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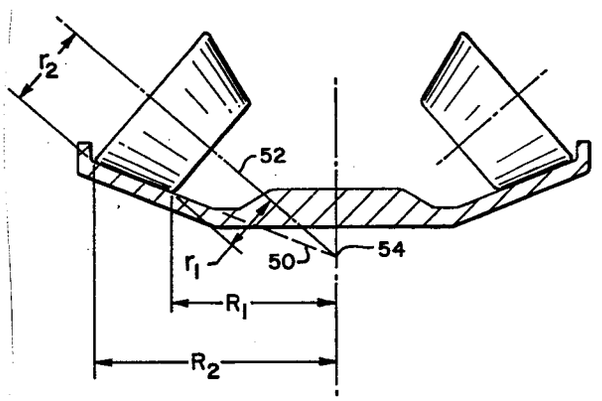
(54) Pulverizing mill having pure rolling motion between the grinding roll and the bowl.

(57) A pulverizing mill (10) having a grinding bowl (12) mounted so as to be rotatable about a central axis (14), and a frusto-conical grinding roll (20) which is in parallel relationship with the grinding surface of the bowl. The bowl is mounted at an angle (15-60°) to the horizontal. The bowl and roll are constructed such that the ratio of the horizontal radial distance from the axis of the bowl to the lower, inner end of the roll where it lies adjacent to the bowl surface (R_1), compared to the radius of that point from the axis about which the roll rotates (r_1), is equal to the ratio of the horizontal radial distance from the axis of the bowl to the upper end of the roll at the point where it lies adjacent to the bowl surface (R_2), compared to the radius of that point from the axis about which the roll rotates (r_2), so that as the bowl and roll rotate about their respective axes (14, 22), the roll surface moves across the bowl surface with only rolling movement, rather than a combination of rolling and sliding movement, to thereby reduce the wear on these surfaces.



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PULVERIZING MILL HAVING PURE ROLLING MOTION BETWEEN THE GRINDING ROLL AND THE BOWL

BACKGROUND OF THE INVENTION

One means of burning coal in the furnace of a steam generator is to grind the coal to a flour-like consistency, transport it to the furnace in an airstream, and burn it in suspension. One means of pulverizing the coal is in a pulverizing mill, where the coal is ground between a rotating grinding bowl and one or more coacting, grinding rolls. Because of the nature of the coal, and particularly hard impurities contained therein, such as small amounts of mineral matter, the outer surfaces of the bowl and rolls are subject to heavy wear, necessitating replacement of the parts on a regular basis. Much time and effort has been expended in attempting to increase the time span between replacement of the bowl and rolls of the pulverizing mill.

SUMMARY OF THE INVENTION

In accordance with the invention, a pulverizing mill is provided having a grinding bowl mounted for rotation about a central axis, and also having a frustoconical grinding roll, the outer surface of which is in parallel relationship with the grinding surface of the bowl. The bowl and roll are constructed such that the ratio of the horizontal radial distance from the axis of the bowl to the surface of the roll, where it lies adjacent to the bowl surface, compared to the radius of that point from the axis about which the roll rotates, is a constant ratio over the whole length of the roll

from its inner diameter to its outer diameter. The roll and bowl liners are contoured to achieve this relationship. Thus as the bowl and roll rotate about their respective axes, the roll surface moves across the bowl surface with only rolling movement, rather than a combination of rolling and sliding movement, to thereby reduce the wear on the surfaces.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 is a side elevational view in section of a bowl mill constructed in accordance with the invention; and

Figure 2 is a schematic showing the geometrical relationship of the grinding roll to the bowl.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is depicted therein a pulverizing bowl mill 10. Inside the housing 11 is positioned a rotatable bowl or ring 12, mounted on shaft 14. The shaft 14 along with the attached bowl is rotated by means of worm wheel 18, which engages worm 16 mounted on a motor driven shaft. One or more grinding elements or rollers 20 are rotatably mounted on shafts 22. Generally there are three rollers equidistantly spaced apart. Adjustable hydraulic loading urges the roller 20 towards the inner surface of the grinding ring 12, by acting against rod 24, by exerting a force on arm 23. The roll 20 is pivotally mounted on trunnion shaft 25. A stop member 26 prevents the roll from actually coming into contact with the grinding surface of the bowl. Such metal-to-metal contact would cause rapid wear of the surfaces. The stop 26 is set to leave a very small gap between these two grinding surfaces.

Coal is introduced into the mill through inlets 36. Air enters through opening 27, and flows upwardly through the annular space 32 to convey the ground material passing over the lip upwardly through the mill interior and into the classifer 30. The air and coal enter the classifier through inlets 28. The larger particles of insufficiently ground coal fall back onto the grinding surface through bottom opening 34 for further

grinding, and the finer particles are carried along by the air and are discharged through outlet 38.

As can be seen, the surface of the bowl on which the grinding takes place is at an angle to the horizontal. This is to enable the coal particles to have some retention time within the bowl, so that they will be subjected to grinding action between the three rolls and the bowl. The lip 40 also aids in giving the coal particles retention time before they are flung off the bowl into the annular space 32 to be picked up by the airstream.

Since the coal particles to be pulverized are rather hard, and contain a certain percentage of foreign matter such as ash and mineral matter, the surfaces of both the grinding bowl and the rollers are subjected to excessive wear relative to other parts within the mill. This necessitates regular replacement of these items, which is costly and time consuming, since the mill must be shut down in order to make such replacements. In accordance with the present invention, this wear on the roll and bowl surface is kept to a minimum, by making the geometry of the rolls and the bowl such that there is pure rolling motion between the roll and the bowl, rather than a combination of rolling and slipping or sliding motion. This geometrical arrangement is shown in Figure 2. Minimum wear is accomplished by making the ratio of the horizontal radial distance from the axis of the bowl to the lower, inner end of the roll where it lies adjacent to the bowl surface, compared to the radius of that point from the axis about which the roll rotates, equal to the ratio of the horizontal radial distance from the axis of the bowl to the upper end of the roll at the point where it lies adjacent to the bowl surface, compared to the radius of that point from the axis about which the roll rotates. Or, in other words, $\frac{R_1}{r_1} = \frac{R_2}{r_2}$. This relationship exists when the extension of the line 50 on which the bowl grinding surface lies, intersects the extension 52 of the roll axis, at the axis 54 of the shaft 14. The above

geometrical arrangement produces true rolling action at every point on the surface of the roll 20, as it rolls on the surface of the bowl 12, as the bowl rotates with the shaft 14. This would not be true if the ratio of $\frac{R_1}{r_1}$ did not equal $\frac{R_2}{r_2}$. For example, if $\frac{R_1}{r_1}$ were larger than $\frac{R_2}{r_2}$, then when there was true or pure rolling motion at point r_2, there would be slippage between the roll and the bowl at point r_1. If $\frac{R_1}{r_1}$ were smaller than $\frac{R_2}{r_2}$, then when there was pure rolling motion at point r_1, there would be slippage between the roll and the bowl at point r_2. When there is sliding motion, the two parts are subject to more wear than when there is rolling motion between these two parts.

CLAIMS

1. In a pulverizing mill, a grinding bowl mounted on a central, vertical shaft, means for rotating the shaft and bowl, a frustoconical grinding roll, the outer surface of which is in parallel relationship with the grinding surface of the bowl, so that material can be pulverized therebetween, the roll being mounted so as to be rotatable about a central axis, the grinding surface of the bowl lying at an angle to a horizontal plane, with the inner radius of the bowl being lower than the outer radius thereof, the roll being of frustoconical shape, with the lower, inner end being of less diameter than the diameter of the upper, outer end, characterized in that the bowl and the roll being constructed such that the ratio of the horizontal radial distance from the bowl shaft to the lower, inner end of the roll at the point where it is adjacent to the bowl surface, compared to the radius of that point from the axis about which it rotates, is equal to the ratio of the horizontal radial distance from the bowl shaft to the upper end of the roll at the point where it is adjacent to the bowl surface, compared to the radius of that point from the axis about which it rotates, so that as the bowl and roll rotate about their respective axes, the roll surface moves across the bowl surface with only rolling movement, rather than a combination of rolling and sliding movement, to thereby reduce the wear on these surfaces.

2. The pulverizing mill set forth in Claim 1, characterized in that the ratio of the horizontal radial distance from the bowl shaft to any point of the roll at a point where it is adjacent to the bowl surface, compared to the radius of that point from the axis about which it rotates, is a constant.

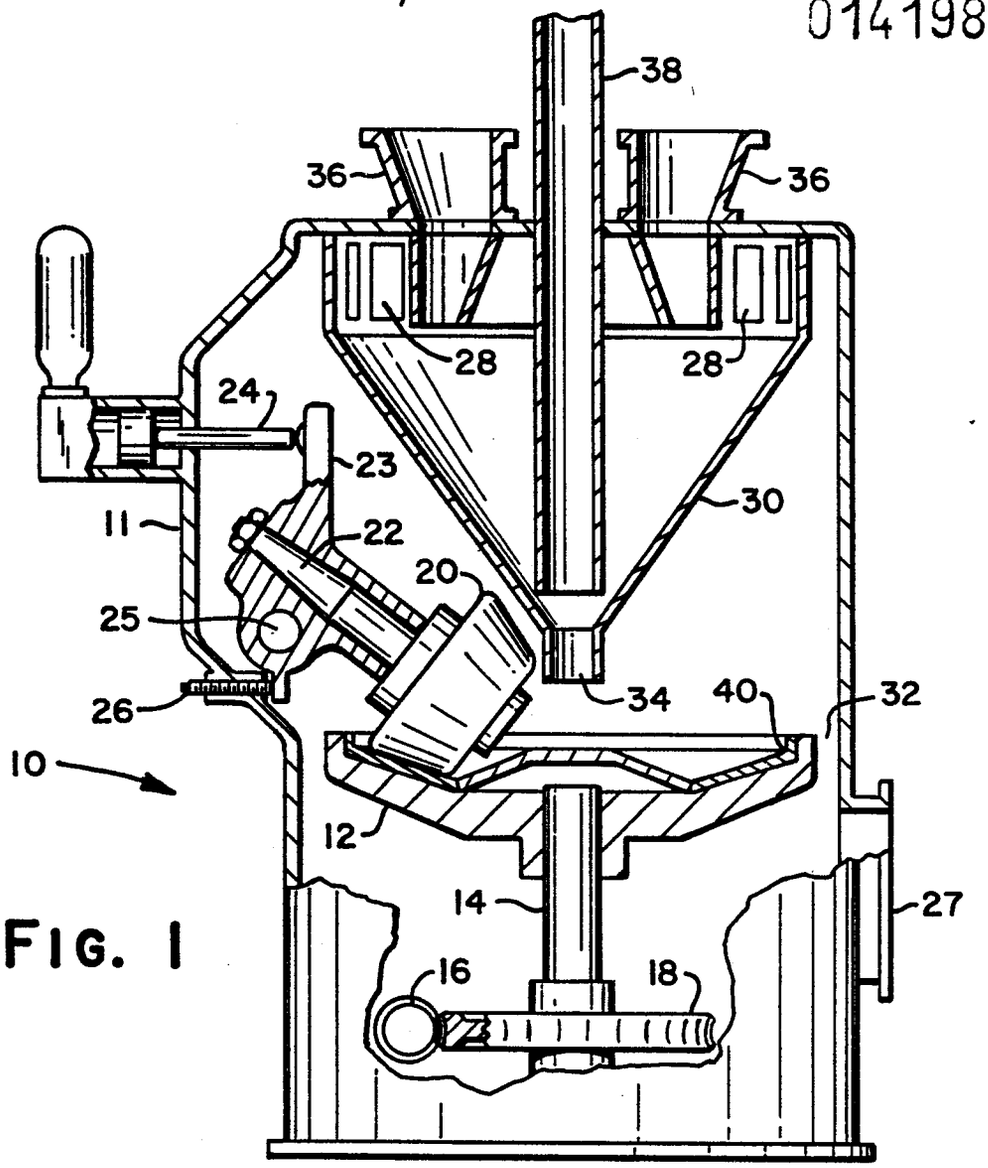
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FIG. 1

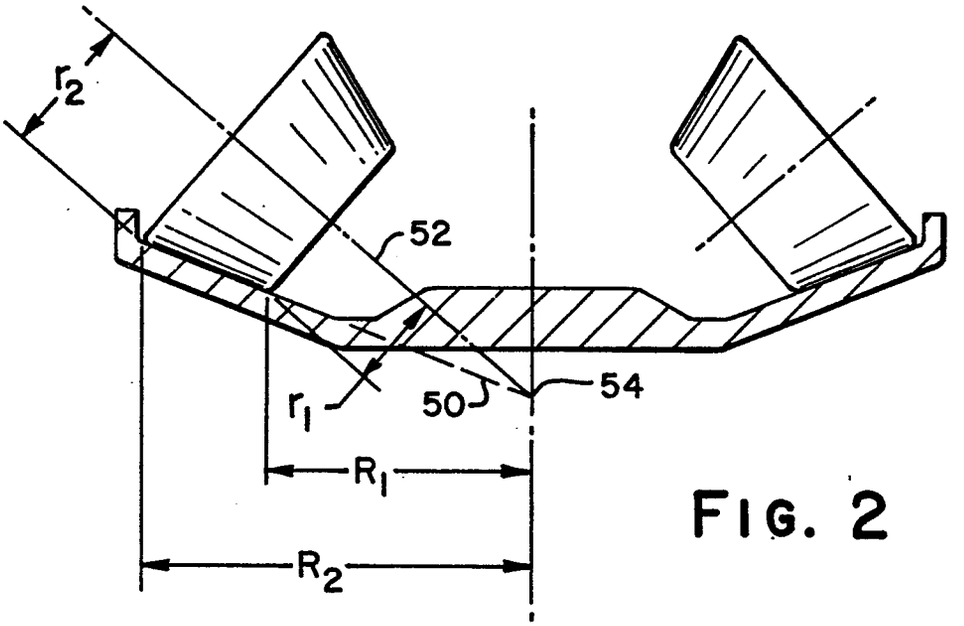
r2
52
r1
50
54
R1
R2

FIG. 2