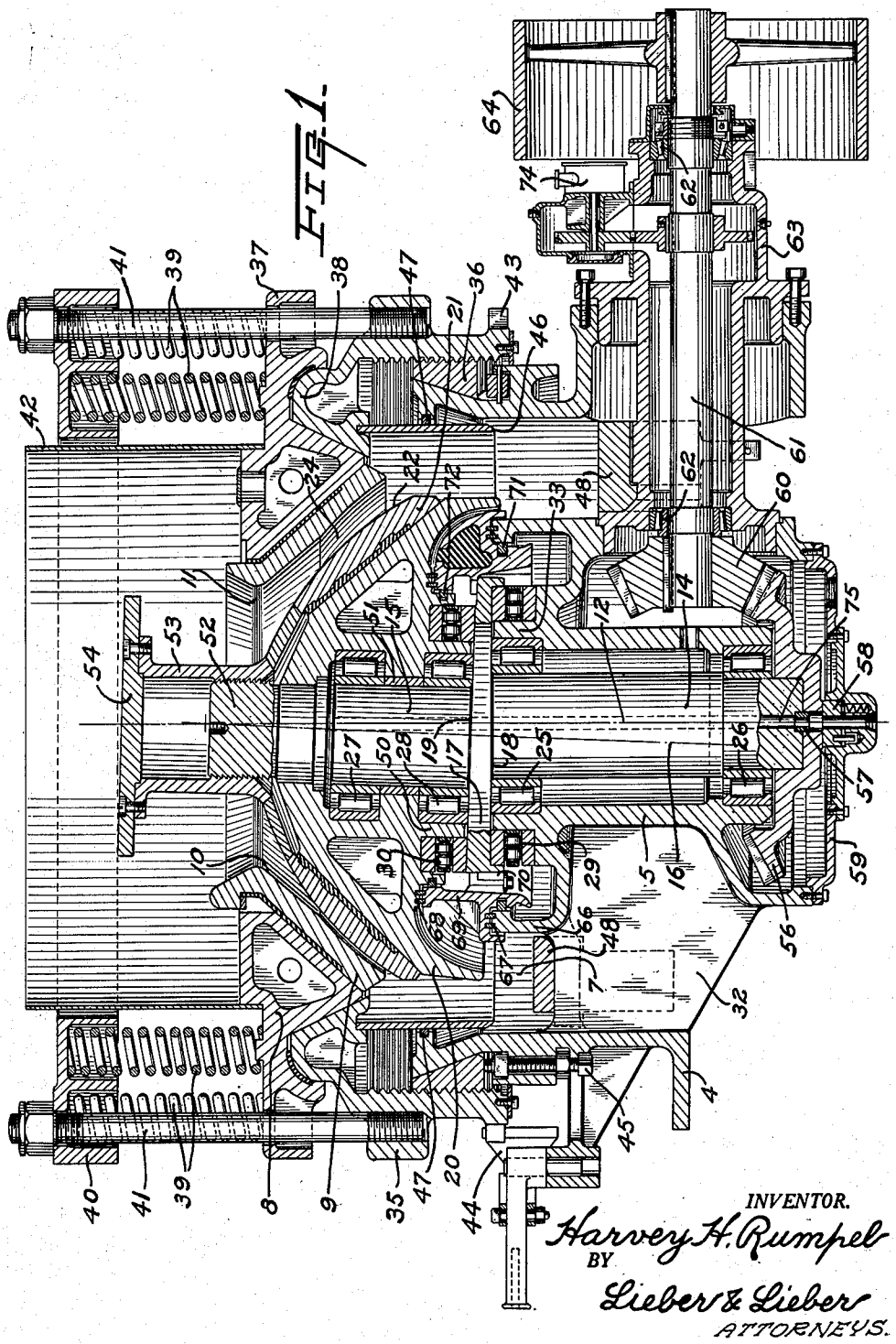
April 7, 1953 H. H. RUMPEL 2,634,061

GYRATORY CRUSHER

Filed Dec. 9, 1949 2 SHEETS—SHEET 1

FIG. 1.



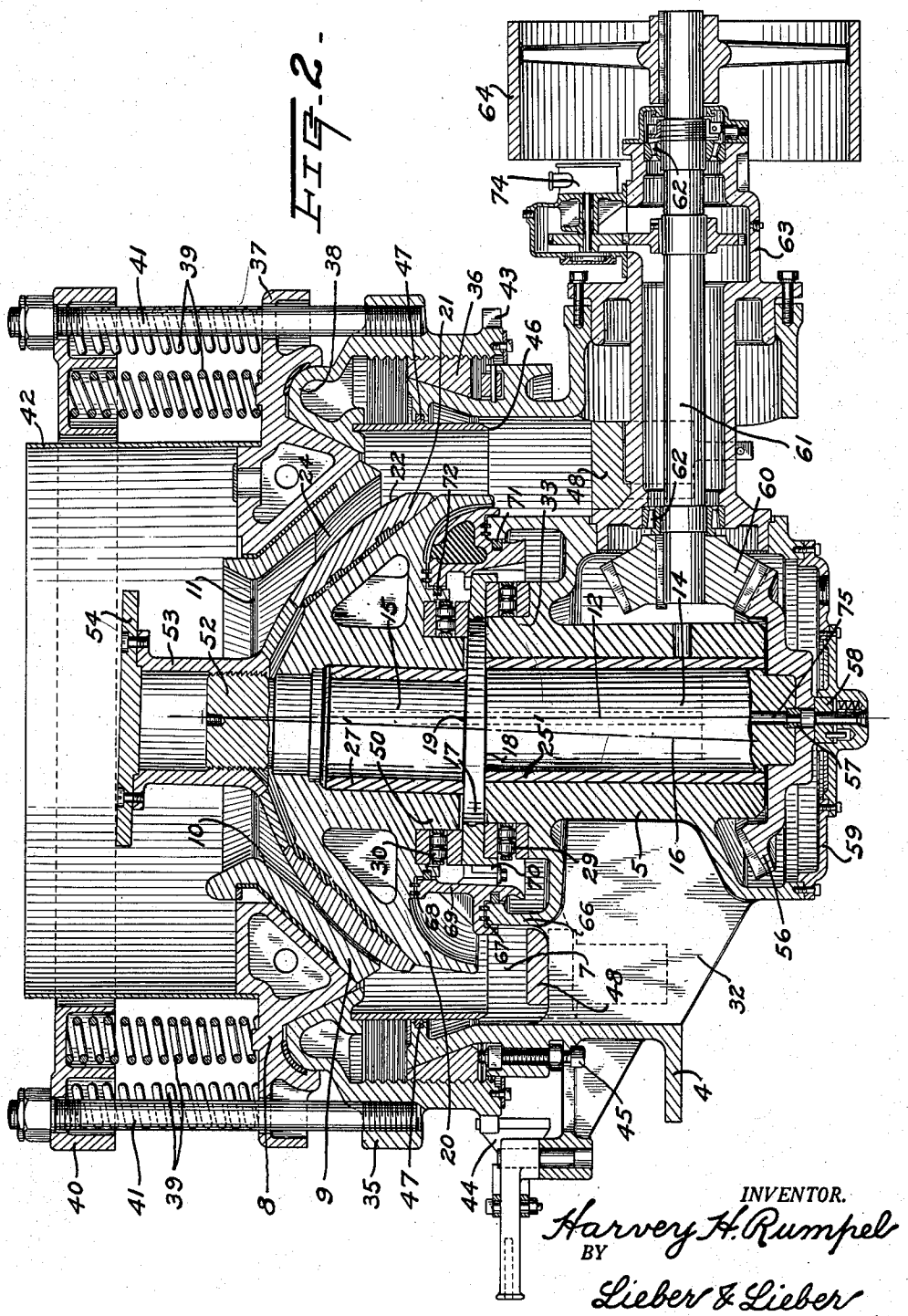
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GYRATORY CRUSHER

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FIG. 2.



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2,634,061

GYRATORY CRUSHER

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My present invention relates in general to improvements in the art of crushing, and relates more particularly to improvements in the construction and operation of gyratory crushers for the reduction of hard materials such as rock, ore, and the like.

The primary object of the present invention is to provide an improved gyratory crusher which is simple and durable in construction, and which is also most efficient in operation.

Gyratory crushers of diverse types have heretofore been utilized extensively for the reduction of rock, ore and like materials, and while some of these crushing units are operable at relatively slow speed and with short crushing strokes, others are operable at higher speeds and with considerably longer strokes so that the latter may therefore be designated as high speed or impact gyratory crushers since they subject the gravitating material to repeated blows. It is a relatively simple matter to provide adequate bearings for the gyrating parts of the slow speed crushers, but far greater difficulty is encountered in connection with the provision of ample and suitable bearings for the corresponding parts of high speed impact machines and which are capable of withstanding the pounding and enormous pressures to which the bearings of such machines are subjected.

In one practical type of these prior high speed impact gyratory crushers, the crushing head is gyrated without the aid of an eccentric sleeve by a rotary shaft having an eccentric upper portion coacting with the freely rotatable head; and in another prior commercial type of the same general class of machines, the head is provided with a depending freely rotatable coaxial shaft and is gyrated by a rotary eccentric sleeve coacting with this shaft. While I have solved the difficulty of providing effective bearings for the latter of these two types of impact crushers as shown and described in Patent No. 2,590,795, granted March 25, 1952, this prior improved bearing assemblage is not well adapted for application to the former of the two types of crushing unit wherein no eccentric sleeve is employed to gyrate the head and in which gyration is effected by a unitary rotary shaft having an eccentric upper portion with which the crushing head coacts.

It is therefore an important object of my present invention to provide an improved bearing assembly for gyratory crushers especially of the high speed sleeveless type, which functions to effectively maintain the crushing head in proper position and to resist the pressures in a most efficient manner.

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Another important object of this invention is to provide improved bearings for most effectively withstanding the radial and axial pressures to which impact gyratory crusher heads are subjected during normal operation, with minimum friction loss and for prolonged periods of use.

A further object of the invention is to provide an improved anti-friction bearing system for impact gyratory crushers, which is simple, compact and durable in structure, and wherein the bearings are located so as to most effectively absorb the shock and pounding action due to crushing.

Still another object of the present invention is to provide an improved gyratory crusher of the type wherein the crushing head is supported entirely from beneath, and in which ample and readily accessible anti-friction bearings are associated with the head and with the gyrating mechanism therefor.

An additional object of my invention is to provide an improved combined axially and radially loaded bearing assemblage for high speed impact gyratory crushing units, wherein a group of bearings for effectively resisting both radial and axial pressures imposed upon the gyratory parts is effectively concealed and protected but is abundantly lubricated while the crusher is operating to reduce material.

A further object of my present invention is to provide an improved gyratory crusher of the type wherein the head is gyrated by means of an upright crank shaft having a rotary lower portion journalled in the crusher frame and also having an upper eccentric portion upon which the crushing head is freely rotatable.

Another object of the invention is to provide various improvements in the construction and operation of gyratory crusher bearings, whereby uniform loading of the bearing surfaces is insured and the cost of construction and maintenance of such bearings is minimized, while the efficiency and life thereof is enhanced.

The above and other objects and advantages of this invention will be apparent from the following description.

A clear conception of the improved bearing assemblage constituting my present improvement, and of the construction and operation of several typical gyratory crushers embodying the same, may be had by referring to the drawings accompanying and forming a part of this specification wherein the same or similar parts are identified by like reference characters.

Fig. 1 is a central vertical section through a typical high speed gyratory crusher embodying

one type of the improved bearings for the gyrating crushing head; and

Fig. 2 is a similar section through a typical high speed gyratory crusher embodying a modified type of crushing head bearing assemblage involving the improvement.

While the invention has been shown and described as being advantageously applicable to high speed, long throw gyratory crushers wherein the gyrating mechanism is gear driven and is disposed and concealed entirely beneath the crushing head, it is not my desire or intent to unnecessarily restrict the utility of the improved features by virtue of this specific embodiment; and it is also contemplated that specific descriptive terms employed herein be given the broadest possible interpretation consistent with the disclosure.

Referring to Fig. 1 of the drawings the improved high speed gyratory reduction crusher illustrated therein comprises in general, a sturdy main frame 4 having a rigid annular hollow central upright hub 5 surrounded by a crushed material delivery space 7; an annular crushing concave 8 carried by the frame 4 above the hub 5 and having a renewable liner 9 provided with an annular lower crushing surface 10 and with a central material supply opening 11 disposed coaxial with the central vertical axis 12 of the frame hub 5; a unitary or one-piece rotary shaft having a lower portion 14 located coaxially of the axis 12 within the hub 5 and also having an upper eccentric portion 15 the axis 16 of which is disposed at an angle relative to and intersects the hub axis 12, the two shaft portions 14, 15 being separated by an integral flange 17 having lower and upper surfaces 18, 19 disposed perpendicular to the axes 12, 16 respectively; a crushing head 20 freely rotatable about the upper shaft portion 15 above the flange 17 and having a renewable annular mantle 21 provided with an upper crushing surface 22 cooperating with the lower concave surface 10 to provide an annular downwardly and outwardly flaring crushing zone or chamber 24; upper and lower radially loaded anti-friction bearings 25, 26 interposed between the hub 5 and the lower upright shaft portion 14; similar radially loaded upper and lower anti-friction bearings 27, 28 interposed between the head 20 and the upper inclined shaft portion 15; lower and upper axially loaded thrust bearings 29, 30 interposed respectively between the flange surface 18 and hub 5 and between the flange surface 19 and head 20; and mechanism for rotating the shaft to gyrate the crushing head 20 relative to the normally stationary concave 8.

The central hub 5 is integrally united with the outer main frame 4 by means of sturdy ribs 32 which span the discharge space 7, and the upper end of the hub 5 is provided with an integral annular upper extension 33 within which the radially loaded bearing 25 is confined, and which is also embraced by the thrust bearing 29 which coacts with the lower surface 18 of the flange 17. The upper crushing member or concave 8 is tiltably mounted upon a vertically adjustable supporting ring 35 which is adapted to be locked to the frame 4 by means of an annular split wedge 36, and the concave is provided with an integral peripheral flange 37 which is normally held firmly against an annular ridge 38 formed on the ring 35, by means of one or more annular series of compression springs 39. The lower ends of these springs 39 press against the concave flange 37 while their upper ends react against an annular spring retainer 40 which is connected to the supporting ring 35 by studs 41, and a feed hopper 42 which communicates with the inlet opening 11 is mounted upon the concave 8 within the retainer 40. During normal crushing operation, the springs 39 will hold the concave flange 37 in snug engagement with the supporting ring 35, but under abnormal conditions of operation the concave 8 may tilt upon or move bodily away from the ring 35 so as to prevent damaging excessively stressed crusher parts.

The lower portion of the concave supporting ring 35 is internally screw threaded for coaction with threads formed on the split wedge 36, and the exterior of the ring 35 is provided with an annular series of teeth or lugs 43 with which a ratchet 44 is cooperable. This ratchet 44 is operable to revolve the ring 35 about the wedge 36 in order to raise or lower the concave 8 and to thereby vary the vertical width of the crushing zone 24, and when proper adjustment of the ring 35 has been effected it may be locked in position by means of a series of jack screws 45 carried by the main frame 4 and coacting with the bottom of the split wedge 36. This adjusting mechanism for the concave 8 is concealed and protected against damage from material discharged at the lower end of the crushing chamber 24, by means of an annular apron 46 suspended from the supporting ring 35 and slidably coacting with a sealing ring 47 mounted on the frame 4, and the ribs 32 which connect the outer frame 4 and hub 5 are also protected against damage and excessive wear by means of wear resistant shields 48 located within the discharge space 7.

The inner crushing member or head 20 which is freely rotatable about the upper inclined shaft portion 15, is provided with a lower annular extension 50 within which the radially loaded bearing 28 is confined, and which is snugly embraced by the thrust bearing 30 coacting with the upper inclined surface 19 of the flange 17. The other radially loaded head bearing 27 is confined within an annular recess formed in the upper portion of the head 20, and the inner elements or races of the bearings 27, 28 are spaced apart by a sleeve 51. The head 20 is also provided with a central plug 52 having a screw threaded portion projecting above the top of the head; and the head mantle 21 which cooperates with the concave liner 9 to form the crushing chamber or zone 24, is firmly but detachably secured to the frusto-conical outer surface of the head 20 by means of a tubular clamping member 53 having a feed plate 54 mounted thereon within the hopper 42. While the crushing surface 22 of the head mantle 21 is illustrated as a spherical zone surface, this configuration may be varied to suit.

The unitary or one-piece rotary crank-shaft 14 with which the flange 17 and upper eccentric or inclined portion 15 are preferably formed integral, and which is supported solely by the flange 17 and the thrust bearings 29, 30 and by the guide bearings 25, 26 extends through the fixed frame hub 5 and extension 33 and is adapted to be rotated at any desired speed by means of a bevel gear 56 drivingly secured to the lower extremity of the shaft 14 by a transverse key 57. The gear 56 rests upon a resiliently supported block 58 carried by the lower closure plate 59 of the frame hub 5, and meshes with a bevel pinion 60 secured to one end of a countershaft 61 which is journalled in bearings 62 carried by a bracket 63, and the opposite end of this shaft 61 is provided with a driving sheave or pulley 64. The lower-

most radially loaded bearing 26 coacts with the shaft 14 closely adjacent to the driving gear 56, and this gear together with the pinion 60, shaft 61 and bearings 62, are concealed and protected by the bracket 63 and main frame 4.

While the hub 5 and head 20 conceal and protect the radially loaded bearings 25, 26, 27, 28, the thrust bearings 29, 30 are disposed externally of the hub and head extensions 33, 50 and in order to seal these axially loaded bearings 29, 30 for exposure to grit and dust, additional sealing means must be provided. The upper end of the fixed frame hub 5 is therefore provided with an annular upstanding wall 66 having sealing rings 67 at its top and being provided with an internal bore adjoining these rings, and the bottom of the head 20 is also provided with sealing rings 68 and with an annular outer surface adjoining these rings. An annular sealing member 69 which is rotatable with the main shaft 14 by means of a driving lug 70 formed on the shaft flange 17, is interposed between and is sealingly engageable with the rings 67, 68, and a snap ring 71 carried by the lower portion of the member 69 coacts with the bore of the wall 66 while a similar ring 72 is carried by the head 20 and coacts with a bore at the upper end of the member 69. The member 69 is rotatable relative to the wall 66 and the crushing head 20 is freely rotatable relative to the rotating member 69, but the rings 67, 68, 72, 71 cooperate with the member 69 to provide an effective enclosure for sealing the bearings 29, 30 from the crushed material delivery passage 7.

As illustrated in Fig. 1, all of the radially loaded bearings 25, 26, 27, 28 are of the cylindrical roller anti-friction type with the rollers confined within their outer races so as to resist only radial pressures and to permit free upward removal of the crushing head 20 when the crushing concave 8 has been removed, and to permit like removal of the shaft 14 when the head 20 has been removed. The axially loaded thrust bearings 29, 30 are also of the cylindrical roller anti-friction type formed to resist only axial pressure and disposed so that the bearing races thereof may shift slightly relative to each other when wear takes place in the radially loaded bearings, and while it is preferable to utilize such anti-friction thrust bearings it is not necessary to provide roller guide bearings for the shaft and head. As shown in Fig. 2, the radially loaded bearings 25', 27' for the crank-shaft 14 are of the ordinary sleeve or ring type, thus providing a less expensive guide bearing assemblage. In both cases, however, the axially loaded thrust bearings are disposed between the eccentric radially loaded bearings and uniform loading of all bearing surfaces is assured; and all of these concealed bearings should be well lubricated by a pump 74 operable from the countershaft 61 and adapted to constantly deliver oil through a central passage 75 formed in the shaft 14.

When the improved crusher utilizing either the anti-friction or the sleeve type of radially loaded bearings, has been properly constructed, assembled and adjusted, the pulley 64 may be rotated to rapidly rotate the shaft 14 about the axis 12 and to simultaneously gyrate the upper eccentric shaft portion 15 and the head 20 upon the axis 16, and to also operate the pump 74 so as to circulate lubricant through the various bearings and over the gear 56 and pinion 60. While the head 20 is thus being gyrated relative to the concave 8, it is still freely rotatable about the inclined axis 16 and its rotary motion may be arrested while the shaft 14 continues to revolve. Material which is to be crushed may then be deposited upon the feed plate 54 within the hopper 42, and will eventually gravitate through the feed opening 11 into the crushing zone 24. The admitted material will thereafter advance through the downwardly and outwardly flaring chamber 24 and will be quickly reduced during such advancement, after which the crushed product will drop through the delivery space 7 and be discharged from the crusher.

During this reduction of the material by the fixed concave 8 and gyrating head 20, the crushing head may rotate freely in either direction or it may merely swing back and forth like the movable jaw of a jaw crusher, but regardless of the head motion, all of the vertical pressures exerted upon the crushing head 20 will be absorbed by the frame hub 5, axially loaded thrust bearings 29, 30, and by the rigid annular shaft flange 17, while all of the radial or horizontal pressures will be resisted by the guide bearings 25, 26, 27, 28 and the hub 5 and shaft 14 coacting therewith. Besides the vertical pressures induced by crushing, the axial thrust bearings also assume the entire weight of the head 20 and shaft 14, so that the radially loaded bearings are entirely relieved of this weight. The springs 39 permit the concave 8 to rise bodily or tilt so as to relieve the unit from abnormal stresses, and the position of the concave may be readily varied with the aid of the ratchet 44 so as to alter the size of the finally crushed product.

From the foregoing detailed description of the construction and operation of the improved crusher, it will be apparent that I have in fact provided a crushing unit of the type wherein the freely rotatable head 20 is gyrated by a rotary crank-shaft having an integral head gyrating portion, and wherein the head and shaft are effectively supported by simple guide and thrust bearings so that the latter will automatically compensate for wear in all of the bearings. The improved composite bearing assemblage not only compensates for such wear by providing extensive thrust bearings between the shaft portions 14, 15 and close to the crushing zone, but also enables ready assembly and dismantling of the crusher, and accomplishes these results with simple anti-friction or sleeve type guide bearings.

The large flange 17 with which the thrust bearings 29, 30 coact, eliminates tipping or tilting of the crank-shaft, and the improved structure also eliminates necessity of providing complicated thrust bearings at the lower end of the head gyrating shaft 14, and furthermore avoids the use of spherical bearings which are difficult to machine. In the improved gyratory crusher, the thrust bearings 29, 30 are located as near as possible in proximity to the crushing zone 24, and the same is true of most of the radially loaded bearings, thereby obviating objectionable leverages to the fullest extent and reducing wear on the bearings to a minimum. All bearings are well concealed and protected against entry of dust and grit, and the improved machine has enormous capacity considering its compactness and relative simplicity.

It should be understood that it is not my desire to limit this invention to the exact details of construction or to the precise mode of operation of the gyratory crushers herein specifically shown and described, since various modifications

within the scope of the appended claims may occur to persons skilled in the art.

I claim:

1. In a gyratory crusher, a frame having a fixed upright hub, a unitary rotary shaft having a lower upright cylindrical portion disposed centrally within said hub and also having an upper cylindrical portion the axis of which is inclined relative to and intersects the axis of said lower shaft portion, said cylindrical shaft portions being separated from each other by an integral flange having lower and upper relatively inclined plane surfaces disposed perpendicular to the axes of said lower and upper shaft portions respectively, an annular crushing concave carried by said frame coaxially of said lower shaft portion, a crushing head cooperating with said concave to provide an annular crushing chamber and being freely rotatable about said upper shaft portion while its entire weight is supported by said flange, an annular sealing member surrounding and being rotatable by said flange while sealingly cooperating with both said frame hub and with said crushing head, spaced guide bearings interposed between said hub and the opposite ends of said lower shaft portion and each comprising an annular series of cylindrical rollers formed to resist radial loading only, other spaced guide bearings interposed between said head and the opposite ends of said upper shaft portion and each comprising an annular series of cylindrical rollers disposed to resist radial loading only, and thrust bearings interposed between said flange surfaces and said hub and head respectively and each comprising an annular series of cylindrical rollers disposed to resist axial loading only.

2. In a gyratory crusher, a frame having a fixed upright hub, a unitary rotary shaft having a lower upright cylindrical portion disposed centrally within said hub and also having an upper cylindrical portion the axis of which is inclined relative to and intersects the axis of said lower shaft portion, said cylindrical shaft portions being separated from each other by an integral flange having lower and upper relatively inclined plane surfaces disposed perpendicular to the axes of said lower and upper shaft portions respectively, an annular crushing concave carried by said frame coaxially of said lower shaft portion, a crushing head cooperating with said concave to provide an annular crushing chamber and being freely rotatable about said upper shaft portion while its entire weight is supported by said flange, spaced guide bearings interposed between said hub and the opposite ends of said lower shaft portion and each comprising an annular series of cylindrical rollers formed to resist radial loading only, other spaced guide bearings interposed between said head and the opposite ends of said upper shaft portion and each comprising an annular series of cylindrical rollers disposed to resist radial loading only, and thrust bearings interposed between said flange surfaces and said hub and head respectively and each comprising an annular series of cylindrical rollers disposed to resist axial loading only.

3. In a gyratory crusher, a frame having a fixed upright hub, a unitary rotary shaft having a lower upright portion disposed centrally within said hub and also having an upper inclined eccentric portion separated from said lower portion by an integral flange having lower and upper relatively inclined plane surfaces disposed perpendicular to the central axes of said lower and upper shaft portions respectively, a crushing concave carried by said frame coaxially of said lower shaft portion, a crushing head freely rotatable about the central axis of said upper shaft portion and cooperating with said concave to provide an annular downwardly and outwardly crushing chamber, the entire weight of said head being supported by said flange, anti-friction guide bearings interposed between said hub and said lower shaft portion and between said head and said upper shaft portion and each comprising an annular series of rollers formed and disposed to resist radial loading only, and anti-friction thrust bearings interposed between said flange and said head and hub and each comprising an annular series of rollers formed and disposed to resist axial loading only.

4. In a gyratory crusher, a frame having a fixed upright hub, a unitary rotary shaft having a lower upright portion disposed centrally within said hub and also having an upper inclined eccentric portion separated from said lower portion by an integral flange having lower and upper relatively inclined plane surfaces disposed perpendicular to the central axes of said lower and upper shaft portions respectively, a crushing concave carried by said frame coaxially of said lower shaft portion, a crushing head freely rotatable about the central axis of said upper shaft portion and cooperating with said concave to provide an annular downwardly and outwardly crushing chamber, the entire weight of said head being carried by said flange and the entire weight of said shaft and head being carried by the upper portion of said hub, spaced anti-friction guide bearings interposed between said hub and said lower shaft portion, an anti-friction guide bearing interposed between said head and said upper shaft portion, each of said guide bearings comprising an annular series of rollers formed and disposed to resist radial loading only, and anti-friction thrust bearings interposed between said flange and said head and hub and each comprising an annular series of rollers formed and disposed to resist axial loading only.

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