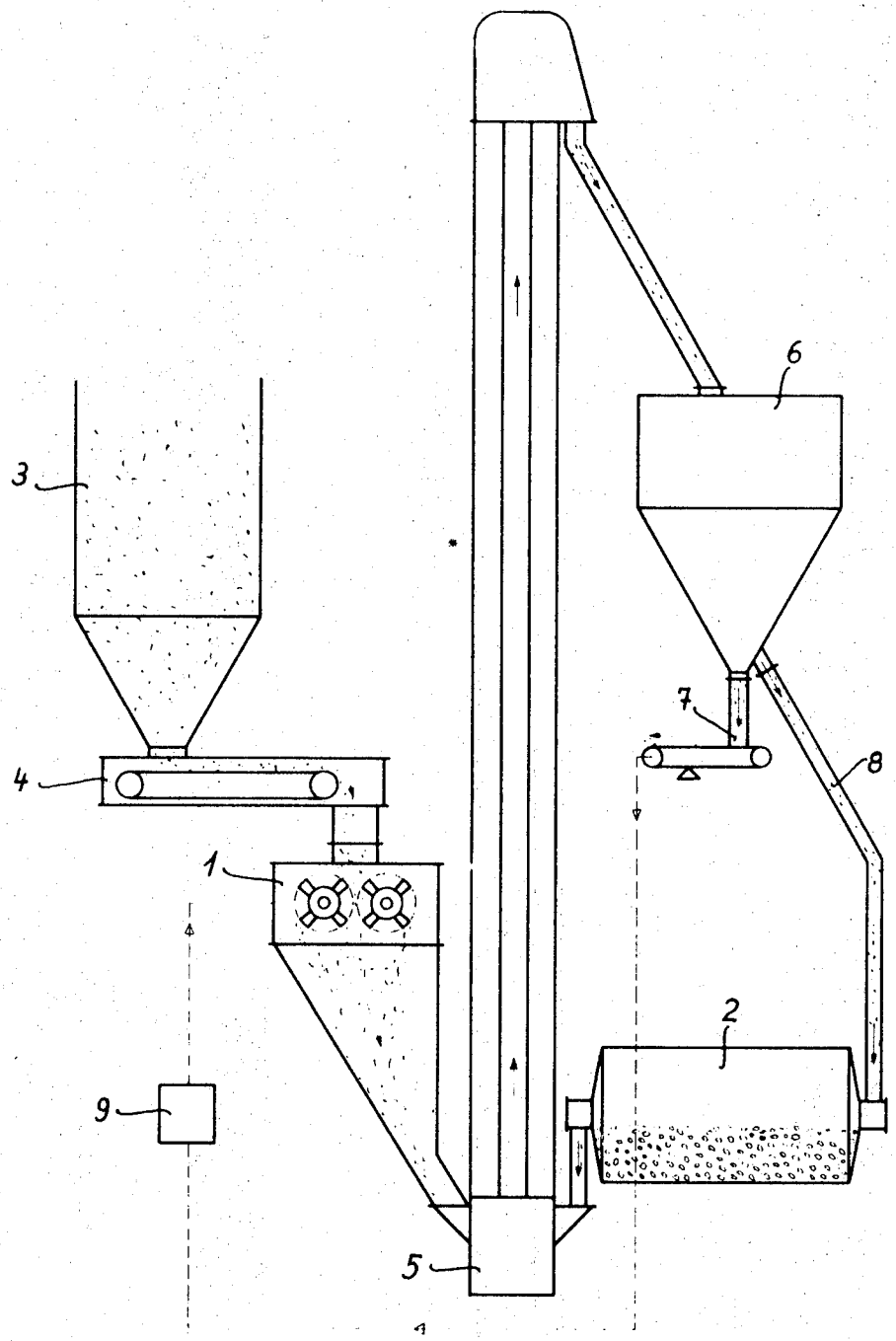
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GRINDING METHOD AND SYSTEM

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GRINDING METHOD AND SYSTEM

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ABSTRACT OF THE DISCLOSURE

In a method and apparatus for grinding a constant feed of materials of different grindability to a constant fines output in a hammer mill and a subsequent tube mill, the entire output of the hammer mill is passed into a classifier which recirculates the tailings through the tube mill and passes the fines into a control means adjusting the efficiency of the hammer mill so as to maintain also the fines output constant; when the fines output decreases, said control means increases the efficiency of the hammer mill, and when the fines output increases, said efficiency is decreased accordingly.

This invention relates to a method and apparatus for pulverizing material of different grindability and frangibility.

For pulverization, it is known to use tube mills which receive and grind material which has been previously reduced in a high speed mill fed with the original raw material. If the raw feed material is not uniform as to grindability and/or particle size, the pulverized end product will not be uniform, provided that similar amounts will be subjected to the grinding operation. It is also known that the operating efficiency of tube mills cannot be changed during operation. Changing the speed of rotation of a tube mill inherently reduced the output because tube mills are set for optimum grinding efficiency by proper selection of the tube diameter, rate of rotation, type and amount of ball charge, construction of the liners, etc. A change in the output can be obtained only by adjusting the feed of the material. Thereby, the grinding efficiency decreases.

Basically, a tube mill operates as follows: When the feed rate is increased, the proportion of coarse grain increases; when the degree of hardness of the raw material increases, the output remains the same but the proportion of coarse grain increases in this case too; when the feed rate is decreased, the proportion of coarse grain decreases, and this is true also for softer material, while the output remains always the same. Therefore, in designing the mill, a safety distance from its maximum output should be taken into account. A change in the rate of feed and any other deviation from the maximum setting regarding proportion and amount of pulverized end product involves an increased power input per unit by weight of the finely ground end product and, in addition, increased wear of the grinding elements and linings.

In contrast to tube mills, the grinding efficiency of high-speed mills can be changed during operation by means of the speed of rotation or also by adjusting the grate bars. Such variations are limited by the increased wear caused by an increase in the output of the end product. As a matter of principle, however, it is possible to grind in a high speed mill material of widely differing properties, to tube mill fineness.

Many systems have been proposed to overcome the recited difficulties. One proposal consists in providing a hammer mill-tube mill combination and to control the feed of the hammer mill as a function of the grindability

of the material; this means that the feed is decreased when more difficulty grindable material appears, whereby the grindability is determined by the values measured in the hammer mill. The output of the hammer mill is then corresponding to the respective optimum load of the tube mill. Generally, however, the aggregates of such mill combinations operate independently of each other, whereby the hammer mill produces a supply of reduced material collected in a bin.

It is a principal object of the invention to provide a method of supplying a constant feed of material to the mill system and of recovering continuously the same quantity in the form of pulverized material of homogeneous grain size.

It is a further object of the invention to provide apparatus suitable for carrying out said method and using a combination of hammer mill and tube mill under conditions where the hammer mill is subjected to wear as little as possible and the output of the tube mill is optimized.

In accordance with the invention, the degree of size reduction of the material in the high speed mill is increased when the output of finished end product from the classifier decreases. Said latter output will decrease always when the mill system is passed by difficultly grindable material. Corresponding to the decrease of the output of finished material, the proportion of preground material supplied to the tube mill will increase. If, in accordance with the invention, the output of finely ground material in the hammer mill is increased, e.g., by increasing the number of beats per unit of time, then the proportion of coarser grain from the classifier will decrease and the proportion of fines will approach the desired value. As soon as the hammer mill receives readily grindable material, the proportion of fines will exceed the selected value, and the fines output of the hammer mill will be decreased.

As the hammer mill is subjected to severe loads only intermittently, the wear can be maintained within reasonable limits.

The control of the hammer mill as a function of the fines output is established by known control means using volumetric or gravimetric parameters. As set forth above, the adjustment can be made by increasing the rotary speed and therefore the number of beats per unit of time or by adjusting the position or spacing of the grinding grate bars. The adjustment of the high speed mill to material of different hardness or frangibility takes place very quickly because the material passes very fast the hammer mill as well as the classifier.

An illustrative embodiment of the invention is shown in the accompanying drawing where the only figure is a schematic view of a grinding system embodying the invention.

Referring now to the drawing, the apparatus shown therein as a preferred embodiment of the invention comprises a hammer mill **1** and a ball tube mill **2**. The hammer mill **1** receives the material from hopper **3** over conveyor means **4** and passes it in reduced form to a bucket or other suitable type of elevator **5**; the elevator feeds the material into the classifier **6** from which the finished pulverized material is withdrawn through outlet **7** while the tailings pass through line **8** into the tube mill **2** from which the ground material also flows into the elevator **5**. The fines coming from outlet **7** actuate the control means **9** which adjusts the fines output of mill **1**. The setting for the desired value of the output of the system is effected at the conveyor means **4**.

I claim:

1. A method of pulverizing materials of different properties comprising the steps of feeding raw materials to

a first mill at a substantially constant rate, said first mill having a variable particle size output capacity, passing the entire output of the first mill directly to the input of a classifier, withdrawing all of the fines from said classifier, passing all of the tailings from the classifier to a second mill, passing the entire output of the second mill with the output of the first mill to the input of the first mentioned classifier, and controlling the output capacity of the first mill in accordance with the fines withdrawn from the classifier.

2. A grinding system for continuous pulverization of materials of different properties at a substantially constant rate comprising primary grinding means having variable particle size output capacity, means for delivering raw material directly to the input of said primary grinding means at a fixed rate, secondary grinding means, classifier means, means for conveying all of the output of said primary and secondary grinding means to the input of said classifier means, means for withdrawing all of the fines from the classifier means, means for conveying all of the tailings from the classifier means to the input of said secondary grinding means, and means for controlling the output of the primary grinding means in accordance with the fines withdrawn from the classifier means.

3. A system as claimed in claim **2** wherein said primary grinding means is a high speed mill and the secondary grinding means is a tube mill.

4. A system as claimed in claim **2** wherein said high speed mill is a hammer mill.

5. A system as claimed in claim **4** wherein said means for controlling the output of the primary grinding means includes means for adjusting the rotary speed of said hammer mill.

6. A system as claimed in claim **4** wherein said means for controlling the output of the primary grinding means includes means for adjusting the spacing of the grinding grate bars of said hammer mill.

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