Nov. 29, 1932. W. DE COURSEY 1,889,436

METHOD AND APPARATUS FOR PULVERIZING MATERIALS

Filed Oct. 23, 1926 3 Sheets-Sheet 1

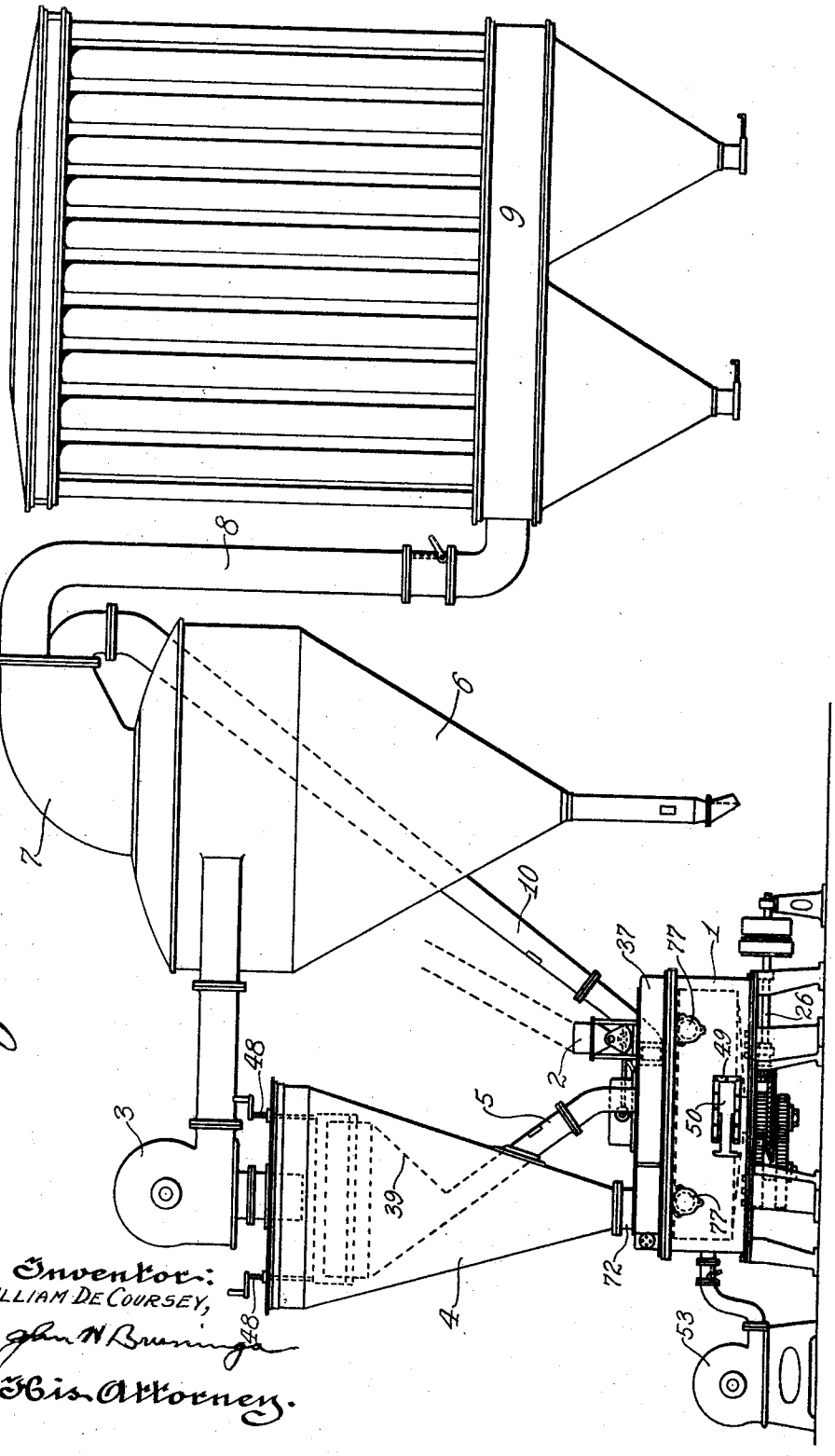

Fig. 1.

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Fig. 2.

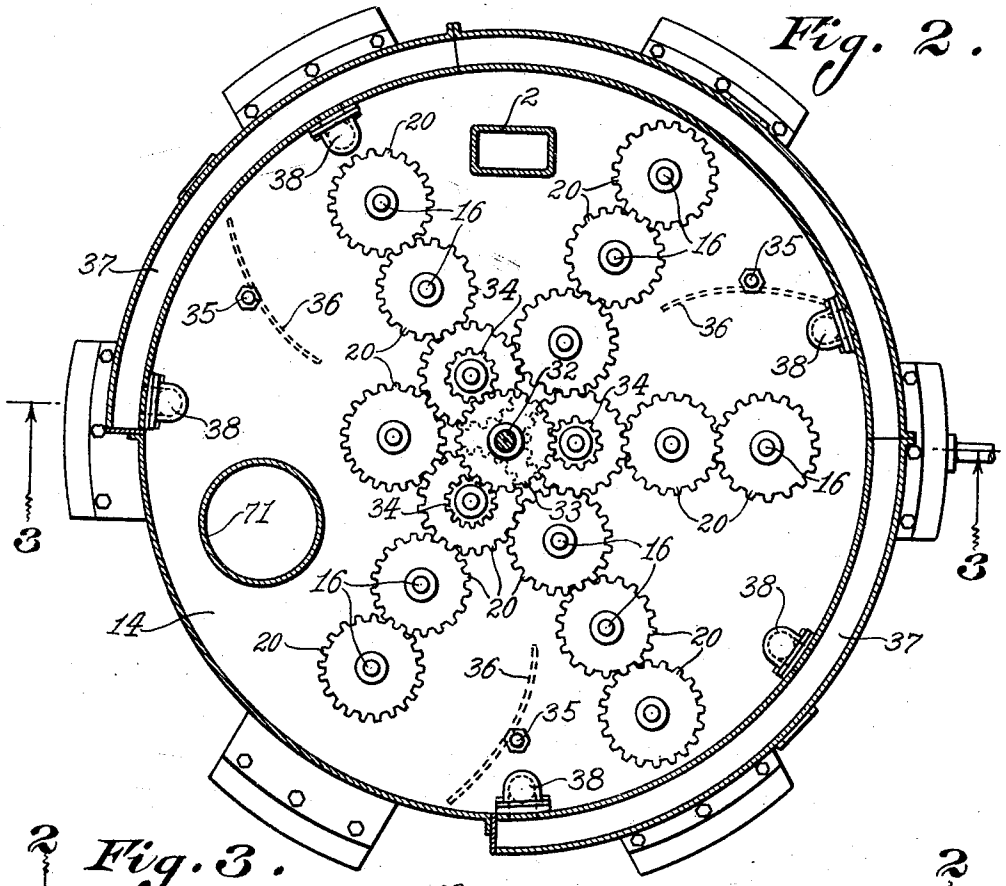

Fig. 3.

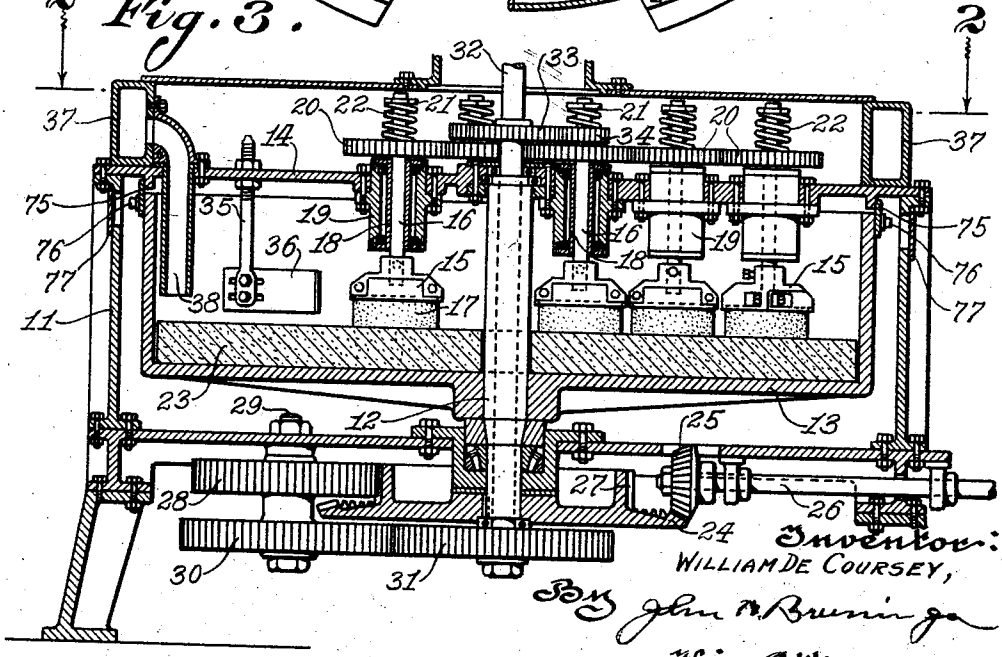

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Fig. 4.

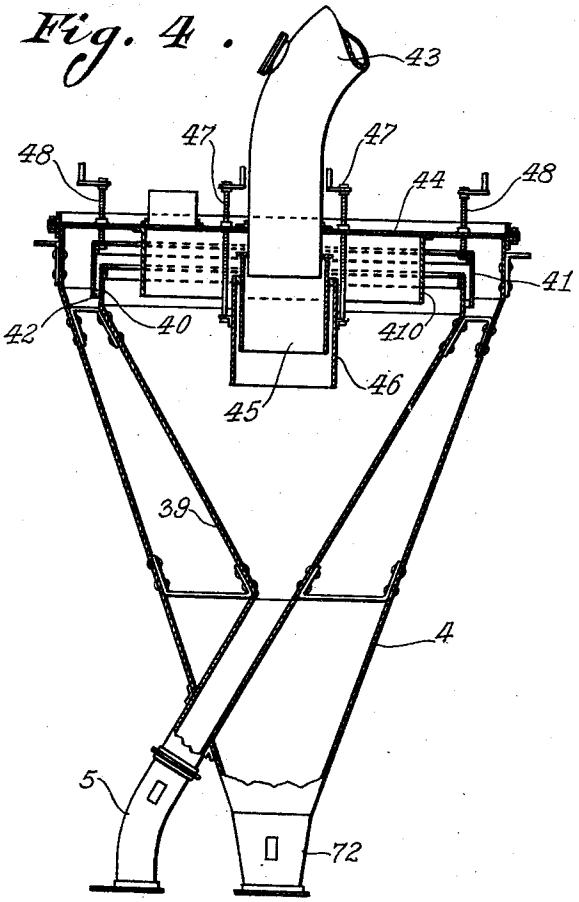


Fig. 5.

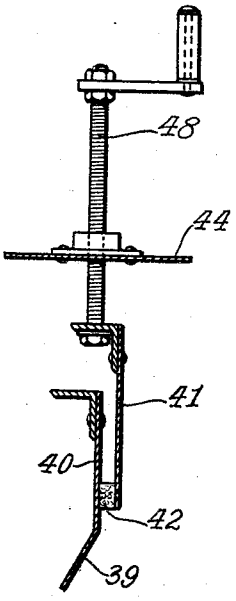


Fig. 7.

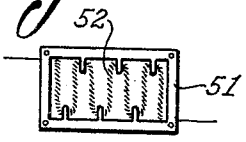


Fig. 6.

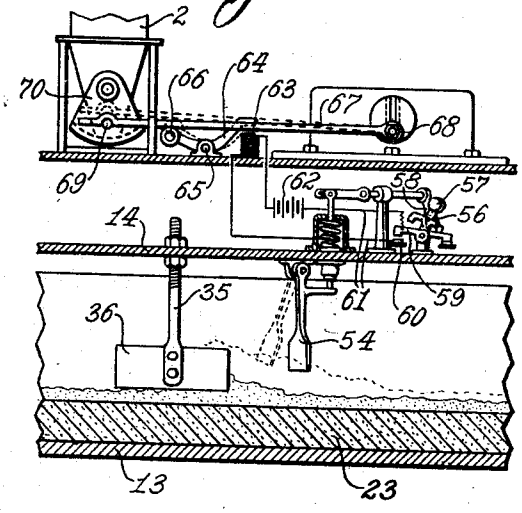
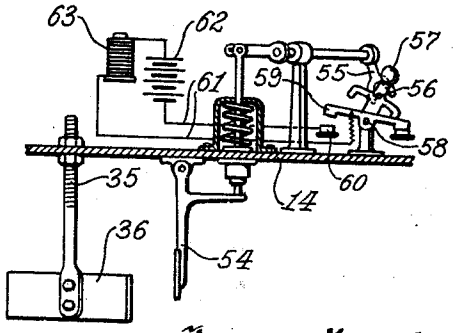


Fig. 8.



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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR PULVERIZING MATERIALS

Application filed October 23, 1926. Serial No. 143,600.

This invention pertains to a method and apparatus for pulverizing materials and more particularly to the handling of materials in the dry state.

One of the objects of this invention is to provide a method and apparatus by means of which materials may be ground to a greater degree of fineness than has been attainable heretofore.

Another object is to provide such a method and apparatus by means of which an increased quantity of material may be handled in a given time.

Another object is to provide a method by which material may be pulverized and the coarse particles separated from the fine particles with improved accuracy and refinement.

Another object is to provide improved apparatus for the separation of the coarse from the fine particles.

Another object is to provide a pulverizer of improved construction which will be efficient in operation and reliable in service.

Further objects will appear from the following description, taken in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic view of an apparatus which may be used in carrying out the process embodying this invention;

Figure 2 is a sectional view of a pulverizer embodying this invention, taken on line 2—2 of Figure 3;

Figure 3 is a section taken on line 3—3 of Figure 2;

Figure 4 is a sectional view of the preliminary separator;

Figure 5 is an enlarged detail of Figure 4;

Figure 6 is a sectional view, somewhat diagrammatic in form, illustrating the feed control mechanism;

Figure 7 is a detail view of the air heater; and

Figure 8 is a detail of Figure 6.

In accordance with this invention the material is fed to a pulverizer 1, whose construction will be more fully described hereinafter, by means of a feeding device 2 of any suitable type. The ground material is taken up from the pulverizer 1 by pneumatic suction produced by a blower 3, and said material is passed through a preliminary separator. The separator 4 separates the coarse particles from the fine, returns the former to the pulverizer through a chute 5, and permits the latter to pass up through the blower 3 to be delivered thereby to a main separator 6. The separator 6 may be of the cyclone type, which separates most of the pulverized material from the air and collects said material in the bottom of the separator. The air passes out through the head 7 and by way of a conduit 8 to a baghouse 9 or other suitable collecting device. The baghouse 9 filters out the finest dust from the air and collects the same. Some of the air which passes through the separator 6 may be returned to the pulverizer through a conduit 10. This air, being drawn from the lower part of the head 7, will carry with it some of the heavier fines which are thus returned to the pan for regrinding.

The pulverizer 1 is shown in detail in Figures 2 and 3. It comprises a frame or base 11, in which is journaled a hollow shaft 12 which has fixed thereto a pan 13 so as to rotate with the shaft. Mounted on a plate 14 above the pan 13 are a series of mullers, each comprising a head 15 mounted on a shaft 16 and carrying a block 17 of carborundum or other abrasive material. The shaft 16 is mounted for longitudinal movement in a sleeve 18, but is splined thereto so as to rotate therewith. The sleeve 18 has a bearing in a support 19 which is removably mounted on the plate 4, as shown in Figure 3. The sleeve 18 has mounted on its upper end a gear 20 adapted to mesh with one or more of a set of similar gears on the other muller shafts, as shown in Figure 2. The upper end of the shaft 16 is equipped with a nut 21 which rests on a spring 22, which in turn rests on the upper end of the sleeve 18 or the gear 20. The spring 22 serves to yieldingly support the weight of the muller, and the nut 21 serves to adjust the tension of said spring so that the pressure exerted by the muller may be regulated thereby. The bottom of the pan 13 may be equipped with a plate 23 of carborundum or other abrasive material, whose upper face is engaged by the faces of the mul-

ler blocks 17. The material is ground between the blocks 17 and the plate 23. If desired, the block 23 may be dispensed with and the mullers used in direct engagement with the bottom of the pan.

The hollow shaft 12 carries at its lower end a bevel gear 24 adapted to mesh with a corresponding gear 25 on a drive shaft 26, which may be driven from any suitable source of power, not shown. The gear 24 may also have mounted thereon a spur gear adapted to mesh with a similar gear 28 on a short shaft 29 journaled on the frame 11 and carrying a second gear 30 adapted to mesh with a similar gear 31 on the lower end of a shaft 32 passing through the bore of the hollow shaft 12.

The upper end of the shaft 32 carries a gear 33 which meshes with a series of pinion gears 34 on certain of the muller shafts 16, as shown in Figure 2. The muller shafts which carry the pinions 34 also carry gears 20 meshing with the other gears 20, as shown in Figure 2. By this arrangement the muller shafts are driven from the main drive shaft 26 through the train of gearing just described.

Mounted on the plate 14, so as to extend downwardly into the pan 13, are a series of arms 35, each carrying at its lower end a plow 36 adapted to engage the material on the plate 23 so as to spread and distribute the same.

Mounted on the upper part of the frame 11 is an annular conduit 37 extending all or part of the way around the frame. This conduit has connected thereto a series of outlet conduits 38 extending downwardly therefrom to the bottom of the pan 13, as shown in Figure 3. The air returned by the conduit 10 is passed into the conduit 37, which delivers it through the conduits 38 to the bottom of the pan. This air, being delivered near the bottom of the pan, assists in stirring up the material on the plate 23.

The preliminary separator 4 is constructed of generally conical form, as illustrated in Figure 4, and has mounted within it another conical hopper 39, the bottom end of which connects to the chute 5. The upper end of the hopper 39 is provided with an upstanding rim 40, which is in turn surrounded by an adjustable rim 41, suitable packing 42 being placed therebetween to prevent the air from passing through. The suction pipe 43 leading to the blower 3 passes through the middle of the cover 44 of the separator. This pipe has fixed to the lower end thereof a downwardly extending sleeve 45. This sleeve is in turn surrounded by an adjustable sleeve 46. Hand screws 47 are provided for the adjustment of the sleeve 46 up and down, while similar screws 48 provide for the adjustment of the rim 41. By adjusting the rim 41 or the sleeve 46, or both, in an upward or downward direction, the degree of fineness of the material separated may be adjusted. A baffle 410 extends downwardly from the cover 44 between the sleeves 41 and 46.

The dust-laden air passes upwardly through the outer cone, over the top of the rim 41, strikes the baffle 410, being retarded thereby, and passes downwardly under the edge of the rim 46, and then up through the pipe 43. This reversal of direction at the lower end of the pipe 46 causes the heavier or coarser particles to be thrown out, while the lighter particles are turned back and carried upwardly by the draft. By adjusting the vertical distance between the lower edge of the sleeve 46 and the upper edge of the rim 41, the degree of fineness of the particles separated can be regulated.

In order to provide a sufficient supply of air to the pulverizer, an inlet opening 49 controlled by a damper 50 is provided.

As the efficiency of the grinding operation depends greatly upon the state of dryness of the atmosphere in the pulverizer, it is important that the air admitted through the opening 49 be properly dried, if necessary. Accordingly, a heater 51, as shown in Figure 7, is provided which may be mounted in the opening 49 to heat and dry the incoming air. This heater comprises a frame on which a suitable heating element 52 may be mounted. An electrical heating element provides a neat and convenient construction.

In order to supply a further quantity of air when necessary for certain purposes, an auxiliary blower 53 is provided to blow air into the pan at any suitable point. When air is supplied by the blower 53 or drawn in through the opening 49, the ring 75, which normally closes the opening between the upper edge of the pan 13 and the plate 14, is lowered by loosening the bolts 76 which work in slots in the ring 75 for this purpose. Hand holes 77 are provided in the frame 11 to provide access to said bolts.

In order to provide for uniformity in the degree of fineness to which the material is ground, it is desirable to maintain a fixed depth of material on the plate 23. To this end the mechanism illustrated in Figure 6 is provided. During the operation of the machine, the material on the plate 23 is carried against the plows 36 and tends to stack up in front of each plow, and, in fact, slides off of the surface of the plow in a continuous stream, in a manner similar to the action of water under similar circumstances. A paddle 54 is pivoted on the frame in a position adjacent one of the plows 36 and so as to be engaged by the material stacked up or thrown off by said plow. The paddle 54 is connected so that by its movement a forked arm 55 may be swung backward or forward. The fork of this arm straddles a pin 56 on a weighted rocker arm 57, pivoted at 58

and adapted to engage a contact arm 59 when rocked in one direction or another, so as to correspondingly rock said contact arm. When the material on the plate 23 tends to stack up too high, it engages the paddle 54, which operates this mechanism so as to cause the arm 59 to engage a contact 60, thereby closing a circuit through the wires 61 so as to connect a battery 62 with an electromagnet 63. This magnet is adapted to control a lever 64 pivoted at 65 and provided with a roller 66 adapted to engage a pitman 67 connecting a crank 68 with a pin 69 so as to operate the oscillating valve 70 of the feeder 2. The crank 68 may be driven by any suitable mechanism, not shown, from the upper end of the shaft 32.

This mechanism provides that when the material acted upon by the plow 36 moves the paddle 54, the circuit to the magnet 63 will be closed, causing said magnet to rock the lever 64, thereby raising the roller 66 which engages the pitman 67, lifting the same clear of the pin 69 and discontinuing the operation of the oscillating valve 70. When the paddle 54 resumes its normal position, the magnet circuit will be opened and the pitman 67 dropped so as to re-engage the pin 69 and start the feed.

In the operation of this pulverizer, the material is passed through the same, as previously described. The raw material is fed onto the plate 23 where it is brought under the action of the mullers 17 to grind the same. The rotation of the pan 13 and the mullers keeps the material in agitation and at the same time tends to move the material outwardly toward the rim of the pan by centrifugal force. The plows 36 act to scrape the material back again toward the center of the pan and thus effect a periodic re-distribution thereof for the repeated action thereon of the mullers 17. As the material assumes a certain degree of fineness, it becomes suspended in the air moving through the pan. This air is sucked up through the opening 71 in the cover of the machine into the intake 72 of the preliminary separator 4. The draft of air entering the pan through the conduits 38 also assists in stirring up the fine particles so as to cause them to become suspended in the moving air. The dust-laden air then passes through the preliminary separator, the main separator and the baghouse, as previously described, so that, first, the coarse particles are separated from the fine and returned to the pulverizer; then the finer particles are separated from the air and collected in the main separator 6, after which the air passes to the baghouse, in which the finest dust is separated out and collected.

The degree of fineness of the grinding is maintained uniform by the regulating device shown in Figure 6, which operates to control the feed in accordance with the level of the material in the pan and thus maintains a fixed level for said material. This level can be adjusted by adjusting the height of the plow 36.

It is obvious that various changes may be made in the details of construction without departing from the spirit of this invention; it is to be understood, therefore, that this invention is not limited to the specific details shown and described.

Having thus described the invention, what is claimed is:

1. In the art of pulverizing materials, the process comprising, grinding the material in a pan in order to pulverize the same, withdrawing the fine material from the upper part of the pan, and maintaining a fixed level of the material in the pan so as to provide uniform fineness of the material withdrawn.

2. In an apparatus of the character described, a pan, grinding means cooperating therewith, an enclosure for said pan, means for withdrawing the pulverized material from said enclosure, a separator adapted to separate the fine from the coarse material withdrawn, and a connection from said separator adapted to return the coarse material to said pan.

3. In an apparatus of the character described, a pan, grinding means cooperating therewith, an enclosure for said pan, means for withdrawing the pulverized material from said enclosure, a separator adapted to separate the fine from the coarse material withdrawn, a connection from said separator adapted to return the coarse material to said pan, and means for collecting the fine material.

4. In an apparatus of the character described, a pan, grinding means cooperating therewith, an enclosure for said pan, means for withdrawing the pulverized material from said enclosure, a separator adapted to separate the fine from the coarse material withdrawn, a connection from said separator adapted to return the coarse material to said pan, a second separator adapted to operate on said fine material to separate the finest dust therefrom, means for collecting said fine material, and a baghouse for collecting said finest dust.

5. A pulverizer, comprising, a vertical drive shaft, a pan fixed to the lower end of said shaft, vertical muller shafts mounted in said pan, mullers on said shafts, a gear on said drive shaft, and meshing gears on said muller shafts, whereby said pan and said mullers may be driven simultaneously.

6. A pulverizer, comprising, a hollow vertical drive shaft, a pan fixed to the lower end of said shaft, vertical muller shafts mounted in said pan, mullers on said shafts, a shaft within said hollow shaft, gear connections between said hollow shaft and said inner

shaft, and gear connections between said inner shaft and said muller shafts.

7. In a pulverizer, a horizontally rotating pan, mullers cooperating therewith, feeding mechanism therefor, means for agitating the material therein in accordance with the depth of the material, an arm in said pan adapted to engage the agitated material, and connections between said arm and said mechanism adapted to maintain a fixed level of material in said pan.

8. In a pulverizer, a pan, mullers cooperating therewith, feeding mechanism therefor, a plow for spreading the material in said pan, an arm adapted to engage the material adjacent said plow, and connections between said arm and said mechanism adapted to maintain a fixed level of material in said pan.

9. In the art of pulverizing materials, the process comprising, grinding the material in a pan to pulverize the same, regulating the feed of the material so as to maintain a layer of material of fixed depth on the grinding bed, and carrying off the pulverized material on a current of air.

In testimony whereof I affix my signature this 25th day of September, 1926.

WILLIAM DE COURSEY.