No. 835,694. PATENTED NOV. 13. 1906.

W. E. WILD.

ROLLER ORE CRUSHING MILL.

APPLICATION FILED MAR. 21, 1905.

3 SHEETS—SHEET 1.

Fig. 1.

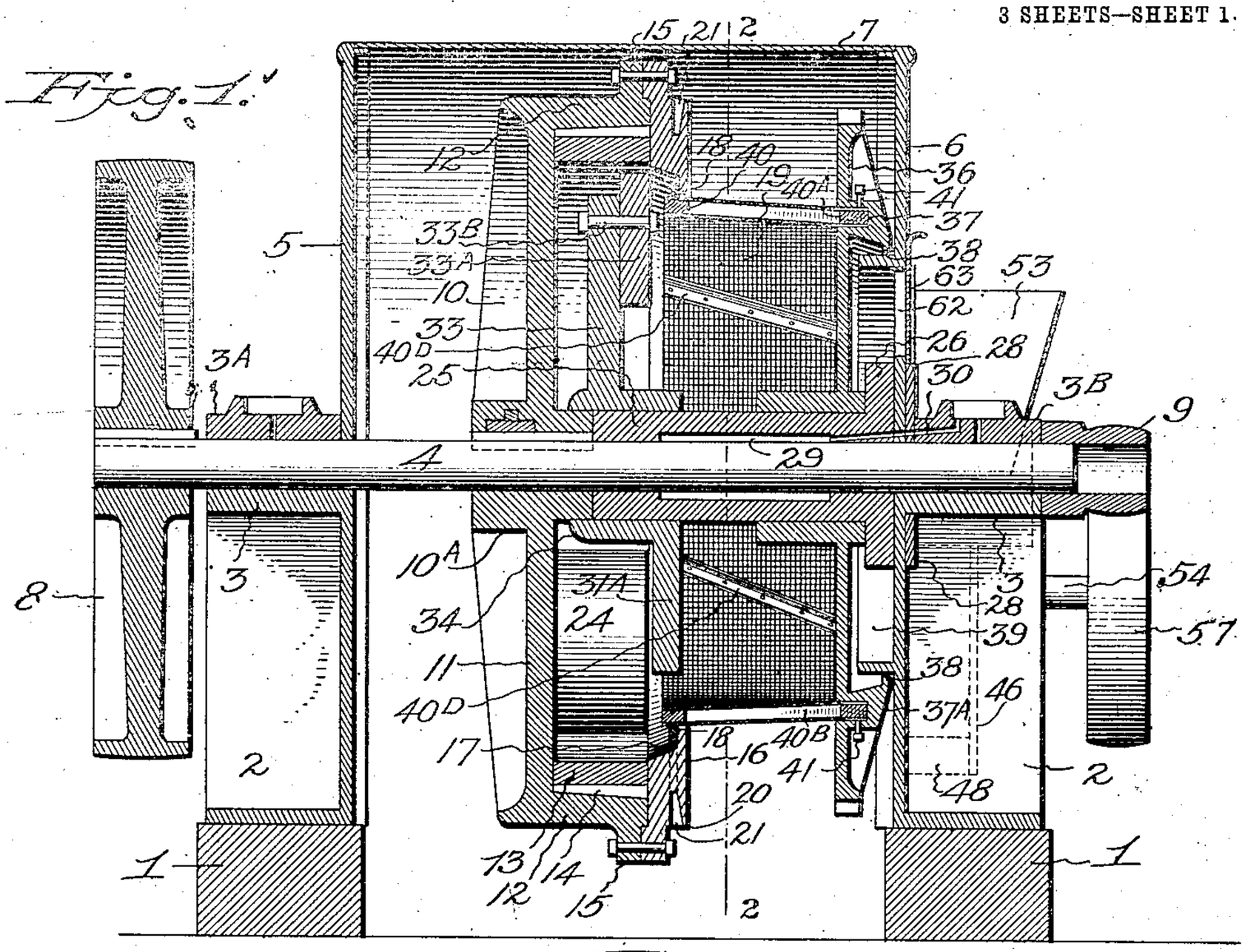


Fig. 2.

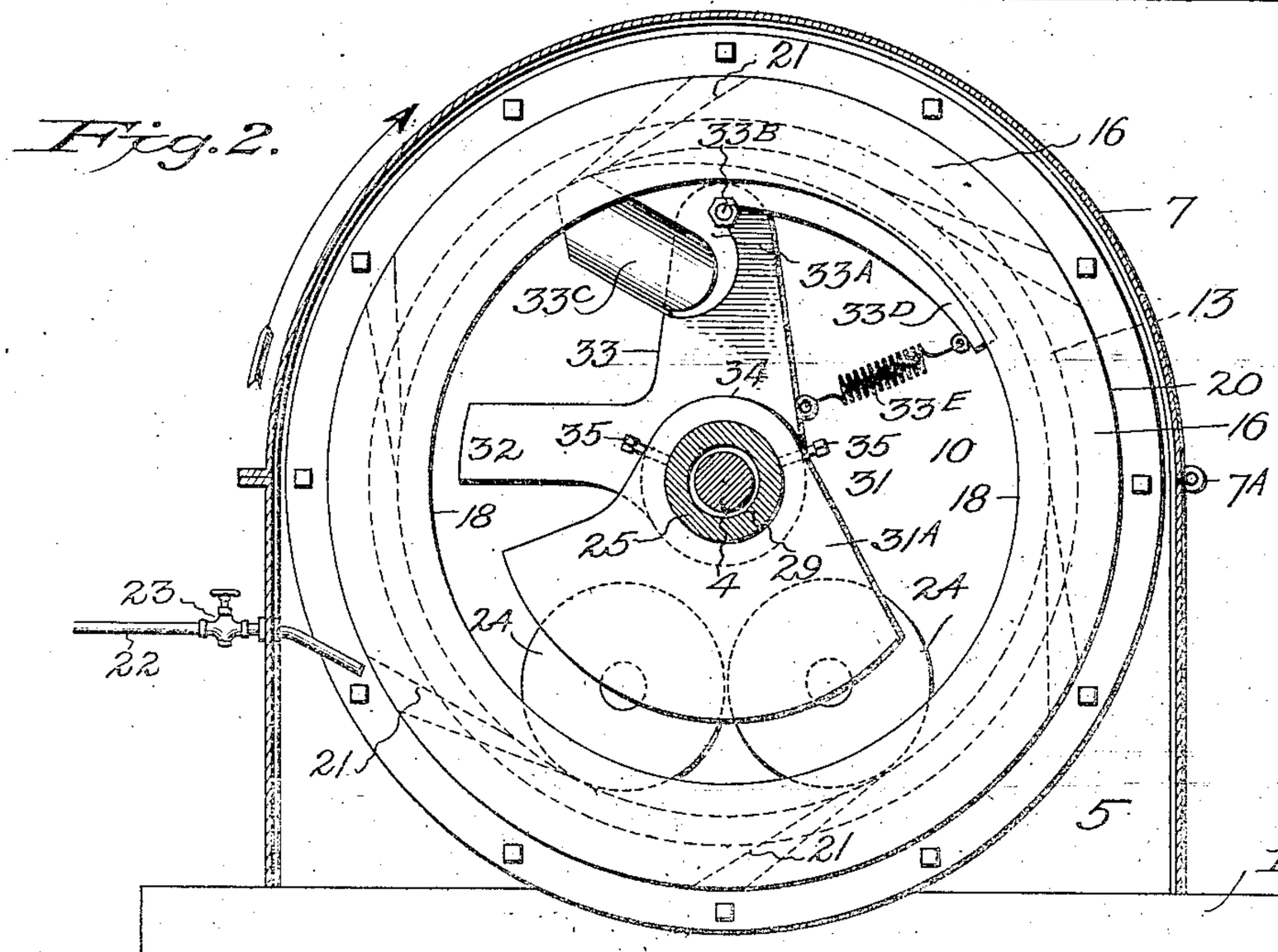
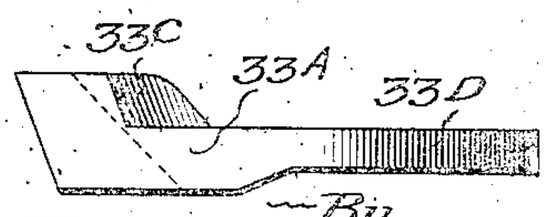


Fig. 7.



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Bessie Thompson.

Inventor:
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3 SHEETS—SHEET 2.

Fig. 3.

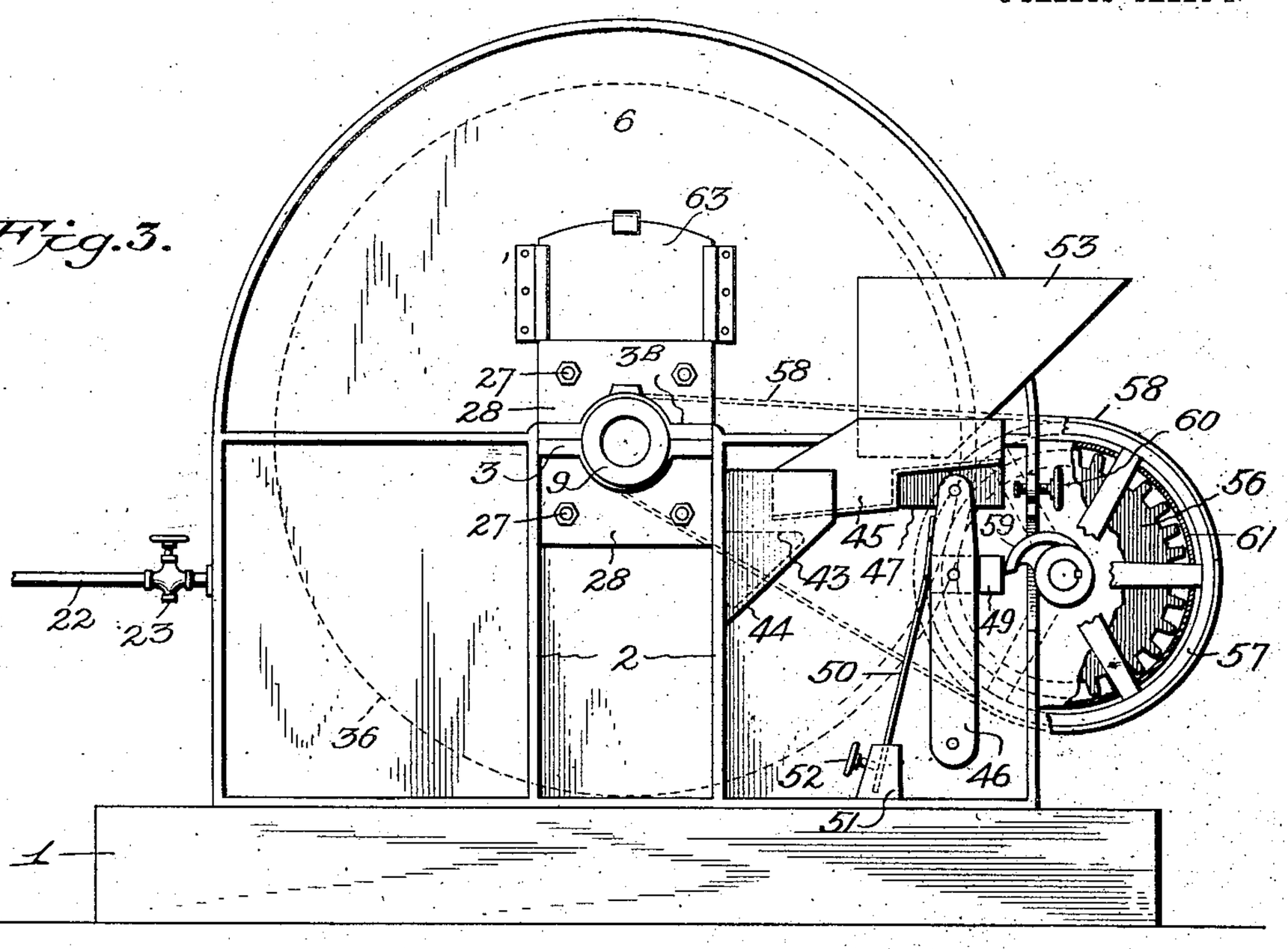


Fig. 5.

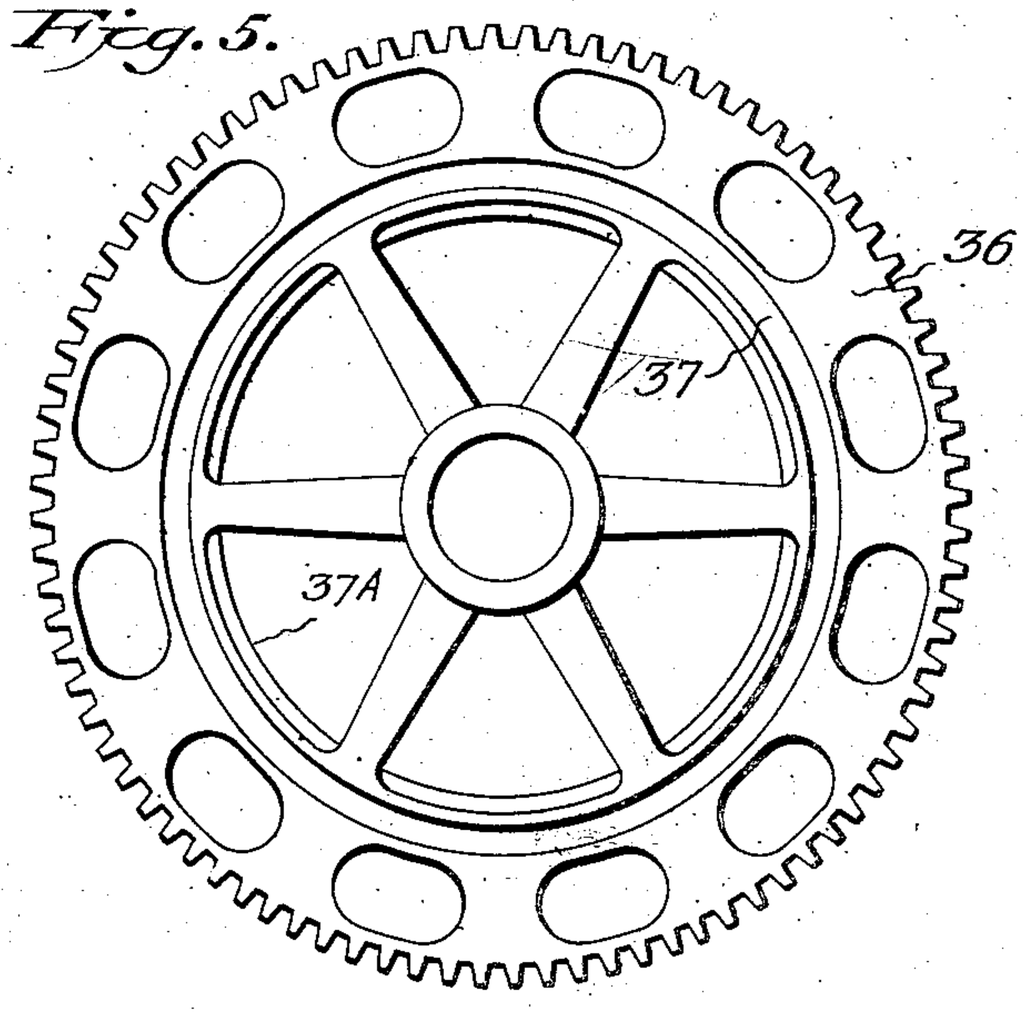
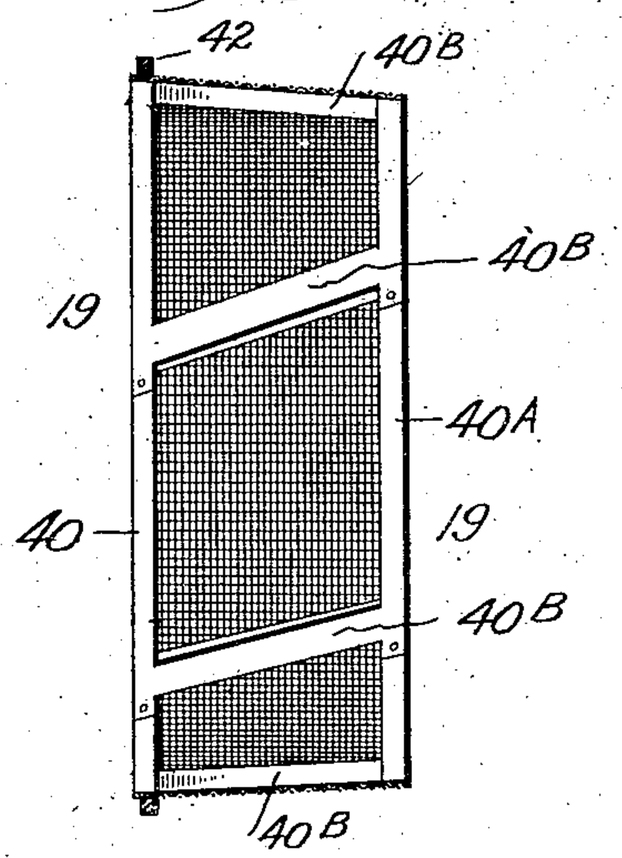


Fig. 6.



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3 SHEETS—SHEET 3.

Fig. 4.

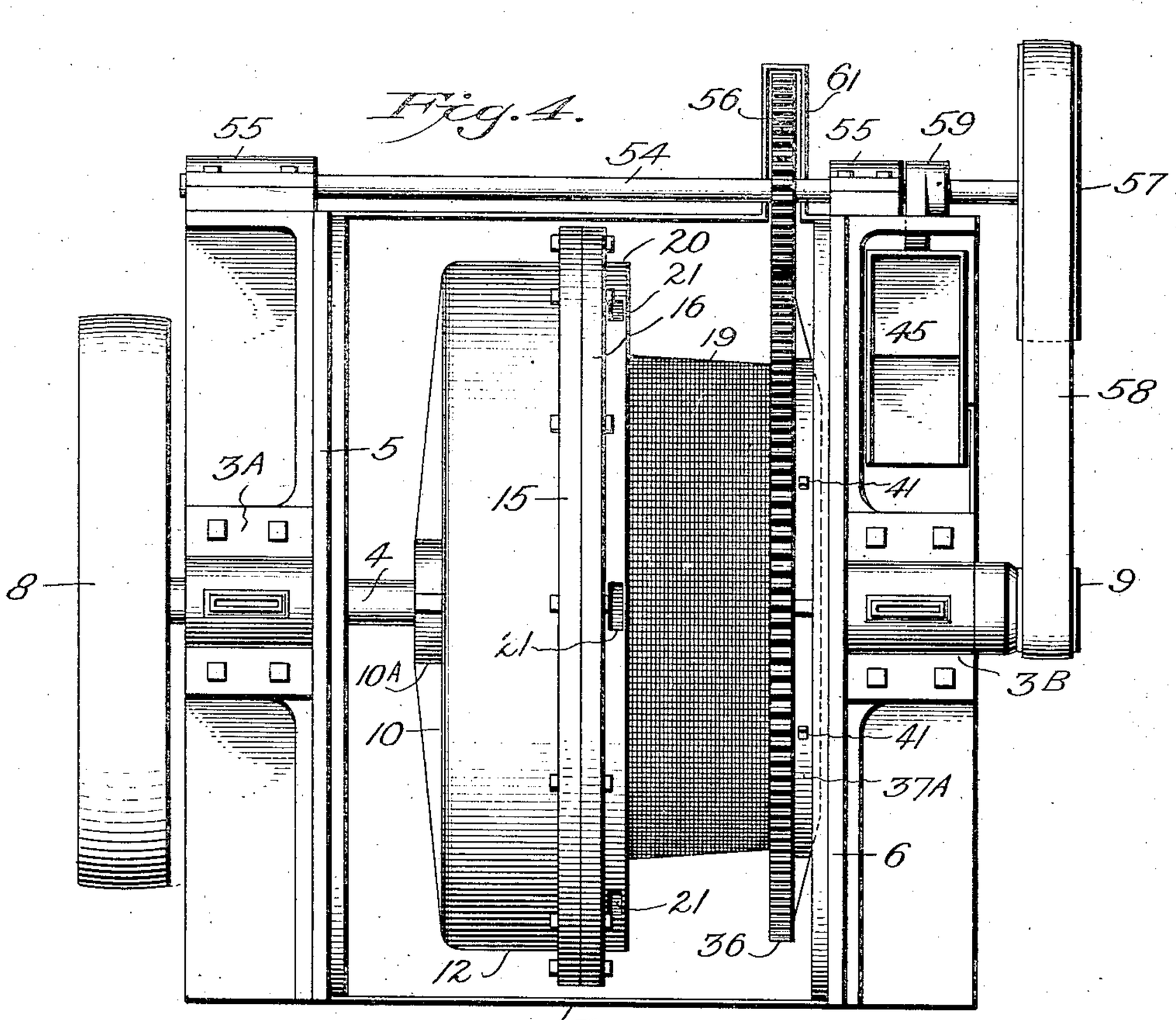
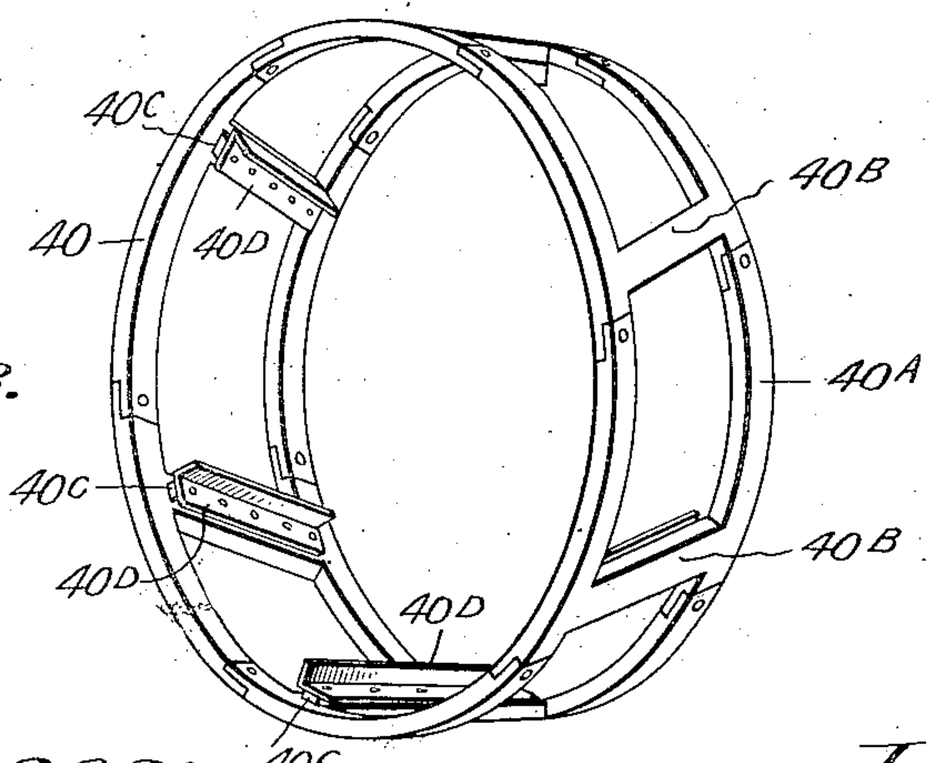


Fig. 8.



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UNITED STATES PATENT OFFICE.

WILLIAM E. WILD, OF DENVER, COLORADO.

ROLLER ORE-CRUSHING MILL.

No. 835,694. Specification of Letters Patent. Patented Nov. 13, 1906.

Application filed March 21, 1905. Serial No. 251,250.

To all whom it may concern:

Be it known that I, WILLIAM E. WILD, a citizen of the United States of America, residing in the city and county of Denver and State of Colorado, have invented a new and useful Roller Ore-Crushing Mill, of which the following is a specification.

My invention relates to improvements in roller ore-crushing mills.

The objects of the invention are, first, to provide a mill which is adapted for wet or dry crushing or grinding of ores and other materials by means of vertically-disposed rollers which are rotated by a die-ring carried by a revoluble casing; second, to provide a coöperating revolving screen which receives the ground product from the rollers and which returns the coarse material to the die-ring for regrinding; third, to provide an improved manner of feeding ore or other material to the rollers and for conveying the ground product to the screen, and, fourth, to provide means for preventing the lateral displacement of the rollers and for limiting their upward movement upon the periphery of the die-ring, due to rapid rotation of the casing. These and other minor objects are attained by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal sectional view of the improved mill. Fig. 2 is a vertical transverse sectional view thereof on the line 2 2 of Fig. 1, the screen being omitted. Fig. 3 is an end view of the feed end of the mill. Fig. 4 is a plan view thereof, the housing being removed. Fig. 5 is a front elevation of the gear-wheel which carries the screen. Fig. 6 is a view showing the ore-screen in elevation, the outer protecting-screen in section, and the supporting-frame, which lies between the two screens and is secured at one end to the screen-carrying gear-wheel. Fig. 7 is a plan view of the scraper, which receives the ground product from the die-ring and delivers it to the revolving screen; and Fig. 8 is a perspective view of a section of the screen-supporting frame.

Referring to the accompanying drawings, the numeral 1 indicates suitable foundation-timbers upon which are mounted a pair of standards 2, having shaft-boxes 3 at their upper ends, which support the driving-shaft 4 of the mill. These standards form an integral part of end plates 5 and 6, the upper portions of which are semicircular in form, as shown. A sheet-metal housing 7 extends from one end plate to the other, and the plates and housing completely inclose the mill. The upper or semicircular portion of the housing is hinged on one side to the lower half, as shown at 7^A, and on the same horizontal plane as the axis of the shaft, while at the opposite side it is secured to the lower half by any suitable form of catch, so that it may be swung back to afford access to the mill when desired. The shaft is held in its boxes by caps 3^A and 3^B, which are provided with the usual oil-receivers. The ends of the shaft extend beyond the boxes 3, and upon one end is keyed a pulley 8, while the other end carries a pulley 9, which is preferably secured upon the shaft by set-screws.

Upon the shaft 4 adjacent to the end plate 5 is mounted a circular ring 10 of suitable depth, one side of which is open. The ring has a hub 10^A, through which the shaft passes, and the hub and shaft are rigidly locked together by the employment of the usual feather and gib, as shown. This ring comprises a disk 11, having an integral flanged shell 12 at right angles thereto within which is fitted a die-ring 13. The inner periphery of the shell tapers slightly, as shown, and the die-ring is of slightly less diameter than the shell, and after the die-ring is placed within the shell wooden wedges 14 are driven in between the shell and ring, and these rigidly secure the ring to the shell of the casing. The flange 15 of the shell 12 is provided with a plurality of bolt-holes, and to this flange is bolted a ring 16, which also rests against the edge of the die-ring and holds it within the ring. The inner diameter of this ring where it abuts against the die-ring is substantially the same as the inner diameter of the said die-ring, and from this point outward a short distance the diameter converges or grows smaller to form an inclined surface 17, which terminates in an annular lip 18, which surrounds a circular screen 19 to be hereinafter described. The ring 16 is reduced in thickness adjacent to its circumference, where it is bolted to the shell 12, and this reduced portion forms an annular shoulder 20, which is provided with a plurality of water-inlets 21, which extend inward through the inclined surface 17. These holes are preferably arranged at a tangent to the axis of the ring and convey water to the interior of the mill from a supply-pipe 22, having a valve 23, by which the supply of water may be regulated. The water is dis-

charged under pressure against the shoulder 20, and as the ring revolves in the direction of the arrow the openings 21 will catch the water, which will be forced by the rapid rotation of the wheel into the interior of the mill.

Within the die-ring I place one or more rollers 24, between which and the die-ring the ore or other material is pulverized as the ring revolves, and as the hard lumps of ore cause the rollers to jump and the rotation of the ring causes the rollers to be carried upon the tread of the die-ring in the direction of its rotation it is essential to provide means for limiting the upward movement of the rollers and for preventing them from being thrown laterally from the ring, and I accomplish this in the following manner: A hub 25 is slipped upon the driving-shaft until one end abuts against the hub of the ring 10. The other end of the hub 25 is formed with a flange 26, which is bolted to the end plate 6 by bolts 27, which also pass through plates 28, which serve to stiffen the end plate 6 at the point where the hub is bolted thereto. The driving-shaft 4 is adapted to rotate freely in the hub 25, and the bore of said hub is formed with an annular oil-space 29. The caps 3^A and 3^B of the shaft-boxes are provided with the usual oil-receivers, as previously mentioned, and from the receiver of the cap 3^B extends a passage 30, which enters the said oil-space 29 and conveys oil from the cap to the portion of the shaft within the hub. A casting 31, comprising a roller-guard 31^A, a stop-arm 32, a scraper-supporting arm 33, and a hub 34, is supported upon the hub 25 and secured thereto by set-screws 35. The hub 34 also overlaps the hub 10^A of the ring and is arranged to prevent grit from working through to the shaft. The guard 31 will prevent the rollers from being thrown from the ring, and the stop-arm 32 will prevent the excessive upward movement of the rollers, due to the rotation of the ring.

Mounted upon the hub 25 adjacent to its flange 26 is a large gear-wheel 36, having an annular groove 37 on that side facing the ring 10. The rim of this wheel is connected to its hub by spokes, so as to provide a plurality of open spaces through which the ore from the hopper may pass, as will presently be shown. The opposite side of the wheel is formed with a circular projection 37^A, having an annular lip 38, which surrounds a circular band 39, formed on the end plate 6, and from the lip the opening through the wheel inclines outwardly, similar to the opening in the ring 16.

Within the groove 37 of the gear-wheel 36 I secure the circular screen 19, and this screen comprises an outer band-screen of fine mesh and an inner band-screen of coarser mesh, the coarser screen being used to protect the fine screen, between which are interposed a pair of rings or bands 40 and 40^A which are located respectively at the front and rear ends of the screen and which are connected by a series of arms 40^B. These arms are preferably set at an angle, as shown in Fig. 6, and the screen has a slight outward incline or is in the form of a frustum of a cone. These screen-bands are preferably formed in sections, which are bolted together, as shown. The smaller end of the screen is placed in the groove 37 and is held therein by set-screws 41, which pass through the projections 37^A and engage the band 40^A, and the outer end of the screen passes through the ring 16 a slight distance, and upon this end of the screen is placed a flexible band 42, preferably rubber, which lies adjacent to the inner face of the lip 18 of the ring.

Upon the under side of each arm 40^B is formed a longitudinal rib 40^C, the section of screen fabric extending between the arms from rib to rib, and upon the ribs are bolted angle-bars 40^D, which catch the pulverized ore as the screen revolves and deposit it upon the screen again. A scraper 33^A is supported upon a bolt 33^B at the upper end of the arm 33 of the casting 31. This scraper comprises an enlarged end which is recessed or hollowed out to form a chute 33^C, the upper end of which terminates in a knife-edge which contacts with and extends across the face of the die-ring 13, and a curved tail 33^D, which serves to balance the chute. The knife-edge is at an angle to the axis of the ring, as shown in Fig. 7, and the chute has a downward and lateral direction. A spring 33^E connects the end of the tail with the arm 33 and normally holds the knife-edge of the chute in contact with the die-ring. The end plate 6 is provided with a feed-opening 43, which is provided with a chute 44, upon which rests the discharge end of a vibrating feeder 45, the opposite end of which is supported by a vertical arm 46, the upper end of which is pivoted to a web 47, formed upon the under side of the feeder, while its lower end is pivoted to a projection 48 on the end plate 6. A cam-tappet 49 is secured to the arm adjacent to its upper end, and a spring 50 bears against the opposite side of the arm from the tappet, the lower end of said spring being secured to a lug 51 on the bottom flange of the end plate by a screw 52. A hopper 53 is secured to the end plate above the feeder 45, and the discharge end of this hopper extends into the feeder, as shown in Fig. 3. A shaft 54 extends across the side of the housing and is journaled in boxes 55 upon the end plates 5 and 6. This shaft carries a gear-wheel 56, which meshes with the screen-carrying gear-wheel 36, and a belt-wheel 57, which connects by a belt 58 with the pulley 9 on the end of the driving-shaft 4. The shaft 54 also car-

ries a cam 59, which engages the tappet 49 on the arm 46, by which the arm is moved forward, and when the cam escapes the tappet the arm is thrown back by the spring 50, its movement in this direction being limited by a screw 60, which passes through a flange upon the edge of the end plate 6 in position to be struck by the edge of the web 47 of the feeder 45. The gear-wheel 56 is inclosed in a housing 61; but when a large screen-supporting gear-wheel is used the smaller gear could be positioned on a lower plane and would lie entirely within the mill-housing 7. In this event the feeder-supporting arm 46 would be centrally pivoted and the cam 59 would contact with its lower end. The end plate 6 is provided with an opening 62, which is closed by a sliding door 63, the said door affording means for inspecting the mill during its operation. In assembling the mill the upper half of the housing is thrown back on its hinge and the hub 25 is secured to the end plate in axial line with the shaft-boxes 3. The gear-wheel 36, carrying the screen 19, is then slipped upon the hub, and the casting 31 is secured upon the outer end of said hub. The ring 10 is then held in axial line with the hub, and the shaft 4 is passed through one of the boxes, then through the hub and ring and through the outer box, after which the ring is secured upon the shaft in the manner before described and the band-wheel 8 and pulley 9 are secured upon their respective ends of the shaft.

The operation of the improved mill is as follows: The ring 10 is revolved at a sufficiently high rate of speed in the direction of the arrow, and the rollers upon the die-ring will be revolved in the same direction and will at the same time be carried upward upon the ring by its momentum. Ore which has been previously reduced to small lumps by a crusher is then fed to the hopper 53, and the ore at this stage may be dry or it may be mixed with water. The ore falls into the feeder 45 and is delivered to the hopper-chute 44 in the following manner: The pulley 9 through belt 58 turns the belt-wheel 57 on shaft 54, and the cam 59 is thereby revolved, giving the feeder an intermittent shaking motion, which throws the ore forward into the chute. At the same time the gear-wheel 56 turns the screen-carrying gear 36 in an opposite direction to that of the ring 10. The ore feeds through the opening 43 in the end plate 6, through the spokes of the gear-wheel, and onto the screen, and any leakage of water will be prevented by the band 39 of the end plate and the lip 38 of the wheel. As the ore falls on and feeds across the screen particles that are fine enough pass through the coarse and fine screens, while such particles as pass the coarse screen, but are too coarse to pass the fine screen, work back through the coarse screen and with the major portion are fed to the die-ring, where they are carried around in the direction of the rotation of the ring, and pass beneath the rollers, where they are reduced to a greater degree of fineness, and being damp they adhere to the ring and are carried around until they strike the scraper 33[A], when they are deflected onto the screen again. The particles which are fine enough to pass through the fine screen are discharged; but the coarser particles are returned to the die-ring and are again acted upon by the rollers, and the ore continues its movement from die-ring to screen until it is fine enough to pass through. Water all the while is being forced into the die-ring through the openings or inlets 21 of the ring 16, and the ore will be of such a watery consistency as to readily pass through the screen. The rubber band upon the end of the screen will prevent the escape of any portion of the mixed ore and water except through the screen and will also prevent the portion which passes through the screen from passing back to the mill again. The larger lumps of ore will cause the roller to jump from the die-ring and strike violently against each other; but they will be held against lateral displacement by the guard 31[A], and when the ring is run at a high rate of speed the rollers will be prevented from climbing too high upon the die-ring by the stop-arm 32.

From the foregoing it will be seen that my improved mill combines lightness and simplicity of construction and that it possesses all the advantages of any of the types of mills in general use and can be much more cheaply manufactured.

The improved style of screen and the manner of constantly bringing the ore in contact with the screen after it has been acted upon by the rollers prevents the ore from being pulverized to such a degree of fineness as to produce slimes, as the instant the ore is sufficiently fine to pass through the fine screen it is discharged therefrom forthwith and has not the chance of again being delivered to the action of the rollers.

The ore may be fed dry when desired, and the water which passes in through the inlets 21 of the ring 16 will mix with the ore while it is being pulverized.

Having described the invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a mill of the character described, a vertical, rotatable ring, open on one side; a die-ring in said ring; rollers movable on said die-ring; a ring secured upon the open side of said ring against said die-ring, having an annular projection provided with tangential inlets which extend to the inner periphery of the ring; a rotatable band-screen, one end of which projects through said ring, and means for rotating said ring and screen in opposite directions.

2. In a mill of the character described, the combination with a horizontal shaft of a circular ring mounted thereon, which is open on one side; a die-ring in said ring; rollers movable on said die-ring; a ring bolted to said ring and against said die-ring, having tangential inlets which extend from the outer to the inner periphery of said ring; a gear-wheel having an annular groove in one of its faces; a band-screen, one end of which fits into said annular groove, while its other end projects into said ring; a stop for limiting the upward movement of said rollers upon the die-ring; a guard for preventing their lateral displacement, and means for rotating said ring and screen in different directions.

3. In a mill of the character described, the combination with standards having a horizontal shaft mounted thereon, of a circular ring rigidly mounted thereon, which is open on one side; a die-ring in said ring; rollers which rest upon said die-ring, and which are movable with respect to a horizontal plane; a ring secured to said ring and against the die-ring, having tangential inlets which communicate with the interior of the ring; a hub upon said shaft which is immovable with respect to the shaft; a gear-wheel mounted on said hub, having a circumferential groove in its face adjoining the ring; a band-screen, one end of which is secured in said groove, while the other extends through the ring upon the ring; means for limiting the lateral and upward movements of the rollers, and means for rotating the screen and ring in opposite directions.

4. In a mill of the character described, the combination with a pair of vertically-disposed end plates, and a housing connecting said end plates, of standards upon said plates having shaft-boxes thereon; a shaft extending through said plates and resting on said boxes; a hub secured to one of said end plates, through which said shaft passes; a gear-wheel revolubly mounted on said hub, having an annular groove in one face; a band-screen, one end of which is secured in said groove; a circular ring keyed to said shaft, which is open on one side; a die-ring in said ring; a ring secured to said ring having a conical bore terminating in an annular lip, which surrounds the other end of said screen, and tangential inlets which communicate with said conical bore; movable rollers which rest upon said die-ring; a casting secured upon said hub comprising an upright arm, a roller-stop, and a roller-gear; a scraper on said upright arm, which contacts with the die-ring, having a chute which deflects the pulverized material into the said screen, and means for rotating said screen and ring in opposite directions.

5. In a mill of the character described, the combination with a vertical, rotatable, ring open on one side and having a die-ring; movable rollers on said die-ring; a ring bolted to said ring, having inlets through its periphery at a tangent to its axis, a stop to limit the upward movement of said rollers upon the die-ring, and a guard to prevent their lateral displacement; of a rotatable band-screen, one end of which extends through the ring upon the ring; means for feeding ore through the other end of said screen, means for rotating said screen and ring in opposite directions, and a scraper which contacts with the said die-ring, and deflects the ore carried thereby onto the said screen.

6. In a mill of the character described, the combination with standards having boxes thereon of a hub secured to one of said standards; a power-driven shaft extending through said hub and resting in said boxes; a gear-wheel mounted on said hub; a circular band-screen secured at one end to said wheel; a circular ring keyed to said shaft, open on one side and having a die-ring; movable rollers on said die-ring; a ring on the open side of said ring, through which the other end of the screen projects; a hub secured upon the end of the first-mentioned hub, having a roller-guard, a roller-stop, and an upright arm; a scraper pivoted on said arm, which contacts with said die-ring; a shaft having a gear-wheel in mesh with said screen-carrying gear; pulleys on one end of each of said shafts; a belt connecting said pulleys, and a vibrating feeder for delivering ore to said screen.

7. In a mill of the character described, the combination with a vertical, rotatable circular ring, open on one side; a die-ring in said ring and rollers loosely mounted on said die-ring, of a circular rotatable band-screen, one end of which projects into said ring; a chute communicating with the opposite end of said screen; a vibrating feeder which discharges into said chute; a hopper above said feeder; and means for rotating said ring and screen in opposite directions.

8. In a mill of the character described, a pair of upright end plates having integral shaft-boxes; a power-driven shaft in said boxes, having a pulley on one end; a shaft parallel to said power-driven shaft, journaled upon said end plates, and having a belt-wheel, a cam and a gear-wheel; a belt connecting said pulley and belt-wheel; a hub secured to one of said end plates, through which said power-driven shaft passes, a gear-wheel on said hub in mesh with the first-mentioned gear-wheel; a circular, conical band-screen, secured to said gear-wheel; a hopper on said end plate; a feeder below said hopper; an arm pivoted to said feeder and to said end plate, having a tappet which is engaged by said cam; a spring for moving said arm against the action of the cam; a chute leading from said feeder to said screen; in combination with a circular rotatable ring, secured to said power-driven shaft, which is open on

one side to receive the opposite end of said screen; a die-ring in said ring, loose rollers on said die-ring; means for limiting the lateral and upward movement of said rollers, and a scraper which contacts with the periphery of said ring and conveys the pulverized product thereon, to the interior of the screen.

9. In a mill of the character described, a vertical, rotatable, circular ring open on one side, having a die-ring and loose rollers on said die-ring; a conical screen, comprising an inner and outer screen of different mesh; a band at each end between said coarse and fine screen, and arms connecting said bands; a gear-wheel to which the smaller end of said screen is secured, while its larger end projects into said ring; a shaft for supporting said ring; means for supporting said screen independent of said shaft, and means for rotating said gear-wheel in an opposite direction to said ring.

10. In a mill of the character described, a vertical, rotatable, circular ring, open on one side; a die-ring in said ring, and loose rollers on said die-ring; a ring bolted to the open side of said ring, the inner periphery of which is conical, and terminates in an annular lip, said ring having tangential inlets communicating with the interior of the ring; a conical screen, one end of which projects through said annular lip; a flexible band on the end of said screen, adjacent to the inner side of said lip; a scraper which contacts with said die-ring and deflects the pulverized material thereon to the interior of said screen; means for delivering material to the opposite end of said screen, and means for rotating said screen in an opposite direction to said ring.

11. In a mill of the character specified, the combination with a vertical, rotatable circular ring, having loose rollers therein, of a gear-wheel having an annular groove in its rim; a conical screen, comprising a pair of screens of different mesh; bands interposed at each end between the two screens, and connected by arms, the larger end of said screen projecting into said ring, while its smaller end lies in the groove of said wheel; a scraper which conveys the pulverized material from the ring to the interior of the screen, and means for rotating the screen and ring in opposite directions.

12. In a mill of the character described, a rigidly-supported sleeve; a shaft passing loosely through said sleeve; a circular rotatable ring carried by said shaft, having a die-ring, and loose rollers on said die-ring, one side of said ring being open; a ring upon the open side of said ring, having peripheral inlets at a tangent to its axis, which communicate with the interior of said ring; a hub secured upon the end of said rigid hub, having an integral guard which prevents lateral displacement of said rollers, a stop which limits their upward movement upon the die-ring, and an upright arm; a scraper secured to said arm; and means for holding it in contact with said die-ring; a conical screen, one end of which projects through the ring having the tangential inlets; a wheel having an annular groove in its rim, in which the other end of said screen is secured, and means for rotating said wheel in an opposite direction to said ring.

13. In a mill of the character described, the combination with a vertical, rotatable, circular ring, open on one side, and having a die-ring and loose rollers on said die-ring; and a revoluble, conical screen, one end of which projects into said ring, of a scraper which contacts with said die-ring; resilient means for maintaining said contact; a support for said scraper, a guard for preventing lateral displacement of said roller, a stop for limiting their upward movement, and means for rotating said screen and ring in opposite directions.

14. In a mill of the character described, a vertical, rotatable, circular ring, open on one side, having a die-ring and loose rollers on said die-ring; and a conical, revoluble screen, one end of which projects into said ring, of a scraper comprising a chute, the upper end of which contacts with said die-ring, said chute being adapted to deflect the crushed material from the die-ring, into the screen, and means for rotating said ring and screen in opposite directions.

15. In a mill of the character described, the combination with the circular ring having a die-ring and loose rollers thereon, of an outer and inner conical screen, having a band at each end between said screens, and arms connecting said bands, one end of said screen projecting into one side of said ring, and means for rotating said screen and ring in opposite directions.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM E. WILD.

Witnesses:
G. SARGENT ELLIOTT,
BESSIE THOMPSON.