is fed in, either with or without stopping the supply of the material previously fed, the result being to remove the accretions already formed. In this way the process may be carried on continuously, it being unnecessary to regulate carefully the proportions of the added material or temperature raising substance, a less or greater quantity being used according as the agglomeration is taking place properly or not. The foregoing results may also be accomplished by adding to the material a substance which contains an ingredient which, in addition to producing a mixture capable of withstanding the high temperature without too much melting, will act as a retarder upon the effective application of the heat generated by the combustion of the sulfur, that is to say a substance capable of endothermic decomposition. A suitable material for this purpose is an alkaline earth sulfate, for example, calcium sulfate, the breaking up of which is endothermic, and which leaves lime, which as above stated prevents too ready fusion of the ore. The oxidization of the sulfur, as above explained, develops a high heat exothermically, so that the addition of a small quantity of calcium sulfate or other retarder having an endothermic action will arrest the fusion until the material has passed through the heat zone of the kiln and permit said material to nodulize.

It will be understood that the substances added to the ore or other material to be agglomerated for the purpose described need not necessarily be in even an approximately poor state, that is to say barren of valuable metallic content. On the contrary in all instances the desired result can be secured by the use of metallic ores which possess the necessary acid, basic, or other characteristics.

Having thus described my invention, I claim:

1. The process of agglomerating comminuted material containing a relatively high proportion of sulfur which consists in mixing with said material a substance which will prevent the complete fusion of the mixture under the influence of the temperature generated by the oxidization of sulfur, applying sufficient heat to said mixture to cause the same to become semi-plastic, and agitating the mass by rolling the same.

2. A process of agglomerating comminuted ores of an acid character, containing a relatively high proportion of sulfur, which comprises mixing with said ores a substance having a more strongly acid character than said ores, in amount sufficient to prevent over fusion, applying sufficient heat to said mixture to cause the same to become semi-plastic, and while in said condition, causing the particles to agglomerate with each other.

3. The process of agglomerating fine sulfid ore of copper which consists in mixing with said ore a substance which raises the point of complete fusion of the mixture above the temperature generated by the oxidization of sulfur, applying sufficient heat to said mixture to cause the same to become semi-plastic, and agitating the mass by rolling the same.

4. The process of agglomerating comminuted material containing a relatively high proportion of sulfur which consists in mixing with said material a quantity of silicious material, applying sufficient heat to said mixture to cause the same to become semi-plastic, and agitating the mass by rolling the same.

5. The process of agglomerating fine sulfid ore of copper which consists in mixing with said ore a quantity of silicious material, applying sufficient heat to said mixture to cause the same to become semi-plastic, and agitating the mass by rolling the same.

In testimony whereof I affix my signature, in presence of two witnesses.

JAMES H. PAYNE.

Witnesses:
MARY C. GREIL,
ALLEN BRYANT.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."