

March 11, 1952

C. TROST
MEANS INHIBITING ESCAPE OF OVERSIZE PARTICLES
FROM CIRCULATORY PULVERIZING MILLS
Filed June 29, 1948

2,588,945

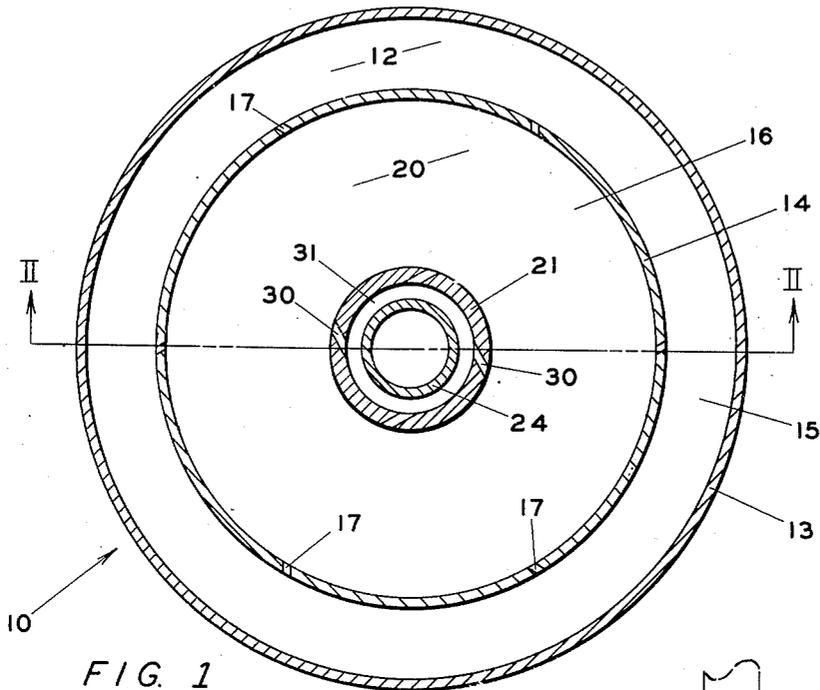


FIG. 1

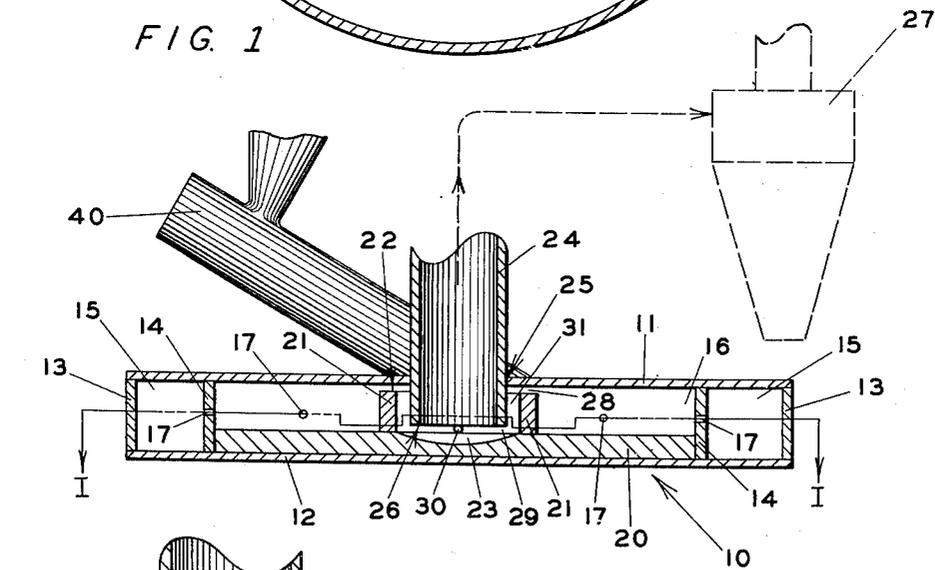


FIG. 2

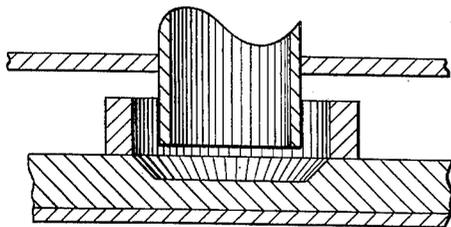


FIG. 3

Inventor
CONRAD TROST

Conrad Trost

Attorney

UNITED STATES PATENT OFFICE

2,588,945

MEANS INHIBITING ESCAPE OF OVERSIZE PARTICLES FROM CIRCULATORY PULVERIZING MILLS

Conrad Trost, Moorestown, N. J., assignor to The Micronizer Company, New York, N. Y., a corporation of Delaware

Application June 29, 1948, Serial No. 35,946

8 Claims. (Cl. 241—39)

1

This invention relates to an improvement in a reentrant circulatory pulverizing mill, whereby the output of uniformly sized, relatively small particles, constituting the product of said mill, may be substantially increased over the output of such particles from mills presently in use.

As a result of both experimental tests and commercial applications, it has been found that in a reentrant circulatory pulverizing mill of a type presently in use, such as disclosed in Andrews Patent No. 2,032,827, a physical phenomenon, referred to in the art as "kickbacks," occurs both (1) as the load on the mill increases and (2) as the mill is required to handle the less frangible materials such as plastic resins, pharmaceuticals or any substance lacking sharply defined cleavage planes. This phenomenon relates to the tendency, which increases as the load on a mill increases, for relatively large oversized particles, called "kickbacks," to escape from the grinding chamber of the mill with the otherwise uniformly small particles and thus appear in the product. This is obviously undesirable and at present is avoided or minimized only by running the mill at low volume of production and in a somewhat starved condition.

The exact cause resulting in the said "kickbacks" is not clearly understood, even though exhaustive research has been devoted to study of the action which takes place in said mill. It is thought, however, that the large oversized particles may be impelled out of the grinding chamber by contact with other particles therein, or are thrown out as a result of the turbulent conditions in said grinding chamber. The assumption that turbulence produces "kickbacks" is substantiated by the fact that as the bed plate of said grinding chamber becomes irregular with wear and thereby increasing the turbulence in said chamber, the quantity of "kickbacks" at a given rate of output increases substantially. It is also possible that such "kickbacks" ricochet off said bed plate irregularities through the outlet opening.

Regardless, however, of the actual reason for the appearance of these oversize particles in the finished product, the fact is that elimination of the above mentioned phenomenon would considerably increase both the efficiency and the total output of any given mill.

Accordingly, a major object of this invention is to provide such improvements in a reentrant circulatory pulverizing mill that the output of uniformly sized particles may be substantially increased over the output of said mills presently in use.

A further object of this invention is to provide

2

means by which those particles within the mill which are relatively larger than the desired product of a given reentrant circulatory pulverizing mill are effectively prevented from being discharged with the product.

A further object of this invention is to provide means, as aforesaid, whereby a substantial increase in the efficiency of output capacity of a given mill may be effected.

A further object of this invention is to provide means, as aforesaid, in which the above objectives may be accomplished at a minimum of expense and with a minimum of difficulty.

A further object of this invention is to provide means, as aforesaid, whereby the means constituting the said improvement may be easily adapted to pulverizing mills presently in use.

Other objects and purposes of this invention will become apparent to persons familiar with this type of equipment upon referring to the accompanying drawings and upon reading the following specification.

In meeting the purposes and objects heretofore set forth, as well as others incidental thereto, I have discovered certain improvements which may be provided within the grinding chamber of a conventional reentrant circulatory type pulverizing mill.

The grinding chamber, to which I shall herein after refer for illustrative purposes only, is substantially round and flat and provides for the rotational circulation of grinding fluid in the conventional manner. It is supplied in the usual manner with raw material to be ground and with grinding fluid. The exhaust stack or offtake therefrom, is received through a suitable, centrally located opening in the top of said grinding chamber and extends part way to the bottom thereof. The said offtake is surrounded within the grinding chamber by a ring radially outwardly spaced from said offtake and having a plurality of tangentially directed openings located close to, or at, the bottom edge thereof, which ring is fastened at its bottom edge to the bed plate of said grinding chamber and extends toward, but does not contact, the top thereof. The said bed plate has a symmetrical depression within the area bounded by the said ring so that a low point thereof is directly below the center of said offtake. It is this ring and the depression in said bed plate associated with said ring which constitutes the said improvements and it is their cooperative combination which increases the efficiency of a conventional type reentrant circulatory pulverizing mill by diminishing the amount of oversize particles in the finished product.

For one, but not necessarily the only, embodi-

ment of the invention, reference is made to the drawings in which:

Figure 1 is a horizontal cross-sectional view of the pulverizing mill grinding chamber, exposing the improvements therein. The section is taken along the line I—I of Figure 2.

Figure 2 is a vertical centrally cross-sectioned view of the grinding device shown in Figure 1, taken along the line II—II thereof, and also shows diagrammatically the relationship of the cyclone chamber with the grinding mill.

Figure 3 is a fragmentary detail of a modification taken on the same sectional plane as Figure 2.

Construction

The axially short, cylindrical outer shell of the circulatory grinding mill 10, appearing in Figures 1 and 2, may be essentially as disclosed by Andrews Patent No. 2,032,827 both in shape and in construction. As such, said outer shell, whose circular section, shown in Figure 1, is normally, but not necessarily, in the horizontal plane and is here so shown, may be comprised of a circular top plate 11, a circular bottom plate 12 and a narrow cylindrical, radially outer wall 13 which is engaged along its upper and lower edges by the peripheries of said top plate 11 and bottom plate 12, respectively. Said top plate, bottom plate and outer wall may be of any conventional and convenient materials, such as steel plates secured of each other in any convenient manner, as by welding.

Material feeding means of any well known type, such as a hopper and injector, may be used and are indicated generally at 40. Several types of feeding means are shown in detail in Andrews Patent No. 2,032,827. Radially disposed inwardly of said cylindrical outer wall 13 and coaxial therewith is another cylindrical wall 14 whose upper and lower edges are completely attached, as by welding, to the top plate 11 and bottom plate 12 respectively. Said cylindrical wall 14 constitutes both the radially inner wall of the relatively narrow, circular fluid chamber or header 15, and the peripheral wall of the relatively large grinding chamber 16.

The wall 14 is pierced by a plurality of jets or openings 17, here shown as six, which are preferably, but not necessarily, equi-distant both from each other and from said top plate and said bottom plate. The longitudinal axes of said jets may be in any desired direction, but are preferably disposed tangentially to a theoretical circle within the grinding chamber and concentric therewith, whereby the energizing fluid emitted from the jets will impart the most efficient grinding impact against, and circulatory motion to, the material being processed in the grinding chamber.

A circular bed plate 20, bounded at its outer periphery by the wall 14, is removably secured to the bottom plate 12, as by bolting. The composition of this bed plate will preferably be a highly abrasion resistant material, such as a high manganese steel.

To the bed plate 20 is secured, as by welding, a cylindrical guard ring 21, which is preferably concentric both with the side wall 14 and the side wall 13. The upper edge 22 of the guard ring approaches relatively close to, but does not contact, the top plate 11. This ring may be constructed of any suitable type of material, but is preferably a reasonably abrasion resistant metal.

A symmetrically concave depression 23, in this

embodiment defined by a section of the surface of a sphere, is provided in the upper surface of the bed plate within the area circumscribed by said ring 21. Its diameter is substantially equal to that of the inner surface of the ring. Its depth is described hereinafter.

A cylindrical offtake 24, of less diameter than the guard ring, is suitably secured within an appropriate opening 25 centrally located in the top plate 11 of the grinding mill 10. The lower extremity 26 of the offtake 24 extends into said grinding mill a sufficient distance that said lower extremity will be telescoped a substantial distance by said ring 21 with which it is preferably coaxial. The resultant overlap should produce no points of contact between the offtake 24 and the ring 21, and the parts are best designed so that the radial distance between the outer periphery of the offtake and the inner surface of the ring is uniform around the entire annular zone within the space of overlap and for the full axial extent of the overlap.

The lower extremity 26 of the offtake 24 extends towards the depression 23, and may or may not enter into same as described below.

The outer and/or upper extremity of the offtake 24 may be connected to a conventional separator, such as an appropriate cyclone chamber 27, shown schematically in phantom, by any conventional means as indicated diagrammatically in Figure 2, for separating the solid particles from the fluid carrying same. The said means by which the pulverized material and energizing fluid are transmitted into the said cyclone 27 for separation is well known to the art and, therefore, will not receive further description.

The ring 21 is provided with a plurality of openings or escape passages 30, here shown as four, whose axes are substantially tangential in clockwise (as this embodiment is illustrated in Figure 1) direction to the radially outer portion of the annular zone 31, which is defined by the outer walls of the offtake 24 and by the inner walls of the guard ring 21. It will be noted that these openings are directed in the same general circulatory direction as the grinding jets 17.

It will be appreciated from the hereinafter appearing description that, in the event the material being pulverized is caused to circulate about the chamber 16 in a counterclockwise direction (referring again to Figure 1), the said passages 30 would advantageously take a position whereby their longitudinal axes would be substantially tangential in a counterclockwise direction to the radially outer portion of the circular chamber 31, without departing from the scope of the invention. These escape passages are here shown as located in the lower part of the ring 21, but, while preferable, this location is not essential for they may be located as high and/or low as desired or required.

The exact relative dimensioning of the parts is important but will vary widely according to the size of the mill and service to be performed. The mill generally is dimensioned as is conventional. The guard ring, the depression and the offtake are dimensioned to meet the following conditions: (1) that the offtake extends sufficiently below the upper edge of the guard ring to force the gases to enter the offtake by a strong circulatory flow and thus assure the existence of substantial centrifugal force adjacent the offtake for either returning oversize particles through the openings 30 to the grinding chamber or holding them against the guard ring until they are

5

reduced to proper size, (2) that the internal cross-sectional area of the offtake 24, the cylindrical area 29 provided by the clearance between the lower extremity 26 of the offtake and the concave surface 23 of the bed plate 20, and the cross-sectional area of the annular zone 31 are all substantially equal to each other and each is of less area than the cylindrical area 28 provided between the upper edge 22 of the guard ring and the under side of the top plate 11 with the controlling area being that of the offtake which is designed in a conventional manner to provide the correct flow rate for gas carrying ground particles to the separator, (3) that in the absence of the guard ring the lower end 26 of the offtake extends to or into the depression 23 to effect the required circulatory motion above mentioned in the region of the offtake, and (4) the depth of the depression in any case being sufficient to cooperate with the end 24 of the offtake and effect strong circulatory flow.

Operation

In operation, material to be processed is first fed into the grinding chamber 16 of the mill 10 by the feeding means 40. Upon entering the chamber 16, said material to be processed is struck, subjected to attrition, carried and urged to circulate, here rotationally clockwise, around said grinding chamber by means of the energizing fluid which is emitted under pressure in streams through the said plurality of jets 17 in the side wall 14 of the chamber 16. The fluid, which for example may be air or steam, is supplied to the circumferential fluid chamber 15 by any suitable means and in any convenient manner, not shown, under sufficient pressure to cause streams to enter said grinding chamber at a high velocity from said jets, all as more completely disclosed in the Andrews Patent No. 2,032,827. Such streams will, as already known to the art, reduce the relatively large incoming particles by direct attrition thereof, as well as impart such speed to their motion through the grinding chamber that these large incoming particles will be further shattered by mutual collisions with each other and at least to a limited extent by impact with the interior of said chamber.

According to well known physical laws governing centrifugal force and fluid dynamics, and in a manner already well known to the art, the said larger particles will tend to circle in the radially outer portion of the said grinding chamber 16 until they are reduced to relatively small particles, whereupon such small particles are entrained by the exhausting gas comprising the energizing fluid and carried towards the radially innermost portion of the grinding chamber. At this innermost point, these small particles are swirled up over the top edge 22 of the ring 21, downwardly through the zone 31 within said ring 21, under the lower end 26 of the offtake 24 and up the offtake 24 in a conventional manner. Under some circumstances, however, there may be a limited period of spinning in the concave depression 23 before a given particle goes on out the offtake.

A modified form of the depression 23 is shown in Figure 3, where there is indicated a depression in the form of an inverted, truncated cone. The operation of this form seems in some cases to be somewhat better than that shown in Figure 2 but the operating principles are the same as above described for the form shown in Figure 2.

It will be understood that the circulatory type

6

pulverizing mills presently in use, although similar in other respects to the pulverizing mill used herein for illustrating the preferred embodiment of the said improvements, are not equipped with either the said ring 21 or the concave depression 23. Consequently, as the material input to the grinding chamber of said present type mill is increased to more than approximately one-half of its real capacity, said "kickbacks" or oversize particles begin to escape from said grinding chamber 16 in prohibitive quantities and flow up through said offtake 24 with the properly pulverized particles and the energizing fluid, thereby reducing the uniformity, hence the quality, of the final pulverized product.

As a result of experimentation, the data from a representative portion of which is reproduced hereinafter, it appears that said guard ring 21, and said depression 23 in the otherwise level bed plate 20, will considerably diminish the quantity of said oversize particles which are carried off with said products of pulverization. Hence, said ring and said depression make possible a considerable increase in the output from a given machine of acceptably pulverized material. One of the particular advantages of the invention is thus its applicability to most existing machines without serious or material changes being necessary to accommodate it.

While the exact reasons for the improved operation are not known with certainty, it is thought that the ring 21 somewhat reduces the quantity of "kickbacks" in part by deflecting away from said offtake 24 those unreduced particles which are caused to move in the direction of said offtake as a result of collision with other particles or by impact against the side walls or bottom of the grinding chamber.

Further, the guard ring and the depression together form a restricted passageway through which the escaping material laden gas stream will move with a strong circulatory motion. This tends to keep at a high level the centrifugal force of the particles by which they resist being carried into the offtake and by which they are more readily either returned to the grinding chamber directly if a depression is used but no guard ring, or returned through the openings 30 if the guard ring is used, or by which the oversize particles are more greatly abraded against each other and against the guard ring before going into the offtake if the guard ring is used but the openings 30 omitted. The guard ring and the depression may be used individually to effect the desired results, but the results when they are used together are substantially better than the mere additive sum of the individual performances. It is thought that the better results effected by the guard ring and depression in combination are due in part to a more efficient, more smoothly flowing, stronger circulatory movement of the gases in the immediate region of the offtake than can be produced by either acting alone.

As heretofore stated, the cylindrical area 28, provided between the ring 21 and the top plate 11, is advantageously approximately equal to or greater than the cylindrical area 29 provided between the lower end of the offtake 24 and said concave surface 23. The pressures in the chambers 16 and 31 are thereby maintained substantially equal. With such pressures substantially equal the mechanism will operate as described, but, if the area at 28 becomes smaller than the area at 29, then there will be a substantial throttling through the space 31 between the said

7

areas and the pressure within the guard chamber 31 will be substantially less than that in the grinding chamber 16. With such differential in pressure there is a strong tendency for grinding fluid to pass into the guard chamber 31 from the grinding chamber 16 through the openings 30. Such passage opposes and consequently hinders the escape of oversize particles through said openings 30. This being undesirable, the size relationships are maintained as indicated.

Experimental results

In order to illustrate the effectiveness of the invention, experimental tests have been conducted on a typical mill in various combinations with the ring 21 and the concave depressions 23.

In these tests, partially comminuted Carborundum which would pass through an eight mesh screen was fed into the grinding chamber of a mill eight inches in diameter at the rate of fifty grams per minute during a forty minute run in each test under the various conditions. The yield of each such test run was screened, in turn, through an 80 mesh gauge screen, a 200 mesh gauge screen and a 325 mesh gauge screen. The tabulations appearing hereinafter will give the percentage by weight of original feed of oversize particles yielded.

In the first test, a conventional mill of eight inch diameter, having a badly worn bed plate and incorporating neither of the disclosed improvements, was used and produced the following results:

80 mesh screen stopped 0.110 per cent oversize particles
 200 mesh screen stopped 0.150 per cent oversize particles
 325 mesh screen stopped 0.460 per cent oversize particles

In the second test, the same mill was used with the ring 21, having six equally spaced passages 30, and produced the following results:

80 mesh screen stopped 0.04 per cent oversize particles
 200 mesh screen stopped 0.08 per cent oversize particles
 325 mesh screen stopped 0.17 per cent oversize particles

In the third test, a concave depression was provided in the bed plate of the same mill, but the ring 21 was omitted with the following results:

80 mesh screen stopped 0.07 per cent oversize particles
 200 mesh screen stopped 0.160 per cent oversize particles
 325 mesh screen stopped 0.280 per cent oversize particles

In the fourth test, both a concave depression in said bed plate and ring having four equally spaced passages, as shown in the drawings, were employed with the same mill and resulted as follows:

80 mesh screen stopped 0.001 per cent oversize particles
 200 mesh screen stopped 0.015 per cent oversize particles
 325 mesh screen stopped 0.020 per cent oversize particles.

In the fifth test, the said mill was provided with a concave depression in the bed plate as aforesaid, and a ring 21 having six escape passages. The results were as follows:

8

80 mesh screen stopped only a trace of oversize particles
 200 mesh screen stopped .0019 per cent oversize particles
 325 mesh screen stopped .0079 per cent oversize particles.

It will be readily observed from the above tabulations of experimental tests that a very substantial improvement in the operating efficiency of said pulverizing mills was realized by incorporation of the above mentioned improvements in said mills.

It should also be noted that although both the ring and the concavity give improved results independently, their joint use yields results which appear to be much better than merely additive of their independent operations. Hence, there appears to be some direct cooperation between the two improvements which results in a still greater gain in efficiency. Other experimental work corroborates these conclusions within the limits of the inherent unpredictability of fluids and particularly gases. As indicated above this improved result of the depression and ring together is thought to be due to the better circulatory motion induced in the immediate region of the offtake effected by both items together than by either item alone.

Although the drawings and description heretofore mentioned apply to one particular, preferred embodiment of the invention, it is not my intention, implied or otherwise, to eliminate other variations which do not depart from the scope of the invention unless specifically stated to the contrary in the hereinafter appended claims.

I claim:

1. In a pulverizing mill having an axially short, substantially cylindrical grinding chamber wherein the material to be ground is fed directly thereinto, grinding fluid is injected thereinto under pressure near the periphery thereof and said fluid and pulverized material are exhausted at the center thereof and said mill includes a top plate and a bed plate defining respectively opposing ends of the grinding chamber, the improvement comprising: an offtake conduit extending through said top plate concentric with said grinding chamber; a guard ring, concentric with said offtake conduit, spaced radially outward therefrom and partially telescoping same, affixed to the bed plate, said ring having a plurality of openings therethrough, which openings are substantially tangentially arranged with respect to the inner wall of said guard ring and extending from the point of tangency in the same direction of rotation as the direction of circulation of grinding fluid, said openings being located closely adjacent the bed plate; said bed plate being imperforate in the area of said guard ring; the surface of said bed plate within the area circumscribed by said ring defining a depression; the upper extremity of said guard ring being spaced from the top plate, and the bottom extremity of said offtake conduit being spaced from the bed plate, said spacing being such that the cylindrical area between the guard ring and the top plate is not less than the cylindrical area between the offtake conduit and the bed plate and both areas are of magnitudes substantially equal to the cross-sectional, interior area of said offtake.

2. In a pulverizing mill having a cylindrical grinding chamber of less length than diameter, having means for feeding the material to be ground directly thereinto, means for injecting the

grinding fluid into said chamber under pressure near the periphery thereof and means for exhausting pulverized material from the center thereof, and means defining and closing the ends of said grinding chamber, the improvement in off-take means comprising: an offtake conduit extending through a first plate closing one end of said grinding chamber; a guard ring, concentric with said offtake conduit, spaced radially outward therefrom and partially telescoping one end of said offtake conduit, affixed to a second plate closing the other end of said grinding chamber, and having a plurality of openings therethrough which openings are substantially tangentially arranged with respect to the inner wall of said guard ring extending therefrom in the same direction of rotation as the direction of circulation of said grinding fluid; the surface of said second plate within the area circumscribed by said ring being imperforate and defining a depression; the free extremity of said guard ring being spaced from the first plate and the said end of said offtake conduit being spaced from the second plate, said spacing being such that the cylindrical area between the guard and the first plate is not less than the cylindrical area between the said end of the offtake conduit and the second plate.

3. In a pulverizing mill having a cylindrical grinding chamber of less length than diameter, having means for feeding the material to be ground directly thereinto, means for injecting the grinding fluid into said chamber under pressure near the periphery thereof and means for exhausting pulverized material from the center thereof, said mill having means defining and closing the ends of said grinding chamber, the improvement comprising: an offtake conduit extending through first means closing one end of said grinding chamber; a guard ring concentric with said offtake conduit spaced radially outward therefrom and partially telescoping one end of said offtake conduit, affixed to second means closing the other end of said grinding chamber, said ring having a plurality of openings therethrough which openings are substantially tangentially arranged with respect to the inner wall of said guard ring and extending therefrom in the same direction of rotation as the direction of circulation of said grinding fluid; said second means being imperforate in the zone of said ring; the free extremity of said guard ring being spaced from the first means and the said end of said offtake conduit being spaced from the second means, said spacing being such that the cylindrical area between the guard ring and the first means is not less than the cylindrical area between the said end of the offtake conduit and the second means.

4. In a pulverizing mill having a cylindrical grinding chamber of less length than diameter, having means for feeding a partially comminuted material to be ground directly thereinto, means for injecting a grinding fluid into said chamber under pressure near the periphery thereof and having means defining and closing the ends of said grinding chamber, the improvement comprising: first tubular means located concentrically and completely within a radially inward portion of said grinding chamber and secured to one end thereof and spaced from the other end thereof for receiving grinding fluid and material entrained thereby from a radially outward portion of the grinding chamber, and for circulating said fluid and material around and within the inner wall of said first tubular means, said one end of said grinding chamber being imperforate

in the zone of said tubular means, said first tubular means having an opening therethrough and tangentially disposed with respect thereto through which portions of said material may escape by centrifugal force; second tubular means concentric with and spaced radially inwardly from the first tubular means, one end of said second tubular means extending through the other end of said grinding chamber and spaced from said one end thereof, and being partially telescoped by the first tubular means for effecting a discharge of the fluid and material within the first tubular means, the cylindrical area defined between said first tubular means and said other end of said grinding chamber being at least equal to the cylindrical area defined between said second tubular means and said one end of said grinding chamber.

5. In a pulverizing mill having an axially short substantially cylindrical grinding chamber into which a material to be ground is fed directly, grinding fluid is injected under pressure, and having first and second end plates defining respectively opposing ends of the grinding chamber, the improvement comprising: one of said end plates having a central, symmetrical, shallow, circular depression in a solid portion of the first end plate within the grinding chamber for receiving circulating grinding fluid and material entrained thereby; and a hollow conduit concentric with the circular depression and of an internal diameter smaller than the diameter of said depression and forming the sole outlet from said grinding chamber, one end of said conduit extending through the second end plate toward the depression and spaced therefrom to provide a cylindrical area between the end of said conduit and the adjacent surface of the depression approximately equal to the internal cross-sectional area of the conduit.

6. In a pulverizing mill having a cylindrical grinding chamber of less length than diameter, having means for feeding a partially comminuted material to be ground directly thereinto, means for injecting a grinding fluid into said chamber under pressure near the periphery thereof, and having means defining and closing the ends of said grinding chamber, the improvement comprising: first tubular means located concentrically and completely within a radially inward portion of said grinding chamber and secured to one end thereof for receiving grinding fluid and material entrained thereby from a radially outward portion of said grinding chamber and for circulating said fluid and entrained material around its inner wall, said one end being unbroken within the zone defined by said first tubular means; said first tubular means spaced from the other end of said grinding chamber; second tubular means located radially inwardly from and partially telescoped by said inner wall and extending through the other end of the grinding chamber for effecting discharge of said fluid and material from within said wall through said second tubular means; said second tubular means spaced from said one end of said grinding chamber; and an opening in the wall of said first tubular means through which oversized particles of said material may escape by centrifugal force from entrainment within said fluid; the cylindrical area defined between said first tubular means and said other end of said grinding chamber being at least equal to the cylindrical area defined between said second tubular means and said one end of said grinding chamber.

7. In a pulverizing mill having a cylindrical

11

grinding chamber of less length than diameter, having means for feeding a partially comminuted material directly thereinto, means for injecting a grinding fluid into said chamber under pressure near the periphery thereof and means defining and closing the ends of said grinding chamber, the improvement comprising: a hollow cylindrical means located completely within one radial portion of said grinding chamber and secured to one end thereof for receiving grinding fluid and material entrained thereby from another radial portion of said grinding chamber and for circulating said fluid and entrained material therewithin, said one end being unbroken within the area defined by said cylindrical means, said cylindrical means having an opening through the sidewall thereof through which oversized particles of said material may escape by centrifugal force from entrainment within said fluid; said cylindrical means spaced from the other end of said grinding chamber; and tubular means of lesser cross sectional area than said cylindrical means and spaced radially inwardly from said sidewall for permitting discharge of said fluid and material entrained therethrough from within said cylindrical means, the end of said tubular means received within said cylindrical means; said tubular means spaced from said one end of said grinding chamber, said spacing being such that the cylindrical area defined between said cylindrical means and said other end of said grinding chamber is at least equal to the cylindrical area defined between said tubular means and said one end of said grinding chamber.

8. In a pulverizing mill having an axially short substantially cylindrical grinding chamber into which a material to be ground is fed directly, a

12

grinding fluid is injected under pressure near the periphery thereof, and having a top plate and a bed plate defining respectively opposing ends of the grinding chamber, the improvement comprising: an offtake conduit concentric with said grinding chamber and extending thereinto through the top plate to a point close to the general plane of the upper surface of said bed plate; a guard ring partially telescoping said conduit, spaced radially outward therefrom and affixed to the bed plate, said guard ring being spaced from the top plate and completely disposed within the grinding chamber, the portion of said bed plate defined by said guard ring being unbroken; and means providing an opening through said guard ring for the escape by centrifugal force of oversized particles of said material back to the grinding chamber from within the zone defined by said guard ring; the cylindrical area defined between said guard ring and said top plate being at least equal to the cylindrical area defined between said conduit and said bed plate.

CONRAD TROST.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,032,827	Andrews	Mar. 3, 1936
2,155,697	Young	Apr. 25, 1939
2,191,095	Hobbie	Feb. 20, 1940
2,257,907	Griswold	Oct. 7, 1941
2,328,240	Wiegand	Aug. 31, 1943
2,376,747	Andrews	May 22, 1945