June 7, 1960 J. T. HAIGH ET AL 2,939,638

PULVERIZING AND CLASSIFYING APPARATUS

Filed Oct. 17, 1956 3 Sheets-Sheet 1

FIG. 1

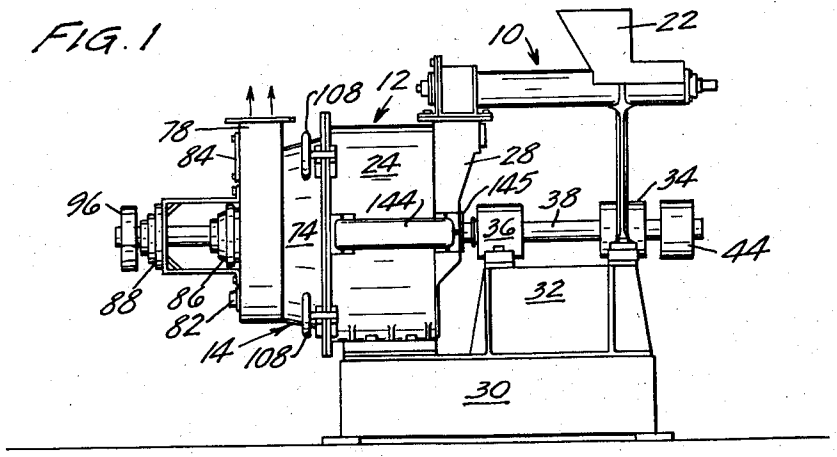


FIG. 2

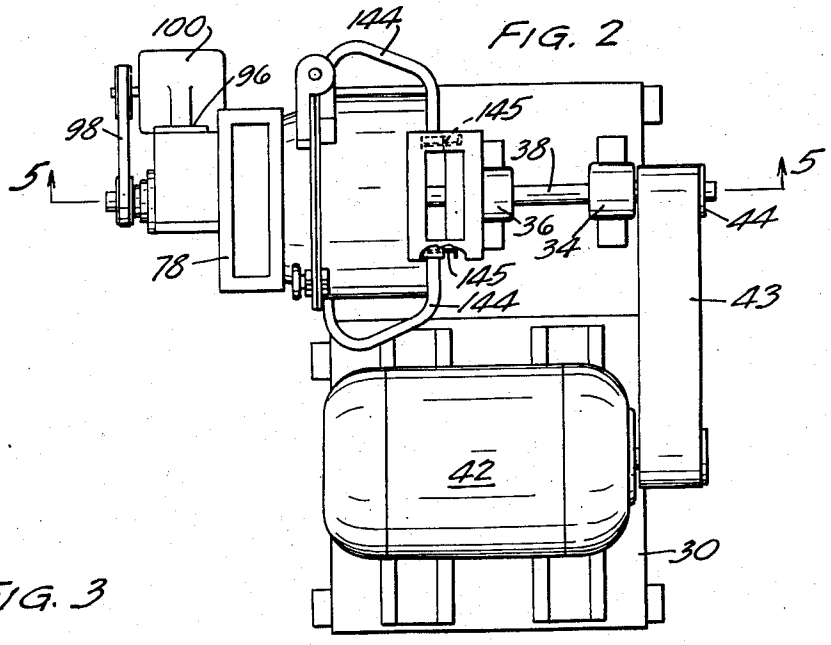
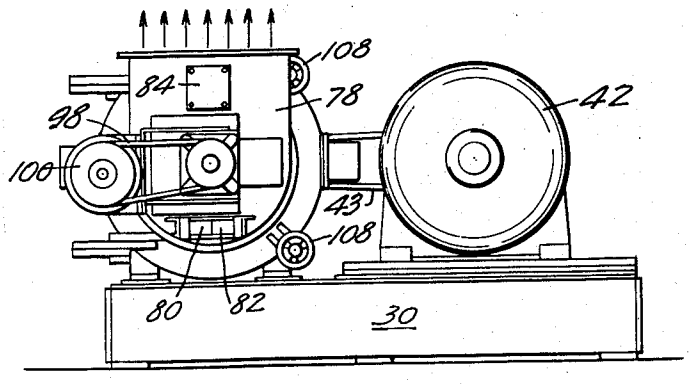


FIG. 3



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FIG. 4

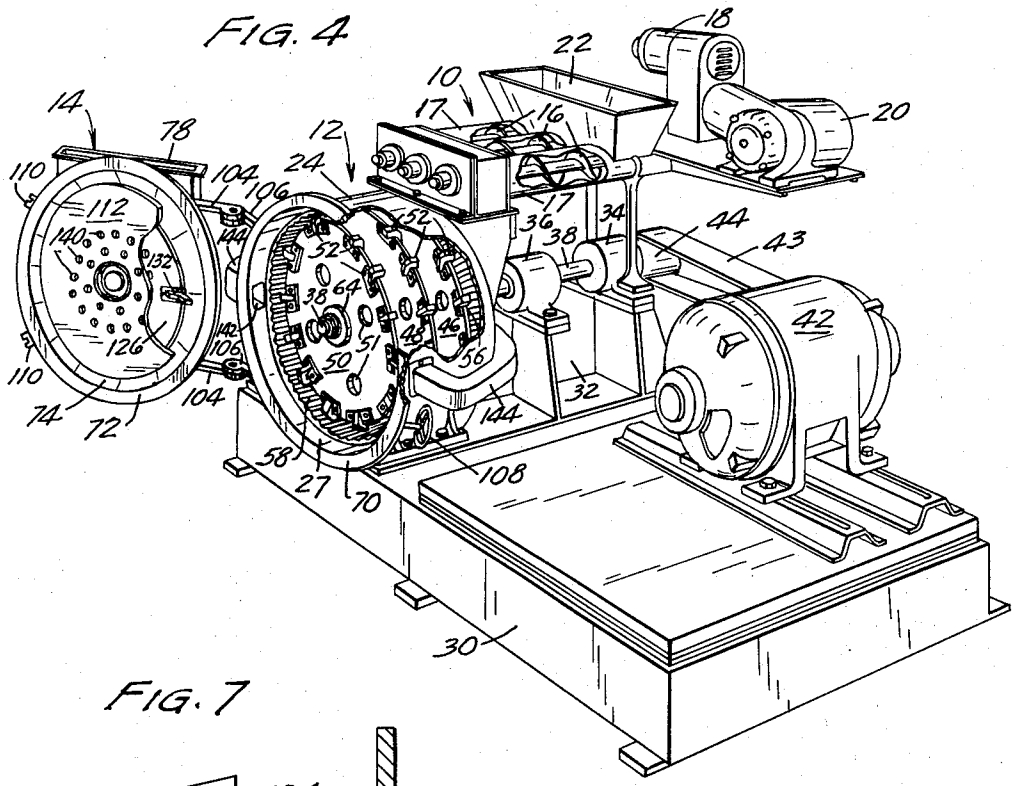


FIG. 7

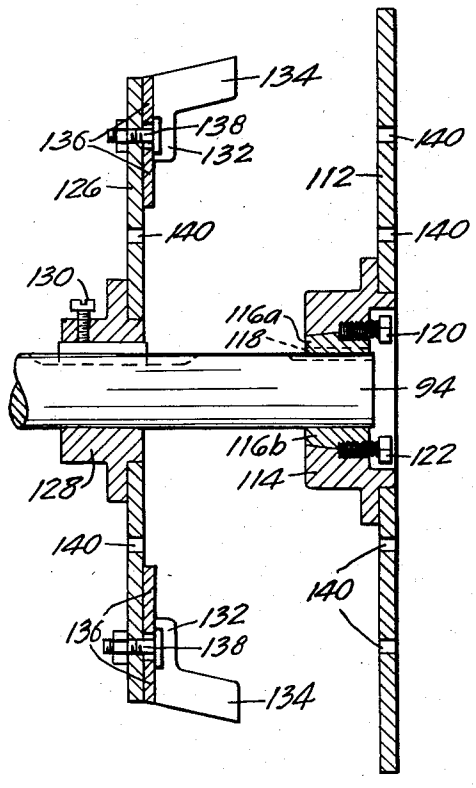
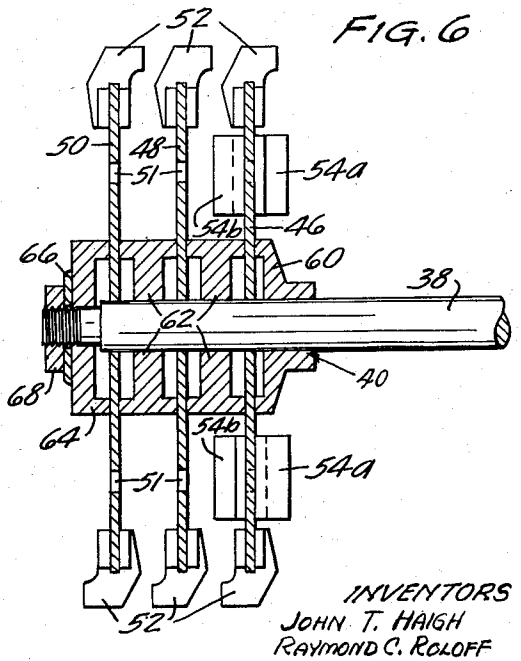


FIG. 6



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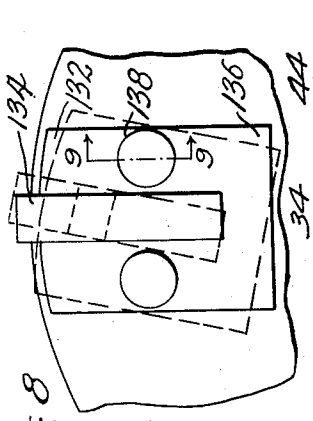


FIG. 8

FIG. 5

FIG. 9

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PULVERIZING AND CLASSIFYING APPARATUS

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18 Claims. (Cl. 241—52)

This invention relates to apparatus for both pulverizing and classifying matter in a dry state so that a preferred maximum particle size is realized in the discharged product.

One object of the present invention is to provide apparatus capable of pulverizing hard or soft materials in the extreme fineness range with a minimum of oversize. More specifically, it is envisaged that a unit constructed in accordance with the teachings of the instant invention be capable of reducing a great many materials to the lower micron sizes with 95–99% of the final particles being finer than five to ten microns. Thus, it will be seen that the invention also has for an aim the obtaining of high product uniformity, there being a virtual elimination of troublesome oversize which is frequently found in superfine products.

Another object of the invention is to provide grinding and classifying apparatus that is exceedingly versatile. In this regard, it is within the purview of the invention to incorporate into the apparatus certain adjustable features that will permit the realization of the above-mentioned fineness of less than five to ten microns and which with minor changes can be made to operate in the coarse particle size range of fifty mesh or thereabouts.

A further object is to provide apparatus of the foregoing character that is highly efficient as far as its overall power consumption is concerned, requiring in many instances appreciably less driving power than demanded by other methods.

A still further object of the invention is to provide unitized apparatus for performing combined pulverizing and classifying functions that is compact and which affords complete accessibility to all of the internal parts in a matter of seconds for inspection, maintenance, cleaning and the making of the simple adjustments necessary to change the size of the discharged fines. Also, it is planned that the simplified construction will permit facile removal and replacement of parts in a minimum of shutdown time should the need arise.

Yet another object is to provide apparatus of the above-mentioned type that will be relatively inexpensive to manufacture and fabricate, thereby further encouraging its widespread adoption.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application which will be indicated in the appended claims.

Figure 1 is a side elevational view of a combined pulverizing and classifying unit typifying the invention;

Figure 2 is a plan view of the apparatus illustrated in Figure 1, the view additionally depicting the respective driving means for the pulverizer and classifier sections;

Figure 3 is an end view of Figure 2;

Figure 4 is a perspective view of the apparatus, portions

thereof having been broken away in order to expose certain features that would otherwise be concealed;

Figure 5 is a sectional view taken in the direction of line 5—5 of Figure 2;

Figure 6 is a detailed view, partly in cross-section, of the rotor assembly for the pulverizer section of the apparatus;

Figure 7 is a detail view of the rotor assembly for the classifier section;

Figure 8 is a fragmentary end view of Figure 5 taken along the line and looking in the direction of the arrows 8—8 to illustrate the mounting of a whizzer blade on the secondary classifying plate, said blade being shown in an adjusted tilted position in dashed lines; and

Figure 9 is an enlarged fragmentary sectional view of Figure 8 taken along the line and looking in the direction of arrows 9—9 to illustrate the mounting of the whizzer blade flange on the secondary classifying plate and the enlarged aperture formed in said plate;

For the purpose of facilitating the ensuing description the apparatus exemplifying the invention will be considered as comprising three basic sections including a feeder 10, a pulverizer or grinding mill 12 and a classifier 14. The feeder 10 may be of any conventional construction, but as can be seen from Figure 4 is of the variable speed, screw variety. Accordingly, the feeder 10 includes several feed worms 16 housed within a casing 17 and driven by a motor 18 via a speed reduction unit 20. A suitable hopper 22 superimposed above one end of the worms 16 permits gravitational introduction of precrushed material to these worms.

It should perhaps be stated at the outset that the action of the pulverizer and classifier sections 12 and 14 are not independent of each other, but as mentioned above the description lends itself more readily to describing them as separate sections. Therefore, referring now in detail to the pulverizer or grinding mill section 12, it will be discerned that this section comprises a cylindrical casing 24 including a fixed closure plate 26 at only the inlet end, the other end labeled 27 being open for communication with the classifier section 12. The closure plate 26 is formed with a chute 28 in communication with the discharge end of the feeder section 10. The casing 24 is bolted directly to a base 30. Also mounted on the base 30 is a pedestal or standard 32 carrying at its upper edge a pair of bearings 34, 36 for journaling a shaft 38 of a rotor assembly designated generally by the numeral 40 and which assembly is set forth in a detailed manner in Figure 6.

The rotor assembly 40 is driven by a motor 42 also mounted on the base 30 through the intermediary of a belt 43 and pulley 44, the pulley being attached to one end of the shaft 38. The shaft 38 overhangs the bearing 36 sufficiently for the support of several annular discs or plates 46, 48, 50 carrying a plurality of peripherally spaced beaters 52 and each provided with a plurality of angularly located apertures 51 spaced peripherally inwardly. As best seen from Figure 4, these beaters 52 are secured to the plates 46, 48 and 50 in an alternate or opposite fashion, one being directed forwardly and the next adjacent one rearwardly so that every other one is on the opposite side of the plates. This beater orientation may also be noted from an inspection of Figures 5 and 6 by comparing the beaters appearing at the top with those appearing at the bottom. Additionally, the plate 46 is equipped with primary beaters 54*a* and 54*b* on opposite sides thereof which are located radially inwardly from the beaters 52. The rear primary beaters 54*a* are axially cooperable with an annular rear grinding plate 56 (Figure 5) of corrugated configuration for primary size reduction of the material entering via the chute 28, whereas the beaters 52 are radially cooperable with a cylindrical liner 58 which has been illustrated in Figure 4 as being

corrugated. However, in some instances this liner 58 would be perforated or even smooth, the facial configuration being a factor in the fineness of the grind.

As best observed from Figure 6 the rotor 40 also includes an end plate retainer 60 shrunk onto the shaft 38. This retainer 60 serves to establish a reference position for the plate 46. Inasmuch as it is desired that the discs 46, 48 and 50 be removably stacked on the shaft 38, a pair of spacers 62 are interleaved between the several discs. A retainer cap 64 held captive by a lockwasher 66 and a nut 68 maintains the stacked relationship of these discs 46, 48 and 50 during operation of the unit.

The casing 24 is provided with a circumferential flange 70 at its open or forward end 27. This flange mates with a flange 72 integrally carried on a casing 74 forming a part of the classifier section 14. Unlike the casing 24, which is cylindrical, it is to be noted that the casing 74 is frustoconical, as clearly evidenced from Figure 5. The casing 74 has a fixed end plate 76 forming one wall of a discharge conduit 78. This discharge conduit is connected to an exhaust blower (not shown). A pair of air gates 80, 82 permit a controlled admission of air into the casing 74, and a removable hand hole cover 84 permits an internal adjustment that will be commented upon later.

The end plate 76 supports an inboard bearing 86 and an outboard bearing 88. The outboard bearing 88 is axially spaced from the inboard one, being supported at the distal end of a U-shaped bracket 90 attached to said end plate 76. A rotor assembly denoted generally by the numeral 92 (see Figures 5 and 7) includes a shaft 94 journaled for rotation in the bearings 86, 88 supports a pulley 96 at one end. By way of a belt 98 driven by a motor 100 (Figures 2 and 3) the shaft 94 can be rotated. It should be pointed out, however, that the motor 100 is secured to the U-shaped bracket 90 by reason of a second bracket 102.

Further, it is to be explained that the casing 74 is rendered pivotal with respect to the casing 24 by means of hinges including an upper and lower hinge arm 104 affixed to the casing 74 and a second upper and lower hinge arm 106 similarly affixed to the casing 24. In this way, the classifier section 14 is rendered pivotal with respect to the pulverizer section 12. It will of course be reconized that since the motor 100 is supported by the brackets 90 and 102 which are in turn supported by the casing 74 via its plate 76 that there is no obstruction to pivotal separation of the casings 74 and 24. Diametrically opposite the side of the flange 70 from the location of the hinge arms 104 are a pair of swingable hand wheels 108, each having a shank engageable in a slotted formation or clevis 110 on the flange 72.

Up to this point it has only been mentioned that the rotor assembly 92 includes a shaft 94. Additionally, the assembly 92 comprises a primary classifying plate 112 which is rotatably carried by that end of the shaft 94 lying adjacent the shaft 38, there being a hub 114 on which the plate or disc is mounted. The hub 114 and of course its plate 112 are axially positionable on the shaft for a purpose soon to be made manifest. Close inspection of Figure 7 will reveal that the hub 114 is actually a sleeve having a tapered bore extending therethrough. This sleeve or hub 114 encircles a split tapered collar composed of separable halves 116*a* and 116*b* splined to the shaft 94 by means of a key 118. In order to simplify the drawings, only one tightening bolt 120 and only one loosening bolt 122 are pictured since this type of taper lock is of conventional construction. Actually a plurality of such bolts would be used. The tightening bolt 120 is received in an aperture formed at the meeting surface of the hub 114 with the collar half 116*a*. However, only the upper half of the aperture is threaded, i.e. the half in the hub 114, so that the end of the bolt 120 abuts against the bottom of the unthreaded half of the same aperture, i.e. the half in the collar half

116*a*. Consequently, tightening of the bolt 120, owing to its threaded engagement with the hub 114, will pull said hub to the right as viewed in Figure 7, thereby forcing the collar half 116*a* against the shaft 94. One or more similar volts 120 will produce the same effect with respect to the lower collar half 116*b*. The net result is that the primary plate 112 will be firmly retained in whatever axial position into which it is placed before this tightening procedure is inaugurated. Conversely, the loosening bolt 122, here again a plurality of such bolts in practice, is received in an aperture formed at the meeting surface of the hub 114 with the collar half 116*b*. Here, though, just the upper half of the aperture is threaded, i.e. the half residing in the collar half 116*b*, so that the end of the bolt 122 abuts against the bottom of the unthreaded half of the same aperture, i.e. the half in the hub 114. Hence, tightening of the bolt 122, due to its threaded engagement with the collar half 116*b*, will force said hub to the left as viewed in Figure 7, thereby freeing the collar half 116*a* from its clamped engagement against the shaft 94. As already pointed out, one or more similar loosening bolts 122 would be employed for the collar half 116*a*. Thus, from the foregoing it is believed apparent that with the classifier section 14 swung into the open position pictured in Figure 4 the bolts 120, 122 are readily accessible to permit shifting of the primary classifying plate 112 to an optimum axial position along the shaft 94. More will be said hereinafter concerning the overall effect of a given axial position of the plate 112. In the position depicted in Figure 5, however, the plate 112 has been locked to the extreme end of the shaft 94.

A secondary classifying plate 126 is also part of the rotor assembly 92 being carried by the shaft 94 by means of a hub 128 that is also axially positionable along the shaft. The hub 128 differs from the hub 114 in that it can be clamped directly to the shaft 94 by way of a radial extending set screw 130. Access to this set may be had by removal of the hand hole cover 84.

The secondary classifying plate 126 differs markedly from the plate 112 by virtue of its carrying a plurality of peripherally spaced whizzer blades 132. As can be observed from Figures 5 and 7, these whizzer blades 132 are substantially L-shaped, having a portion 134 angled so as to be parallel to the frusto-conical casing 74. Also each blade 132 is formed with a mounting flange 136 having a pair of oversized apertures 135 therein for the accommodation of anchoring bolts 138. By making the apertures oversized, sufficient clearance is provided by which the whizzer blades 132 may be tilted to a preferred angle with respect to a true radial line passing through the center of the plate 126.

Both of the classifying plates 112 and 126 are provided with a plurality of apertures 140 through which certain of the ground particulate material may pass. Functionally, these apertures 140 correspond to the previously mentioned apertures 51 formed in the pulverizing plates 46, 48 and 50.

Returning to the pulverizing section 12 for a moment, since mention has now been made to the primary classifying plate 112, it is to be observed that the casing 24 is equipped with a pair of tailings openings 142 leading into a pair of tailings conduits 144. These conduits 144 extend rearwardly to the inlet chute 28 for the return of certain material to the inlet end of the pulverizer section 12. A slide gate 145 in each conduit 144 adjacent the chute 28 provides a control medium for governing quickly the quantity of material returned to the inlet and of the pulverizer section 12. The primary classifying plate is adjustable relative to the tailings openings 142 for a reason hereinafter made manifest.

Before describing a typical operation it might be well to review certain basic constructional features that have been built into the combined unit comprised of the sec-

tions 12 and 14. First of all it is to be noted that the rotor assemblies 40 and 92 are each rotatably supported in what might be termed a cantilever fashion, inasmuch as the plates 46, 48, 50, 112 and 126 are mounted more to one end of their respective shafts 38, 94 and the bearings 34, 36, 86 and 88 for journaling these shafts are more to the other end. Actually, in the preferred construction of the pulverizer and classifier sections 12, 14 those bearings 34, 36, 86 and 88 are located exteriorly of the casings 24 and 74. With respect to the rotor assembly 40 it is to be emphasized that considerable versatility is introduced in the stacked make-up of this rotor, for the number of beater plates 46, 48 and 50 may be varied to suit different grinding conditions. The use of fewer beater plates reduces the effective grinding action, thereby producing a coarser product. In this regard, when a beater plate is removed, a standard collar having the same thickness as the removed plate is substituted in its stead. Quite obviously, with the casing 74 disconnected from the casing 24 by disengagement of the hand wheels 108 and their connected shanks from the clevises 110 access may be had to the nut 68 and subsequent removal of the desired beater plate (or plates) from its (or their) stacked position on the shaft 38.

Considerable leeway is also possible with the rotor assembly 92. Here, swinging movement of the casing 74 affords access to the primary classifying plate 112 for positioning it properly on the shaft 94 after properly manipulating the bolts 120, 122. In most instances this plate will reside slightly within the casing 24, as shown in Figure 5, during operation, leaving at least some of the tailings openings 142 forward thereof. Adjustments can be made to the secondary classifying plate 126 via the opening normally closed by the cover 84. Movement along the shaft 94 of this plate 126 toward the rear end of the shaft, i.e. the end carrying the plate 112, will increase the radial clearance prevailing between the whizzer blades 132 and the casing 74. Shifting of the secondary classifying plate 126 in the above direction will have the effect of providing less restriction and hence less return to the inlet end of the pulverizer section 12 via the tailings conduits 144. Consequently, the resultant product will be coarser. Also, the angle of the whizzer blades 132 may be changed from their normal or radial relationship to likewise return less material to the tailings return conduits 144, thereby producing a coarser final product.

Inasmuch as the ultimate particle size is highly important in the great majority of grinding operations and since the instant machine is endowed with a number of features contributing to this objective, it might be well at this time to summarize and classify the factors influencing the particle size range.

Accordingly, the factors that affect the fineness of grind that are at all times available for change by the attendant or operator are as follows:

(1) The number of beater plates 46, 48 and 50 within the pulverizing section 12.

(2) The position of the primary classifying plate 112 within the section 14.

(3) The removal of the primary classifying plate.

(4) The position of the secondary classifying plate 126.

(5) Percentage of product recirculated through the internal air classification system as determined by the position of either tailings gate 145.

(6) The angle of the whizzers 132 on the secondary classifying plate 126.

(7) The amount of air permitted to enter past the air gates 80 and 82.

(8) The rate at which the feed section 10 is operated.

Those factors requiring a more major change or replacement of parts are as follows:

(1) The clearance between the primary beaters 54*a* and the grinding plate 56.

(2) The clearance between the beaters 52 and the liner 58.

(3) The type of liner 58, i.e. whether corrugated, smooth or perforated.

(4) The peripheral speed of the beaters 52.

(5) The r.p.m. of the primary and secondary classifying plates 112 and 126.

Considering now a typical operation, we will assume that all adjustments have been made for the fineness desired and that the various members are in the relative positions pictured in the drawings. The feeder section 10, of course, advances the pre-crushed material from the hopper 22 to the inlet chute 28 through which it falls into the casing 24 of the pulverizer section 12.

As the pre-crushed material enters the casing 24 it encounters the primary beaters 54*a*. Centrifugal forces produced by the high peripheral speed of the beaters 54*a* distribute the entering material so that the material is effectively dispersed between the corrugated back grinding plate 56 and said beaters 54*a*. Therefore, a primary reduction in particle size is realized in this region.

Since the centrifugal forces act upon the larger and heavier particles more forcibly than the smaller and lighter weight ones, the great bulk of the material at this initial stage moves radially outward, only a small fraction passing through the apertures 51 in the plate 46. After subjection to the action of the primary beaters 54*a* the particles are thrown against the inside of the casing 24 where it then first passes between the tips of the beaters 52 on the plate 46. Owing to the presence of the liner 58 more size reduction takes place.

Centrifugal forces will keep the most of the larger particles adjacent the liner 58, whereas the fines are carried radially inward in the air stream and thence through the apertures 51 in the plate 48. Those larger particles remaining next to the liner 58, of course, advance between the beaters 52 on the plate 48 and are further ground to a smaller size. This results in additional fines that are airborne inwardly and pass through those apertures 51 located in the plate 50. The coarser particles, however, receive further grinding treatment from the beaters 52 on the plate 50.

The next step is the exposure of the ground material to the action of the primary classifying plate 112. Since both of the classifying plates 112 and 126 are driven by the motor 100, whereas the pulverizing plates 46, 48 and 50 are driven by the motor 42 it follows that the speed of the primary classifying plate 112 is wholly independent of the pulverizing plates. At any rate, it is to be understood at this time that as the pulverized material approaches the primary classifying plate 112 the larger particles are retained adjacent the inner side of the casing 24 by centrifugal forces. The airborne fines, on the other hand, are drawn by the air current through the apertures 140 in the plate 112. The coarser of the larger particles adjacent the casing 24 will be induced to leave the casing via the openings 142 for return to the inlet end of the pulverizer section 12 for regrinding. Not only does the axial position of the plate 112 influence the amount of material exiting through the openings 142 but the control gates 145 in the conduits 144 also function in this capacity, too, the gates 145 governing the air velocity through said conduits.

Further classification of the airborne fines passing through the openings 140 in the primary classifying plate 112 is accomplished by the inclusion of the secondary classifying plate 126. Here again, centrifugal force plays an important role, for the coarser particles are thrown radially outward to strike the frusto-conical casing 74. Through the action of the whizzer blades 132 on the plate 126 the larger particles are forced back toward the plate 112. These larger particles in their reverse or counter travel then either exit through the open-

ings 142 immediately or pass by the peripheral edge of the plate 112 to these openings. In this regard it will be recalled that the primary classifying plate 112 is axially positionable on the shaft 94 and therefore can be positioned to expose more or less of the openings 142 to either side of said plate 112. Those particles reaching the openings 142 are then returned through the tailings conduits 144 to the inlet end of the pulverizer section 12 for regrinding along with those particles that reach these openings without passing through the apertures 140 in the primary classifying plate 112.

The classified particles, that is those not directed rearwardly by the whizzer blades 132, pass through the apertures 140 in the secondary classifying plate 126 into the discharge conduit 78. Air drawn by the external fan (not shown) provides the conveying air to move the pulverized material from the discharge conduit 78 to the dust collector (also not shown). The degree of lifting action obtainable from the external blower is of course controllable by means of the gates 80, 82. Hence, it is believed readily apparent that the selective action afforded by the exemplified machine will result in the obtaining of a quality control not heretofore realized.

As many widely apparent different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments herein.

What is claimed:

1. A combined pulverizer and classifier comprising; a pulverizer section including a generally cylindrical casing provided with an inlet at one end for the introduction of material into the casing and being substantially open at its other end, and a rotor assembly provided with a shaft and a plurality of beater plates mounted thereon for rotation in unison within said casing, each beater plate having a number of apertures disposed inwardly from its peripheral edge; a classifier section including a frusto-conical casing provided with a discharge outlet at one end and being substantially open at its other end for cooperation with the open end of said cylindrical casing, and a rotor assembly provided with a shaft and a plurality of classifying plates mounted thereon for rotation in unison, each classifying plate having a number of apertures disposed inwardly from its peripheral edge; and means for separably connecting said casings together in axial alignment.

2. The combination set forth in claim 1 in which said plurality of classifying plates includes a primary classifying plate and a secondary classifying plate, said primary classifying plate being located within the axial confines of said cylindrical casing and the secondary classifying plate being located within the axial confines of said frusto-conical casing.

3. A combined pulverizer and classifier comprising; a pulverizer section including a casing provided with an inlet at one end for the introduction of material into the casing and being substantially open at its other end, and a rotor assembly provided with a shaft and a plurality of beater plates mounted thereon for rotation in unison within said casing, each beater plate having a number of apertures disposed inwardly from its peripheral edge; a classifier section including a casing provided with a discharge outlet at one end and being substantially open at its other end for cooperation with the open end of said first casing, and a rotor assembly provided with a shaft which is rotatable independent of rotation of the shaft of the pulverizer section and a plurality of classifying plates mounted thereon for rotation in unison, each classifying plate having a number of apertures disposed inwardly from its peripheral edge; and means for separably connecting said casings together in axial alignment.

4. The combination set forth in claim 3 in which said last-mentioned means includes a pair of hinge elements.

5. A combined pulverizer and classifier comprising: a pulverizer section including a casing provided with an inlet at one end for the introduction of material into the casing and being substantially open at its other end, a shaft, a beater plate mounted near one end of said shaft having a number of apertures disposed inwardly from its peripheral edge, and a pair of axially spaced bearings situated nearer the other end of said shaft for journaling said shaft for rotation of said beater plate within said casing in cantilever fashion; a classifying section provided with a discharge outlet at one end and being substantially open at its other end for cooperation with the open end of said first casing, and a rotor assembly provided with a second shaft and a plurality of classifying plates mounted thereon for rotation in unison, each classifying plate having a number of apertures disposed inwardly from its peripheral edge, and a pair of axially spaced bearings situated nearer the other end of said second shaft for journaling said second shaft for rotation of the plurality of classifying plates within said second casing in cantilever fashion; and means for separably connecting said casings together in axial alignment.

6. The combination set forth in claim 5 in which said last-mentioned means includes a pair of hinge elements.

7. The combination set forth in claim 6 including driving means for said second shaft supported by said second casing so as to be movable with said second casing when it is swung into a separated position relative to said first casing.

8. The combination set forth in claim 5 including means for adjustably securing the classifying plate most closely adjacent the beater plates in an adjusted axial position on said second shaft.

9. A combined pulverizer and classifier comprising: a pulverizer section including a generally cylindrical casing provided with an inlet at one end for the introduction of material into the casing and being open at its other end, a shaft, a plurality of plates mounted nearer one end of said shaft than the other, said plates each being equipped with a series of peripherally spaced beater elements and each plate having a number of apertures spaced between its peripheral edge and said shaft, means limiting movement of the first of said plates away from said one shaft end, spacer means between said plates, means at said one end for retaining said plates on said shaft, and a pair of axially spaced bearings situated nearer the other end of said shaft for journaling said shaft for rotation of said plates within said casing in cantilever fashion; a classifying section including a second casing provided with a discharge outlet at one end and being substantially open at its other end for cooperation with the open end of said first casing, a shaft, first and second classifying plates mounted near one end of said second shaft, said classifying plates each having a number of apertures spaced between its peripheral edge and said second shaft and said second classifying plate being equipped with a series of peripherally spaced whizzer blades, respective means for anchoring each of said classifying plates at preferred axial locations on said second shaft so that said first classifying plate extends into said first casing and said second classifying plate resides within said second casing, and a pair of axially spaced bearings situated nearer the other end of said second shaft for journaling said second shaft for rotation of said classifying plates in cantilever fashion; and means for separably connecting said casings together.

10. The combination set forth in claim 9 including tailings conduit means leading from the open end of said first casing back to said inlet end, said means being free of internal protrusions or obstructions.

11. The combination set forth in claim 10 including a series of primary beater elements mounted radially inwardly from the peripheral edge of said first pulverizer plate on the rear side thereof, a second series of primary beater elements mounted on the side of the pulverizing plate opposite from the first-mentioned series, and a rear grind plate cooperable with said primary beater elements.

12. The combination set forth in claim 11 including a grind plate cooperable with the radial tips of said first-mentioned beater elements.

13. The combination set forth in claim 12 in which said casing connecting means includes a pair of hinge elements.

14. A combined pulverizing and classifying unit comprising a first casing, said casing having an inlet and a substantially open outlet end, a shaft journaled for rotation in said casing, a beater plate mounted on said shaft, a second casing having an inlet end that cooperates with the outlet end of the first casing to receive material therefrom and a discharge opening, a shaft journaled for rotation in said second casing, a classifying plate mounted on the last-mentioned shaft such that said classifying plate extends into the outlet opening of the first casing, said classifying plate having apertures located in the central portion thereof, a conduit means free of internal obstructions and protrusions for recirculating classified coarse particles, said conduit means having a sole inlet opening in the first casing spaced radially outwardly from the classifying plate shaft and located adjacent to the outer peripheral edge of the classifying plate to recirculate the classified coarse particles before said particles enter the discharge area of the second casing, and means connecting the first casing to the second casing.

15. The structure of claim 14 further characterized in that there is provided means for adjustably retaining the classifying plate in an adjusted position along the axial length of the classifying plate shaft to adjustably vary the effective size of the conduit inlet opening.

16. A combined pulverizer and classifier comprising; a pulverizer section including a generally cylindrical casing provided with an inlet at one end for the introduction of material into the casing and being substantially open at its other end, and a rotary assembly provided with a shaft and a plurality of beater plates mounted thereon for rotation in unison within said casing, each beater plate having a number of apertures disposed inwardly from its peripheral edge; a classifier section including a frusto-conical casing provided with a discharge outlet at one end and being substantially open at its other end for cooperation with the open end of said cylindrical casing, and a rotary assembly provided with a shaft and a plurality of classifying plates mounted thereon for rotation in unison, each classifying plate having a number of apertures disposed inwardly from its peripheral edge; means for separably connecting said casings together in axial alignment, said plurality of classifying plates including a primary classifying plate and a secondary classifying plate, said primary classifying plate being located within the axial confines of said cylindrical casing and the secondary classifying plate being located in the axial confines of said frusto-conical casing, means

for adjustably retaining the primary classifying plate in an adjusted position along the axial length of the classifying shaft, and means for adjustably retaining the secondary classifying plate in an adjusted position along the axial length of the classifying shaft.

17. A combined pulverizer and classifier comprising a pulverizer section including a generally cylindrical casing having an inlet at one end for the introduction of material into the casing and being substantially open at the other end, and a rotary assembly including a pulverizer shaft and a beater plate mounted on said pulverizer shaft for rotation in unison within said casing; a classifier section including a casing generally circular in cross-section having a discharge outlet at one end and being substantially open at the other end for cooperation with the open end of said cylindrical casing, and a rotary assembly having a classifier shaft that is independently rotatable of the rotation of the shaft of the pulverizer section, and at least one classifying plate mounted on the classifier shaft for rotation in unison with said classifier shaft, said classifying plate having at least one aperture disposed inwardly from its peripheral edge; and means for separably connecting said casings together in axial alignment, said beater plate and said classifying plate being secured in a position on their respective shafts to provide a structure free space therebetween bounded by a pair of spaced parallel planes perpendicular to the rotational axis of the shafts, the inner periphery of the casing, and the cylinder generated by rotating a line perpendicular to the surface of the center portion of the classifying plate around said rotational axis.

18. The combination set forth in claim 17 in which there is provided means for adjustably securing the classifying plate in an adjusted position along the axial length of the classifying shaft.

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