May 29, 1934. H. H. RUMPEL 1,960,980

CRUSHER

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Fig. 1.

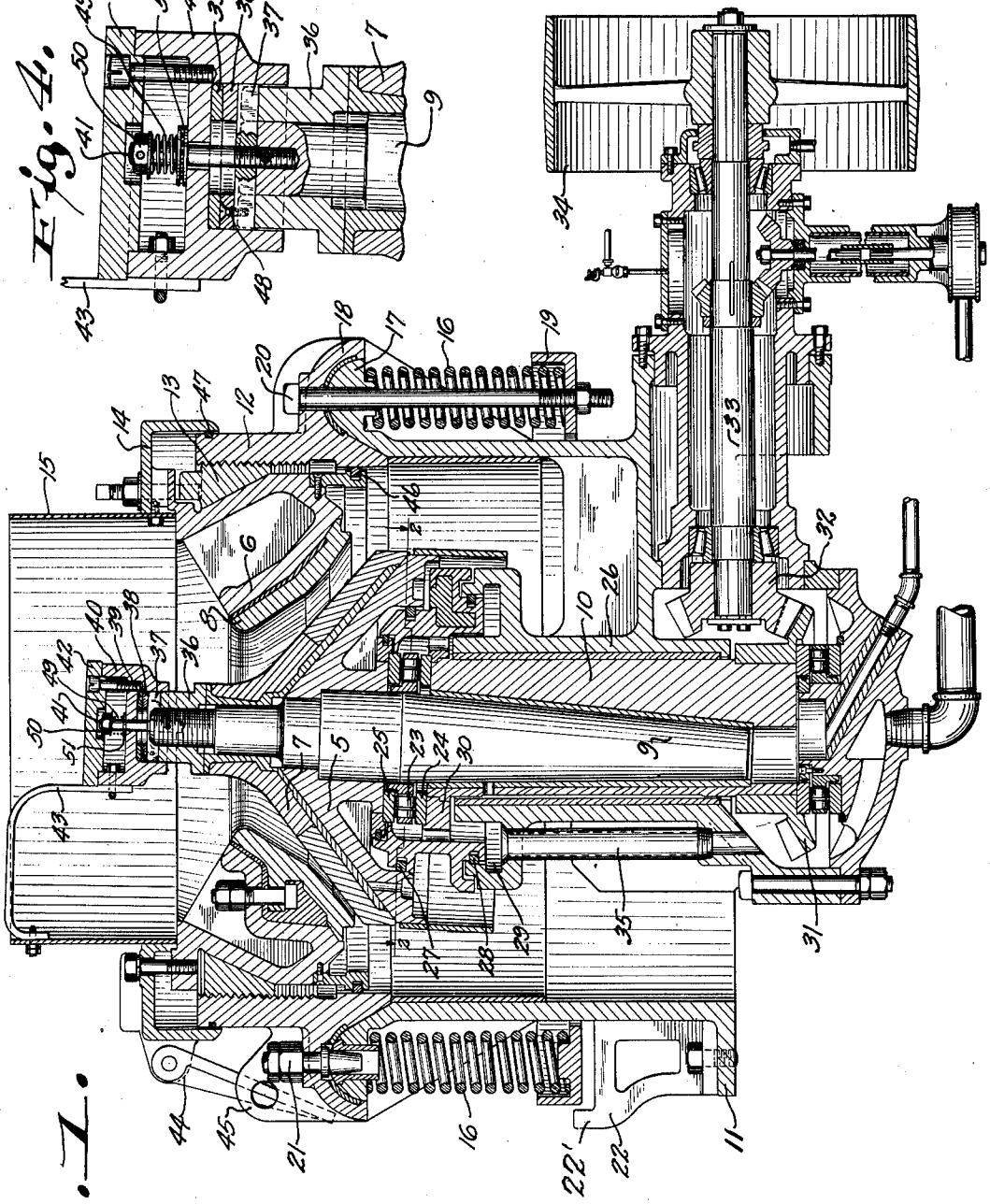


Fig. 2.

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Fig. 2.

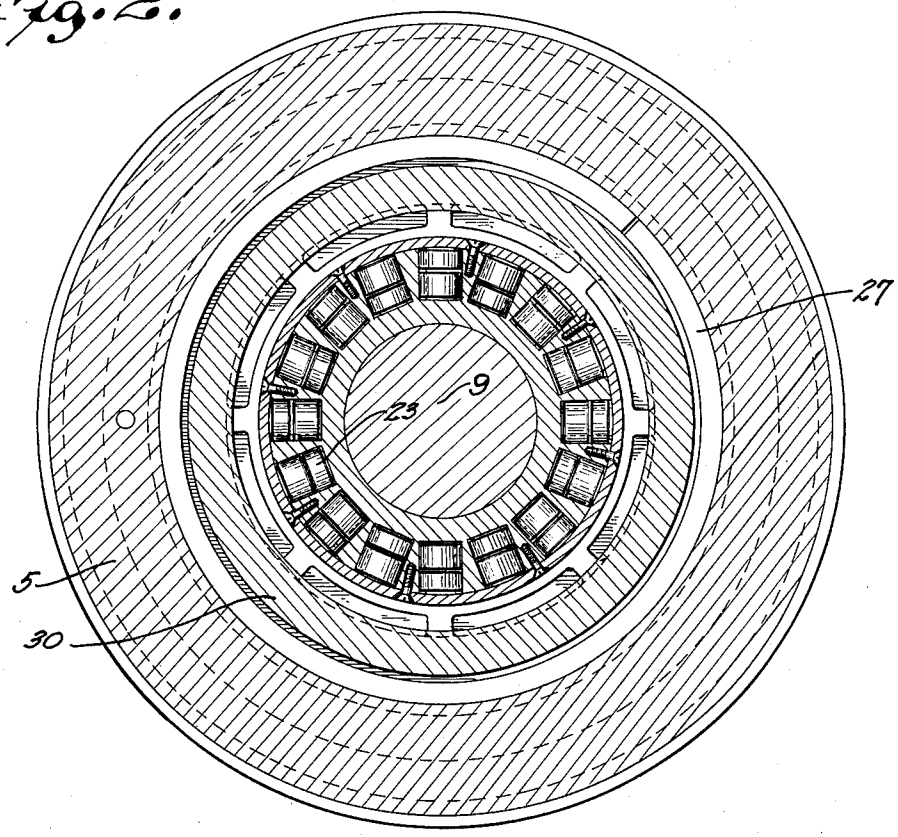
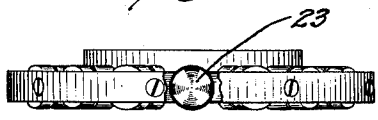


Fig. 3.



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1,960,980

CRUSHER

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Application July 21, 1930, Serial No. 469,428

12 Claims. (Cl. 83—10)

The present invention relates in general to improvements in the art of crushing, and relates more specifically to improvements in the construction and operation of rock crushers of the type wherein the material is reduced by the periodic approach of two relatively moving crushing members.

An object of the invention is to provide improved means for protecting the actuating and adjusting mechanisms of a crusher, against ingress of dust and dirt, in order to prolong the life of these mechanisms and to retain the crusher in most efficient operating condition. Another object of the invention is to provide an improved dust seal for preventing entry of dust to and escape of oil from the actuating mechanism of a crusher, and especially a crusher of the gyratory or jaw type. A further object of the invention is to provide improved means for protecting the adjusting mechanism for affecting variation in the size of the product produced by a crusher, against entry of dust thereto, thereby maintaining such mechanism in condition for rapid and effective actuation at all times. Still another object of the invention is to provide simple and efficient means for eliminating friction losses in crusher structures of the rotary or gyratory type, while preventing undesirable free rotation or spinning of one of the crushing members relative to a coacting member when the crusher is operating empty. A further object of the invention is to provide improved mechanism for protecting a crusher structure against damage due to accidental delivery of a piece of steel or the like to the crushing chamber, and means for permitting convenient assembly and dismantling of the crusher without interference by such protecting mechanism. Still another object of the invention is to provide various improvements in the details of construction of crushers of the gyratory type, whereby the efficiency of operation thereof is enhanced to a maximum, and the cost of manufacture and operation is reduced to a minimum. These and other objects and advantages will appear from the following description.

Some of the novel features of crusher construction, disclosed but not specifically claimed herein, form the subject of co-pending applications Serial No. 306,381, filed September 17, 1928; Serial No. 311,346, filed October 9, 1928; Serial No. 313,460, filed October 19, 1928; and Serial No. 358,579, filed April 27, 1929.

A clear conception of an embodiment of the several features of the present improvement and of the mode of constructing and of operating mechanisms built in accordance therewith, may be had by referring to the drawings accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views.

Fig. 1 is a central vertical section through a cone type of gyratory crusher embodying the present invention.

Fig. 2 is an enlarged transverse horizontal section through the thrust bearing, positioning member, and inner crushing member of the gyratory crusher, the section being taken along the line 2—2 of Fig. 1.

Fig. 3 is a similarly enlarged side view of the anti-friction thrust bearing for the inner crushing member, a part of the structure having been broken away in order to clearly illustrate the construction.

Fig. 4 is an enlarged fragmentary central vertical section through the mechanism for retarding free rotation of the inner crushing member when the crusher is operating empty.

While the various improvements have been illustrated herein as being specifically applied to a cone type of gyratory crusher, the novel features are obviously capable of more general application, and the specific disclosure should not be considered as an intent to limit the scope of the invention. The improved cone type of gyratory crusher specifically shown in the drawing comprises in general inner and outer crushing members 5, 6 respectively, cooperating to form an annular crushing chamber, and means for relatively gyrating the members 5, 6 to crush material as it advances downwardly and outwardly through the crushing chamber.

The inner crushing member or head 5 is rigidly attached to an actuating shaft 9, and is provided with a protective mantle 7 which is clamped upon the upper tapered surface of the head 5 by means of a lock nut 36 and a key 37 disposed within a transverse recess formed in the nut and in the end of the shaft 9. The head 5 rests upon an annular anti-friction or roller thrust bearing comprising a series of radiating rollers 23 and races 24, 25 coacting therewith, and is gyratable about the central vertical axis of the crusher by means of an eccentric 10 rotatably supported in a stationary central guide bearing in the frame portion 26 and upon a roller thrust bearing supported upon a cap secured to the frame portion 26. A head supporting and positioning member 30 is carried by and is rotatable with the eccentric 10, the head 5 being freely rotatable upon the roller thrust

bearing carried by this member, and the peripheral lower portion of the head 5 being provided with an annular apron formed to shield the rotary member 30 from the product being discharged by gravity from the crushing chamber. The eccentric 10 is rotatable by means of a bevel gear 31 meshing with a pinion 32 secured to a horizontal driving shaft 33 which is mounted upon roller bearings carried by a detachable support secured to the main frame 11, and having its outer overhanging end provided with a driving pulley 34. While the member 30 in the specific embodiment of the invention shown herein, functions as a supporting and positioning member for the head 5, it is not essential that the member 30 perform such supporting and positioning function since it will be obvious that this member 30 might readily be associated with the eccentric without performing such function.

The rotary positioning member 30 is provided with vertically spaced peripheral grooves the lower of which is formed concentric with the crusher axis, and the upper of which is formed concentric with the axis of the head supporting shaft 9. Due to the relative inclination of these axes, the planes of these grooves are likewise relatively inclined, and while such relative inclination is not necessary, these grooves will in all cases be disposed eccentrically with respect to each other when applied to a gyratory crusher structure. Slidably disposed within the lower and upper eccentric grooves, are expansible sealing rings 28, 27 respectively, which have cylindrical peripheral surfaces snugly fitting adjacent surfaces of the frame portion 26 and of the head 5 respectively. An annular oil collecting pocket 29 may be formed in the frame portion 26 adjoining the lower ring 28, beyond the adjacent peripheral portion of the rotary member 30, in order to conduct the oil delivered from the rotating member 30 by centrifugal force past the lower seal and to an adjoining drain 35. The lower and upper seal rings 28, 27 serve to seal the joints between the ends of the rotary member 30 and the adjacent elements which are not positively rotated, against entry of dust to the bearing surfaces and also against escape of oil from the lubricating system. If so desired, a second similar seal ring may be provided as shown in Fig. 1 between the lower portion of the head 5 and an integral cylindrical surface of the member 30, directly above the roller thrust bearing, but this second seal ring is not necessary.

While the head 5 is not positively rotatable, it is desirable to permit this head to rotate relatively to the eccentric 10 under the crushing action, but due to the use of an anti-friction thrust bearing for the head 5, this head might tend to spin with the rotary member 30 when no material is being crushed. Such spinning or free rotation of the head 5 may in some cases be undesirable, and is effectively eliminated by means of the structure shown in Figs. 1 and 4. An element 40 loosely fitted over the upper end of the lock nut 36, is attached to any fixed portion of the crusher structure such as the feed chute 15, by means of a flexible cable 43 or the like, in order to avoid interfering with gyration of the head 5. The element 40 engages a floating friction plate 39 which rests upon a lower friction plate 38 secured to the locking key 37 by means of screws 48. A coil spring 49 reacts between a nut 50 carried by the upper extremity of a stud 41 the lower end of which is attached to the shaft 9, and a ball bearing 51 carried by the element 40. The nut 50 is normally housed within a pocket in the element 40 by means of a closure plate 42 which may be removed to permit manipulation of the nut 50 for variation in tension of the spring 49. The assemblage of elements is obviously such that when the nut 50 has been properly adjusted the spring 49 will urge the element 40 downwardly against the floating friction plate 39 which in turn coacts with the plate 38 secured to the key 37, in a manner to retard the free rotation of the head 5 and shaft 9, thereby preventing spinning of the head 5 when the crusher is operating empty.

The outer annular crushing member or concave 6 is provided with a detachable protective liner 8 and is adjustably supported upon the main frame 11 by means of a supporting and positioning member or ring 12 the interior of which has screw thread coaction with an annular adjusting wedge 13. The concave 8 is carried directly by a ring cap 14 having jack screws coacting with the concave and with the adjusting wedge, the construction being such that when the wedge 13 is moved along the screw threads of the supporting ring 12, the concave 6 is raised or lowered relative to the head 5, thereby varying the size of the crusher discharge opening. The annular adjusting wedge 13 may be protected against entry of dust and dirt by means of lower and upper seal rings similar to those provided for protecting the head and eccentric bearings. The lower expansible ring 46 is slidable within a recess in a lower extension of the concave 6 and coacts with an adjacent cylindrical surface of the ring 12. The upper expansible ring 47 is slidable within a recess in the upper outer portion of the supporting ring 12, and coacts with an adjacent cylindrical surface of the ring cap 14. The expansible rings 46, 47 thus provide seals below and above the adjusting wedge 13, these seals being effective to prevent entry of dirt to the concealed adjusting wedge irrespective of the position of adjustment thereof.

An annular feed chute 15 secured to the ring cap 14 and resting upon the concave 6, serves to conduct the raw material into the upper end of the crushing chamber. The ring cap 14 may also be provided with one or more latch elements 44 cooperating with lugs 45 formed integral with the ring 12 so as to prevent the wedge 13 and the elements associated therewith from moving relative to the ring 12 while the crusher is in operation, while permitting convenient assembly, dismantling and adjustment of the parts. The lower portion of the positioning ring 12 is provided with an integral annular outwardly extending flange 18 having a recess therein coacting with an annular integral abutment 17 of the main frame 11, the flange 18 being normally retained in intimate contact with the abutment 17 by means of a series of compression springs 16 which react between the abutment 17 and a ring 19, the latter of which is connected with the flange 18 by means of bolts 20. The positioning ring 12 may also be provided with retaining pins 21 coacting with openings in the abutment 17 to prevent relative lateral displacement of the ring 12 upon the frame 11. Located directly beneath the reaction ring 19 and secured to the frame 11, is a series of stops 22 which serve to permit release of the retaining bolts 20 without materially decreasing the initial tension to which the springs 16 are subjected. The stops 22 besides maintaining the springs 16 under initial tension upon release of the bolts 20, also function to retain the entire group of springs in assembled relationship, by virtue of the engage-

ment of the lugs 22' with the periphery of the ring 19. It will be apparent that upon release of the bolts 20 the concave 6, wedge 13, ring cap 14 and ring 12 are freely vertically removable, thereby permitting free upward removal of the head 5 and its supporting shaft 9.

During normal operation of the crusher, the head 5 is being gyrated by means of the eccentric 10 to which rotation is imparted from the pulley 34 through the shaft 33 and gears 32, 31. The eccentric guide bearing formed in the frame portion 26, is being constantly supplied with lubricating oil through suitable passages formed in the eccentric, and oil is thus being supplied to the anti-friction or lower thrust bearing of the head 5. The oil discharged from this thrust bearing flows by gravity along the interior of the rotary head positioning member 30 and is eventually delivered to the annular oil pocket 29 from which the oil flows by gravity to the lower portion of the crusher and is finally discharged. The material admitted through the feed chute 15 to the crushing chamber is rapidly reduced, and is eventually delivered from the discharge opening leading from the crushing chamber from whence it is discharged from the crusher by gravity.

It is important in a crusher of this type to protect the bearings against entry of dust and other foreign matter, and the seal rings 28, 27, effectively perform this function. These seal rings being of the expansible or spring type, are slidable within the annular recesses of the rotating member 30 and snugly coact with the adjacent cylindrical surfaces of the frame portion 26 and of the head 5 respectively. The seal rings will remain tight irrespective of the wear thereon, and due to the cylindrical and plane formation of the bearing surfaces of the rings, they may be readily fitted to produce tight joints. This is not possible with spherical sealing surfaces such as have heretofore been used.

The seal rings 46, 47 which serve to prevent entry of dust and other foreign matter to the adjusting wedge 13, likewise effectively perform their intended function and may be readily machined to form tight joints. These seal rings 46, 47 will remain tight irrespective of the position of adjustment of the wedge 13, and in no manner interfere with dismantling and assembly of the crusher structure. It may be pointed out that both the rings 27, 28 and the rings 46, 47 serve to seal a joint between relatively movable parts, the rings 27, 28 sealing the joint between the constantly rotating member 30 and the adjacent elements, and the seal rings 46, 47 sealing the joint between the adjustably movable concave 6 and the relatively stationary ring 12.

The mechanism illustrated in Fig. 4 serves to prevent free rotation or spinning of the head 5 when the crusher is operating empty, without preventing rotation of the head 5 during normal operation of the crusher. This mechanism therefore obviates undesirable spinning of the head 5 due to the use of an anti-friction thrust bearing for the head, and the cable 43 by virtue of its flexibility does not interfere with the normal gyration of the head 5 by the eccentric 10. While the cable 43 is shown as being attached to the chute 15, it will be apparent that this cable may be attached to any normally stationary part of the crusher structure. This cable furthermore does not interfere with the adjustment of the crusher discharge opening by the wedge 13.

In order to prevent the springs 16 from functioning during normal operation of the crusher, these springs should be placed under an initial tension sufficient to prevent the concave 6 from moving upwardly during normal crushing. The single ring 19 against which all of the springs 16 react, cooperating with the bolts 20, serves to retain the springs 16 under such initial tension. In the absence of means for preventing such action, release of the bolts 20 would likewise cause the tension of the springs 16 to be entirely released, but the stops 22 secured to the frame 11 prevent such undesirable complete release of the spring tension, and the stop lugs 22' further prevent lateral displacement of the segments of the ring 19 to such an extent that the grouped assembly of the springs might be destroyed. When the bolts 22 are released, the reaction ring 19 quickly engages the stops 22 and retains the springs 16 under a tension which is only slightly less than that to which the springs are subjected when the assemblage is complete. These stops 22, therefore, facilitate assembly and dismantling of the crusher structure.

The latches 44 cooperating with the lugs 45 of the ring 12 also serve to prevent the adjusting wedge 13 from moving relatively to the ring 12 during normal operation of the crusher. These latches 44, however, do not interfere with dismantling and assembly of the crusher, since the latches may during such operations be lifted away from the lugs 45, thereby permitting unobstructed rotation of the ring cap 14 and of the elements associated therewith relative to the supporting ring 12.

From the foregoing description, it will be apparent that the present invention provides simple and efficient means for protecting the actuating and adjusting mechanisms of a crusher against entry of dust and other foreign matter. It will also be apparent that the mechanism for preventing undesirable spinning of the head enables the use of anti-friction bearings, thereby reducing the power consumption to a minimum. The stops 22 cooperating with the emergency release springs 16 facilitate assembly and dismantling of the crusher structure, and it has been found that these several improved features have greatly added to the efficiency of crusher structures of the gyratory cone type.

It should be understood that it is not desired to limit the invention to the exact details of construction herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In a crusher, inner and outer crushing members cooperating to form a crushing chamber, a normally fixed supporting element for said outer crushing member having a cylindrical inner surface and an outer annular groove, said outer crushing member having a cylindrical inner surface surrounding said element groove and having an outer annular groove surrounded by said inner element surface, a resilient sealing ring slidably engaging each of said grooves and said surrounding cylindrical surfaces, and adjusting mechanism for moving said outer crushing member relative to said inner crushing member to vary the size of said chamber, said mechanism being located between said outer crushing member and said element and between said rings.

2. In a crusher, a frame, an outer crushing member normally fixedly supported by said frame, an inner crushing member cooperating with said outer crushing member to form a crushing cham-

ber, an eccentric journalled in said frame for gyrating said inner crushing member relative to said outer crushing member, said inner crushing member being rotatable relative to said eccentric about an axis which is inclined with respect to the central axis of rotation of said eccentric relative to said frame, a thrust bearing between said inner crushing member and the adjacent end of said eccentric, a housing for said bearing rotatable with said eccentric, a sealing ring between said housing and said frame lying in a plane perpendicular to the central axis of said eccentric, and a sealing ring between said housing and said inner crushing member lying in a plane perpendicular to said inclined axis.

3. In a crusher, a frame, an outer crushing member normally fixedly supported by said frame, an inner crushing member cooperating with said outer crushing member to form a crushing chamber, an eccentric journalled in said frame for gyrating said inner crushing member relative to said outer crushing member, said inner crushing member being rotatable relative to said eccentric about an axis which is inclined with respect to the central axis of rotation of said eccentric relative to said frame, a thrust bearing between said inner crushing member and the adjacent end of said eccentric, a housing for said bearing rotatable with said eccentric, a resilient sealing ring located within an annular groove in said housing and coacting with a cylindrical surface of said frame and lying in a plane perpendicular to the central axis of said eccentric, and a second resilient sealing ring located within an annular groove of said housing and coacting with a cylindrical surface of said inner crushing member and lying in a plane perpendicular to said inclined axis.

4. In a crusher, a frame, an outer crushing member normally fixedly supported by said frame, an inner crushing member cooperating with said outer crushing member to form a crushing chamber, an eccentric rotatable in said frame for gyrating said inner crushing member relative to said outer crushing member, said inner crushing member being rotatable relative to said eccentric about an axis which is inclined with respect to the central axis of rotation of said eccentric relative to said frame, a thrust bearing between said inner crushing member and said eccentric, a housing for said bearing movable with said eccentric, a sealing ring between said housing and said inner crushing member, and a sealing ring between said housing and said frame, said rings lying in planes disposed at an angle relative to eoch other which is equal to the angle of inclination of said axes.

5. In a crusher, a frame, an outer crushing member normally fixedly supported by said frame, an inner crushing member cooperating with said outer crushing member to form a crushing chamber, an eccentric rotatable in said frame for gyrating said inner crushing member relative to said outer crushing member, said inner crushing member being rotatable relative to said eccentric about an axis which is inclined with respect to the central axis of rotation of said eccentric relative to said frame, a thrust bearing between said inner crushing member and said eccentric, a housing for said bearing movable with said eccentric, a sealing ring between said housing and said inner crushing member, and a sealing ring between said housing and said frame, said rings lying in planes disposed at an angle relative to each other which is equal to the angle of inclination of said axes and each of said rings being both slidable along and rotatable within cylindrical surfaces of adjacent parts.

6. In a crusher, inner and outer crushing members cooperating to form a crushing chamber, a stationary frame, an eccentric rotatable in said frame to gyrate said inner crushing member relative to said outer crushing member, said outer crushing member being tiltably supported by said frame, a series of springs having corresponding ends coacting directly with said frame, retaining means coacting with the opposite ends of said springs, a series of bolts cooperating with said retaining means and with said outer crushing member to subject said springs to sufficient pressure to prevent tilting of said outer crushing member during normal crushing, and an abutment cooperable with said retaining means to prevent complete release of the spring tension when said bolts are released.

7. In a crusher, a head, a concave cooperating with said head to form a crushing chamber, an annular normally fixed supporting element for said concave having inner and outer substantially cylindrical surface portions, said concave having inner and outer substantially cylindrical surface portions adjustable therewith and movable along and adjacent to said outer and inner element portions respectively, a sealing ring within said element and interposed between said inner element portion and said outer concave portion, a sealing ring surrounding said element and interposed between said outer element portion and said inner concave portion, and adjusting mechanism for varying the size of said chamber by movement of said concave along said element and relative to said head, said mechanism being located between said concave and said element and between said rings.

8. In a crusher, a frame, an outer crushing member supported by said frame, an inner crushing member cooperating with said outer crushing member to form a crushing chamber, an eccentric journaled in said frame for gyrating said inner member relative to said outer member, said inner member being rotatable relative to said eccentric about an axis which is inclined with respect to the central axis of rotation of said eccentric relative to said frame, a thrust bearing between said inner member and the adjacent portion of said eccentric, a housing for said bearing rotatable with said eccentric, annular sealing means between said housing and said frame, and other annular sealing means between said housing and said inner member, said sealing means cooperating with said inner member, with said housing, and with said frame to enclose said bearing.

9. In a crusher, a concave, a head cooperating with said concave to form a crushing chamber, a normally stationary frame supporting said concave, a rotary eccentric journaled in and supported by said frame for gyrating said head relative to said concave, the entire weight of said head being carried by said eccentric and said head being freely rotatable relative to said eccentric, and a brake associated with said frame and coacting directly with said head to retard rotation thereof with said eccentric when no material is passing through said chamber.

10. In a crusher, a head, a concave cooperating with said head to form a crushing chamber, a frame, an eccentric rotatable in said frame and cooperable with said head to gyrate the latter, said concave being tiltably supported by said

frame, a series of springs having corresponding ends cooperable with said frame and having their opposite corresponding ends cooperable with retaining means to maintain the springs in grouped assembly, a series of tensioning members cooperable with said retaining means and with said concave to subject said springs to pressure sufficient to prevent tilting of said concave during normal pressure, and stops engageable with said retaining means upon release of said tensioning members, said stops coacting with end portions of said retaining means to prevent complete release of the spring tension and with other portions thereof to prevent shifting of the retaining means sufficiently to destroy the grouped assembly of the springs.

11. In a crusher, a frame, a concave supported by said frame, a head cooperating with said concave to form a crushing chamber, an eccentric journaled in said frame and cooperable with said head to gyrate the same relative to said concave, said head being driven by said eccentric and journaled to rotate relative thereto about an axis which is inclined with respect to the central crusher axis, supporting means for said head supported upon the adjacent end of said eccentric, a housing rotatable with said eccentric, annular sealing means between said head and said housing, and other annular sealing means between said housing and said frame.

12. In a crusher, a frame, a concave supported by said frame, a head cooperating with said concave to form a crushing chamber, an eccentric journaled in said frame and cooperable with said head to gyrate the same relative to said concave, said head being driven by said eccentric and journaled to rotate relative thereto about an axis which is inclined with respect to the central crusher axis, a housing rotatable with said eccentric, annular sealing means between said head and said housing, and other annular sealing means between said housing and said frame, said sealing means lying in planes disposed at an angle relative to each other which is equal to the angle of relative inclination of said axes.

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