May 13, 1930. G. F. PETTINOS 1,758,010

GRINDING MILL

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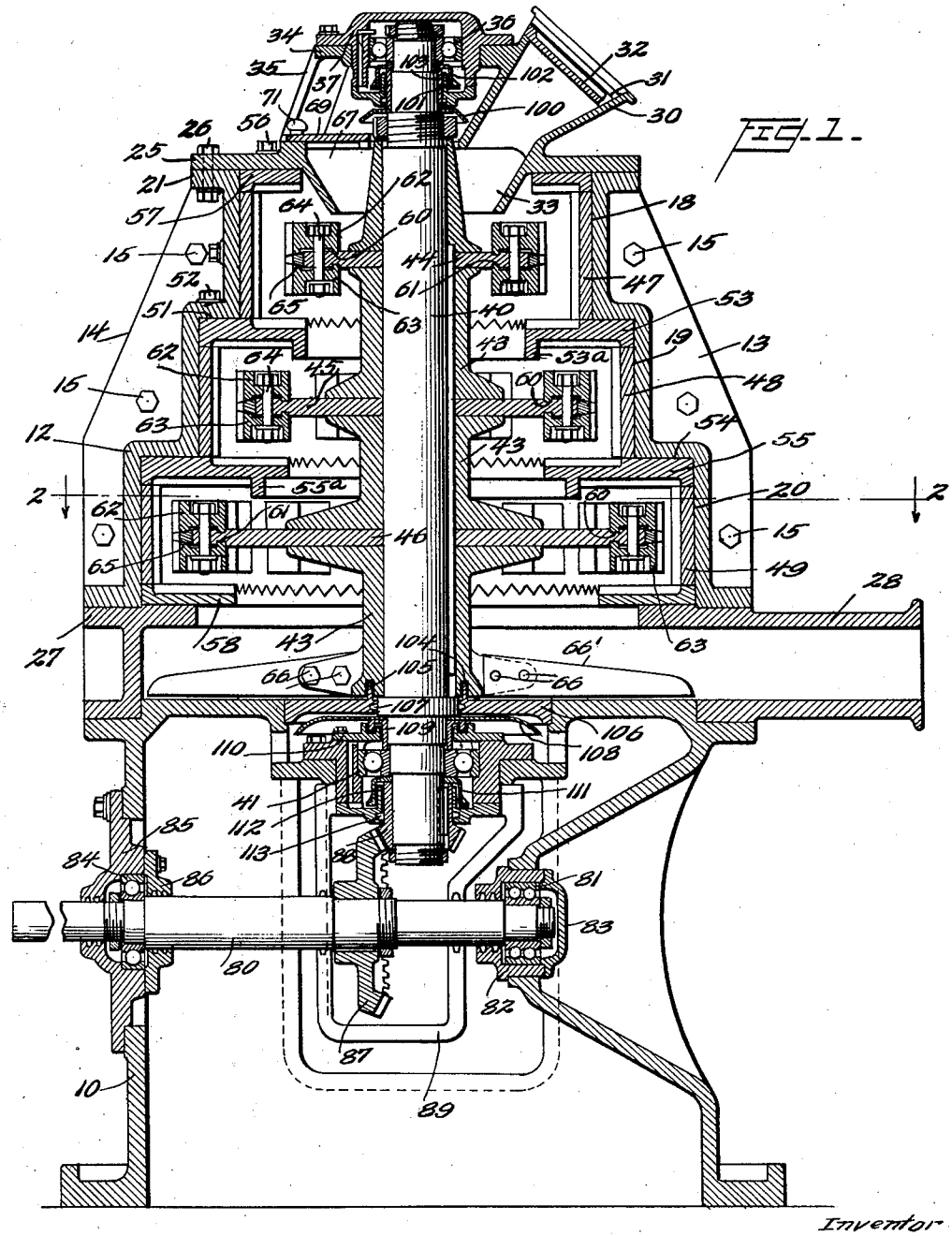

FIG. 1.

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FIG. 2.

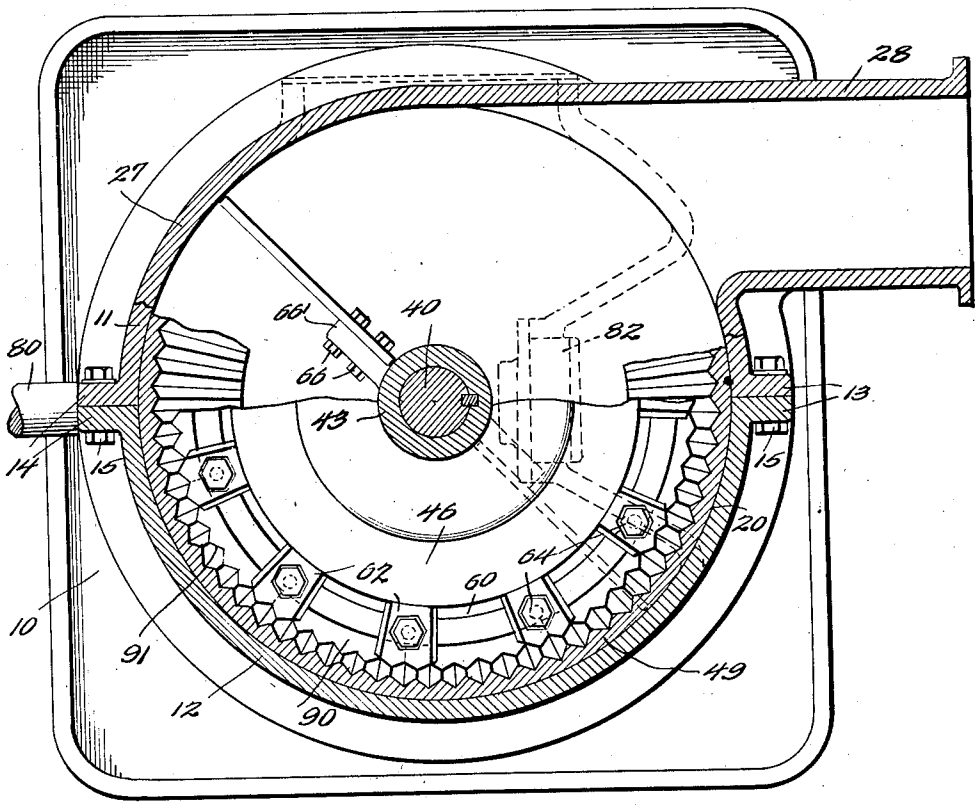

FIG. 6.

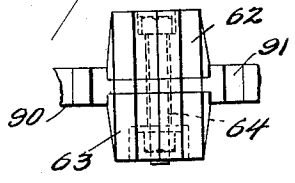

FIG. 4.

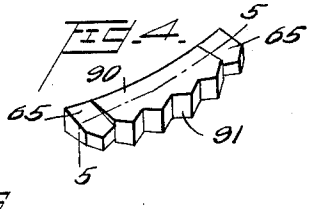

FIG. 7.

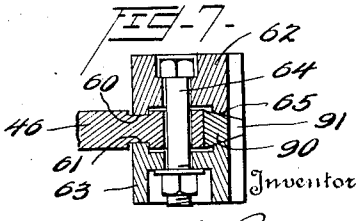

FIG. 5.

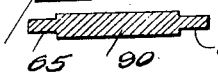

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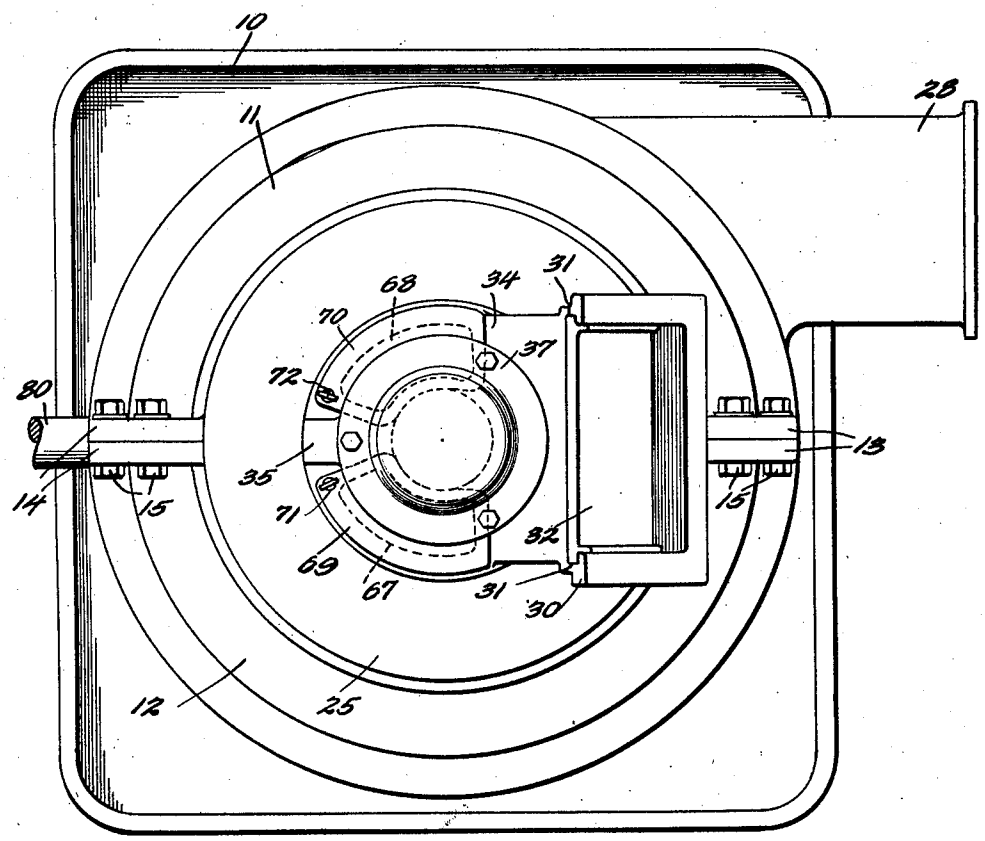
FIG. 3.



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Patented May 13, 1930 1,758,010

UNITED STATES PATENT OFFICE

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GRINDING MILL

Application filed August 18, 1928. Serial No. 300,605.

This invention relates to grinding mills, and more particularly to the centrifugal type comprising a casing and a grinding element rotatable therein.

Grinding mills of this character have comprised a casing and a rotary grinding element journaled therein, this element consisting of a plurality of disks of the same, or stepped diameters, the disks carrying centrifugal hammers which coact with the inner walls of the casing to perform the grinding or pulverizing process. The purpose of the present invention is to simplify and improve the construction and operation of apparatus of this type.

One of the objects of the present invention is to provide a substantially continuous grinding surface as a path for the material in its progress through the mill.

Another object of the invention is to prevent the passage of the material through the mill until it is reduced to a desired degree of fineness.

A further object of the invention is to provide a control device for regulating the amount of material to be ground which is introduced into the mill.

Still another object of the invention is to provide a draught inducing means for withdrawing the ground material from the mill, which means will also project the material by impact.

Another object of the invention is to provide means for driving the mill at selected speeds from a constant speed prime mover.

Other objects and features of novelty will be apparent from the following description, as taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical cross section through the improved grinding mill according to the present invention;

Figure 2 is a horizontal cross section taken along the line 2—2 of Fig. 1 and showing the construction of the hammers and disks; and

Figure 3 is a top plan view of the grinding mill.

Figure 4 is a perspective view of one of the grinding segments which are secured to the hammer disks;

Figure 5 is a section on line 5—5 of Fig. 4;

Figure 6 is a face view, and Figure 7 a sectional view showing the details of one of the hammers.

Referring more particularly to the drawings, the improved grinding mill is supported upon a frame 10, as shown in Fig. 1, which may be of any desired construction to afford the necessary rigidity and strength, but in the preferred form of the invention shown in this figure it comprises a single casting. The frame 10 supports the casing of the grinding mill which comprises two shells 11 and 12, each provided with flanges 13 and 14 receiving bolts 15 by means of which the two shoulders are secured together to form the casing.

The interior of the casing comprises three stepped cylindrical chambers of varying diameter, as indicated in Fig. 1, and designated 18, 19 and 20 respectively. The upper portion of the casing terminates in an annular flange 21, to which is bolted a cover plate 25 as by means of bolts 26. The cover plate constitutes the top wall of the casing and comprises a journal for the grinding element, and a means for introduction of the material to be ground, as well as air for the induced draught.

Interposed between the frame 10 and the casing is an annular ring 27 having an integral tangentially directed spout 28 which constitutes the delivery for the pulverized material.

Integrally formed in the cover 25 is an inlet pipe 30 having grooves 31 formed in its lateral sides and adapted to receive a slide 32 for regulating the feed of material to be ground. The pipe 30 delivers to a conical, inwardly directed flange 33. Also integral with the pipe 30 is a lateral web 34 having a strut 35 secured thereto to support its outer edge. A bearing indicated generally at 36 is mounted in an aperture in the web 34 and is closed by an upper cap 37.

Journaled in the bearing 36 is a vertical shaft 40 which rotatably supports the grinding element of the machine. The lower end of the shaft is supported by a bearing 41 in turn supported by the frame 10. Keyed to

the shaft 40 are a plurality of spacer members 43 which serve to maintain in spaced relation the grinding disks 44, 45 and 46 which are respectively housed in the chambers 18, 19 and 20.

The cylindrical walls of the chambers 18, 19 and 20 are fitted with segmental liners 47, 48 and 49, each having grinding surfaces formed on their inner surfaces. In the preferred form of the invention shown, this surface takes the form of the serrated or channeled contour shown in Fig. 2.

The junction of the cylindrical chambers 18 and 19 forms an annular shoulder 51 to which is secured, as by bolts 52, a flat annular plate 53, the upper and lower surfaces of which are provided with corrugations similar to those described for the cylinder liners. The junction of the chambers 19 and 20 forms a shoulder 54, to the underside of which is secured an annular plate 55 similar to the plate 53, but extending further inward in proportion to its diameter. Above the liner 47, and secured to the cover 25 as by bolts 56 is a flat annular ring 57 having corrugations on its lower side, and fitted in the bottom of the casing just above the flange 27 is an annular ring 58 similar to the ring 57 but inverted and of larger diameter so as to fit under the liner 49.

Each of the disks 44, 45 and 46 carried by the shaft 40 carries a series of hammers spaced around its margin. In the form shown, the disks are formed with annular grooves 60 and 61 in their upper and lower surfaces, and the hammers are formed as segmental elements 62 and 63 respectively above and below the disks in pairs, and a bolt 64 passing through the disk and the members 62 and 63 serves to hold the parts together.

The radial faces of the hammers are preferably inclined as shown in Figure 6.

As shown in Figures 2, 4 and 5, segments 90 are fitted to the disks between the hammers, these segments being serrated on their outer peripheries as shown at 91. The ends of these segments are outwardly tapered or wedge-shaped as at 65 where they fit between the hammer sections, and they are locked in place by the bolts which secure the hammers to the disks. The peripheral edges of the disks are thereby protected and additional grinding surface provided. The hammers and segments provide a continuous serrated grinding surface surrounding each disk.

It will thus be noted that a substantially continuous grinding surface is provided for the interior of the casing. In other words, the upper hammer parts of the disk 44 coact with the ring 57, and its peripheral surface coacts with the liner 47, while its lower hammer parts coact with the upper side of the ring 53. In like manner the upper hammers of the disk 45 coact with the lower side of the ring 53, and their peripheries coact with the liner 48 while the lower hammers coact with the upper surface of the ring 55. Similar conditions prevail in the lower chamber 20.

The rotation of the disks and hammers creates a downward draft within the casing, which assists gravity in carrying the ground material to the bottom or floor of the mill where a pair of blades 66′ sweep it out through delivery spout 28. These blades are shown attached by bolts 66 to arms on the lowest spacer member 43. The draught of air through the mill is controlled by adjustable cover plates 69, 70, on the air inlets 67, 68. The cover plates may be secured in any desired position by set screws 71, 72.

It should be noted that the plates 53, 55 and 58 extend inward definite distances inside of their respective liners 47, 48 and 49. This inward extension is so designed as to retain the material in a given chamber until the material therein has been reduced to the desired degree of fineness for that stage of the grinding. When the desired degree of fineness is reached, the air draught is such as to float the material past the ring into the next chamber or stage. To prevent the material from passing over the hammers, I preferably provide downwardly projecting ribs or flanges 53^a, 55^a, on the rings 53 and 55.

It is desirable to change the speed of rotation of the grinding element, either when different materials are to be ground, or to suit other conditions. At the same time, it is quite desirable to drive the machine from a constant speed shaft, in view of the popularity of alternating current motors. For this reason, a horizontal drive shaft 80 is provided, having its free end journaled in a thrust bearing 81 carried by a journal box 82 and closed by a cover 83. The driven end of the shaft is supported by a radial bearing 84 supported by a removable plate 85 having an inner cover 86 bolted thereto. The plate 85 is bolted to the rim of a suitable aperture in the frame 10.

Keyed to the shaft 80 is a gear 87 meshing with a pinion 88 on the lower end of the shaft 40, which transmits the drive from the prime mover to the grinding element. The gear and pinion are covered by a housing 89 which is constructed larger than would ordinarily be necessary to house the gears, and provision is made to have these gears readily accessible so that they may be removed and another set of gears of different ratios substituted to permit the speed of the shaft 40 to be selected as desired without changing the speed of the shaft 80.

In grinding and pulverizing machines, it is very important to prevent grit or dust from getting into the bearings, and I have therefore provided novel and effective means for sealing the housings of the bearings, espe-

cially of the shaft 40 which carriers the disks and hammers.

Referring to Figure 1, there is mounted on the upper end of the shaft a thrower-plate 100, the rotation of which will project through discharge radially any gritty particles which come in contact with it. This plate is just below the housing of the bearing 36. The housing, as previously described, is closed excepting at its lower side, where the shaft enters, and the thrower-plate is so located as to prevent any particles from entering the housing. As an additional protection for the bearing, I provide a fixed flange 101 between the rotating bell-shaped member 102 and the shaft, or a sleeve 103 on the shaft, these parts constituting a seal which will intercept any dust which might pass inwardly over the thrower-plate.

As the dust is more likely to enter the lower bearing of the shaft 40 than the upper bearing, I have provided effected preventive means as follows: In the lower end of the spacer member 43 is an annular slot 104 into which fits a fixed annular rib 105 on the plate 106, these parts constituting a seal to prevent dust from the discharge chamber from entering the housing of the bearing 41. I provide also a packing ring 107 in the inner margin of the plate 106. Just below the plate 106 I provide a thrower-plate 108, the action of which is similar to that of the plate 100 above described. Just below the thrower-plate and above the bearing is a double seal provided by the rotating flanged sleeve 109 and a fixed annular plate 110, these parts having two complementary grooves and ribs which effectively prevent any grit getting in above the bearing 49 should it not be kept out by the thrower-plate 108. While the gritty matter is not likely to enter below the bearing, I provide an additional seal below the bearing, comprising a rotating bell-shaped part 111 and a fixed collar 112 which enters the bell. The joint between the sleeve which carries the pinion 88 and the lower cover of the bearing housing is further protected by the packing ring 113.

The operation of the grinding mill is as follows: The material to be ground is introduced at the spout 30 and gravitates through the flange 33 and falls on top of the disk 44. The rapid rotation thereof will project the material radially against the liner 47, and the upper hammers will project some of the material against the plate 57. There will, of course, be rebound back and forth, but the material will ultimately be drawn down to the plate 53 where it will be engaged by the lower surface of the hammers. The inwardly directed flange constituted by the plate 51 will retain the material in the chamber 18 until it has reached such fineness that the draught, due to fan effect of the entire rotor, will draw it therearound into the next stage constituted by the disk 45 and the chamber 19 and their grinding surfaces. Here the material is ground to a still finer degree in the manner described for the preceding stage and is finally drawn by the draught over the inwardly directed flange of the plate 55 and descends into the last stage constituted by the disk 46 and the chamber 20 together with their grinding surfaces, where it is reduced to its final form. The flanges 53^a, 55^a will cause the material discharging from one chamber to drop onto the disk in rear of the hammers in the next chamber below.

When the draught draws the material over the inner flange of the plate 58, the material descends into the chamber 27 where it is engaged by the discharge blades themselves and projected by impact out of the spout 28, the draught assisting in the delivery.

The inwardly directed flanges constituted by the plates 53, 55 and 58 serve as an automatic control of the passage of the material through the machine. However, this control may be further regulated by the slide 31 which may be set to limit the amount of material to be ground which is fed into the machine. At the same time, the draught produced by the rotation of the disks and hammers may be regulated by adjusting the angle of the plates 69 and 70 to provide any desired amount of air through the machine.

While one embodiment of the invention has been shown and described in great detail for the purposes of adequate disclosure, the broad idea of the invention is not to be limited to any of the details shown or described, but embraces such embodiments thereof as fall within the scope of the subjoined claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a grinding mill comprising a vertical shaft and grinding elements mounted thereon, a stepped cylindrical casing providing a plurality of compartments of different diameters, each compartment having a cylindrical grinding surface, an inwardly projecting annular plate forming a grinding surface at the upper side of the compartment, and an inwardly projecting annular plate forming a grinding surface at the lower side of the compartment, certain of said plates having downwardly projecting flanges, for the purpose set forth.

2. In a grinding mill having a circular casing and suitable stationary grinding surfaces within said casing, a centrally arranged shaft, a disk mounted on the shaft, a series of detachable segmental blocks mounted on the periphery of the disk, and means for locking said blocks rigidly to the disk.

3. In a grinding mill having a circular casing and suitable stationary grinding surfaces within said casing, a centrally arranged

shaft, a disk on said shaft, a series of segmental blocks having grinding surfaces fitted to the periphery of said disk, hammers fitting the periphery of the disk, and common means for securing said hammers and said blocks to the disk.

4. In a grinding mill the combination with a casing having a circular lining of grinding material, of a shaft within the casing, a disk carried by the shaft, grooves in the faces of the disk adjacent the margin, hammer sections above and below the disk interlocked with the grooves, and means for securing said hammer sections to the disk.

5. In a grinding mill the combination with a casing having a circular lining of grinding material, of a shaft within the casing, a disk carried by the shaft, grooves in the faces of the disk adjacent the margin, hammer sections above and below the disk interlocked with the grooves, and means for securing said hammer sections to the disk, said hammer sections having toothed outer faces and inclined lateral faces, for the purpose described.

6. In a grinding mill the combination with a casing having an inner cylindrical lining, of a shaft, a disk on the shaft, a series of grinding blocks on the periphery of the disk, said blocks having inclined faces at their ends, hammer sections above and below the disk having inclined faces adapted to engage the inclined surfaces of the blocks, and means for clamping the hammer sections and blocks removably to the disk.

7. In a grinding mill a vertically arranged cylindrical shell having outwardly and downwardly stepped compartments of increasing diameter, inwardly projecting annular plates having grinding surfaces located above and below each of said compartments and forming upper and lower grinding surfaces therefor, a central shaft, a disk carried by said shaft in each of said compartments, and hammer sections above and below said disk to cooperate respectively with the upper and lower annular grinding surfaces in the compartment.

8. In a grinding mill, the combination with a casing provided with an interior grinding surface, of a rotatable element within said casing having a series of peripherally disposed ribbed portions thereon, said ribbed portions being recessed on one side of said element at spaced peripheral points, and hammers seated in said recesses and extending laterally of said element, said hammers being ribbed on the outer surface thereof to conform with said ribbed portions to provide a continuous ribbed peripheral surface on said element.

9. In a grinding mill, the combination with a casing provided with an interior grinding surface, of a rotatable element within said casing, a plurality of segmental ribbed elements secured to said first named element peripherally thereof, said elements being recessed at their adjacent ends on either side of said first named element, hammers seated in said recesses and projecting laterally of said first named element on opposite sides thereof, said hammers being ribbed on the outer surface thereof to conform with said ribbed portions to provide a continuous ribbed peripheral surface on said first named element.

10. In a grinding mill, the combination with a casing, of a vertically disposed rotatable shaft within said casing, a grinding element carried by said shaft and provided with a continuous peripheral grinding surface and with circumferentially spaced radial grinding surfaces above and below the element, said casing having continuous grinding surfaces opposing each of the grinding surfaces on the said element.

11. In a grinding mill, the combination with a casing provided with an interior grinding surface, of a vertically disposed rotatable element within said casing cooperating with the interior grinding surface of said casing for grinding material introduced at the upper end of the casing, a circular chamber disposed beneath said casing for receiving the ground material and having a delivery opening therein, a shaft for supporting said rotatable element and extending through said chamber, a bearing for said shaft disposed beneath said chamber, a thrower plate carried by said shaft between said chamber and bearing for propelling ground material outwardly of said shaft and bearing, and interfitting annular seals immediately adjacent to and on each side of said thrower plate.

In testimony whereof I hereunto affix my signature.

GEORGE F. PETTINOS.