

April 4, 1939.

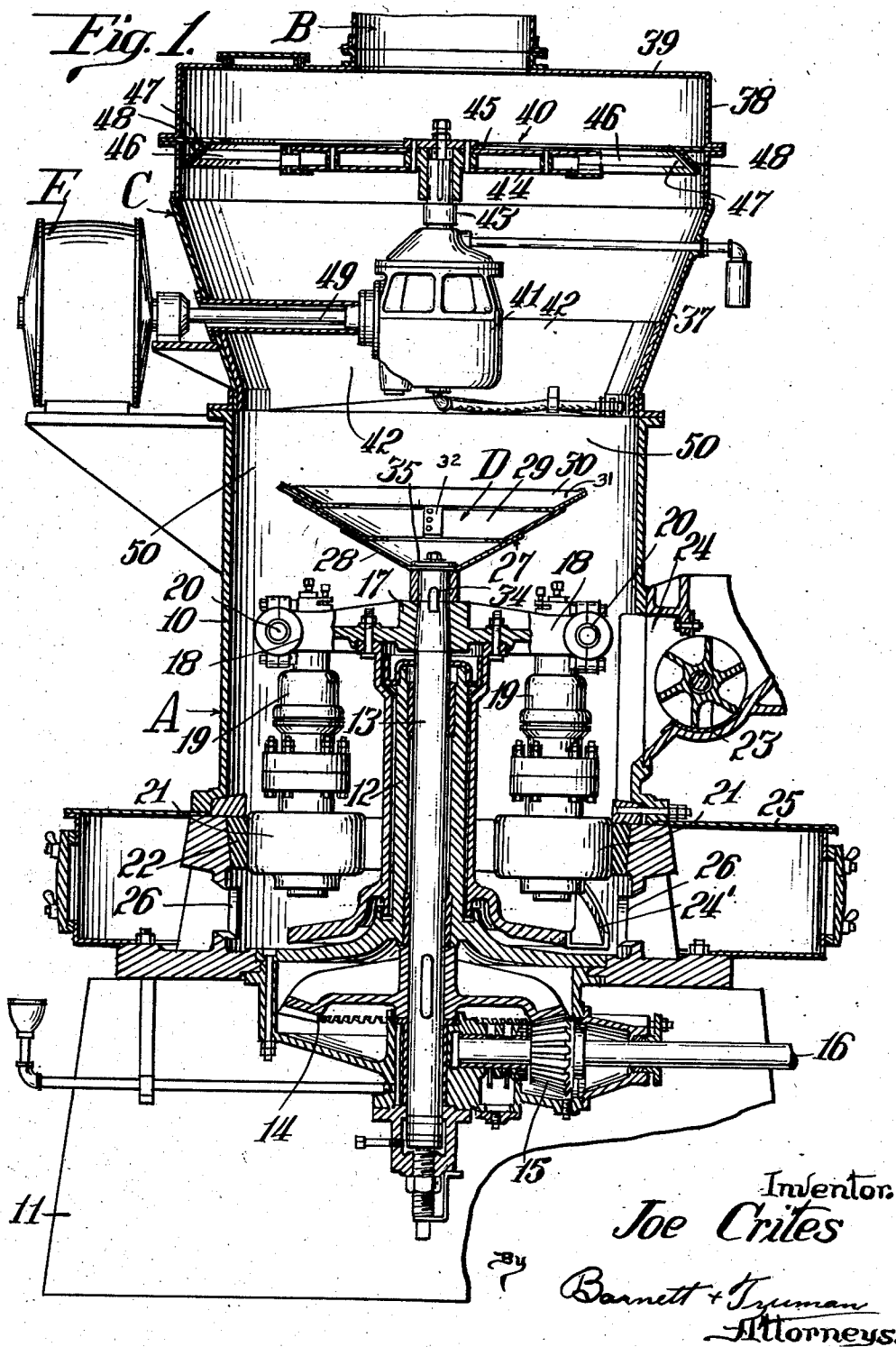
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GRINDING AND CLASSIFYING APPARATUS

Filed Jan. 18, 1937

2 Sheets-Sheet 1



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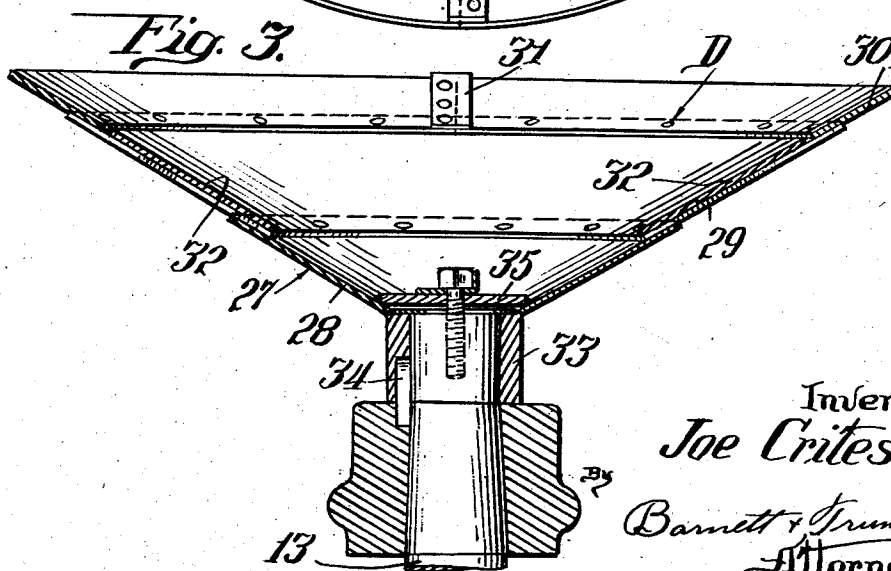
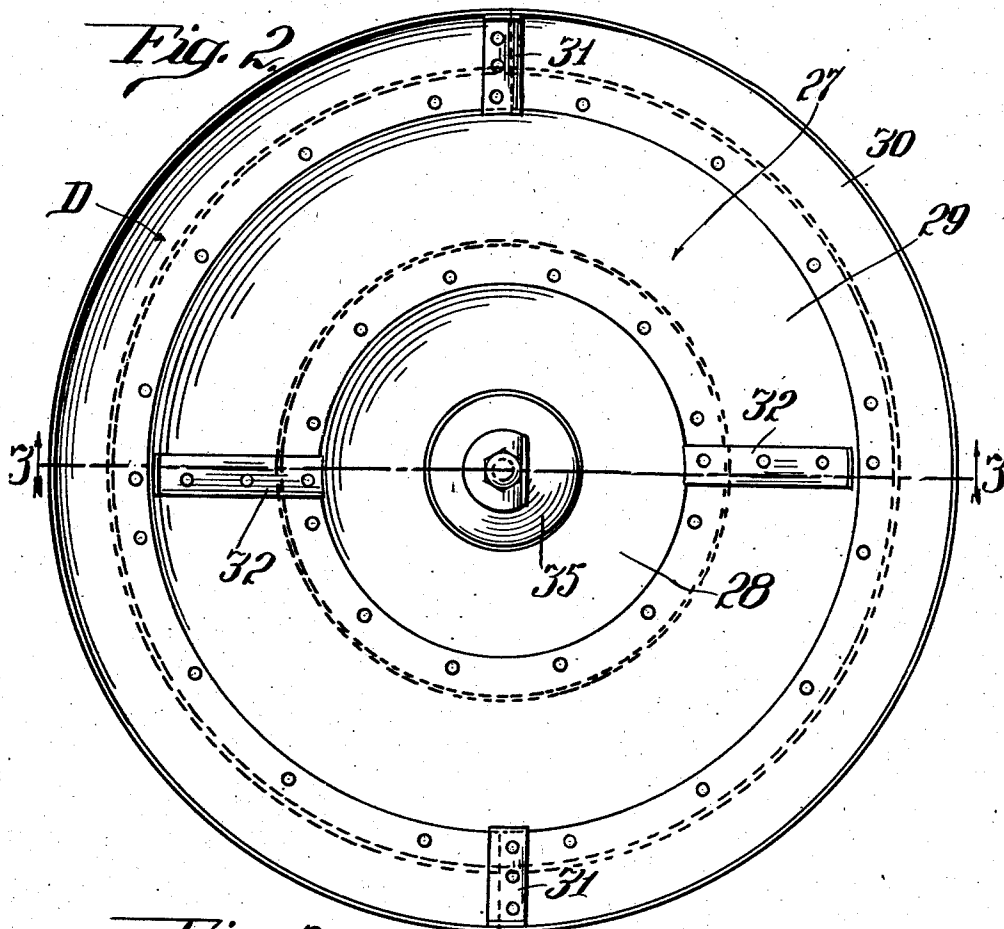
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GRINDING AND CLASSIFYING APPARATUS

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Application January 18, 1937, Serial No. 121,182

4 Claims. (Cl. 83-45)

This invention relates to certain new and useful improvements in a grinding and classifying apparatus, and more particularly to an apparatus of this character in which the material rejected by the classifying or separating portion of the apparatus is returned to the grinding mechanism for further treatment.

In apparatus of the above character, it is customary to cause a stream of air to flow through the pulverizing chamber so as to carry the finely divided material in suspension into the classifying or separating chamber. The heavier particles of material, and to some extent portions of the lighter material, are thrown out of the main air stream either by the expansion and whirling movements of the air stream itself or by direct contact with a revolving element of the classifier. Heretofore, a substantial portion of the fine material ejected from the air stream has been returned to the grinding or pulverizing chamber of the mill along with the heavier material. The fine material thus returned to the grinding chamber not only interferes with the grinding operation of the mill but also lowers the saturation of material in the air stream adjacent the classifier and thereby interferes with the efficient separation or grading of the material.

The principal object of the present invention is to provide new and improved mechanism which functions to increase the grinding capacity of apparatus of the above character without the use of additional power and which functions also to maintain the air stream heavily laden with pulverized material in the zone of classification, whereby the classifying or separating mechanism will be highly selective in its function of determining the degree of fineness of material discharged from the apparatus.

A more specific object of the invention is to provide, in apparatus of the above general character, means for intercepting the material gravitating from the zone of classification and reintroducing said gravitated material into the air stream whereby the lighter particles of such material will be again carried upwardly into the zone of classification and whereby the heavier particles of material will be permitted to drop into the grinding chamber.

Further objects and advantages of the invention will be readily apparent from the following detailed description of one approved form of apparatus constructed and operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is a vertical sectional view taken through

the grinding and separating chambers of an apparatus constructed in accordance with this invention.

Fig. 2 is a plan view of a cone element employed in the construction of Fig. 1 for intercepting material gravitating from the upper portion of the classifying chamber and for returning it to the air stream so that the lighter portions of the intercepted material will be again returned to the classifier; and

Fig. 3 is a vertical section taken on line 3-3 of Fig. 2.

The apparatus herein shown may be generally described as comprising a pulverizing mill A, from which an air stream carrying pulverized material in suspension is discharged through a conduit B, a classifier C for determining the degree of fineness of the material to be discharged from the apparatus, and the improved means D adapted to receive portions of the material gravitated from the classifier and return such material to the air stream, whereby the finer portions of the material will be again carried into the zone of classification, while the heavier particles of the intercepted material will be permitted to return to the grinding mechanism for further treatment. It will be understood that the said air stream may be caused to flow through the grinding and separating chambers of the mill by means of a suitable blower or exhauster (not shown) connected somewhere in the system, usually in the conduit B and that the material suspended in the air stream and thereby discharged through the conduit B may be separated or removed from the air stream by means of any suitable dust collector.

The mill A and the classifier C of the present apparatus may be of any suitable construction. For the purpose of convenience, the improvements of the present invention are illustrated in connection with a mill and a classifying mechanism of the type shown in the copending application of Richard F. O'Mara, Serial No. 16,443, filed April 15, 1935, now Patent No. 2,108,609.

The mill A comprises a vertically disposed cylindrical casing 10 supported on a suitable frame structure 11. A bearing member 12 extends into the grinding chamber of the mill and supports a vertical shaft 13. The shaft is operated by means of a bevel gear 14 mounted on its lower portion and meshing with a pinion 15 on a horizontal shaft 16, the latter of which may be driven by any suitable source of power. A spider member 17 secured to the upper end of the shaft 13 is provided with radially extending arms 18 adapted to support a circular series of roller-car-

riers 18, each pivoted at 20 to one of the spider arms 18 so that the grinding rollers 21 supported on the carriers 19 for free rotation may swing radially toward and from the shaft 13. When the vertical shaft 13 is rotated the rollers 21 swing outwardly under the influence of centrifugal force and bear against a bull-ring 22. The material to be pulverized is fed into the mill by means of a pocket feeder 23 rotatably mounted in a chute 24, the latter of which communicates with the grinding chamber at a location above the rollers 21 and bull-ring 22. In order to pick up material which may fall below the rollers 21 a suitable plow structure 24' is carried by a vertically disposed sleeve member from the spider 17 so as to revolve therewith.

Air from an annular manifold 25 is admitted into the grinding chamber through air passages 26 and is caused to pass upwardly through the grinding chamber by means of a suitable blower or fan positioned in the circulating system, preferably in the discharge conduit B previously referred to. The air stream picks up finely divided material and carries it upwardly toward the classifier C. According to the present invention, a rotary deflecting means D is positioned in the path of the air stream. This means is in the form of a cone-shaped member 27 which is preferably secured to the upper end of the shaft 13 so as to rotate therewith about the vertical axis of the grinding mechanism. It will be understood, however, that the member 27 can, if desired, be rotated by a separate mechanism without departing from the principles of the present invention. Preferably the cone is made up of a central sheet 28 and a plurality of semi-circular intermediate and outer sheets 29-30. The edge portions of the sheets 29 and 30 are secured together in abutting relation by means of butt strips 31-32 so as to provide relatively smooth inner and outer surfaces to the cone shaped member. The center sheet 28 is secured to the intermediate sheets 29-29 and to a hub member 33 which is slotted to receive a portion of the key 34 and thereby secure the hub rigidly to the shaft 13. The hub is held to the shaft against upward movement by means of a bolt which passes through the central disk 35 and into the upper end of the shaft 13. The said disk 35 preferably is brazed or suitably welded to the center sheet 28 substantially as shown in Fig. 3 of the drawings.

The upwardly moving air stream impinges against the bottom of the cone 27, the coarser particles being returned to the grinding mechanism, and the air stream with the fined material suspended therein being deflected outwardly so as to pass around the outer edges of the cone and into the classifier C.

The classifier, of the present embodiment of the invention, is arranged above and in direct communication with the grinding chamber of the mill. The classifier chamber consists, preferably, of a casing having a conical portion 37, an upper cylindrical portion 38 and a top cover 39. The discharge conduit B is preferably arranged to communicate through the central portion of the plate 39 at a location above a revoluble classifying mechanism designated generally by the reference numeral 40. Gear casing 41 is supported centrally within the downwardly and inwardly tapered portion 37 of the classifier by means of radially extending supporting plates 42, the said plates 42 being arranged edgewise to the movement of the air stream so as to provide

as little resistance as possible. A vertical shaft 43 extends upwardly from the gear casing 41 and supports a revoluble deflector or whizzer 44. This member preferably comprises a closed central portion 45 and a plurality of radially projecting vanes or blades 46. The outer ends of these blades are beveled inwardly and upwardly as indicated at 47 and rotate in close proximity to the lower surface of a downwardly and outwardly projecting annular conical deflector 48 secured to the inner wall of the cylindrical portion of the classifier housing. The deflector member 40 and shaft 43 are operatively connected to a horizontally extending shaft 49 by means of suitable gearing arranged in the gear casing 41. The shaft 49 may be driven by any suitable source of power, for example, a variable speed motor E. It is customary, in classifiers of the type herein shown, to vary the speed of the deflector mechanism in accordance with the grade or degree of fineness of material desired. The operation of the deflector or separator, it has been discovered, is more selective as to the number of grades of material discharged when the air stream is heavily laden with material in the zone of classification. This desirable condition is maintained in the present improved apparatus by means of the rotating cone member 27. The heavier particles of material and a portion of the sufficiently pulverized material are ejected from the air by the expansion and whirling movements of the air after it passes through the restricted passage 50 between the cone and the wall of the grinding chamber. Further quantities of material are rejected and thrown out of the air stream by direct contact with the deflector blades 46 of the classifier mechanism. A portion of the material, particularly the heavier particles thereof, may return directly to the mill through the space 50. However, a large portion of the material gravitating from the zone of classification toward the grinding chamber is intercepted by the cone 27 and thrown outwardly by the rotation of the cone into the path of the air stream, whereby the lighter particles of the material are added to the dust laden air from the grinding chamber and carried upwardly toward the rotating deflector 40. The heavier particles of intercepted material thrown outwardly by the rotation of the cone 27 will drop through the opening 50 into the grinding chamber wherein they are further pulverized by the rollers 21.

By intercepting the rejected material in the manner above described, the material returned to the grinding chamber is confined largely to the heavier particles or tailings. The finer particles of material, which might otherwise reenter the grinding chamber and interfere with the grinding operation, are reintroduced into the air stream at a location above the grinding mechanism so as to increase the saturation of finer material in the air immediately below the rotating deflector 40. As the saturation of dust in the air above the revolving cone increases, the air will drop the heavier of these particles of material which are too fine to otherwise return to the grinding zone and are too coarse to be discharged with the finished product. Eventually a state of balance will be reached whereby additional oversized material passing into the classifying chamber will be returned to the grinding zone without returning an appreciable amount of material which has been sufficiently pulverized.

I claim:

1. A grinding and classifying apparatus com-

prising a casing, grinding mechanism including a vertically disposed shaft in the lower portion of the casing, an air inlet in the lower portion of the casing, an outlet in the upper portion of the casing for the discharge of pulverized material in suspension in the air moving upwardly through the casing, a revoluble deflector in the upper portion of the casing for ejecting the heavier portions of material from the air stream, whereby the ejected material gravitates toward the lower portion of the casing, and a revoluble inverted cone element centrally fixed to the vertical shaft of the grinding mechanism for intercepting and returning upwardly and outwardly into said air stream portions of material gravitating from the upper part of the casing.

2. A grinding and classifying apparatus comprising a casing having a vertically disposed cylindrical grinding chamber and a classifying chamber communicating with the grinding chamber, grinding mechanism in the grinding chamber including a vertically disposed shaft and a circular series of roller elements swingably supported thereon to rotate about a vertical axis, means for feeding material into the grinding chamber, an inlet for admission of an air stream to the grinding chamber, an outlet conduit leading from the upper portion of the classifying chamber for the discharge of pulverized material suspended in said air stream, a classifier in the upper portion of the classifying chamber comprising a revoluble deflector having a closed central portion and a plurality of radially extending deflector blades adapted to eject the heavier particles of material from the air stream, whereby the said ejected material gravitates toward the grinding chamber, and means comprising an inverted cone member secured to the upper portion of said vertically extending shaft at a location intermediate the grinding and classifying mechanisms for intercepting the said gravitating material and returning it upwardly and outwardly, under the influence of centrifugal force, to the said air stream whereby the lighter particles thereof are again carried upwardly to the classifying mechanism.

3. A grinding and classifying apparatus comprising a casing, a grinding mechanism in the casing including a vertically disposed shaft and a circular series of roller elements supported thereon to rotate about a vertical axis, an inlet for the admission of an air stream to the lower portion of the casing, an outlet conduit leading from the upper portion of the casing for the discharge of pulverized material suspended in said air stream, a classifier in the upper portion of

the casing comprising an outer annular stationary deflector member, and a revoluble deflector associated therewith and comprising deflector blades with openings therebetween for the passage of the air stream, and means for maintaining the air stream heavily laden with finely divided material comprising a revoluble inverted cone member mounted on the vertically disposed shaft to rotate about a vertical axis at a location intermediate the grinding mechanism and said classifying mechanism and positioned in the path of the air stream, whereby the air stream impinging against the lower surface of the cone member is deflected outwardly to pass around the outer edges of the cone and whereby material ejected from said air stream above the cone shaped member is collected on the upper surface of the cone and delivered by the influence of centrifugal force upwardly and outwardly into the air stream, whereby the heavier particles of such material are returned to the grinding chamber and the lighter particles are carried upwardly toward the classifying mechanism.

4. A grinding and separating apparatus comprising a casing provided with a grinding chamber and having an inlet in its lower portion for an air stream and a separating chamber positioned above and in direct communication with the grinding chamber, the air stream carrying pulverized material upwardly in suspension from the grinding chamber to the separating chamber, a grinding mechanism in the grinding chamber, a revoluble deflector in the separating chamber for rejecting and returning downwardly toward the grinding chamber the heavier portions of material from the air stream, an outlet in the upper portion of the chamber for the discharge of pulverized material in suspension in the air stream, and a revoluble inverted conical member pivoted centrally between the grinding and separating chambers to rotate about a vertical axis with its periphery spaced from the casing wall to provide an annular space, the cone serving as a deflector to force the air stream to flow upwardly through the annular space adjacent the casing wall, and the upper surface of the cone serving as a receptacle for collecting materials gravitating downwardly from the separating chamber and returning these materials outwardly and upwardly by centrifugal force into the upwardly flowing air stream, whereby the lighter particles of this material may be again carried upwardly by the said air stream, and the heavier particles may gravitate downwardly through the annular space into the grinding chamber.

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