

May 1, 1962

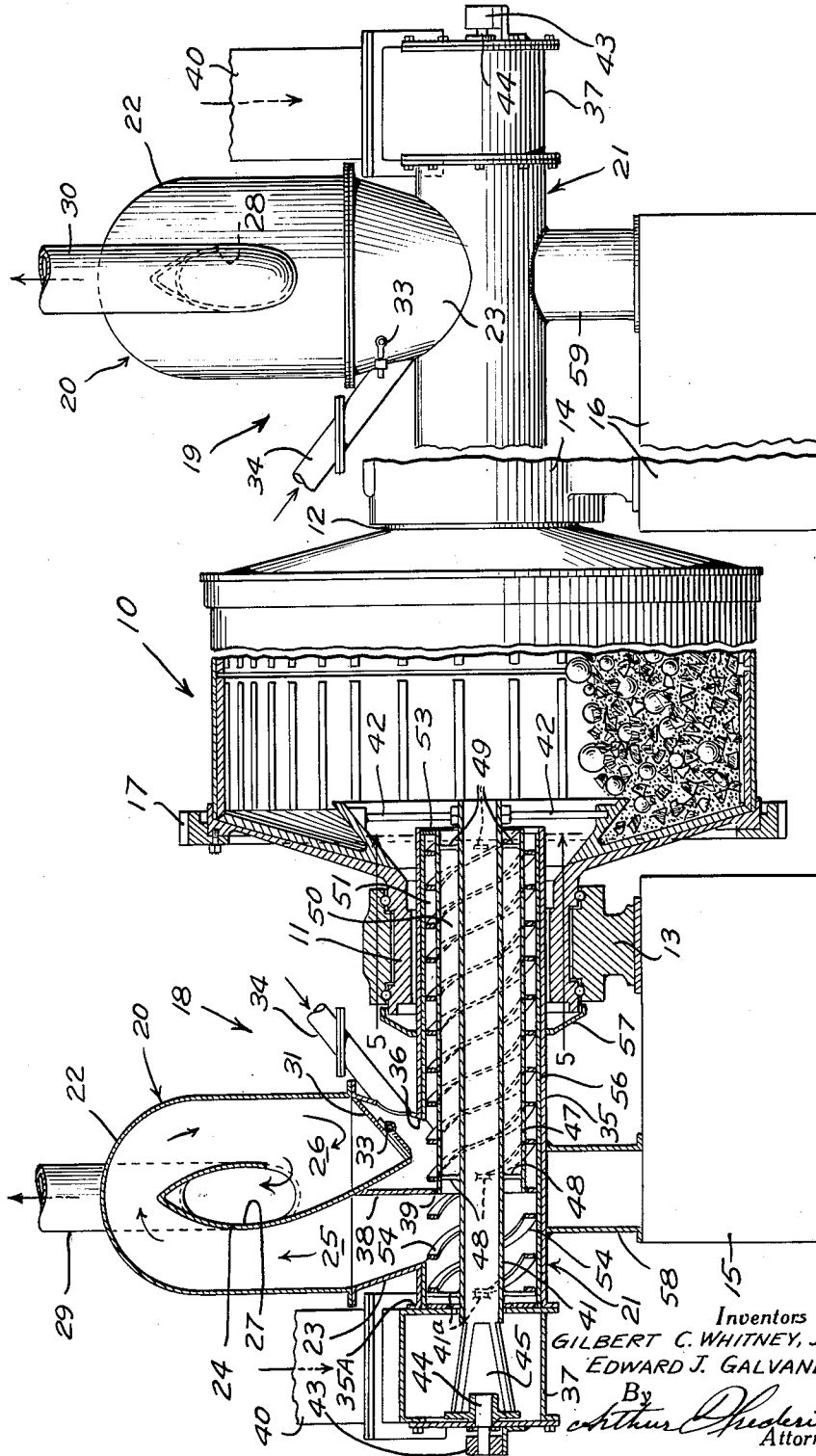
G. C. WHITNEY, JR., ET AL
BALL MILL WITH MATERIAL SEPARATORS AT EACH END
FOR RECYCLING OVERSIZE MATERIAL

3,032,280

Filed May 17, 1960

3 Sheets-Sheet 1

Fig. 1.



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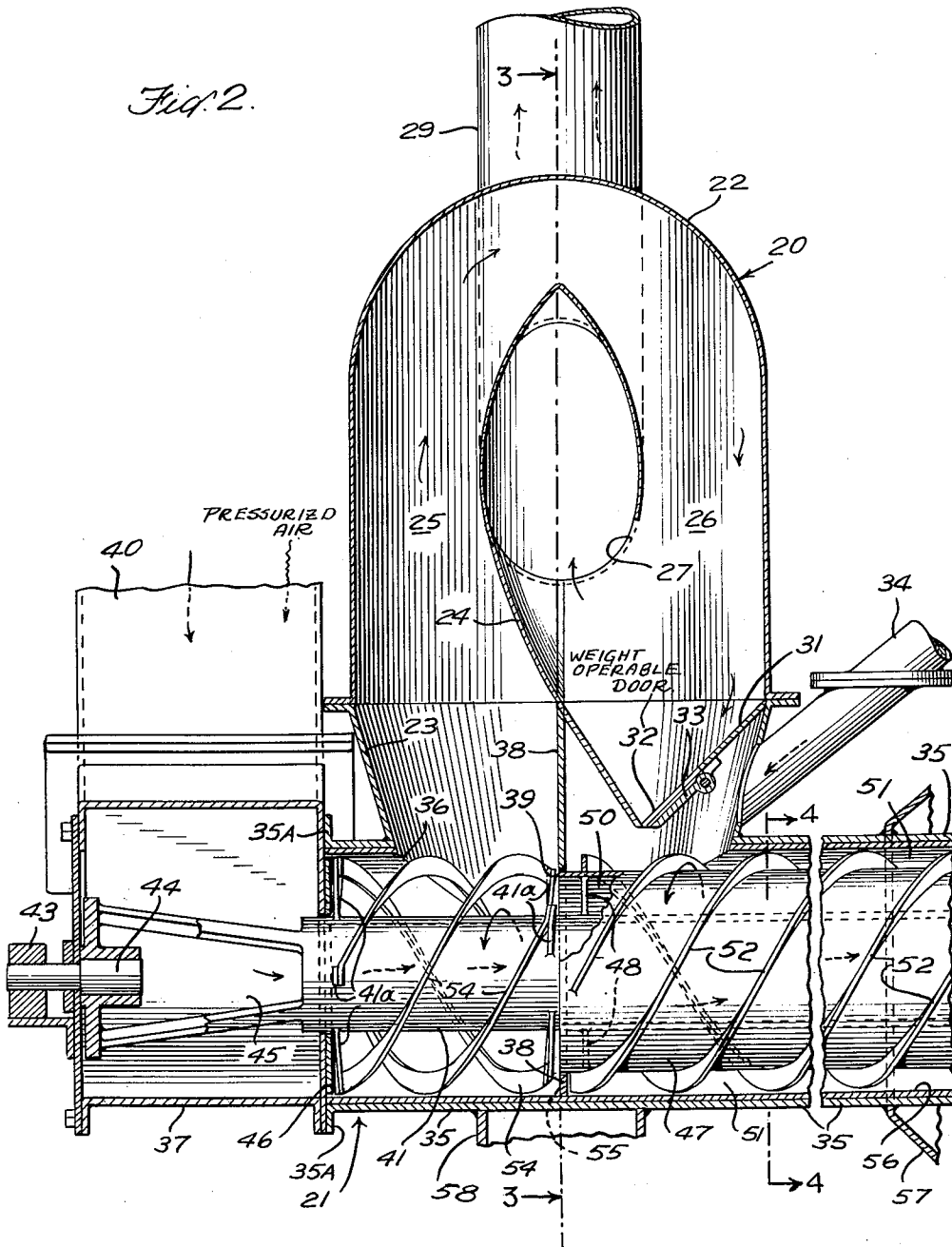
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Fig. 3.

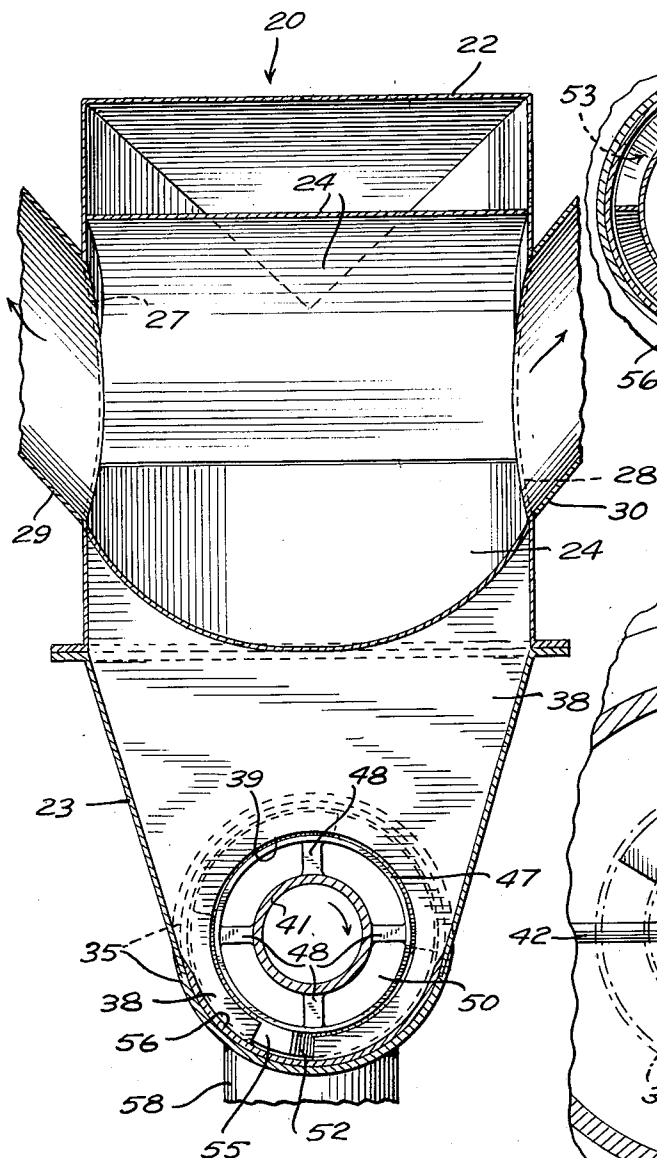


Fig. 4.

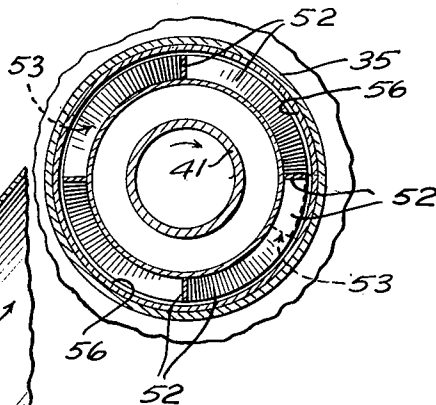
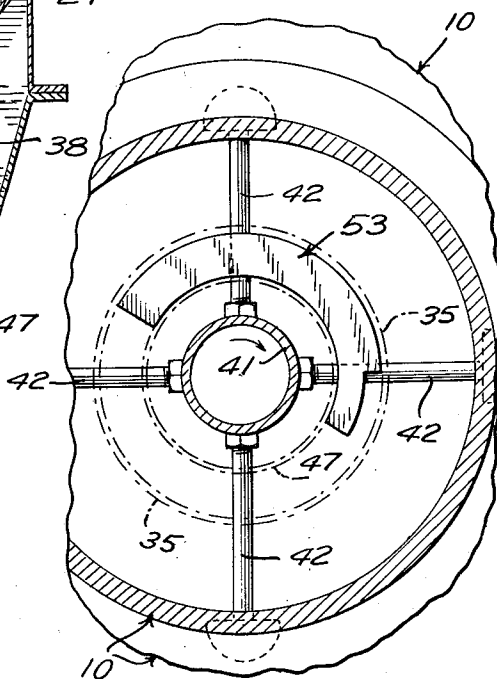


Fig. 5.



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BALL MILL WITH MATERIAL SEPARATORS AT EACH END FOR RECYCLING OVERSIZE MATERIAL

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Filed May 17, 1960, Ser. No. 29,723
12 Claims. (Cl. 241—52)

This invention relates to the comminution of materials and more particularly pertains to apparatus for the pulverization of coal, cement or other material of similar nature.

In pulverizing apparatus of the rotating drum, ball type, hereinafter referred to as a "ball mill" pulverizing apparatus, such as shown in U.S. Patent No. 2,285,429, wherein pulverized material rejected in a classifier is returned to the drum along with the raw feed material by means of a feed screw in direct counter-flow relationship to the flow of pulverized material and air mixture flowing from the drum to the classifier, it has been discovered that a substantial amount of the rejected pulverized material is re-entrained, before re-entering the drum, in the pulverized material and air mixture flowing from the drum, and that some of the re-entrained particles are carried back to the classifier where they are again rejected while the other particles drop out of suspension before passing through the classifier. This action results in purposeless recirculation of partially pulverized material within the apparatus which interferes with the free flow of the stream of air and entrained pulverized material flowing from the drum, and thereby increases wear on the apparatus, reduces efficiency and causes unstable operation.

Another disadvantage of the above-described ball mill pulverizing apparatus is that the air velocity entering the drum is restricted to a relatively low maximum value for an output of pulverized material of specified degree of fineness because, as the air velocity out of the drum increases, a greater amount of rejected pulverized particles is re-entrained in the air-pulverized material mixture flowing from the drum which results in less rejected material being returned to the drum for further pulverization. This factor limits the size and capacity of the present pulverizing apparatus for an output of pulverized material of a specified degree of fineness since increased size and capacity requires an increase in the air velocity entering the drum.

It is, therefore, an object of the present invention to provide an improved ball mill pulverizing apparatus wherein recirculation of rejected particles outside of the drum is eliminated.

Another object of this invention is to provide a ball mill pulverizing apparatus having increased output over conventional ball mill pulverizers of comparable size.

A further object of the present invention is to provide a ball mill pulverizing apparatus of increased size and capacity over conventional ball mill pulverizing apparatus for an output of pulverized material of a specified degree of fineness.

Accordingly, it is contemplated by the present invention to provide an improved ball mill pulverizing apparatus, comprising means for passing the air and pulverized material mixture from the pulverized zone to a classifying zone in a path separate from the path of flow of feed material to be pulverized and pulverized material rejected in the classifying zone to the drum, and other means for receiving and passing oversized pulverized material which drops out of suspension in the air and pulverized material mixture before being rejected in the classifying zone back to the drum for further pulverization. The air and pulverized material mixture is flowed

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at such velocities that a negligible amount of or no pulverized material settle out of suspension in the path of flow to the classifying zone, except, where the other means is provided to receive and return the settled out material to the pulverization zone.

The invention will be more fully understood from the following detailed description thereof when considered in connection with the accompanying drawings wherein but one embodiment of the invention is illustrated by way of example and in which:

FIG. 1 is a combined vertical sectional and elevational view of a form of pulverizing apparatus embodying the present invention;

FIG. 2 is a vertical sectional view, similar to the left hand section of FIG. 1 but on an enlarged scale, of the combined feeder and classifier shown in FIG. 1;

FIG. 3 is a sectional view taken substantially along line 3—3 of FIG. 2;

FIG. 4 is a view in section taken along line 4—4 of FIG. 2; and

FIG. 5 is a sectional view on an enlarged scale taken substantially along line 5—5 of FIG. 1.

The invention is disclosed as embodied in and carried out by a pulverizing apparatus of the rotating drum, ball type but it will be understood that this application of the invention is merely illustrative of one application of the principles of the invention and that the invention may be applied to other types of pulverizing apparatus, such as stationary drum types, having grinding means other than a ball charge.

Referring to the drawings, and more particularly to FIG. 1, reference character 10 designates a drum of the pulverizing apparatus, which drum is illustrated as cylindrical in form although it may be frusto-conical in shape or may be of some other suitable configuration. Drum 10 is provided at its opposite ends with trunnions 11 and 12, which are mounted in and rotatably supported by bearings 13 and 14, respectively, resting on support members 15 and 16, respectively. A gear 17 is mounted exteriorly on one end of drum 10 and is suitably connected to a source of rotary power (not shown) for rotation of drum 10.

In the application of the invention as shown in FIG. 1, two combined feeders and classifiers 18 and 19 are shown disposed adjacent each end of drum 10 and in communication with drum 10, as hereinafter more fully described, to provide for the simultaneous feed of material to be pulverized into both ends of drum 10 and the simultaneous flow of air into both ends of drum 10. Moreover, the simultaneous flow of the pulverized material and air mixture is provided from both ends of drum 10 to each of the combined feeders and classifiers 18 and 19, in which, the oversized material carried from the drum by the air stream is separated from the material which has been sufficiently pulverized and the oversized material is returned to the drum at both ends thereof simultaneously. While the pulverizing apparatus is illustrated as having two combined feeders and classifiers with pulverized material and air being delivered to the drum simultaneously at both ends thereof, the pulverizing apparatus may be provided with but one combined feeder and classifier, or may be constructed to provide for delivery of material to be pulverized into the drum at one end and air into the opposite end of the drum, or may be constructed to provide for delivery of material to be pulverized and air into the same end of the drum but opposite from the end from which the mixture of pulverized material and air flows to the classifier assembly, without departing from the scope and spirit of this invention. Since the combined feeders and classifiers 18 and 19 are identical in construction, only feeder-classifier 18 will be described in detail. Component parts of feeder-

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classifier 19 which are shown in the drawings will be identified by the same reference numeral designating corresponding parts of feeder-classifier 18.

Feeder-classifier 18 comprises a classifier assembly 20 and a feeder assembly 21 which interconnects the drum 10 and the classifier assembly. As best shown in FIG. 2, the classifier assembly 20 comprises a vertically extending cylindrical shell having a dome shaped top portion 22 and an inverted, open ended, frusto-conical bottom portion 23. A scroll shaped baffle 24 is disposed within the shell of the classifier assembly 21 to divide the interior of the shell of classifier assembly 20 into an inlet chamber 25 and a reject chamber 26. Baffle 24 extends from a point in relatively close spaced relationship with the bottom of the frusto-conical bottom portion 23 of the shell, upwardly in a gradual curve to a point in spaced relationship with the top of dome portion 22 of the shell and thence downwardly in a curve, to a point substantially spaced from the lower end of baffle 24 and in spaced relationship with the upwardly extending portion of the baffle. Since baffle 24 is spaced from the top of dome portion 22, inlet chamber 25 and reject chamber 26 communicate with one another above baffle 24 to allow passage of the mixture of pulverized material and air to flow from inlet chamber 25 into reject chamber 26. As best shown in FIG. 3, the shell of the classifier assembly 20 is provided with two outlet openings 27 and 28 which are disposed opposite each other and between the upwardly and downwardly extending portions of baffle 24. Two outlet ducts 29 and 30 (FIG. 3) are connected to the shell and communicate through outlet openings 27 and 28, respectively, to receive the mixtures of pulverized material and air from chamber 26. While two outlet ducts are shown in the drawings, the classifier assembly 20 may have only one outlet duct communicating with chamber 26 through the top of baffle 24. An inclined plate 31 is disposed in reject chamber 26 and extends from the inner surface of the shell to the lower end of baffle 24 to form a hopper shaped floor. An opening 32 is provided in plate 31 adjacent baffle 24, which opening is closed by a gravity weighted door 33. Door 33 is constructed and adjusted to automatically open, when the weight of rejected material in chamber 26 reaches a predetermined value, to pass the rejected or oversized material into the feeder assembly 21. An inclined feed pipe 34 is connected at one end to the frusto-conical portion 23 of the shell of the classifier assembly 20 and at the opposite end to a suitable source of material to be pulverized (not shown) to receive from the latter material to be pulverized and deliver the same into the feeder assembly 21 through the classifier assembly 20.

The feeder assembly 21 comprises an outermost open ended cylindrical housing 35 which extends concentrically through trunnion 11 of drum 10 to a point within drum 10 slightly beyond the end wall of which trunnion 11 is a part. Cylindrical housing 35 is provided with an opening 36 in the upper portion thereof and is connected to classifier assembly 20 at the end edge of the bottom portion 23 of the shell of classifier 20, which end edge is secured, as by welding, to the periphery of opening 36. The outer end (the end furthest removed from drum 10) of housing 35 is provided with a flange 35A to which is secured a windbox 37. A vertical partition 38 is disposed within cylindrical housing 35 and extends upwardly, through opening 36 into abutment with baffle 24, substantially in the plane of the vertical axis of the shell of classifier assembly 20. Partition 38 has a circular opening 39 therein which lies in concentric relationship to cylindrical housing 35. An air duct 40 is connected at one end to the windbox 37 and at the opposite end to a source of air under pressure (not shown) to receive and deliver air to windbox 37.

The air is conducted from windbox 37 to the interior of drum 10 by means of tube 41. Tube 41 is of substantially smaller diameter than the diameter of housing 35 and extends, from within drum 10, at a point slightly

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beyond the inner end of housing 35, outwardly in coaxial relationship with housing 35, through opening 39 in partition 38 and an opening in a wall of windbox 37, into windbox 37. The inner end of tube 41 is supported by and secured to drum 10 by means of a plurality of spaced radial spokes or rods 42 (FIG. 1) so that, upon rotation of drum 10, air tube 41 is rotated. As best shown in FIG. 2, the opposite or outer end of air tube 41 is supported for rotation in a bearing 43 mounted on the outer wall of windbox 37, the bearing 43 receiving a spindle 44 which is secured to the outer end of tube 41. The end portion of tube 41, within windbox 37, is provided with a plurality of peripherally spaced slots 45 so that the interior of tube 41 communicates with the interior of windbox 37 to receive therein air from the latter. To prevent air from by-passing the interior of tube 41 thru the interstices between the opening in the inner wall of windbox 37 and the surface of tube 41, a seal plate 46 is secured to tube 41 and in surface abutment against the wall of windbox 37.

A tube 47, having a diameter of a dimension intermediate of the diametrical dimensions of cylindrical housing 35 and tube 41, is disposed within the annular space formed between housing 35 and tube 41 and in concentric relationship with housing 35 and air tube 41. Tube 47 extends from the plane of the inlet chamber 25 side of partition 38, through opening 39 in partition 38, and terminates at the opposite end in drum 10 adjacent the end of housing 35. As best shown in FIGS. 1 and 3, tube 47 and air tube 41 are connected together in concentric spaced relationship and for conjoined rotation by two sets of spaced radially extending arms 48 and 49 which are disposed adjacent opposite ends of tube 47. Since tube 47 is of a diameter intermediate the diameter of housing 35 and air tube 41, tube 47 divides the annular space between housing 35 and air tube 41 into an annular passageway 50 defined between the inner surface of tube 47 and the outer surface of air tube 41, and an annular passageway 51 formed between the outer surface of tube 47 and the inner surface of housing 35. Annular passageway 50 is in communication at one end with the interior of drum 10 to receive the mixture of air and pulverized material and at the opposite end with inlet chamber 25 of classifier assembly 20 to pass the mixture of air and pulverized material into inlet chamber 25. Annular passageway 51 is in communication with reject chamber 26 of classifier 20 and with feed pipe 34 to receive oversized pulverized material rejected in the classifier assembly 20 and material to be pulverized.

To convey the rejected oversized pulverized material and fresh material to be pulverized through the annular passageway 51 to the interior of drum 10, tube 47 is provided with a spiral screw comprising a plurality of threads or flights 52 which are secured to the outer surface of tube 47 and rotate therewith. As best shown in FIG. 5, the end of passageway 51 in drum 10 is partially sealed by an arcuate shaped seal plate 53 which is secured to housing 35. The purpose of seal plate 53 is to cause the stream of rejected material and fresh material to be pulverized to discharge into drum 10 at the lower periphery of annular passageway 51 so that the pulverized material which discharges from passageway 51 into drum 10 will not pass in front of the inlet end of passageway 50 where some of the reject material would be re-entrained in the outflowing mixture of pulverized material and air before being subjected to further pulverization in drum 10.

The feeder assembly 21 is provided with a second spiral screw disposed in the chamber formed in housing 35 to the left of partition 38, as viewed in FIGS. 1 and 2. The second spiral screw comprises a plurality of threads or flights 54 which are secured to air tube 41 by radial supports 41A. Flights 54 of the second spiral screw are pitched to feed over-sized material which drops out of suspension in the mixture of air and pulverized material in inlet chamber 25 of classifier assembly 20 toward

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partition 38. As shown in FIG. 3, partition 38 is provided with an arcuate opening 55 at the bottom thereof, which opening 55 communicates with the chamber formed in housing 35 to the left of partition 30 with passageway 51 so that the oversized material may pass into passageway 51 for return to drum 10 by flights 52. To provide free movement of material through opening 55 into passageway 51, flights 54 are arranged slightly out of phase with flights 52 in passageway 51.

Since housing 35 is subject to attrition by reason of the contact of pulverized material thereagainst housing 35 is suitably lined by a liner 56 which comprises a plurality of sections (not shown) which are suitably secured to the housing so that they may be readily removed and replaced. A ring shaped seal plate 53 is secured to housing 35 and trunnions 11 to prevent the passage of air and pulverized material to the atmosphere through the space between the trunnion and housing 35.

The feeder-classifiers 18 and 19 are supported respectively on support member 15 and 16 by legs 58 and 59, respectively.

In operation of the aforescribed pulverizing apparatus, air under pressure is delivered through air duct 40 into windbox 37. The air flows into the interior of air tube 41, from windbox 37 through slots 45, and thence, through air tube 41, into the interior of drum 10. As drum 10 is rotated through gear 17, the ball charge therein pulverizes the material in drum 10, and as the air sweeps the interior of the drum it entrains pulverized material. The mixture of pulverized material and air passes from drum 10 into annular passageway 50 and, through the latter, into inlet chamber 25 of classifier assembly 20. From inlet chamber 25, the mixture of air and pulverized material flows over the top of baffle 24 into reject chamber 26 and thence through outlets 27 and 28 into outlet ducts 29 and 30 for delivery to storage or place of use (not shown). The mixture of air and pulverized material in flowing through classifier assembly 20 is subjected in chamber 26 to a centrifugal action which throws out the entrained oversized particles, the oversized particles being collected on the hopper shaped floor formed by baffle 24, inclined plate 31 and door 33. When the weight of the oversized particles reaches a predetermined value, it causes door 33 to swing open thereby discharging the oversized particles into passageway 51. Additional material to be pulverized is delivered in controlled amounts into passageway 51, through feed pipe 34. Since tube 47 is secured to air tube 41 and air tube 41 is in turn secured to drum 10 by means of spokes 42 for conjoined rotation with the latter, tube 47 is rotated thereby rotating the flights 52 which are secured to tube 47. The rotation of flights 52 conveys the rejected oversized material and fresh material to be pulverized through passageway 51 and discharges the material from the lower periphery of passageway 51 into drum 10 for pulverization.

In chamber 25, some of the oversized pulverized particles entrained in the mixture of air and pulverized material flowing therethrough will drop out of suspension and will collect on the lower peripheral surface of housing 35. This oversized material is fed by means of flights 54, through opening 55 in partition 38, into passageway 51 where flights 52 pick-up and convey the oversized material back to the drum.

It is now apparent that the present invention provides a pulverizing apparatus wherein rejected oversized particles are returned, from a classifier assembly, to a mill for further pulverization by a flow path which is separate and apart from the flow path of the mixture of an air and pulverized material flowing from the mill to the classifier assembly. The invention provides a pulverizing apparatus capable of increased output over pulverizing apparatus of comparable size. In addition, the invention provides a pulverizing apparatus capable of providing an output of pulverized material of a desired degree

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of fineness under air velocities substantially greater than was heretofore possible, thereby permitting the construction of pulverizing apparatus of larger size than was previously possible.

Although but one embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the arrangement of parts without departing from the spirit and scope of the invention, as the same will now be understood by those skilled in the art.

What is claimed is:

1. Pulverizing apparatus comprising a pulverizing section and a classifying section, said classifying section having an inlet chamber and a reject chamber therein, means for supplying material to be pulverized to said pulverizing section for pulverization therein, first conduit means communicating at one end with said classifying section and at the opposite end with said pulverizing section, a second conduit extending co-axially of said first conduit and communicating at one end with a source of air and at the opposite end with the pulverizing section to supply air to the latter for entrainment of pulverized material, said second conduit means being of smaller transverse dimensions so that an annular space is defined between said first and second conduit means, a third conduit means disposed in said annular space and extending in coaxially spaced relationship with said first and second conduit means to define a first annular passageway between the inner surface of said third conduit means and the outer surface of said second conduit means and a second annular passageway between the outer surface of said third conduit means and the inner surface of said first conduit means, said first annular passageway being in communication with the pulverizing section and the inlet chamber of said classifying section to pass air and pulverized material entrained therein from the pulverizing section to the receiving chamber of said classifying section, said second annular passageway being in communication with the reject chamber of the classifying section and the pulverizing section to receive rejected pulverized material disentrained from the air in said reject chamber, and means in said second annular passageway for feeding said rejected pulverized material to said pulverizing section for further pulverization.

2. The pulverizing apparatus of claim 1 wherein means are provided for feeding pulverized material disentrained in the inlet chamber of the classifying section into the second annular passageway for return to the pulverizing section.

3. Pulverizing apparatus comprising a pulverizing drum having at least one hollow trunnion, means for supplying material to be pulverized to said drum, means in said drum for pulverizing material therein, other means for causing air to flow in said drum to entrain pulverized material, a classifier having a partition therein to divide the interior of said classifier into an inlet chamber and a reject chamber, said partition having an opening therein, a first conduit disposed to extend through said hollow trunnion and communicating at one end with the reject chamber of the classifier and at the opposite end with said drum, a second conduit disposed coaxially within said first conduit and communicating at one end through the opening in said partition with the inlet chamber of the classifier and at the opposite end with the interior of said drum to receive from the latter air and entrained pulverized material and conduct the same to the inlet chamber, said second conduit being of smaller diameter than said first conduit to define with the latter an annular passageway communicating at one end with the inlet chamber of the classifier and at the opposite end with the interior of the drum, feed means disposed within said annular passageway for feeding rejected pulverized material to said drum, a second opening in said partition for communicating said passageway with the inlet cham-

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ber of said classifier, feed means disposed within said inlet chamber for feeding pulverized material which falls from suspension from the air in said inlet chamber through said second opening in said baffle into said passageway for return to said drum.

4. The apparatus of claim 3 wherein said feed means in said passageway and in said inlet chamber are screw conveyors.

5. Pulverizing apparatus of claim 3 wherein said means for supplying material to be pulverized to said drum is a feed pipe connected at one end to a source of material to be pulverized and at the opposite end connected to the classifier to pass said material to be pulverized to said passageway for delivery to the drum by said feed means in said passageway.

6. Pulverizing apparatus comprising a pulverizing drum having at least one hollow trunnion, a classifier having a partition disposed therein to divide the interior of the classifier into an inlet chamber and a reject chamber said baffle being constructed and arranged so that the inlet and reject chambers are in communication with each other and separation of oversized pulverized material from the air is achieved, said partition having an opening therein, a first conduit disposed to extend through said hollow trunnion and communicating at one end with said drum and at the opposite end with the reject chamber of the classifier, a second conduit of smaller diameter than said first conduit and the opening in said partition disposed coaxially within said first conduit and extending through said opening in the partition and communicating at one end with a source of air and at the other end with the drum to pass air into said drum for entrainment of pulverized material, a third conduit of smaller diameter than said first conduit but of larger diameter than said second conduit disposed in coaxial relationship with said first and second conduits to define a first annular passageway and a second annular passageway, said second conduit communicating at one end with said drum and the opposite end being disposed in register with said opening in the partition so that said first annular passageway communicates with the inlet chamber of the classifier to conduct air and entrained pulverized material from the drum to the inlet chamber, said second annular passageway communicating at one end with the drum and at the opposite end with the reject chamber of the classifier to receive pulverized material rejected by the classifier, an inlet conduit connected at one end to said classifier and to a source of material to be pulverized to feed material to be pulverized into the reject chamber of said classifier, and screw conveyor means disposed in said second annular passageway to convey rejected pulverized material and said feed material to be pulverized into said drum.

7. The apparatus of claim 6 wherein said partition is provided with a second opening for communicating the inlet chamber with the second passageway, and screw conveyor means disposed in said inlet chamber of said classifier for feeding disentrained oversized material from the receiving chamber through said second opening into said second passageway for return to the drum.

8. Pulverizing apparatus comprising a pulverizing section, means for passing material to be pulverized into said pulverizing section, second means for causing flow of air through said pulverizing section for entrainment of pulverized material, a classifying section, means forming a first passageway communicating with the pulverizing section and classifying section to conduct air and entrained pulverized material from the pulverizing section to the classifying section, and other means forming a second passageway separate and apart from said first passageway and said second means and communicating with the classifying section to receive rejected pulverized material and with the pulverizing section, and conveying means within said second passageway for conveying pulverized material to the pulverizing section for further pulveriza-

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tion therein, said conveying means comprising blade means, means for rotating said blade means to thereby advance pulverized material.

9. Pulverizing apparatus comprising a pulverizing section and a classifying section, means for passing material to be pulverized into said pulverizing section, second means for supplying air to said pulverizing section for entrainment of pulverized material, a first conduit means in communication at one end with the pulverizing section and at the opposite end with the classifying section to pass air and entrained pulverized material from a pulverizing section to the classifying section, and a second conduit means disposed in coaxial relationship with said first conduit means and in communication at one end with the pulverizing section and at the opposite end with the classifying section to receive from the latter rejected pulverized material, and conveying means within said second conduit means for conveying rejected pulverized material to said pulverizing section for further pulverization in the latter, said conveying means comprising blade means inclined to the axis of said second conduit, means for rotating said blade means to thereby advance pulverized material.

10. Pulverizing apparatus comprising a pulverizing section and a classifying section, said classifying section having an inlet portion and a pulverized material reject portion, means for supplying material to be pulverized to said pulverizing section for pulverization therein, other means for supplying air to said pulverizing section to entrain pulverized material, a first conduit means in communication at one end with the pulverizing section and at the opposite end with the inlet portion of the classifying section to receive and conduct air and entrained pulverized material from the pulverizing section to the inlet portion of the classifying section, a second conduit means disposed in coaxial relationship with said first conduit means and in communication at one end with the pulverizing section and at the opposite end with the reject portion of the classifying zone to receive from the latter rejected pulverized material, and conveying means in said second conduit means for conveying rejected pulverized material to said pulverizing section for further pulverization in the latter, said conveying means comprising blade means inclined to the axis of said second conduit, means for rotating said blade means to thereby advance pulverized material.

11. Pulverizing apparatus comprising a pulverizing drum and a classifier, said drum having means for pulverizing material therein, means for delivering material to be pulverized to said drum, second means for causing air to flow through said drum to entrain pulverized material, a conduit connected at one end to said drum and at the opposite end to said classifier to receive and conduct the air and pulverized material entrained therein to said classifier, and a second conduit means connected at one end to said classifier to receive pulverized material rejected by the classifier and connected at the opposite end to said drum, and conveying means within said second conduit means to feed said rejected pulverized material to said drum in a flow path separate and apart from said air and pulverized material stream flowing through said first-mentioned conduit, said conveying means comprising a continuous helical blade connected to said second conduit means, means for rotating said second conduit means to thereby advance pulverized material along said helical blade.

12. Pulverizing apparatus comprising a pulverizing drum having at least one hollow trunnion, a classifier having an inlet chamber and a reject chamber therein, means for supplying material to be pulverized to said drum, means in said drum for pulverizing the material therein, other means for causing air to flow into said drum to entrain pulverized material, a first conduit disposed in said hollow trunnion and communicating at one end with the interior of said drum and at the opposite end with the reject chamber of the classifier, a second conduit dis-

posed within said first conduit and communicating at one end with the inlet chamber of the classifier and at the opposite end with the drum to receive and conduct air and entrained pulverized material from the drum to the inlet chamber of the classifier, and second conduit 5 being of smaller diameter than said first conduit to form with the latter a passageway communicating with the drum and the reject chamber of the classifier to receive reject pulverized material from the latter, and feed means 10 within said passageway for feeding rejected pulverized material from the classifier into said drum for further

pulverization, said feed means comprising a screw conveyor.

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