

Feb. 7, 1967

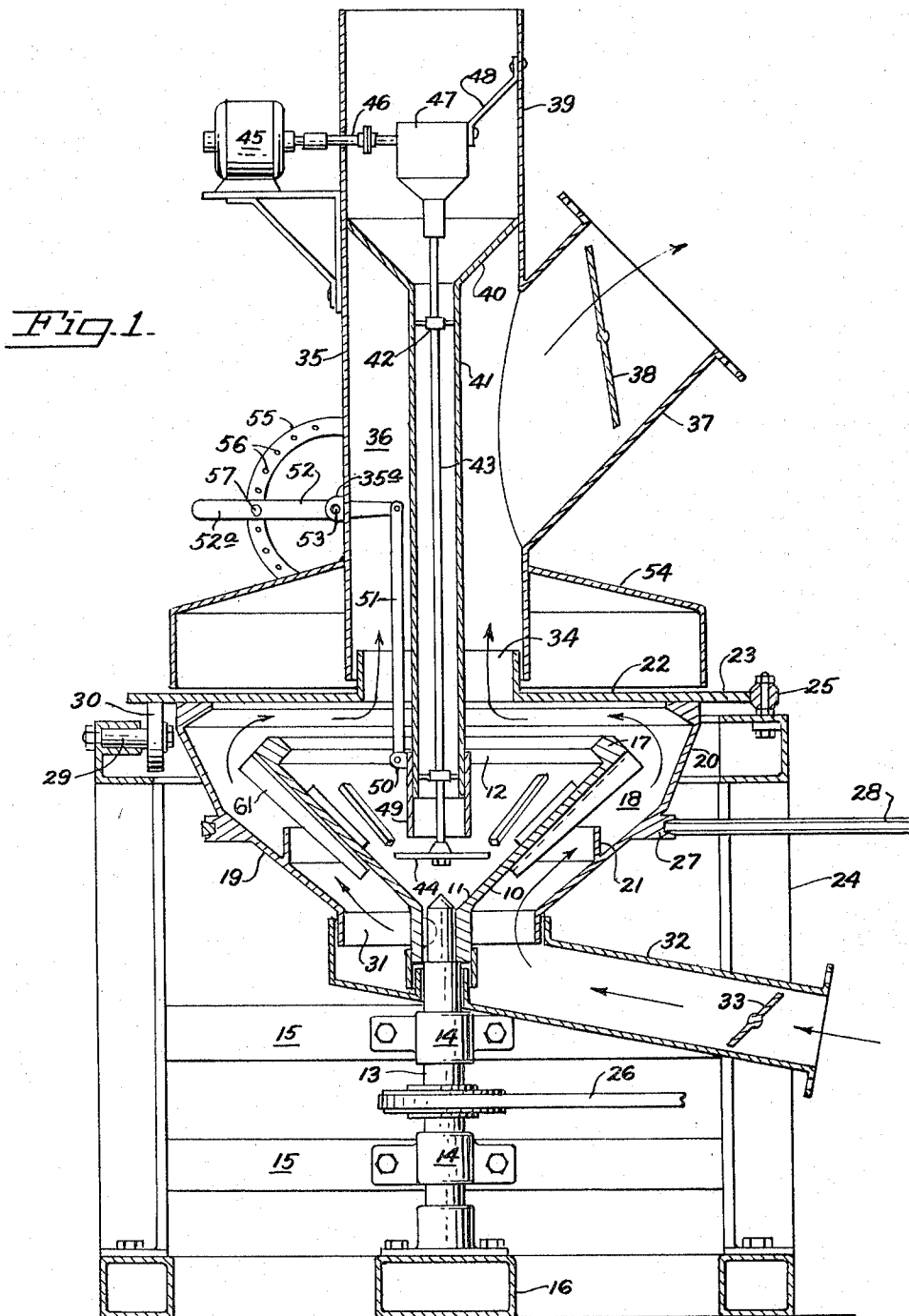
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3,302,895

PULVERIZING APPARATUS

Filed Aug. 26, 1963

2 Sheets-Sheet 1



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Fig. 2.

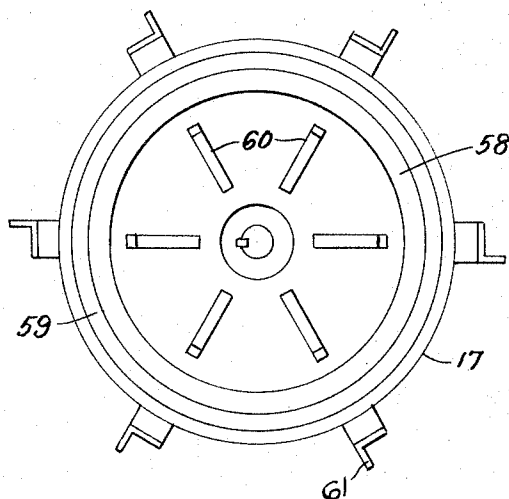


Fig. 3.

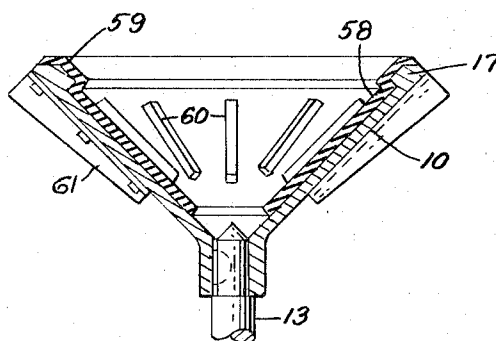
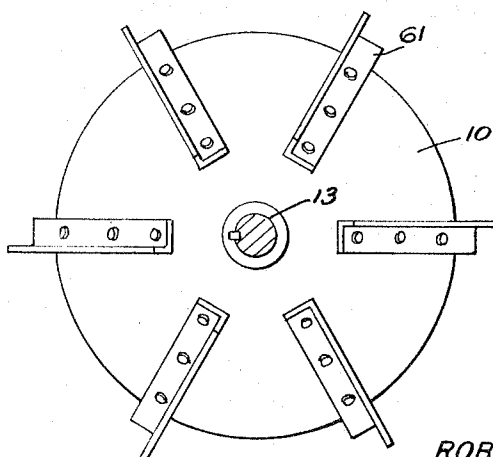


Fig. 4.



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PULVERIZING APPARATUS

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Filed Aug. 26, 1963, Ser. No. 304,559
4 Claims. (Cl. 241-59)

This invention relates to pulverizing or grinding apparatus of the type employed in the reduction of ores, rock and the like to a required fineness.

The present invention provides, and has for its primary object, improved pulverizing or grinding apparatus which is adapted to throw particles of material such as ore, rock or the like by centrifugal force against other similar particles, thereby pulverizing the material and reducing it to a desired fineness. The grinding operation is carried out in a suitable grinding chamber located between two (2) oppositely rotating conical-shaped members which are instrumental in effecting the bombardment of the particles against one another to reduce the material to a powder-like form. The pulverized material is conveyed from the grinding chamber by an air stream the velocity of which is adapted to be controlled to regulate the fineness of the product.

Other and further objects of my invention will be pointed out hereinafter or will be indicated in the appended claims or will be obvious to one skilled in the art upon an understanding of the present disclosure. For the purpose of this application, I have elected to show herein certain details of pulverizing apparatus which are representative of my invention; it is to be understood, however, that the embodiment of my invention herein shown and described is for illustration purposes only, and that it is not to be regarded as exhaustive of the variations of the invention in the art.

In the accompanying drawings:

FIG. 1 is a vertical cross-sectional view taken centrally through a grinding mill embodying my invention;

FIG. 2 is a top plan view of the inner cone-shaped member;

FIG. 3 is a vertical sectional view taken centrally through the inner inverted cone, showing a resilient liner on the inner face thereof; and

FIG. 4 is a bottom view of the inner inverted cone.

The material to be reduced to a desired fineness is fed into a rotating inverted inner cone which is closed at its apex and open at its base. Secured to the inner face of the inner cone are a plurality of radial guide members which tend to retard or prevent the slipping of the material on the inner side of the said cone. An outer inverted cone is arranged in a suitably spaced relationship to the inner cone to provide a grinding chamber, the said cones being arranged to rotate in opposite directions. The inner cone also carries a plurality of radial blades extending outwardly from its outer face. The material discharged from the inner cone by centrifugal force enters the grinding chamber and forms a layer along the inner face of the outer cone. Particles of the material are carried upwardly by centrifugal force in the grinding chamber toward the area into which the particles were first discharged from the inner cone. The action of the oppositely rotating cones is such that particles of the material in a continuous stream are carried into the path of the particles discharged by centrifugal force from the inner cone. The outer blades on the inner cone tend to facilitate the upward movement of the particles in the grinding chamber so the bombardment by the outwardly discharged particles from the inner cone may be more effective to breaking the particles into smaller pieces. An upwardly flowing stream of air admitted to lower areas of the grinding chamber carries the smaller particles upwardly while at the same time allowing the larger particles to drop down-

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wardly to be advanced again for further grinding action. The heavier particles dropping downwardly in the grinding chamber are supported by the outer cone and urged upwardly by centrifugal force toward the upper area of the said chamber so they may again be subjected to a bombarding action. As the particles are reduced to a suitable fineness, they are carried by the air stream to a controlled outlet. By controlling the velocity of the air stream into and through the grinding chamber, the fineness of the material may be regulated.

Referring to the drawings, the numeral 10 designates an inverted hollow inner cone having a closed apex 11 and an opening 12 at its base. The cone 10 is mounted at its apex 11 on a shaft 13 which is supported in bearings 14 carried on frame members 15 and on a base member 16. Extending inwardly from the upper edges of the inner cone's base is an annular protuberance or rim 17 which is adapted to restrain some of the upwardly moving particles and thereby form a protective lining on the inner face of the inner cone. The rim 17 is formed with inwardly converging annular sides to direct the upwardly moving particles radially and outwardly toward the upper area of a grinding chamber 18. The grinding chamber 18 is formed between the inner cone 10 and an outer inverted concentric cone 19, the latter having a frusto-conical shape. A portion of the outer cone is in substantially parallel relationship with the outer face of the inner cone 10, but such parallel portion of the outer cone terminates at a level below the rim 17. The outer cone is formed with a gradually widened base portion as at 20. Secured to the inner side of the outer cone 19 is an annular upstanding flange 21, the upper edges of which are suitably spaced from the inner cone to permit the upward flow of an air stream through the grinding chamber 18. The flange 21 provides means adapted to intercept particles of the material dropping downwardly in the grinding chamber, such intercepted particles being restrained and held to provide a lining on the inside surface of the outer cone.

Suitably secured as by bolts (not shown) or other means to the upper edge of the outer cone 19 is a circular cover plate 22 having an annular portion 23 extending outwardly beyond the upper edge of the outer cone to provide a centering flange. Supported on a suitable frame 24 are a plurality of guide rollers 25 (one of which is shown) mounted for rotation about vertical axes, such rollers engaging with the peripheral edge of the centering flange 23 to prevent the lateral displacement of the cover plate 22 and the outer cone 19.

The inner cone 10 and the outer cone 19 are rotated simultaneously in opposite directions. The apex portion 11 of the inner cone is keyed to the vertical shaft 13, and a belt transmission 26 connected to an electric motor (not shown) and to the shaft provides means for rotating the inner cone. Secured to the outer cone 19 is a peripheral grooved flange 27 connected by a belt transmission 28 to an electric motor (not shown). Mounted on the frame 24 for rotation about horizontal axes 29 are a plurality of rollers 30 (one of which is shown) which underlie and support the annular flange portion 23 of the cover plate 22, the said rollers providing means for rotatably supporting the outer cone and the cover plate. The inner cone 10 is arranged to rotate at a considerably slower speed than the outer cone 19 and in a direction opposite to the direction of rotation of such outer cone. While the rotative speeds of the inner and outer cones may vary, it has been found that satisfactory grinding results may be obtained with certain materials by having the inner cone rotate at about two thousand (2,000) revolutions per minute and the outer cone at about five hundred (500) revolutions per minute.

The lower end of the outer cone 19 is formed with an annular air inlet opening as at 31 to which is connected

a conduit 32 for delivering air under pressure to the grinding chamber 18 from a suitable source. A butterfly type of control valve or damper 33 in the conduit 32 provides means for controlling the flow of air into and through the grinding chamber.

The cover plate 22 is provided centrally with an outlet opening 34 for the discharge of particles of the comminuted material carried by the air stream from the grinding chamber 18. Mounted centrally above the cover plate 22 is a tubular member 35 having a chamber 36 which is adapted to receive the particles carried by the air stream upwardly through the outlet opening 34. Connected to the tubular member 35 is a delivery conduit 37 communicating with the chamber 36. The upwardly moving air stream passing through the chamber 36 and the delivery conduit 37 continues to convey the particles of finely ground material to a suitable collector (not shown) which is ordinarily connected to the delivery conduit. A control valve 38 of the butterfly type positioned in the delivery conduit 37 serves to control the flow from the collecting chamber 36.

The upper portion of the tubular member 35 provides an open hopper 39 into which is fed raw material to be ground to a desired fineness. The hopper 39 is provided with a bottom 40, the sides of which converge downwardly and connect with a vertical hopper tube 41 extending downwardly through the outlet opening 34 in the cover plate 22. The outlet end of the hopper tube 41 is positioned to deliver the raw material centrally into the inner cone 10. Supported in a vertical position in suitable bearing 42 arranged inside the hopper tube 41 is a rotatable shaft 43 which has a rotatable material distributing disc 44 secured to its lower end. The disc 44 is preferably somewhat larger in diameter than the diameter of the hopper tube, and its position is such that the raw material discharged from such tube falls thereon, to be evenly distributed by the rotating disc onto the sides of the inner cone 10 so such material may then be uniformly distributed when it is discharged from the inner cone. The shaft 43 and the disc 44 are rotated by a variable speed motor 45 which is connected thereto by a shaft 46 and a suitable gear reduction unit (not shown) which is mounted inside a housing 47, the latter being supported inside the hopper by means such as a strap or bar 48 secured to a side of the hopper.

Slidably fitting over and projecting below the lower end of the hopper tube 41 is a telescopically arranged adjustable tubular extension 49 having an outwardly protruding lug 50 on its upper end. Pivotally connected at its lower end to the lug 50 is an elongated upstanding link 51 which is pivotally connected at its upper end to the inwardly disposed end of a lever 52. The lever 52 is pivotally mounted at a point between its ends on a pivot 53 which is supported by a lug or protuberance 35a secured to and projecting outwardly from the tubular member 35. The outer end portion 52a of the lever 52 serves as a handle to adjust the tubular extension 49 upwardly or downwardly to position the latter's lower end closer to or farther from the rotating disc 44, thereby controlling the discharge of the material from the hopper tube. By adjusting the handle portion 52a of the lever 52 downwardly, the tubular extension 49 is elevated, thereby increasing the flow of the material into the inner cone 10, and conversely, by adjusting the handle portion 52a upwardly the tubular extension is lowered to restrict the flow of the material.

Suitably secured as by welding to the tubular member 35 and a hood-like supporting structure 54 is a member 55 of suitable shape having a plurality of suitably spaced holes 56 arranged in semi-circular formation and in concentric relation to the pivot 53. A pin 57 extending through a hole in the lever 52 is adapted to extend also through any of the holes 56 to maintain the lever in a suitably adjusted position, thereby also holding the tubular extension 49 against displacement when the latter has once

been adjusted to regulate suitably the flow of the raw material into the inner cone.

As shown in FIG. 3, the inner cone 10 may be provided with a resilient lining member 58 made of rubber or the like which fits snugly against the inner face of such cone. The lining member 58 has a somewhat frusto-conical shape, and its base portion is formed with an annular hollow lip 59 which is adapted to embrace the rim 17 of the inner cone to prevent normally the displacement of the lining member. The lining member is provided with a plurality of inwardly protruding radial guides 60 to prevent the material from slipping on the sides of the inner cone. The resilient lining member protects the inner cone 10 against wear.

In operation, the raw material is fed through the hopper tube 41 onto the rotating disc 44 which discharges it uniformly onto the sides of the rotating inner cone 10. Centrifugal force moves the material upwardly along the sides of the inner cone and radially outwardly across the rim 17. Some of the particles of the material close to the inner face of the inner cone are restrained by the rim 17 in their upward movement and accumulate to form an inner lining. Other particles moving inside the inner cone at high speed strike against such inner lining rather than against the inner face of the cone. An inner cone of approximately two and one-half feet (2½') in diameter at its base, rotating at a speed of approximately one thousand, seven hundred (1,700) revolutions per minute, will discharge particles at a speed of approximately fourteen thousand (14,000) feet per minute into and across the grinding chamber 18. The bombardment of these fast-moving particles against others traveling along another path breaks the colliding particles into minute pieces.

The outer cone 19 is rotated at a slower speed than the inside cone 10. It has been found that an outer cone of about forty-three inches (43") in diameter at its base is capable of moving particles therein at a velocity of about two thousand, two hundred feet (2,200') per minute in an upward direction and in the path of the higher velocity particles discharged from the inner cone. The two (2) streams of particles collide in the grinding chamber, with the result that such colliding particles are broken into smaller pieces. The annular restraining flange 21 on the outer cone in combination with the widened base portion 20 will cause the accumulation of some of the particles on the inside face of the outer cone to form a protective lining against which other particles will impinge. While the pulverizing action in the grinding chamber 18 is in progress, air under suitable head pressure is admitted into and discharged from the conduit 32 through the air inlet opening 31 in the outer cone and into the grinding chamber 18. The air stream passing upwardly through the grinding chamber picks up and carries with it particles of predetermined fineness. The particle-laden air stream passes upwardly through the outlet opening 34 and into and through the chamber 36, from whence it travels through the conduit 37 to a suitable particle collector. A plurality of suitably spaced radial blades or vanes 61 on the outer face of the inner cone increase the flow through the grinding chamber 18 and also assist in the movement of particles inside the grinding chamber. The larger particles not carried away by the air stream will fall downwardly in the grinding chamber where they will be broken up to a fineness permitting the air stream to convey them through the outlet opening 34. By reducing the velocity of the air stream through the grinding chamber by suitably adjusting the valve 33 in the conduit 32, the fineness of the particles may be increased, and by increasing the velocity of the air stream somewhat larger particles may be carried from the grinding chamber.

What I claim is:

1. In material pulverizing apparatus, an outer hollow inverted cone of frusto-conical shape having an air inlet

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opening in its lower end, an inner inverted hollow cone mounted for rotation inside the outer cone, the sides of the cones diverging upwardly and arranged in concentric spaced relationship to each other to form an annular grinding chamber therebetween communicating at its lower end with the inlet opening in the outer cone, means to rotate the cones in opposite directions to one another about a substantially vertical common axis, the inner cone being adapted to discharge material laterally and into the grinding chamber, means to feed raw material to be comminuted to a desired fineness into the inner cone, including a hopper, an upright delivery tube having an inlet at its upper end connected to the hopper and having an outlet at its lower end arranged to discharge the raw material into the inner cone, a motor-driven shaft extending through the delivery tube, a rotatable material distributing member connected to the lower end of the shaft and arranged below the outlet end of the delivery tube to intercept the raw material discharged from the delivery tube, whereby the raw material may be distributed onto the sides of the inner cone, means connected to the inlet opening of the outer cone to admit an air stream into the lower area of the grinding chamber, and outlet means connected to the upper area of the grinding chamber to convey the air stream and comminuted material carried thereby from the grinding chamber.

2. In material pulverizing apparatus, as defined by claim 1, including tubular means for conveying an air stream to the inlet opening of the outer cone, and means for controlling the velocity of the air stream.

3. In material pulverizing apparatus, an outer hollow inverted cone having an air inlet opening in its lower end, an inner hollow inverted cone mounted for rotation inside the outer cone, the sides of the cones diverging upwardly and arranged in concentric spaced relationship to one another to form an annular material grinding chamber therebetween communicating at its lower end with the air inlet opening in the outer cone, means to rotate the cones in opposite directions to one another about a substantially vertical common axis, a cover plate on the outer cone spaced above the base portion of the inner cone and having a central outlet opening communicating with the grinding chamber, an upright tubular member mounted above the central outlet opening and having a chamber communicating with the outlet opening, means connected to the tubular member to convey an air stream and particles of the comminuted material carried by such air stream from the chamber, means to feed raw material to be comminuted to a desired fineness into the inner cone, including a raw material holding hopper in the upper end portion of the tubular member, an upright material delivery tube extending through the tubular member and having an inlet at its upper end connected

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to the hopper and an outlet at its lower end arranged to discharge raw material into the inner cone, a motor-driven shaft extending through the delivery tube, a rotatable material distributing member connected to the lower end of the shaft and arranged below the outlet of the delivery tube to intercept the raw material discharged from the delivery tube, whereby the discharged raw material may be distributed onto the sides of the inner cone, and means connected to the inlet opening of the outer cone to deliver an air stream into the lower area of the grinding chamber.

4. In material pulverizing apparatus, an outer hollow inverted cone having an air inlet opening in its lower end, an inner hollow inverted cone mounted for rotation inside the outer cone, the sides of the cones diverging upwardly and arranged in concentric spaced relationship to one another to form an annular grinding chamber therebetween communicating at its lower end with the air inlet opening, means to deliver an air stream to the inlet opening of the outer cone, means to rotate the cones in opposite directions to one another about a substantially vertical common axis, the inner cone being adapted to discharge material laterally and into the grinding chamber, means to feed raw material to be comminuted to a desired fineness into the inner cone, including a hopper, an upright delivery tube having an inlet at its upper end connected to the hopper and having an outlet at its lower end arranged to discharge the raw material into the inner cone; a motor-driven shaft extending through the delivery tube, a rotatable material-distributing member connected to the lower end of the shaft and arranged below the outlet end of the delivery tube to intercept the raw material discharged from the said tube, an adjustable tubular extension mounted telescopically on the lower end portion of the delivery tube, means for adjusting the tubular extension upwardly and downwardly, and means connected to the grinding chamber to convey the air stream and the comminuted material carried thereby from such chamber.

References Cited by the Examiner

UNITED STATES PATENTS

1,605,025	11/1926	Hildebrandt	241—47
2,164,409	5/1939	Johnson	241—5
2,562,560	5/1951	Macartney	241—50 X
3,062,459	11/1962	Dearing	241—26 X
3,065,919	11/1962	Burkett et al.	241—5 X
3,162,382	12/1964	Danyluke	241—275 X

FOREIGN PATENTS

740,362 11/1955 Great Britain.

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