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(54) METHOD FOR GRINDING SINTERABLE POWDERED MATERIAL

(71) We, I.O.S. INDUSTRIA OSSIDI SINTERIZZATI S.r.l., an Italian Company, of Malgesso, Varese, Italy, do hereby declare this invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention concerns a method for grinding sinterable powdered material, more especially ferrites of barium, of strontium and of lead.

In the present state of the art, the grinding of powdered materials in the so-called ball mill takes place by introducing the material into the grinding chamber together with balls which in practice are steel spheres having a diameter of about 9 mm. Operation of the mill causes propulsion of the spheres which, by rubbing against the material and colliding with one another, grind the material with which they are mixed. However, the spheres, indeed constituting the grinding members, undergo in their turn a certain amount of self-grinding and the particles which result therefrom are mixed intimately with the material being worked to form a heterogeneous component thereof. This is a serious problem in special conditions where the material to be worked is harder than the material of the grinding bodies and when the heterogeneous component constitutes a pollutant of the material to be worked. For example, in a process for grinding ferrites of barium, of strontium or of lead having an initial granulometry of 3 to 4 microns which has to be reduced to a final fineness of one micron through a process lasting quite a lot of hours and carried out with steel spheres having a diameter of 9 millimetres, the loss in weight of the steel spheres is 2 kilograms for each 100 kilograms of finished material, that is to say that the finished material is 98% ferrite of barium, strontium or lead and 2% steel.

Another disadvantage which results from the use of steel grinding bodies is that the grinding bodies do not remain effective until exhausted but are effective only within a range of diameters between the nominal diameter and two-thirds approximately of the nominal diameter. For example a sphere of 9 millimetres nominal diameter can be used effectively as long as its diameter does not drop below about 6 millimetres, that is to say that when the grinding bodies have lost about one-third of their nominal diameter they have to be rejected and replaced with new grinding bodies at a cost which is not inconsiderable.

The object of the present invention is to obviate the disadvantages mentioned above in respect of the grinding of sinterable materials.

With this object in view the present invention provides a method of grinding sinterable powdered materials such as ferrites of barium, of strontium and of lead, wherein the grinding is effected in a mill containing grinding bodies having at least their outer portions formed from a sintered material which does not form or comprise a contaminant to the powdered material.

The general case is that of the grinding of sinterable powders which, once sintered, assume a degree of hardness approximating that of the powders of which they are composed. Use of the invention can be extended to those cases where the material to be ground has at is disposal surrogates (or substitutes), succedanea (or substitutes) or products of synthesis capable of carrying out the function of grinding bodies without constituting a pollutant of the material being worked. When these conditions occur, several advantages result therefrom. Above all else, pollution is eliminated. The grinding bodies of the majority of cases will be able to be prepared directly by the firm which

uses them in that generally whoever grinds sinterable powders then transforms them into sintered manufactured goods. Since the supplying of the spheres constitutes an important component of the production costs of the ground matter, the self-supply of the grinding bodies can be considered as an economical solution and lead as a consequence to economies of scale. Furthermore, when the material of the grinding bodies is homogeneous as regards the material to be ground, in other words is the very material to be ground, the grinding bodies whose diameters have been reduced beyond one third of the nominal diameter are left in the mill. In fact, so long as they can carry out any grinding function they are left because of the fact that, then, they assume the function of the material being ground with total recovery of the material from the grinding bodies.

The method through which one can pass from the sinterable powder to the grinding bodies, that is to say to sintered spheres, is known and therefore does not need any special description.

Rather, in order better to expound the features of the present invention, reference is made to the following examples which show some possible embodiments in a diagrammatic and purely explanatory manner.

Conventional example

To grind 500 kg of powder of ferrite of barium ($BaO\text{-}6Fe_2O_3$), the powder was put into a grinding chamber of a so-called ball mill together with 4,OOO kg of new steel spheres having a diameter of 11 millimetres. The mill was set rotating at a speed of 18 revolutions per minute with prior addition of 500 litres of water.

Grinding was carried out for 22 hours until the powder being ground, which initially had a granulometry of 3 to 4 microns, reached a granulometry of about 1 micron.

At this point the mill was stopped and emptied. The ground matter was separated from the grinding bodies and from the water; the first two were weighed and it was found that the weight of the material to be ground had increased by 11 kg with regard to the initial value, while the weight of the grinding bodies had correspondingly decreased substantially by an equal weight. The powdered material was then sintered in standard conditions into bodies of the following characteristics; parellelepipedons of dimensions 8 x 35 x 20 mm. and had the following magnetic characteristics:

Remanance: 3625 Gauss. Coercitive field: 2245 Oersted.

Example I

To grind 500 kg of powder of ferrite of barium ($BaO\text{-}6Fe_2O_3$) with a granulometry of 3 to 4 microns, grinding bodies as followed were prepared:

Powder of ferrite of barium of a granulometry of 1 micron was pressed in a suitable mould to form spherical bodies of about 11.5 millimetres diameter. During the pressing, the most up-to-date devices and technologies were used to achieve the maximum density. Then the grinding bodies being prepared were subjected to sintering, here too taking care to operate so as to attain the maximum final density, so that the specific weight of the grinding bodies was 4.9 and the diameter was about 11 mm.

Some 2,800 kg of these spheres were placed, together with the powder to be ground, into a mill of the so-called ball type, with the addition of 500 litres of water.

Grinding was conducted at a speed of 26 revolutions per minute for 19 hours during which the granulometry of the matter being ground was reduced from the initial 3 - 4 microns to about 1 micron. The mill was stopped and emptied and the ground matter was separated from the grinding bodies which were weighed after removing the water. The ground matter had an increased weight of 505.8 kg and correspondingly the grinding bodies had a reduced weight of 2,794.2 kg. From the ground matter obtained, there were formed sintered bodies of characteristics corresponding to those of the conventional example. They had the following magnetic characteristics;

Remanance 3823 Gauss; Coercitive field: 2480 Oersted.

Since the invention has been described and illustrated merely by way of example and not restrictively, numerous modifications can be made to its whole and to its details, without however departing from the scope of the invention as set forth in the appended claims.

WHAT WE CLAIM IS:-

1. A method of grinding sinterable powdered materials such as ferrites of barium, of strontium and of lead, wherein the grinding is effected in a mill containing grinding bodies having at least their outer portions formed from a sintered material which does not form or comprise a contaminant to the powdered material.

2. A method as claimed in claim 1 in which the sintered material has the same constituents as the powdered material to be ground.

3. A method as claimed in claim 1 or 2 in which the grinding bodies are formed entirely by sintered material.

4. A method as claimed in any preceding claim in which the grinding bodies are balls.

5. A method of grinding sinterable powdered materials, as claimed in claim 1 and

substantially as hereinbefore described, with reference to example I.

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