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METHOD OF GRINDING QUICKLIME

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Fig. 1

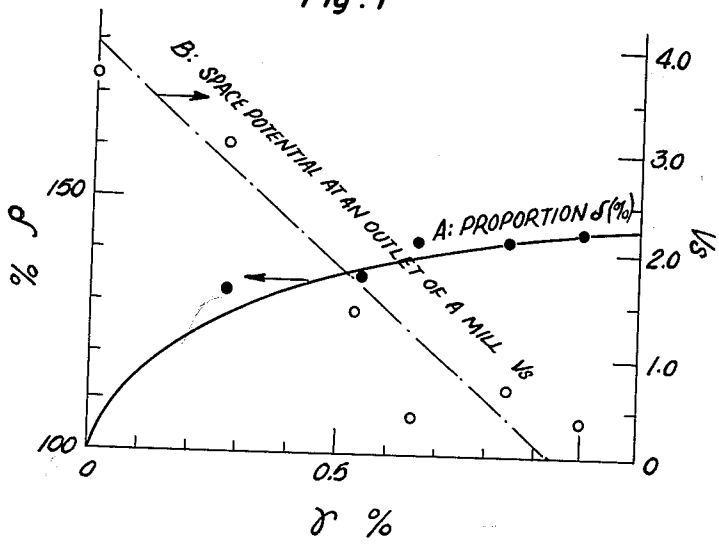
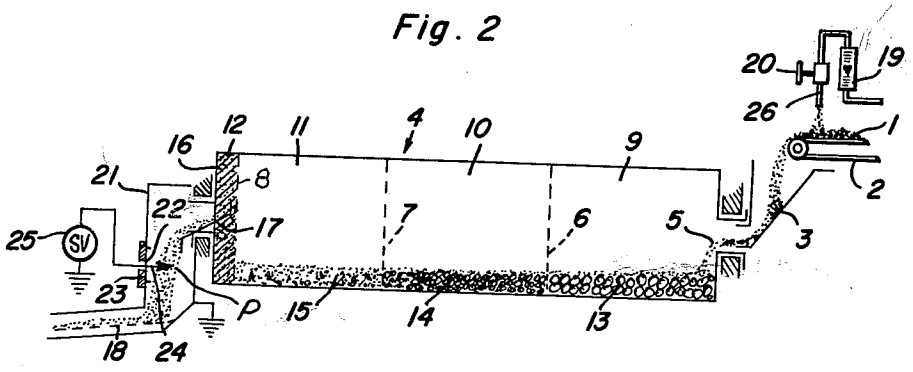


Fig. 2



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METHOD OF GRINDING QUICKLIME

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4 Claims. (Cl. 241—16)

The present invention relates to an improvement in the method of grinding quicklime by means of a ball mill.

In the past, the grinding of quicklime was extremely difficult, since quicklime generates a large amount of electrostatic charge upon being ground by a mill due to its inherently very high electric resistivity, and thereby the powders of quicklime deposit and solidify on the inner wall or balls of the mill or aggregate themselves into granules, resulting in absorption of impulsive forces caused by the ball mill.

The present invention provides a novel method for eliminating the above disadvantages and remarkably improving a grinding power of quicklime grinding mill by removing electrostatic charges generated therein through a very simple and less-expensive way.

One feature of the present invention exists in that very small proportion of either liquid water or saturated steam which is apt to condense into minute water drops with respect to the amount of quicklime to be ground is poured into a quicklime grinding mill so as to be absorbed by a part of CaO to form $Ca(OH)_2$ which is electrically conductive, and thus lowers, as a whole, the virtual electric resistance of the quicklime powders to be ground within the mill, whereby the generated electrostatic charges are removed away through electric conduction to eliminate the above-referred disadvantages and the grinding power of the mill may be remarkably improved.

In this connection, the proportion of the amount in weight of the liquid water or saturated steam to be poured or jetted per unit time versus the amount in weight of the quicklime to be supplied per unit time is selected, in such manner that the relative amount of the water is sufficient enough to afford the quicklime lime powders such a virtual electric resistance as well as removing the disadvantageous electric charges generated within the ball mill, but is not so large as generating excessive heat of reaction due to bonding of CaO and H_2O.

In order to pour water into a mill, it may be either dispersed into or dropped on the quicklime to be ground before being supplied into the mill so as to be introduced into the mill together with the quicklime to be ground, or alternatively a pouring pipe or a nozzle may be provided at the inlet or outlet of the mill so that the pouring or spraying of water may be achieved therethrough. For pouring saturated steam into the mill, also a pipe may be provided at the inlet or outlet of the mill, and the saturated steam may be jetted therethrough.

These and other features and advantages of the invention will become more apparent upon perusal of the following description taken in connection with the accompanying drawing, in which;

FIG. 1 is a diagram showing the effect of pouring or jetting various proportions of water with respect to supplied quicklime, in which the proportion γ(percent) indicated in abscissa, represents the percent of the amount in weight of the water or saturated steam to be poured or jetted per unit time versus the amount in weight of the quicklime to be supplied per unit time, while δ(percent) indicated in ordinate, represents the proportion of the amount in weight of the quicklime ground per unit of time upon pouring or jetting of water or saturated steam versus the amount in weight of the quicklime ground per unit time without pouring or jetting water or saturated steam,, and V_S (kv.) also indicated in ordinate, represents a space potential at an outlet of a ball mill, and

FIG. 2 is a schematic view of a practical apparatus for practicing the method according to the present invention.

Referring now to the drawing, the relation between the proportion γ(percent) of the amount in weight of water or saturated steam poured or jetted per unit time versus the amount in weight of quicklime supplied per unit time to a mill upon operating the mill in such manner that the supplying rate of the quicklime at its inlet is regulated so as to maintain a predetermined fineness of the finished powders at its outlet, and the proportion δ(percent) of the corresponding ground amount per unit time with respect to the reference ground amount per unit time without pouring water or jetting saturated steam for example, (395 kg./h. per 1 ton of balls), is indicated by curve A in FIG. 1. As will be seen from the figure, the above referred proportion δ(percent) and consequently the ground amount per unit time rapidly increases as the relative pouring or jetting amount per unit time of water or saturated steam is increased, but it tends to saturate at the neighborhood of $\gamma=0.3\%$, and thus even if the relative pouring amount per unit time were increased to higher than $\gamma=1.0\%$, no more effect could be recognized. Therefore, when the method of removing electrostatic charges according to the present invention is practiced, the amount in weight of water or saturated steam to be poured or jetted per unit time may be taken, in any case, between 0.1 and 5% with respect to the amount in weight of the quicklime supplied to the mill per unit time, and in usual it may be sufficient if selected between 0.3 and 1.0% in term of the proportion γ(percent). In addition, in the case of such degree of small proportion of poured water or jetted saturated steam, the loss of CaO is quite small, and also the temperature increase of the quicklime powders at the outlet due to bonding of CaO and H_2O is maintained within a small value, such as 10° to 20° C. for water and 10° to 40° C. for steam, thus resulting in no substantial disadvantage with regard to the operation of the mill and the quality of products.

When an insulated needle-shaped electric charge collector 24 is disposed in such manner that its tip is located at the center P of the falling stream of finished powders at the outlet of the mill as shown in FIG. 2, the needle-shaped electric charge collector becomes to have the same potential as that of point A due to a sharp-end discharge. Accordingly, by connecting said electric charge collector to an electrostatic voltmeter 25, the space potential V_S at the center P of the falling stream of finished powders may be measured. Generally, in the case of a quicklime grinding mill, the finished powders at the outlet of the mill are negatively charged due to the generation of electrostatic charges within the mill, and therefore V_S indicates the negative potential which is proportional to the amount of generated electric charge. As the electrostatic charge generated within the mill is removed, the potential V_S will naturally decrease. Curve B in FIG. 1 shows the relation between the above-referred proportion γ(percent) and the potential V_S. More particularly, when $\gamma=0$, V_S is indicated as about 4 kv., and it lowers linearly as γ increases until it becomes 0 at the neighborhood of $\gamma=0.9\%$. The potential V_S is about 2.7 kv. when

γ=0.3%. Therefore, the amount of water or saturated steam to be poured or jetted per unit time could be selected by measuring Vs so that the value of Vs may become lower than about 3 kv.

As a preferred example for practicing the method for improvement in grinding quicklime according to the present invention, there is shown in FIG. 2 an apparatus in which water is dropped on quicklime to be ground before being supplied into a mill, and supplied into the mill together with the quicklime to be ground.

In the same figure, quicklime to be ground **1** is carried towards an inlet **5** of a mill **4** by means of a belt conveyor **2**, and supplied to the inlet **5** of the mill **4** through a supplying shoot **3**. In this example, the mill is divided into four sections **9**, **10**, **11** and **12** by three sheets of porous plates **6**, **7** and **8**. The quicklime supplied from the inlet **5** is ground in the respective sections **9**, **10**, and **11** by means of balls **13**, **14** and **15** respectively, then supplied to an exhausting shoot **17** by means of scraping pockets **16** equipped in the last section **12**, and falls on a powder exhausting airslide **18** so as to be carried out. The water for removing the electrostatic charge drops directly from a pipe **26** upon the quicklime on the supplying belt conveyor **2**, and is thus supplied into the mill **4** together with the quicklime. The supplying rate of water is measured by a flow rate meter **19**, regulated by a valve **20**, and thus maintained at such a suitable rate with respect to the supplying rate of quicklime, for example, 0.3% in terms of the above-referred proportion γ(percent), that a sufficient effect of removing electrostatic charge may be obtained. Alternatively, an opening **22** (having a diameter of about 10 cm.) is provided on a wall of an outlet chamber **21**, a needle-shaped electric charge collector electrode **24** is inserted therein by means of a support of insulating plate **23** having a highly insulating nature so as to locate its tip at the center P of the falling flow of quicklime powders to measure the potential Vs at that point by means of an electrostatic voltmeter **25**, and thus the supplying rate of water and consequently the proportion γ(percent) may be regulated by means of the valve **20** so that the indication for the potential Vs may become a sufficiently low value such as, for example, about 200 v.

According to the described method of the present invention, the electrostatic charge generated within a quicklime grinding mill may be removed with lower expense, more safely and more reliably without any practical disadvantage than could be done by any other method, and thereby the grinding power of the mill may be remarkably improved.

What I claim is:

1. A method of grinding quicklime by means of a ball mill comprising the step of: continuously adding water in the form selected from the group consisting of liquid and saturated steam to the quicklime to be ground, the weight proportion of water added to quicklime per unit time lying between 0.1 and 5% whereby the virtual electric resistance of the quicklime is lowered to such extent that electric charges generated within the mill are considerably reduced through electric conduction but generation of excess heat of reaction due to bonding of CaO and H_2O is essentially avoided.

2. A method of grinding quicklime by means of a ball mill comprising the steps of: continuously adding water in the form selected from the group consisting of liquid and saturated steam, to the quicklime to be ground; measuring the electric potential at the center of the flow of the quicklime powders at the outlet of the mill; and controlling the weight proportion of the water added per unit time to the quicklime to be supplied in response to said measured electric potential so that said measured electric potential becomes lower than 3 kv., whereby the virtual electric resistance of the quicklime is lowered to such extent that electric charges generated within the mill are considerably reduced through electric conduction but generation of heat of reaction due to bonding of CaO and H_2O is essentially avoided.

3. An apparatus for grinding quicklime comprising a ball mill, means for continuously supplying quicklime to said ball mill, means for continuously exhausting ground quicklime having a predetermined fineness from said ball mill, and means associated with said supplying means for adding a predetermined small proportion of water to said quicklime to be ground, the weight proportion of the water per unit time to the quicklime being between 0.1 to 5%, whereby the virtual electric resistance of the quicklime is lowered to such extent that electric charges generated within said ball mill are considerably reduced through electric conduction nevertheless generation of heat of reaction due to bonding of CoO and H_2O is essentially avoided.

4. An apparatus for grinding quicklime comprising a ball mill, means for continuously supplying quicklime to said ball mill, means for continuously exhausting ground quicklime having a predetermined fineness from said ball mill, means associated with said supplying means for adding a predetermined proportion of water to said quicklime to be ground, said proportion of water being between 0.1–5% in weight with respect to said quicklime to be ground, and means associated with said exhausting means for measuring an electric potential at the center of the flow of ground quicklime in said exhausting means as a measure for determining the proportion of the amount in weight of the water to be added to the quicklime to be supplied per unit time.

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