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[54] **MILL FOR GRINDING MINERALS**

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[52] **U.S. Cl.** **241/30;** 241/DIG. 2

[51] **Int. Cl.** **B02c 1/12**

[58] **Field of Search** 241/DIG. 2, 30

[56] **References Cited**

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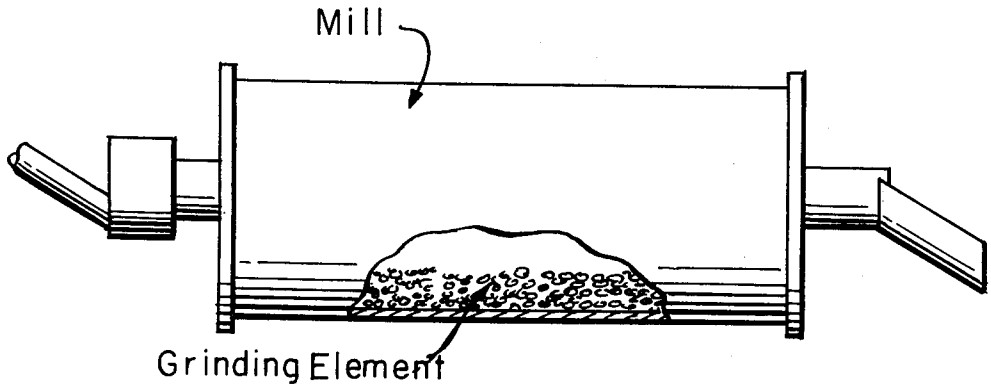
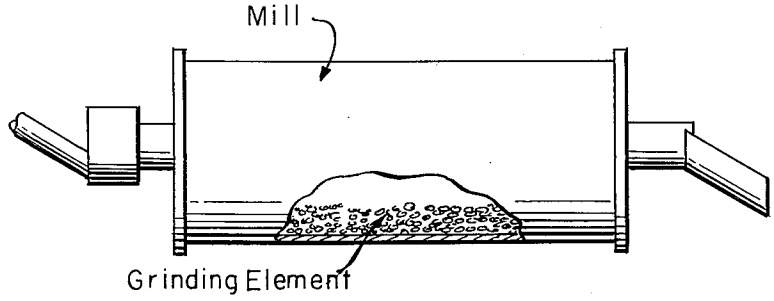
[57] **ABSTRACT**

Grinding elements containing 30 to 70% by weight of zirconium oxide, 0.1 to 5% by weight of aluminum oxide and 5 to 20% by weight of silicon oxide, process of grinding and mills containing the grinding elements.

20 Claims, 1 Drawing Figure




Mill
Grinding Element

MILL FOR GRINDING MINERALS

The present invention relates to a mill for grinding minerals which are used as pigments or fillers.

It is known to carry out the grinding of mineral products, such as chalk, crystalline calcium carbonate, dolomite, kaolin, lime etc., which are used as pigments or mineral fillers either by dry grinding or by wet grinding. In the last-mentioned case grinding takes place either in ball mills with a horizontal axis, the grinding elements generally consisting of grinding stones of maritime origin or of steel balls, or in mills with a vertical axis, so-called sand mills or bead mills or, quite generally, in mills with micro grinding elements.

The sand mills which are most widely used consist of a cylindrical mill body with a vertical axis and a rotor with discs or crowns, the rotor simultaneously moving the grinding elements and the liquid suspension of the material to be ground in the cylinder.

The liquid suspension of the material to be ground enters the mill at the bottom and is discharged at the top by means of an overflow.

The known grinding elements consist of sand, glass balls, stearite balls, molocite balls, steel balls or nylon balls.

Especially in the case where pigments or fillers are to be produced with a high degree of whiteness and high chemical purity, the known grinding elements have the disadvantage of contaminating the materials to be ground, due to rapid wear. Another disadvantage of the known grinding elements consists in that they can only be used for suspensions of comparatively low viscosity because of their low specific weight. In other words: with a given type of mill and, for example, glass balls, the concentration of the solids is limited by the viscosity which cannot be exceeded.

It is therefore a task of the present invention to provide a mill for grinding minerals wherein pigments and fillers can be produced with a high degree of whiteness and fineness and wherein suspensions of high viscosity can be processed.

This task is solved according to the invention in that the grinding elements consist of 30 – 70% by weight of zirconium oxide, 0.1 – 5% by weight of aluminium oxide and 5 – 20% by weight of silicon oxide.

Ball mills the balls of which have a diameter of 0.5 – 10 cm, bead mills the balls of which have a diameter of 0.05 – 0.5 cm, preferably 0.1 – 0.25 cm, or sand mills are preferably used.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is representative of one type of mill which can employ the grinding elements in accordance with the present invention.

The grinding elements used according to the invention have a smooth surface. Apart from their great hardness and their resistance to abrasion, one of the most important properties of the grinding elements of the invention is their specific weight amounting to 3.5 – 5, dependent upon the content of zirconium oxide.

With the aid of the grinding elements according to the invention it is now even possible to grind "soft" minerals (hardness 1 according to Mohs), especially chalk from coccolith shells and talc, in such a way that a specific surface of over 12 sq.m/g is obtained; hitherto this has only been possible in an economically viable way with "hard" minerals such as Carrara marble, if at all.

Further advantages and features of the invention can be seen from the following example:

A mill was charged with 920 kg of grinding elements in the form of balls according to the invention with a diameter of between 1 and 2.5 cm.

The material to be ground consisted of an aqueous suspension of chalk with a concentration of 64% solids. The throughput amounted to 1,000 litres/h. A product with 95 – 98% of particles below 2 microns and a degree of whiteness of 95% Elrepho (blue filter) was obtained.

When the mill was operated under the same conditions and with the same chalk but with glass balls, it was only possible to achieve a maximum fineness of 90% of particles below 2 microns and a degree of whiteness of only 93% Elrepho (blue filter).

In comparison with the use of glass balls as grinding elements, the specific surface of the finished product was found to have increased by 20 – 25%. It was also found that, in contrast to the use of glass balls, the mill performed with satisfactory regularity and that the ampere value remained constant and no vibration occurred.

The increase in the degree of whiteness achieved by using the mill according to the invention can be explained not only by the increase in fineness but also by a substantially lower contamination of the finished product. In fact, the wear of the balls used was substantially lower than that of glass balls, as is shown by the following comparison.

Balls used according to the invention: 0.3 kg/t finished product; glass balls: 1 – 1.3 kg/t finished product.

Another advantage of the present invention consists in the fact that the grinding elements based on zirconium, in contrast to balls of glass or other substances, do not contain metals such as lead, manganese, copper etc. which could lead to contamination of the finished product.

A further advantage of the mill according to the invention consists in the possibility of grinding aqueous suspensions of substantially higher viscosities and hence substantially higher solids concentration than with the use of grinding elements of different composition, and this results in a higher throughput while the fineness obtained remains the same. On account of the high specific weight of the grinding elements, the concentration of solid particles in the material to be ground can be increased to 70% in the process of the invention, whereas in the case of, for example, glass balls, the optimal concentration is about 64%, the fineness achieved being the same in both cases.

A further advantage of the mill of the invention consists in that substances of a comparatively high specific weight can be ground such as e.g. barite or various lead salts.

What we claim is:

1. A mill for grinding minerals for use as a pigment or filler, the mill having grinding elements comprising 30 to 70% by weight of zirconium oxide, 0.1 to 5% by weight of aluminium oxide and 5 to 20% by weight of silicon oxide.

2. A mill according to claim **1** in the form of a ball mill, the grinding elements comprising balls having a diameter of from 0.5 to 10 cm.

3. A mill according to claim **1** in the form of a bead mill, the grinding elements comprising balls having a diameter of from 0.05 to 0.5 cm.

4. The mill of claim 1 wherein said grinding elements ave a specific weight of 3.5 to 5.

5. The mill of claim 1 wherein said grinding elements omprise balls having a diameter of 0.1 to 0.25 cm.

6. A process for grinding of a material which comrises grinding said material in a mill having grinding lements comprising 30 to 70% by weight of zirconium xide, 0.1 to 5% by weight of aluminum oxide and 5 to 0% by weight of silicon oxide.

7. The process of claim 6 wherein said grinding ele- ients comprise balls having a diameter of from 0.5 to 0 cm.

8. The process of claim 7 wherein said material comrises coccolith shells or talc.

9. The process of claim 6 wherein said grinding ele- ients comprise balls having a diameter of from 0.05 to .5 cm.

10. The process of claim 9 wherein said material omprises coccolith shells or talc.

11. The process of claim 6 wherein said grinding ele- ients have specific weight of 3.5 to 5.

12. The process of claim 11 wherein said material comprises coccolith shells or talc.

13. The process of claim 6 wherein said grinding elements comprise balls having a diameter of 0.1 to 0.25 cm.

14. The process of claim 13 wherein said material comprises coccolith shells or talc.

15. The process of claim 6 wherein said material comprises coccolith shells or talc.

16. A ground material when produced by a process in accordance claim 15.

17. Grinding element for grinding minerals in a mill comprising 30 to 70% by weight of zirconium oxide, 0.1 to 5% by weight of aluminum oxide and 5 to 20% by weight of silicon oxide.

18. The grinding element of claim 17 comprising balls having a diameter of from 0.5 to 10 cm.

19. The grinding element of claim 17 comprising balls having a diameter of from 0.05 to 0.5 cm.

20. The grinding element of claim 17 which comprises balls having a diameter of 0.1 to 0.25 cm.

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