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CLASSIFICATION SYSTEM FOR
PULVERIZED MATERIALS

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3 Claims.

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This invention relates to grinding mills and pulverizers, and more particularly to a system for classifying the material pulverized in the mills or pulverizers.

An object of the invention is to provide an improved pulverizing apparatus in which the feed, oversize, and air all enter and leave at the same end of the apparatus.

Another object of the invention is to provide an improved pulverizing apparatus in which the material is fed to a grinding mill in such a manner that it mingle with the dry oversize material discharged from a classifier prior to coming in contact with dry air being conducted to the mill, so that the wet feed is partially dried, thereby enabling the fresh dry air which subsequently contacts the feed to quickly remove or absorb moisture in the feed before the feed enters the mill.

With the foregoing and other objects and advantages in view, the invention consists in the preferred construction and arrangement of the several parts which will be hereinafter fully described and claimed.

In the accompanying drawings:

Figure 1 is a general view, partly in vertical section, and partly in elevation, showing one form of the invention in connection with a cylindrical ball mill; and

Fig. 2 is a view, similar to Fig. 1, of another form of the invention in connection with a conical mill.

Referring to the drawings and especially to Fig. 1, the material pulverizing and collecting system may be characterized as a closed-circuit system in which fluid currents, such as air, are circulated throughout the system. It includes a pulverizing mill 11, which may be of any well-known construction having hollow trunnions 12, 13, at each end, the trunnion 13 in the instant case being closed by a plate or cover 14, so that only the trunnion 13 at the other end of the mill is open.

The air or other elastic fluid which conveys the fine product is caused to circulate continuously through the system by a blower 15, which discharges directly into the open end 13 of the mill 11 through fixed conduit 16 and rotating conduit 17.

Conduit 17 is mounted in the discharge hollow trunnion 13, being spaced a suitable distance from the interior of said trunnion, so as to provide an annular space 18 for the dust and fluid leaving the mill 11.

The inner end of conduit 17 projects into the mill 11 a suitable distance, and a grate 19 extends from the inner portion of said conduit outwardly to a conical ball retractor 20 extending inwardly from the end wall of the mill 11.

Extending from the wall of the ball retractor 20 to the conduit 17 and located on the outer side of the grate 19, are lifters 21, the purpose of which will be hereinafter described.

It is usual to feed material into pulverizing mills automatically. The material descends from a bin into a hopper 22 and is permitted to pass into chute 23 by means of a rotary pocket feeder 24.

Feeders of this type are known as an air-lock type of feeder and such feeders are adapted to prevent positive pressure from being carried upwardly into the hopper 22. However, it will be understood that any type of feeder which would choke off the air from entering the hopper will be satisfactory.

The feed from chute 23 passes in and around the bottom of a classifier 25 and enters conduit 26. In passing through the classifier 25, the feed joins with the oversize dropped from the classifier. This helps to dry the wet feed, as the oversize is very dry, and mingling with the feed picks up any free moisture and has the advantage of absorbing this moisture over a large surface area so that the air also entering the mill 11 will evaporate this moisture more rapidly than if the feed were placed in contact with the air without first mingling with the oversize.

Below the conduit 26 is a movable gate 27, which is provided to prevent back pressure of air from entering the lower portion of the classifier 25 before it should. The gate 27 is so balanced that pressure of the oversize and the feed on top of it, overcomes the back pressure of air below, and the oversize and feed trickle down past the gate into conduit 28, and from thence enter the conduit 19 near the inner end of said conduit 19.

The blower 15 draws air in the suction conduit 29 from an outside source, and if appreciable moisture is present, it is preferable to provide means for supplying hot air through conduit 30, as this hot air will dry the moisture in the feed more rapidly than cold air, as is well known in the art. The hot air then travels through conduit 10 and mixes with the feed and oversize entering conduit 16 from the feed conduit 29 and conveys the feed and oversize by forced draft through the rotating conduit 17 into the mill 11.

As shown by the arrows, Fig. 1, the air after entering the mill 11 reverses and flows out-
wardly through the grate 19 and into the annular space 18 between conduit 17 and trunnion 13. The ball rejector 20, heretofore referred to, forms a pocket and the lifters 21 pick up any tramp oversize, small balls and refuse which may lodge between the grate 19 and the ball rejector 20. The oversize then slides down the lifters 21 as they rotate with the mill 11 and enters the conduit 17 where the air forces the oversize back into the mill 11.

The air circulating through the mill 11 picks up the fine product in the form of dust, and carries this dust outwardly through the grate 19, and annular space 18, and conduit 17, to classifier 25.

The classifier 25 has an inner casing 31 along the outside of which flows the current of material-laden air entering through conduit 30. The vortex created within the classifier causes the heavier particles to be cast out of the stream of flowing air. These heavy or large particles leave the inner casing 31 at its lower end 32, which directs the particles towards the fresh feed in conduit 24, and as stated before, helps to dry the incoming feed. Oversize also drops out around the casing of the classifier 25 and in sliding down the sides, also mingles with the incoming feed.

The fines then pass through conduit 23 into a burner 34, if the operation is one using the conventional form of what is known as a unit pulverizer for direct firing of powered fuel.

It will be noted that the blower 18 places the whole system under pressure; with a mill under pressure, loss of air would be likely to occur at the joint 35 between the inner end of the non-rotating conduit 30, and the outer end of the rotating trunnion 13 of the mill 11, if no provision were made to prevent such occurrence.

Therefore, I enclose the joint 36 with a box 37, which forms a joint with the flange or outer end 38 of the trunnion 13. This joint is made to fit as closely as is practicable by methods ordinarily used.

Connected to the chamber within box 37 by a pipe 39, is a small blower 35, which forces air under sufficient pressure into the joint to prevent the escape of dirty air and over-ride from the material at this joint.

In order to control the operation of the device, there is a damper 40 which regulates the amount of incoming air from the blower 18 entering the mill 11.

There is also a damper 41 which regulates the same air, but in this case by-passes the air around the mill 11 directly to the classifier 25, through conduit 42 which connects conduit 16 with conduit 30.

When during operation the capacity is reduced below the rated output of the apparatus by partially closing damper 40, the velocity in the system, particularly in the classifier 25 and conduit 33, may be below the velocity which is sufficient to carry all of the material in suspension. By opening the damper 41, sufficient air may be by-passed the mill 11 to maintain the desired velocity.

Particular attention is directed to the fact that the feed mixes with the oversize and joint 14, and the hot air before the feed enters the mill 11, and, furthermore, that the product and the air leaves at the same end of the mill. This method of operating a pulverizing system is contrary to all previous practices, since herebefore the feed and the air entered at opposite ends of the mill. There is a distinct advantage in this method of operation, not only because the combination of the feed mixing with the oversize and the air, dries the feed, thereby increasing the grinding capacity of the mill, but the whole unit is simple in construction, and there is consider-
the vent 65 discharges excess air and moisture, as well as places the system as a whole under partial vacuum. The amount of air passage through vent 65 is controlled by regulating the damper 66.

Moreover, if the feed is very wet, hot air must be introduced. In such event, the damper 66 is opened wider to cause a pronounced suction throughout the system, and hot air is then drawn through conduit 75 from an outside source, the flow of the hot air through conduit 75 being controlled by damper 74.

Even though conduit 75 is on the pressure side of the blower 61, since the whole system is now under a partial vacuum, air will be actually drawn in, since the conduit 74 will be at a negative pressure with respect to the atmosphere.

Thus, there is in this form of the invention, as in the form of the invention shown in Fig. 1, means whereby the feed, oversize, and the hot air all mingle together before they enter the mill 33.

The mill 33 shown in this form of the invention, is of the well-known type of conical mill. Even though the coarse feed is introduced through the discharge end of such form of mill, the coarse feed will migrate to the barrel or center of the mill, where the material will be ground by the heavy balls. There is a distinct advantage of an arrangement of this type over the use of a plain cylindrical mill of the form shown in Fig. 1, since the latter type of mill has no definite way of forcing the coarse material towards the far end of the mill. Accordingly, time must be resorted upon to distribute the feed throughout the mill 11 in order to obtain the necessary grinding results.

Having thus described my invention, what I claim is:

1. A rotary drum mill having a combined feed and discharge opening only at one end of the drum and closed at the other end, a blower, an inlet conduit leading from said blower to said drum for conducting air into the drum, a feed conduit for material connected to said inlet conduit exteriorly of the drum, a classifier, a conduit connecting the classifier with said drum whereby dust-laden air circulated through the drum is carried to said classifier, a grate mounted in the drum and spaced from the discharge end of the mill and surrounding but not extending across the inlet conduit whereby the matter discharged from the mill to said classifier-drum conduit passes through said grate and the incoming feed enters the mill unrestrictedly through said inlet 7 conduit, and means between the grate and the discharge end of the drum for removing oversize material caught between said grate and the discharge end of the drum, said last named means having an end portion entering the feed conduit 10 to discharge oversize into said feed conduit.

2. A rotary drum mill having a combined feed and discharge opening only at one end of the drum, a screen mounted within the drum and spaced from the discharge end thereof, said screen having a central opening therein for the incoming feed, means between the screen and the discharge end of the drum for removing oversize material caught between said screen and the discharge end of the drum, said last named means having an end portion entering the central opening to discharge oversize into said central opening.

3. An apparatus of the class described comprising a drum mill containing a plurality of grinding bodies free to move in all directions therein, said mill being closed at one end and having an opening at the opposite end, a horizontal conduit positioned in said opening for delivering heated air under pressure to the mill, another conduit extending from said classifier to an air classifier and adapted to convey the ground products suspended in exhaust air to said classifier, a screen mounted within the mill and spaced from the discharge end thereof, said screen having a central opening therein registering with the first mentioned conduit, means between the screen and the discharge end of the mill for removing oversize material caught between said screen and the discharge end, said means having an end portion entering the first mentioned conduit to deliver the oversize to said conduit, means to pass the feed in a relatively turbulent condition through the classifier and in such proximity to the exhaust air from the mill that fines and dust in the feed are removed therefrom, and means to convey the dust-free air and classifier oversize to the heated air conduit where they are dried and delivered to the mill.

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