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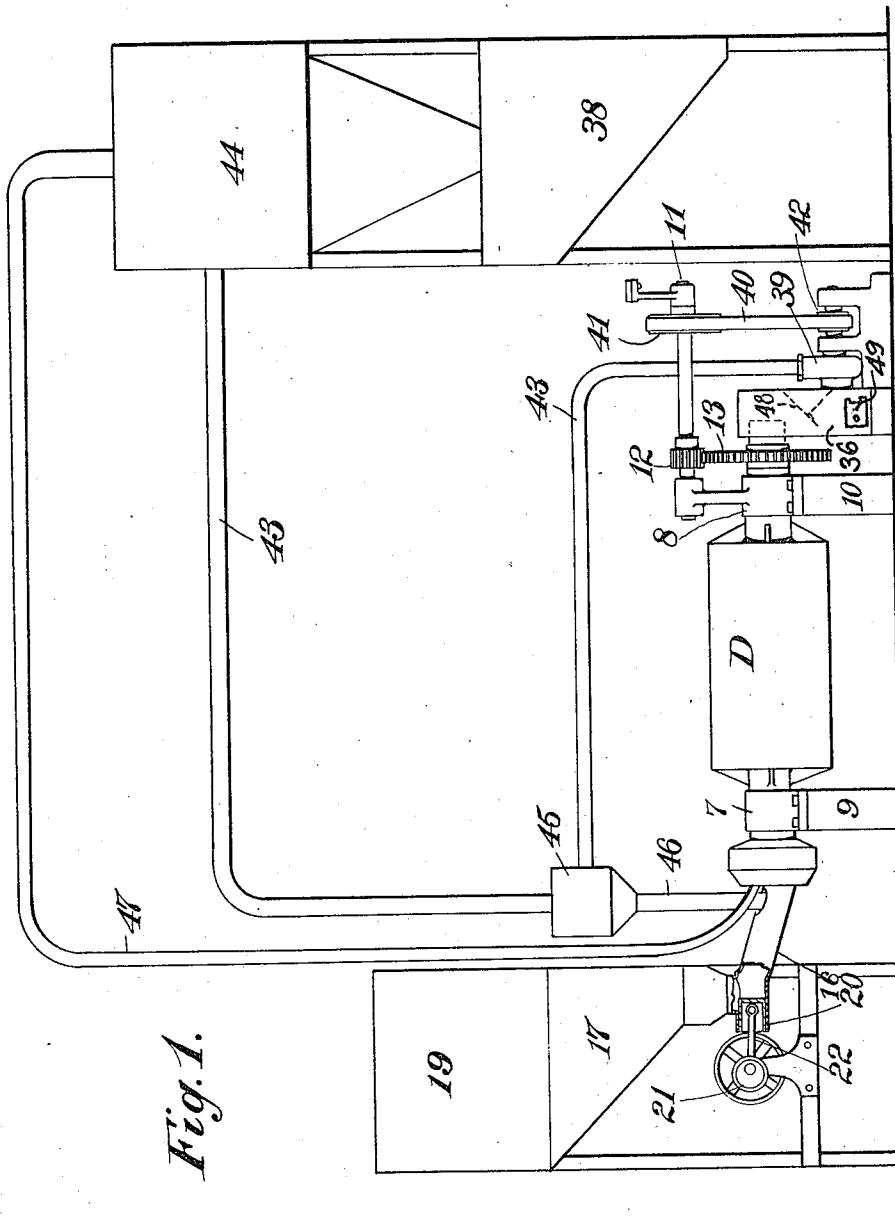
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J. E. KENNEDY

APPARATUS FOR PULVERIZING MATERIAL

Filed Dec. 16, 1919

2 Sheets-Sheet 1



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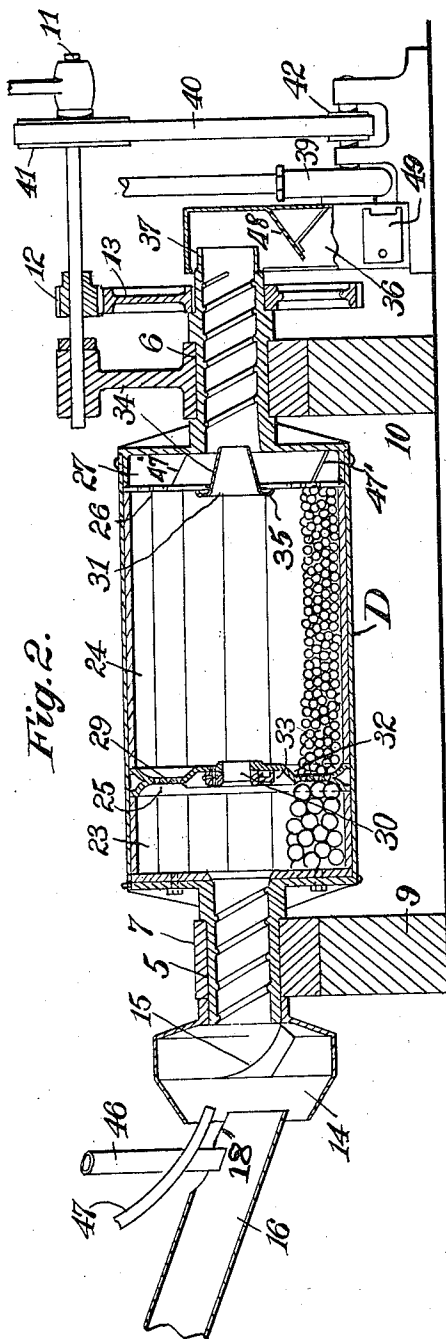
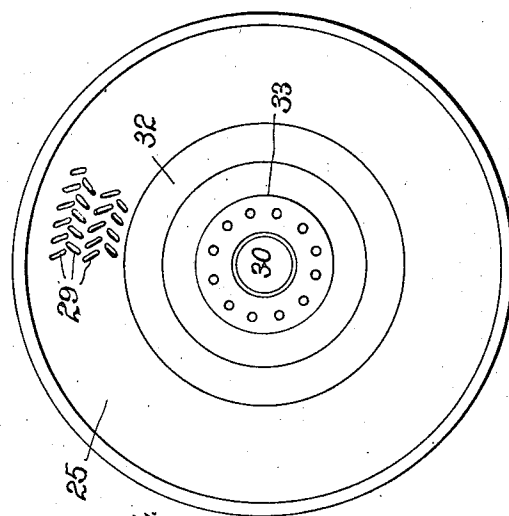
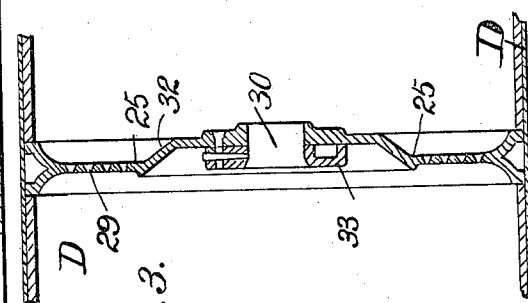
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APPARATUS FOR PULVERIZING MATERIAL

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR PULVERIZING MATERIAL.

Application filed December 16, 1919. Serial No. 345,211.

This invention relates to apparatus for pulverizing or comminuting material particularly adapted for pulverizing coal, lignite and peat, although it is applicable for pulverizing other materials, such as ore, rock, phosphate, bone, etc.

It is an object of the invention to provide pulverizing apparatus in which the pulverized material is delivered by pneumatic means arranged with means in the delivery to separate unpulverized or coarse material from the pulverized material and return it to the pulverizing means.

It is a further object of the invention to provide in apparatus of this character a revoluble drum having grinding means to pulverize the material therein and in which the pneumatic delivery means for the pulverized material is caused to pass a current of air through the drum.

It is still another object of the invention to provide an improved drum in which to pulverize the material to facilitate the pulverizing and delivery of the pulverized material with improved means to deliver material to be pulverized to the drum.

It is a further object of the invention to provide in a pulverizing drum of this character, in which the grinding means constitute balls to have free rolling movement in the drum during the revolving thereof, a perforated partition or partitions to separate the drum into chambers, and to provide an opening axially through the drum provided with means to direct the balls away from such openings during the revolving of the drum.

It is a still further object of the invention to provide a pulverizing drum arranged with hollow trunnions axially at opposite ends through one of which the material to be pulverized is fed to the drum and the material discharged from the drum through the other trunnion, the feed trunnion being arranged with a hopper to revolve with the drum and receive the material to be fed to the drum, and having means to deliver the material from the hopper through the charging opening of the drum during the revolving thereof, and the discharge trunnion projecting into a close box or chamber to which a blower fan is connected to draw air through the drum and deliver the pulverized material, said drum being arranged with means to direct any of the balls which may be delivered with the pulverized material

away from the connection of the fan with said chamber.

Other objects and advantages will hereinafter appear.

In the drawings accompanying and forming a part of this specification, Figure 1 is an elevational view of an installation of a pulverizing apparatus illustrating an embodiment of my invention.

Figure 2 is an enlarged sectional side elevation of a drum in which to pulverize material showing the charging hopper connected thereto with the means to deliver material from the hopper to the drum, and also showing the arrangement and connection of the fan with the drum.

Figure 3 is a sectional view of a partition to separate the drum into chambers and showing the manner of mounting the partition in the drum; and

Figure 4 is an end elevation of the partition shown in Figure 3 looking at the right thereof.

Similar characters of reference designate like parts throughout the different views of the drawing.

The embodiment of my invention shown in the drawings comprising a drum D having hollow trunnions 5, 6 at opposite ends and axially of the drum whereby the drum is revolubly supported in pillow blocks 7, 8 mounted upon standards 9, 10. The trunnion 5 serves as a charging opening for the drum and the trunnion 6 as the discharge outlet for the drum, and the inner surface or walls of said trunnions are arranged in the form of a spiral to facilitate the charging of the material to and discharge of the material from the drum, as clearly shown in Figure 2. The drum is revolved from a shaft 11, driven from a suitable source of power, by a pinion 12 on said shaft meshing with a gear 13 keyed to the projecting end of the trunnion 6 of the drum.

The charging opening 5 of the drum has a charging feeder 14 secured thereto to revolve with the drum and which may be substantially of the form shown in Figure 2 to receive material delivered thereto, comprising a hopper 14 mounted on charging trunnion 5 of the drum and having a portion of larger diameter than the diameter of the opening in the trunnion with an inlet opening of reduced diameter with the walls of the hopper diverging from the inlet to the portion of the chamber of larger diameter.

A blade 15 is arranged in the portion of the hopper of larger diameter, said blade being constructed and arranged to pick up material in the hopper from below the axis and lift it above the axis and direct it into the opening of the charging trunnion to discharge the material from the hopper to the drum during the revolving of the drum.

Means are provided to deliver material to the feeder 14 from a suitable source of supply, and is shown as comprising a chute 16 leading from a hopper 17 into the opening of the feeder 14, the cross sectional dimensions of said chute being less than the diameter of the feeder opening to provide an open space around said chute and feeder opening as shown in Figure 2 for a purpose to be hereinafter described, the upper end of the discharge chute 16 being preferably open as shown at 18 to facilitate the delivery of material therefrom. The feeder 14 is arranged in line with the outlet of a bin 19 for the material to be pulverized. To force feed the material from the hopper 17 to the drum suitable means may be provided and shown as consisting of a plunger or piston 20 reciprocally mounted in the chute 16 and reciprocated by an eccentric 21 rotated from a suitable source of power and connected to the plunger by a rod 22.

The drum D is separated into chambers, shown in the present instance as separated into two chambers 23 and 24, by a partition 25 and in which chambers the material is ground or pulverized, said chambers having grinding means therein consisting of balls having free rolling movement during the revolving of the drum as clearly shown in Figure 2, with the balls in the chamber 23 of a larger size than the balls in the chamber 24 to perform the primary function of grinding. A partition 26 provides a chamber 27 between said partition and the discharge end of the drum for the pulverized material. The grinding chambers 23, 24 of the drum are provided with a lining of wear resisting material such as manganese steel, and which lining may serve to position the partition 25 in the drum against endwise movement by abutting against opposite sides of an annular bifurcation of said partition.

The partitions 25 and 26 are arranged with a series of circularly and concentric arranged perforations 29 for the discharge of the material from one chamber to the next adjacent chamber. The walls of the perforations diverge from the delivery to the discharge side of the partitions, or in a direction longitudinally of the drum from the charging to the discharge end as clearly shown in Figure 3, thereby facilitating the delivery of the material through said perforations or openings and preventing the material from packing in and clogging the perforations. The partitions 25 and 26 are

also provided with openings 30, 31 which are preferably located axially of the drum and of a size substantially the same as the discharge and charging openings of the drum.

To prevent the balls from being discharged through the opening 30 in the partition 25 from the chambers 23, 24 during the revolving of the drum the opening is arranged in a portion of the partition carried by a portion of the partition inclining in a direction into the chamber 24 and in a direction toward the axis of the drum, as shown at 32. It will be obvious that any balls in the chamber 24 adjacent the partition and tending to be carried around by the revolving of the drum will be directed back into the chamber 24 away from the opening as they move above the axis of the drum. To prevent the balls from the chamber 23 being delivered into the chamber 24 due to the arranging of the partition with the inclined portion 32 an annular member or ring 33 is secured to the partition to extend around the opening within the chamber 23 to serve as a guide to direct any balls which have a tendency to pass through the opening from the chamber 23 to the chamber 24 back into the chamber 23.

The material from the chamber 24 is delivered in a pulverized state through the perforations of partition 26 into the chamber 27 and discharged from the latter through the trunnion 6 and is directed into the latter trunnion by a cone shaped blade 34 fixed to the partition 26 to extend around the opening 31 with the wall inclining in a direction toward the trunnion opening as clearly shown in Figure 2. The tendency of this chute is to direct any of the balls which may enter the chute from the chamber 24 during the revolving of the drum back into the chamber 24, but to prevent the balls from entering the chute and direct them back into the chamber 24 an annular flange member 35 is arranged about the opening 31 in the chamber 24. The material is discharged from the trunnion opening 6 into a closed chamber or box 36 into the upper end of which the trunnion projects as shown at 37, Figure 2.

The pulverized material is delivered or fed from the drum to a predetermined distant point, such as a storage bin 38, by means of a rotary fan or blower fan shown in a general way at 39, the inlet of which fan is in communication with the drum through the chamber 36 by being connected thereto preferably at a point below the discharge trunnion 6 and above the bottom of the box 36. By this arrangement not only is the pulverized material delivered by the fan 38, but owing to the arrangement of the openings axially in the partitions 25, 26 and the enlarged opening of the hopper 14 a current of air is caused to pass through the drum

taking up any of the pulverized material in the form of dust and also facilitating the discharge of the material from the drum. The fan is suitably driven, as by a belt 40 passing around a pulley 41 on the shaft 11 and a pulley 42 on the shaft of the fan. The outlet of the fan is connected by a conduit or pipe 43 to a cyclone collecting chamber 44 the outlet of which is connected to a bin 38.

To separate any unpulverized or coarse material from the pulverized material which may be discharged from the drum and delivered by the fan, and deliver such unpulverized material to the material to be fed or delivered to the charging opening of the drum, there is provided a second cyclone chamber 45 in the connecting pipe 43 of the fan with the chamber 44. The outlet of this chamber 45 is connected by a pipe or chute 46 with the charging chute 16 (Figure 1). To facilitate the passing of the current of air through the drum and to utilize air which has previously been passed through the drum and to relieve the chamber 44 of air pressure said latter chamber is connected by a conduit or pipe 47 with the drum by leading said pipe into the space between the opening of the chute 14 and the charging chute 16.

To facilitate the discharge of the material from the chamber 27 into the discharge chute 34 to deliver material from said chamber 27 into the discharge trunnion 6 the chamber 27 has transverse blades or vanes 47' therein arranged to pick up the material in said chamber from below the axis of the drum and lift it above the axis of the drum and discharge it onto the chute 34 loosening the material, part of which is drawn off and delivered by the current of air passed through the drum by the operation of the fan 39 and a portion directed into the discharge trunnion 6 to be delivered into the receptacle 36.

To direct any balls delivered through the discharge trunnion into the receptacle 36 away from the connection of the fan with said receptacle a grizzly 48 is mounted in said receptacle to extend inward and incline downward from the wall of the receptacle opposite to the wall through which the trunnion 6 projects. This will direct the balls to the wall opposite to which the fan is connected and the balls will drop to the bottom of the receptacle 36 and may be removed through an opening normally closed by a door 49. This door 49 is also used for the purpose of regulating and controlling the suction. By opening the door to a greater or less extent the force of the suction of the air through the drum is decreased and increased without impairing the delivery of the suction means. By entirely closing the door a coarser material will be drawn off

from the drum and delivered by the suction means than if the door is partially or entirely open, in which latter case only material pulverized to an impalpably fine state will be drawn from the drum by the suction 70 means and any material which is relatively coarse to the material drawn off by the suction means and may be delivered from chamber 27 from the discharge opening will gravitate and settle in the bottom of the receptacle or box 36 from which it may be removed through the door opening. Furthermore, by the arrangement of connecting the suction or air exhaust to the discharge end of the drum in the manner set forth and the 80 arranging of a connection in the delivery of the suction means leading to the charging opening of the drum, the suction means serves as a common means to draw or exhaust air from the discharge end of the 85 drum and to deliver air under pressure to the charging end of the drum, and by the arrangement of the opening with the adjustable closure in the connection of the suction means with the drum the force of the suction of the air from the drum may be decreased and increased without affecting the delivery of the air to the drum.

Variations may be resorted to within the scope of my invention and portions thereof 95 may be used without others.

Having thus described my invention, I claim:

1. In apparatus for pulverizing material, a revoluble drum in which to pulverize the material; having charging and discharging openings axially at opposite ends; a collecting chamber; suction means to draw air through the drum and draw the material from the drum and deliver said air with the material to the collecting chamber; means in the connection of the suction means with the collecting chamber to separate unpulverized material from the pulverized material delivered by the suction means and return the unpulverized material to the charging opening of the drum; and means to connect the collecting chamber in air circulation with the charging end of the drum for the purpose specified. 100 105 110 115

2. In apparatus for pulverizing material, a revoluble drum having a charging opening at one end and a discharge opening at the opposite end and axially of the drum; partitions separating the drum into chambers, said partitions having openings axially of the drum; pulverizing means in said chambers to have free movement during the revolving of the drum; and guide flanges at the axial openings of the partitions to direct the pulverizing means away from said openings for the purpose specified. 120 125

3. In apparatus for pulverizing material, a drum having heads at opposite ends with axially projecting hollow trunnions to rev- 130

olubly support the drum, one of said trunnions serving as the charging opening for the drum and the other as a discharge opening; perforated partitions separating the drum into a plurality of chambers carrying pulverizing means and a chamber for the pulverized material at the discharge opening of the drum, said partitions having openings axially of the drum; flanges at the axial opening; of the partitions to direct the pulverizing means away from said openings, and the partition of the chamber for the pulverized material arranged with means to direct the material from said chamber through the discharge opening in the one trunnion for the purpose specified.

4. In apparatus for pulverizing material, the combination of a revoluble drum having charging and discharge openings axially at opposite ends: means to deliver material through the charging opening of the drum; means to pulverize material in the drum during the revolving of the drum; suction means to draw air through the drum from the charging opening to the discharge opening to deliver the pulverized material; and means to connect said suction means to the discharge end of the drum arranged with means for regulating and controlling the suction means for the purpose specified.

5. In apparatus for pulverizing material, a revoluble drum having a charging opening and a discharge opening at opposite ends and axially of the drum; transverse partitions in said drum having an axial opening and perforations arranged around said axial opening to separate the drum into chambers; means in the drum to pulverize material therein during the revolving of the drum; suction means; means to connect said suction means to the outlet to receive material discharged from the drum and to draw air through the drum from the charging to the discharging opening and draw pulverized material therefrom and deliver such pulverized material and the material delivered from the drum at a predetermined point; and means in the delivery of the suction means to separate unpulverized material from the material delivered by the suction means and arranged to deliver said separated material to the material to be fed to the drum.

6. In apparatus for pulverizing material, a revoluble drum having a charging and discharging openings at opposite ends and axially of the drum; perforated partitions in the drum to separate the drum into chambers arranged with means therein having free movement during the revolving of the drum to pulverize material in such chambers; and a chamber for the pulverized material at the discharge end of the drum, said partitions having openings axially of the drum; means arranged around the axial

openings in the drum to direct the pulverizing means in said chambers away from such openings; a blower fan having the inlet in communication with the discharge end of the drum and a pipe connected to the delivery end thereof, said blower being adapted to draw air through and pulverized material from the drum and deliver such material with the material discharged from the drum; and a separator connected to the delivery pipe of the blower having an outlet connected to the receiver for the pulverized material and an outlet connected to the charging opening of the drum for the purpose specified.

7. In pulverizing material, a revoluble drum having heads at opposite ends with axially projecting hollow trunnions, one of said trunnions being arranged with charging means for the drum and the other serving as a discharge opening for the material from the drum; transverse perforated partitions in said drum having an enlarged axial opening to separate the drum into chambers, means having free rolling movement in the drum during the revolving thereof to pulverize material in drum; a receptacle for the pulverized material at the discharge end of the drum and into which the drum trunnion with the discharge opening extends, said receptacle having an opening with an adjustable closure; and suction means connected to said drum at a point below the discharge of the receptacle for the purpose specified.

8. In pulverizing apparatus, a revoluble drum having an opening axially at one end arranged with means to feed material there-through to the drum and an opening axially at opposite end of the drum through which to discharge the material from the drum; means to have free movement in the drum during the revolving thereof to pulverize material in the drum; a stationary receptacle for the pulverized material at the discharge end of the drum and having an opening with an adjustable closure; and suction means connected to said receptacle for the purpose specified.

9. In apparatus for pulverizing material, a revoluble drum having charging and discharging openings axially at opposite ends; balls to have free rolling movement in the drum during the revolving thereof to pulverize material in the drum; a closed receiver for the pulverized material at the discharge end of the drum; suction means connected to said receiver at a point below the discharge of the drum and above the bottom of the receiver; and means in said receiver to direct any of the pulverizing balls which may be delivered from the discharge opening with the pulverized material into the receiver away from said suction means.

10. In apparatus for pulverizing material, a revoluble drum having heads at opposite

ends with axially projecting hollow trunnions, one of said trunnions serving as a charging opening for the drum and the other as a discharging opening for the drum; means having free movement in the drum during the revolving thereof to pulverize material in the drum; and a charging hopper connected to the charging trunnion of the drum of larger diameter than the diameter of the opening in the trunnion and having an inlet opening of reduced diameter the walls of which chamber diverge from the inlet to the portion of the chamber of larger diameter and having a blade arranged therein to pick up material in the hopper from below the axis and lift it above the axis and direct it into the opening of the charging trunnion to discharge material from the hopper to the drum during the revolving of the drum.

11. In apparatus for pulverizing material, the combination with a revoluble tubular drum having charging and discharge openings at opposite ends, and means to grind material in the drum during the revolving thereof, of suction means to draw air through and deliver pulverized material from the drum, and means for connecting and affording free open communication between the intake to the suction means and drum, and said connecting means arranged with adjustable means to variably open the suction means to the atmosphere with adjustable means to regulate the pull of the air through the drum by the suction means.

12. In apparatus for pulverizing material, the combination with a revoluble tubular drum having charging and discharge openings at opposite ends, and means to grind material in the drum during the revolving thereof, of suction means to draw air through and deliver pulverized material from the drum, and means for connecting and affording free open communication between the suction means and the discharge end of the drum including a receptacle having an opening to the atmosphere exterior of the drum and arranged with an adjustable closure for the purpose specified.

13. In apparatus for pulverizing material, the combination with a tubular drum revoluble on a horizontal axis having charging and discharging openings at opposite ends with means therein to pulverize material

during the revolving of the drum, of common suction means in operatable communication with the discharge end of the drum to exhaust air and draw pulverized material from the drum, a connection with the delivery side of the suction means leading to the charging opening of the drum to deliver air under pressure to the drum, and regulatable means in the connection of the suction means with the discharge end of the drum to variably open the suction means to the atmosphere and thereby control the exhaust of the air from the drum for the purpose specified.

14. In apparatus of the class specified, the combination with a revoluble drum in which to triturate material having an opening in opposite ends, means to charge material and admit air through one of said openings to said drum, a fan having the air intake thereof connected to an opening at one end of the drum to draw air with pulverulent material from the drum, a separator connected to the delivery side of the fan to separate pulverulent material from the air, a pipe leading from said separator to the other opening of the drum, and regulatable means to variably open the intake to the fan to the atmosphere and thereby control the suction of the air by the fan from the drum.

15. In apparatus of the class specified, the combination with a revoluble drum in which to triturate material having an opening in opposite ends, means to charge material and admit air to said drum, a fan having the air intake thereof connected to an opening at one end of the drum to draw air through a pulverulent material from the drum, a separator connected to the delivery side of the fan for separating material from the air delivered by the fan having an outlet for said separated material arranged with means to return said material to the drum, a separating collector connected to the first separator, a pipe leading from said collector and connected to the opening of the drum at the end opposite to that at which the fan is connected, and regulatable means to variably open the intake to the fan to the atmosphere and thereby control the suction of the air from the drum.

Signed at New York, in the county of New York and State of New York.

JOSEPH E. KENNEDY.