April 3, 1934. A. W. FAHRENWALD 1,953,472

GRINDING MILL

Filed June 30, 1932 2 Sheets-Sheet 1

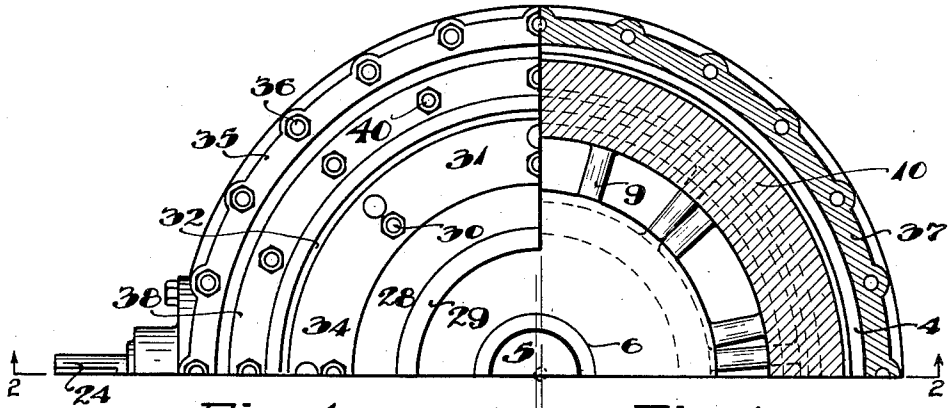


Fig. 1. Fig. 1a.

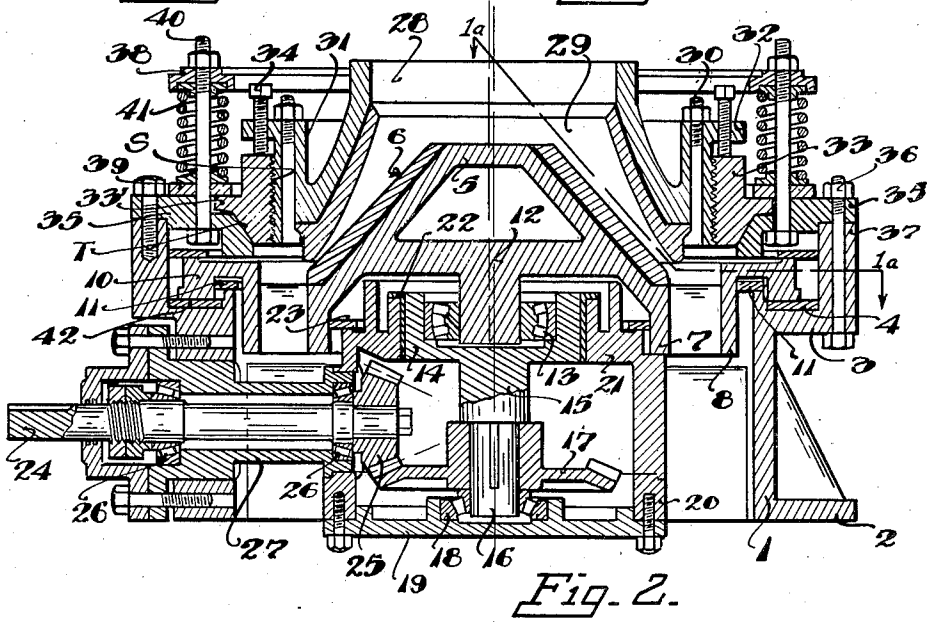


Fig. 2.

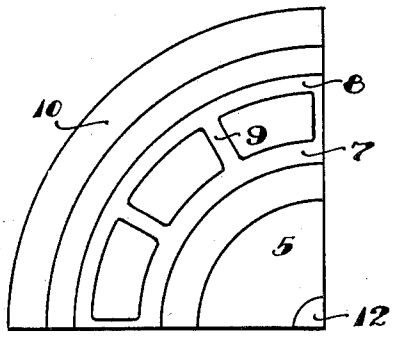


Fig. 4.

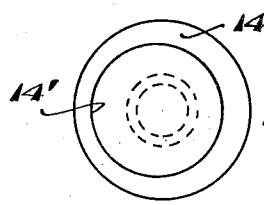


Fig. 3.

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GRINDING MILL

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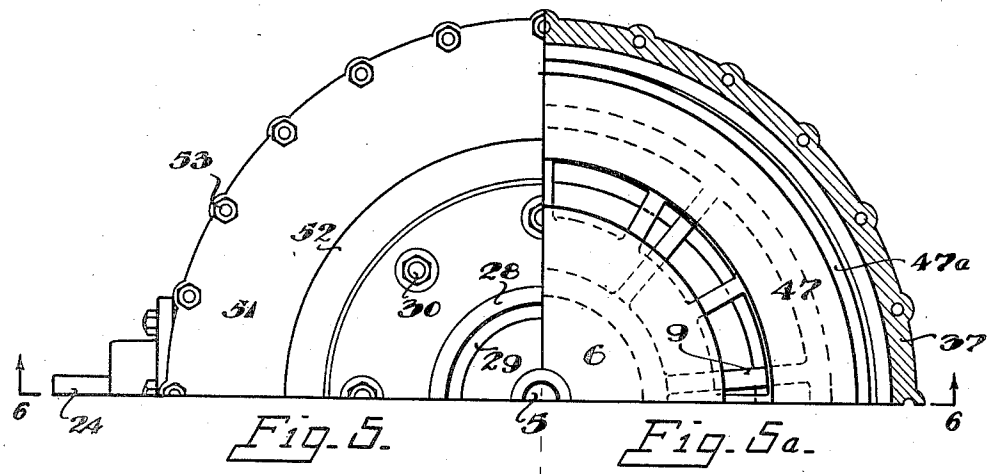


Fig. 5. Fig. 5a.

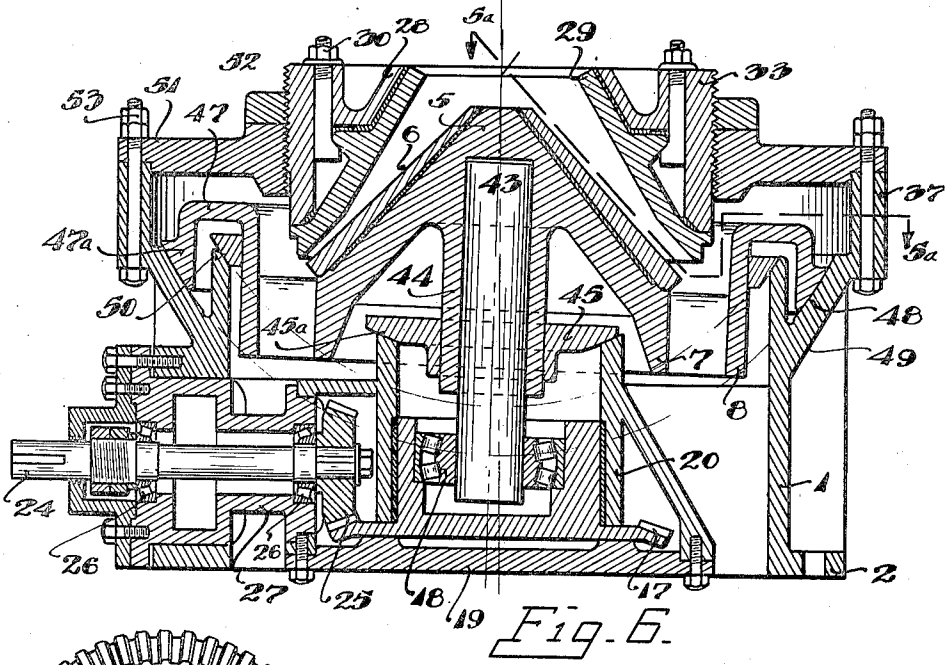


Fig. 6.

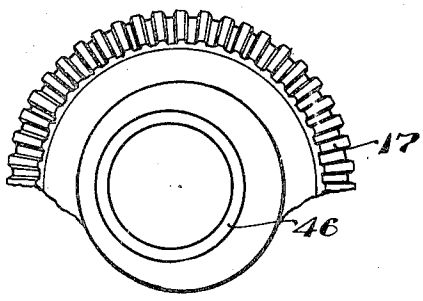


Fig. 7.

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UNITED STATES PATENT OFFICE

1,953,472

GRINDING MILL

Arthur William Fahrenwald, Moscow, Idaho

Application June 30, 1932, Serial No. 620,254

10 Claims. (Cl. 83—10)

My present invention relates to improvements in grinding mills of the compound movement type involving the use of a floating, gyratory head, and an inverted bowl-shaped stationary crushing head. The grinding mill of my invention is designed for use in crushing or grinding ores, as well as rock, and for the latter purpose the machine is compact and comparatively light in weight in order that it may be transported from place to place in the construction of roads, highways, etc. In carrying out my invention I have improved several features in machines of this type in order to secure increased power, strength, and durability, together with the required flexibility in the machine, and to provide for uniformity in standard sizes of the crushed product, with an increased capacity for production.

In addition to the crushing of ores and of rocks, the grinding mill is capable of adjustment and adapted for use in cement plants and similar places where the crushing or grinding reaches the fineness required for powder products.

The invention consists in certain novel combinations and arrangements of parts for accomplishing the above purposes, as will hereinafter be more fully set forth and claimed. In the accompanying drawings I have illustrated one complete example (and a modified form) of the physical embodiment of my invention, wherein the parts are combined and arranged according to modes I have thus far devised for the practical application of the principles of my invention.

Figure 1 is a top plan view of a portion of the grinding mill embodying my invention, and Figure 1*a* is a similar view, in section, as at line 1*a*—1*a* of Figure 2.

Figure 2 is a vertical central sectional view, with some parts in elevation, as at lines 2—2 of Figures 1 and 1*a*.

Figure 3 is a plan view of the eccentric member employed in imparting the gyratory motion to the floating crusher head or muller.

Figure 4 is a plan view of a portion of the crusher head, as seen from below.

Figure 5 is a top plan view of a portion of a slightly modified mill involving my invention, and Figure 5*a* is a plan view of a portion of the crushing head with part of the supporting base in section as at line 5*a*—5*a* in Figure 6.

Figure 6 is a vertical, central section, with parts in elevation, of the modified mill.

Figure 7 is a plan view of a portion of the eccentric member employed in imparting the gyratory movement to the crushing head.

In the form of the mill illustrated in Figure 2 where the gyratory crushing head follows a cylindrical crushing path, the machine is supported on a circular or cylindrical base 1 with an attaching or supporting flange 2 by means of which the mill is appropriately mounted upon a suitable foundation. The circular base is fashioned with an elevated, exterior, horizontal flange 3 which performs the functions of a bearing-ring, and a renewable wear ring 4 is located on the bearing ring, the wear ring, of course, being renewable after wear.

The cone shaped muller, or hollow, gyratory crushing head 5 is centrally supported in the machine and fashioned with an exterior wear shell or liners 6. At the base of the head an inner, circular flange 7 is fashioned, and an outer, concentric flange 8 is spaced from the inner flange and joined thereto by integral webs or spokes 9 to provide discharge spaces for the product of the mill, and this material falls by gravity into a suitable receptacle below the circular base 1.

At the exterior periphery of and laterally of the lower portion of the gyratory crusher head, an integral annular flange or bearing ring 10 is fashioned, complementary to the wear ring 4 and bearing ring 3 of the machine base, and the crusher head, in its gyration, has a "floating" support through the bearing ring on the wear ring, as the crusher head follows a cylindrical path over the wear ring.

The bearing ring 10 travels through an oil chamber in which the wear ring is located, and an interior dust ring 11 is interposed between the rotary head and the circular base to exclude dust from the oil chamber and to prevent escape of oil from the chamber.

The crusher head is centrally engaged by the pin 12 integral therewith and projecting downwardly from its base, and this pin is provided with a lateral anti-friction bearing 13 that is supported in an eccentrically located recess in the bearing cup 14. As best seen in Figure 3 the inner circular wall 14' of the cup is eccentric to the center of the machine or mill, while the outer wall or periphery of the cup is concentric with the center of the mill, and on the lower face of the cup a stub shaft 15 and its extension 16 are axially alined with the center of the mill.

On the extension 16 of the eccentric member, a horizontally disposed gear 17 is keyed, and below the gear, at the end of the shaft-extension, a lateral anti-friction bearing 18 for the shaft is stepped in the bottom plate 19. This plate is circular in shape and is bolted on the lower edge of an annular flange 20 integral with the base ring

1, but spaced within the ring to provide discharge space for the ground material as it falls through the discharge spaces of the rotary head.

At its upper edge the annular flange 20 is fashioned with a horizontal inner flange 21 which forms a bearing ring for the eccentric, rotary member, a wear ring 22 being interposed between the stationary bearing ring 21 and the bearing head or cup 14. The bearing 13 is also lubricated in oil, and a dust ring 23 is interposed between the bearing head 21 and the flange 7 of the crusher head to exclude dust from the oiled bearing.

Rotary motion is imparted to the eccentric bearing head 14 through the gear 17 and a complementary pinion 25 on the horizontally disposed drive shaft 24 that is journaled in bearings 26 of a housing 27 that is suitably supported in the base ring 1 of the mill, and the shaft 24 receives power through suitable transmission mechanism.

The stationary crushing member, complementary to the gyrating crusher head 5 comprises an inverted bowl-shaped, adjustable head 28 which forms the feed hopper for the mill and is provided with an inner wear shell or lining 29, and disposed with relation to the head 5 to form the usual throat and mouth of the mill through which the material passes from the hopper. The head 5, in the form of a truncated cone, uniformly and equally distributes the material as it is fed through the hopper and then crushed between the movable and the stationary crushing heads.

The liner or wear-shell 29 of the stationary head is secured by bolts 30 in the screw ring 31 of the upper head, and this screw ring is fashioned with an annular, exterior flange 32 located just above the annular head-holder 33, the flange 33′ and holder being threaded as at S, and the holder and flange are relatively fixed by the use of set bolts 34 threaded in the flange 32 and impinging against the top or upper edge of the holder.

The holder is fashioned with an exterior, tapered, or conical face T that is seated against a complementary tapered face of the supporting ring 35, and the latter is secured by bolts 36 on the upper, circular edge of the supporting flange 37 of the base 1.

To provide a resilient resistance for the upper head of the crusher, with relation to the lower head 5, as for the purpose of accommodating unusually hard objects, I utilize two horizontally disposed, vertically spaced rings 38 and 39 arranged concentrically about the upper head, and with the lower face of the lower ring normally resting upon the upper faces of the flange 33′ of the holder and the supporting ring 35. Bolts 40 are passed through the spaced rings and the supporting ring 35, and springs 41 which are coiled about these bolts are interposed between the two spaced rings.

Thus, it will be apparent that the head 28 is threaded at S into the holder to the adjusted position and there locked by turning the set bolts 34, and the holder, which rests upon the tapered or conical seat T, together with the upper crusher head, may be lifted against the tension of the springs 41, which tension is applied against the upper, fixed ring 38 of the resilient presser for the head.

Additional packing or dust rings, as 42 are employed to exclude dust, and to prevent escape of oil.

From the above description taken in connection with my drawings it will be apparent that the gyrating crusher head with its widely distributed bearing surface, of comparatively large diameter, on the wear ring 4, "floats", or rides smoothly in a horizontal path of cylindrical shape, and this bearing or support for the gyrating head is located exterior of the discharge passages for the ground material. The plane surface of the wear ring 4 forms a cylindrical path for the muller or gyrating head, and the crushing distance or space between the heads is uniform at both the mouth and throat of the mill. The immersion of the operating parts in a bath or pool of oil, from which the dust is excluded by the dust rings, insures durability, and a smooth operation of the parts.

The speed of oscillation or gyration of the truncated-cone shaped crusher head 5 may range from 500 to 600 revolutions per minute for small machines or mills, to 250 to 350 revolutions per minute for largar machines, and the sizes of the machine or mill may vary within a wide range because of the construction whereby the gyrating crusher head is mounted with a floating effect and carried on the main or base frame 1 as a support. The angularity of the periphery of the conical muller may vary with the nature of the grinding or crushing to be effected, and the mill is adapted for both wet and dry crushing operations.

In the modified form of the invention as disclosed in Figure 6, the center of the eccentric bearing for the gyrating crusher head is in the arc of a circle scribed by the radius of the gyration, instead of having the center of the eccentric bearing substantially in the plane of the large bearing ring or wear ring 4, as in Figure 2, and in both instances the arangement is such as to avoid possibility of the muller or gyrating head to tip or tilt.

In Figure 6 and the related figures of the drawing, instead of an integral pin 12 of Figure 2 I employ a gudgeon or spindle 43 for the gyrating head 5, and the gudgeon is mounted in a sleeve 44, which is provided with a dust cap 45 having an annular, spherical face 45*a* in frictional contact with the complementary upper face of the inner annular flange 20 of the main casting or circular base 1. The lateral bearings 18 for the gudgeon are set in an eccentric cup 46, and the gear 17, which is driven from the pinion 25 is integral with the cup.

The gyrating head 5 is fashioned with the inner and outer, spaced, vertical flanges 7 and 8, and in addition, the head is fashioned with a horizontal exterior flange 47 that terminates in an annular, concentric flange 47*a* having an annular, spherical face 48 that has its bearing against a complementary spherical bearing face of the conical shaped bearing flange or supporting flange 49 that is fashioned integrally with the base ring 1.

The bearing flange 47*a* also travels in an oil pool or bath, and a dust ring 50, having a spherical face engages the upper edge of the base ring 1. The upper edge of the base ring is provided with a spherical face complementary to the face of the ring 50, and this ring excludes dust from the oil chamber of the bearing parts.

The head holder 33 is threaded into the head ring 51, and locked by the lock nut 52, and the head ring is rigidly bolted, as at 53 to the supporting ring 37 of the base ring or main frame 1.

In Figure 6 the center of the gyratory movement is at the point where the apex of the trun-

cated cone muller occurs, and the several spherical bearings described are on arcs of circles scribed from this center.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a grinding mill, the combination with a crusher head having a laterally extending bearing ring and discharge passages between the ring and the head, a mill base, and a bearing-support rigid with the mill base for said bearing ring.

2. In a grinding mill, the combination with a gyratory cone-shaped crusher-head having a laterally extending bearing ring at the base of the head and discharge passages between the ring and the head, and a bearing-support for said bearing ring.

3. In a grinding mill, the combination with a gyratory cone-shaped crusher-head having a laterally extending bearing ring at the base of the head and discharge passages betwen the head and ring, a bearing-support for the bearing ring, driving means, and eccentrically operating transmission means between said driving means and said head.

4. In a grinding mill, the combination with a gyratory, cone-shaped crusher-head having a laterally extending bearing ring and discharge passages between the head and ring, of a bearing-support for the ring, a center-pin rigid with the head, a driven shaft and bearings therefor, and an eccentric power-transmission connection between said shaft and pin.

5. In a grinding mill, the combination with a gyratory crusher-head having a laterally extending bearing ring and discharge passages between the ring and head, of a bearing-support for the ring, an integral center pin on the head, an alined driven shaft beneath the pin, a bearing head on the shaft having an eccentric recess surrounding the pin, an anti-friction bearing within said recess between the pin and head, and a bearing support for the lower end of the driven shaft.

6. A crusher-head for use in grinding mills having a laterally extending bearing-ring and a series of discharge openings between said head and ring, and a rigid center-pin at the underside of the head.

7. A cone-shaped crusher head for use in grinding mills having a bearing ring extending laterally of its base, a series of spokes connecting the head and ring and forming discharge passages between said head and ring, and a rigid center-pin at the underside of the head.

8. A cone shaped crusher-head for use in grinding mills having an exterior bearing-ring at its base, a pair of spaced annular flanges between the ring and the head, and a series of spokes connecting said flanges and forming spaced discharge openings.

9. In a grinding machine of the compound movement type, the combination with a cone-shaped, gyratory crusher-head and a mill base, and means for operating said head, of a supporting member on the base, a laterally extending bearing-ring on the head co-acting with said supporting member, there being an annular series of discharge openings between the head and the bearing-ring, a stationary ring above the bearing ring and rigid with base and forming a holder, an inverted bowl-shaped head complementary to the gyratory head and seated in said holder, and resilient means supported on the holder to provide resistance for the bowl-shaped head.

10. The combination in a grinding mill with a mill base having a bearing-support, of a gyratory crusher-head having an exterior bearing-ring on said support and means for operating said head, a supporting ring rigid with the bearing-support and located above the bearing ring, a head-holder seated in said supporting ring, a bowl-shaped head and means for adjusting said head in the holder, a series of bolts rigid with supporting ring, a lower resistance ring on said bolts engaging the top faces of the supporting ring and holder, an upper resistance ring on the bolts, and a series of springs coiled about the bolts and interposed between said resistance rings.

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