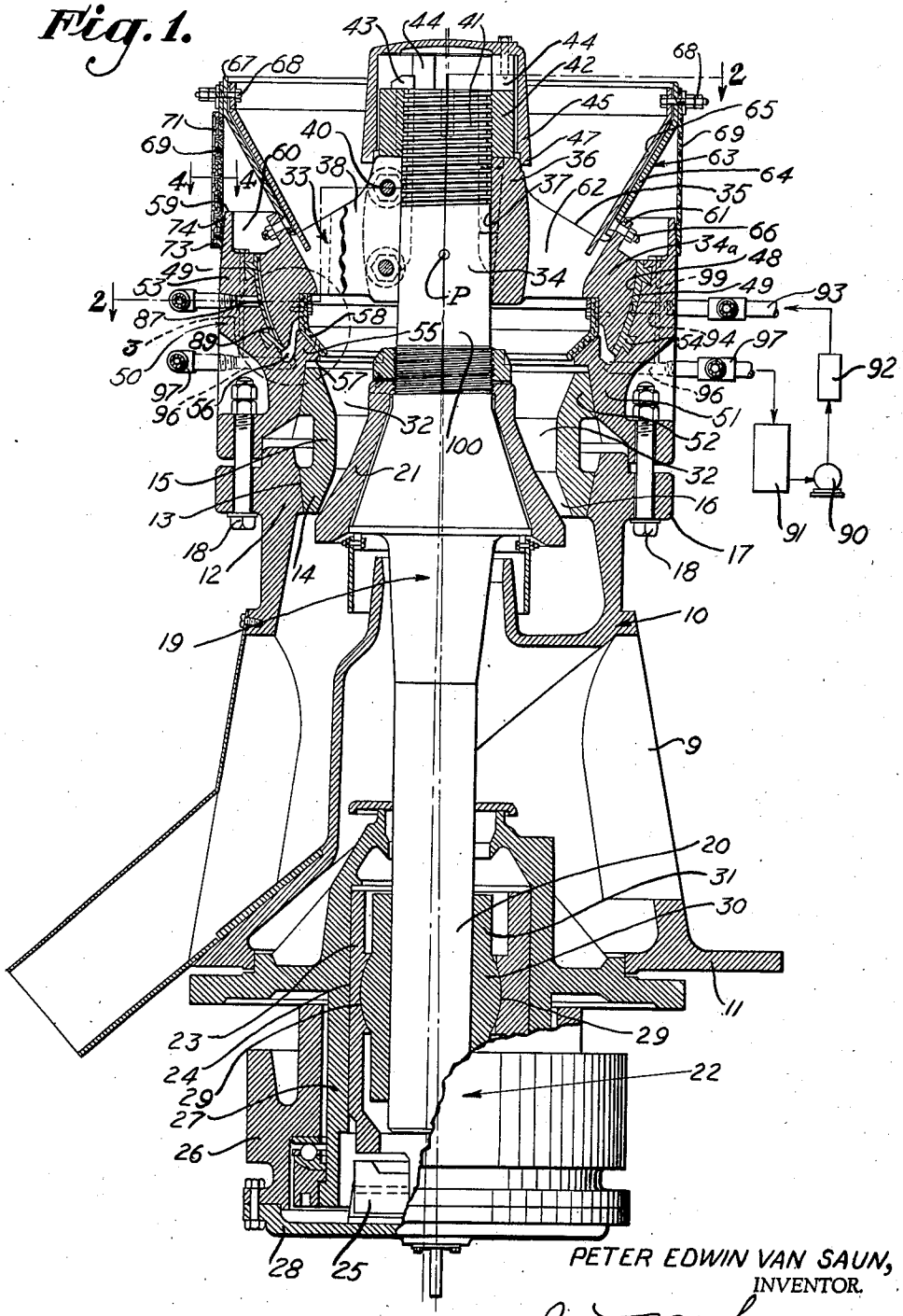
July 28, 1942. P. E. VAN SAUN 2,291,122

GYRATORY CRUSHER

Original Filed Nov. 20, 1937 3 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

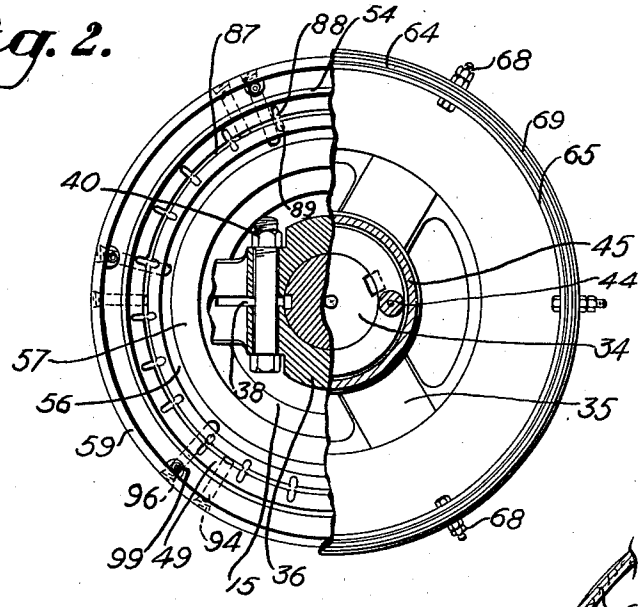


Fig. 4.

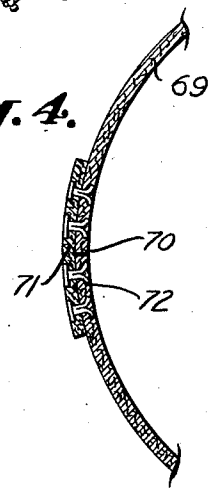
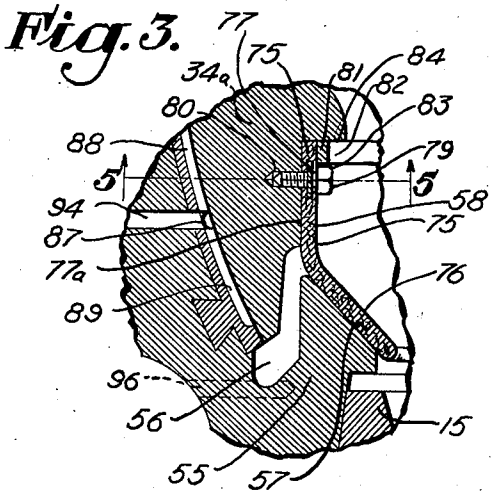


Fig. 3.



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Fig. 6.

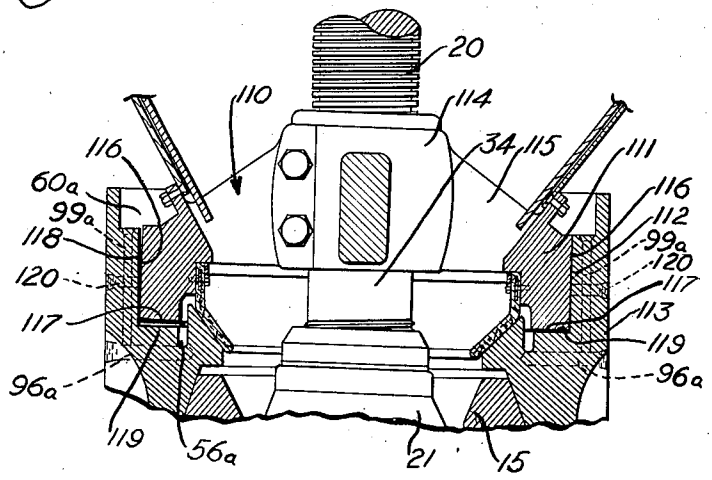
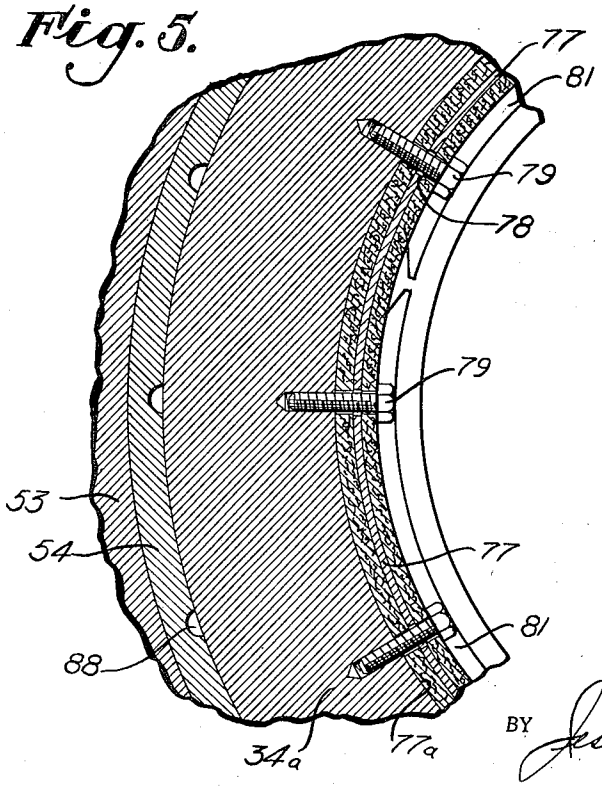


Fig. 5.



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Patented July 28, 1942 2,291,122

UNITED STATES PATENT OFFICE

2,291,122

GYRATORY CRUSHER

Peter Edwin Van Saun, Los Angeles, Calif., assignor of one-half to Lester L. Robinson, Los Angeles, Calif.

Refiled for abandoned application Serial No. 175,699, November 20, 1937. This application March 21, 1940, Serial No. 325,261

8 Claims. (Cl. 83—10)

This is a substitute for application Number 175,699, filed November 20, 1937.

My invention relates to crushers of the type used for crushing ore, and relates in particular to improvement in gyratory crushers by which they are made capable of high speed operation and the relatively fine grinding of materials. Gyratory crushers of the type to which this invention particularly relates have an upwardly converging crushing cone which is gyrated within an annular crushing member by a nearly vertical shaft which extends through the annular crushing member and at its lower end is connected to a power drive which moves the lower end of the shaft through a circular orbit and gives the shaft and the conical crushing member a circumductory movement around a point near to and above the upper end of the annular crushing member. The stresses applied to the upper portion of the shaft are very severe in this type of crusher, especially where fine grinding is attempted and it is found that there is a very marked liability to breakage of the shaft at a point between the conical crushing element and the upper bearing which is supported at the center of circumduction of the shaft by radial arms which extend inwardly from the annular wall forming the upper end of the crusher. Also, operation of these crushers under heavy loads produces a relatively rapid deterioration of the upper bearing with the result that it is frequently necessary to shut down the crusher to replace the upper bearing.

It it an object of my present invention to provide a gyratory crusher having an improved form of upper bearing and an improved construction at the upper end of the crusher resulting in an increased rigidity and durability in the gyratory structure, which enables the same to be used for fine crushing and operation at relatively high speeds without liability of breakage and need for frequent replacement of the upper bearing. I have provided a simple and novel upper construction for gyratory crushers which may be readily applied to existing crushers to cure the weaknesses at present existing therein.

It is a further object of my invention to provide a gyratory crusher having an inner gyratory crushing element operating within an annular crushing member, the upper end of this inner crushing member having outwardly extending supports which carry an upper or suspension bearing of annular form disposed in adjacent relation to the upper end of the annular crushing member. As the particle size, to which the material is being ground, is decreased, the number of planes of breakage against which the crushing members must operate increases so rapidly that a crusher which will satisfactorily crush to a fineness of ¼" diameter will often break down when it is adjusted to crush to a size of ⅛". It is an object of my present invention to provide a type of construction which will materially strengthen a gyratory crusher at those points where the severe strains are concentrated, without increase in the size of the remaining parts of the crusher.

In the present types of gyratory crushers having the suspension bearing disposed above the crushing cone, lubricant passes from the lower end of the bearing into the material being crushed. This may be considered of little importance in ordinary rock crushing, but in crushing of certain types of ore this leakage of grease from the suspension bearing is a very definite fault. It is an object of my invention to provide a gyratory crusher having a suspension bearing which may be amply lubricated, but from which no lubricant can leak into the material being crushed. Likewise, in my present invention there is no material loss of lubricant owing to the fact that the same is circulated in the closed circuit from which no leakage can occur.

It is an object of my invention to provide a gyratory crusher of the character hereinbefore discussed having a plug and socket bearing at the upper end thereof for supporting the gyratory crushing member, such bearing being of large diameter and having one or more openings through the same through which the materials to be crushed may be fed into the space between the annular crushing member and the gyratory crushing cone.

A further object of the invention is to provide in a gyratory crusher a plug and socket suspension bearing for the gyratory crushing member, wherein the plug element of the bearing member is floated in oil and therefore operates freely and with a minimum wear of the bearing surfaces of the plug and socket bearing. In the preferred form of the invention the bearing surfaces of the plug and socket bearing are spheroidal and give the bearing the characteristics of a ball and socket joint.

It is a further object of the invention to provide a gyratory crusher having an annular plug and socket suspension bearing at the upper end thereof and depending guard walls for preventing entry of abrasive materials into the plug and

socket bearing, together with means for guiding the material to be ground through the openings of the suspension bearing structure into the crushing zone of the device.

Further objects and advantages of the invention will be brought out in the following part of the specification:

Referring to the drawings, which are for illustrative purposes only:

Fig. 1 is a vertically-sectioned, elevational view showing a preferred embodiment of my invention.

Fig. 2 is a cross-sectional view taken as indicated by the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary enlargement of the area enclosed by the dotted line 3 of Fig. 1.

Fig. 4 is an enlarged fragmentary section taken on a plane represented by the lines 4—4 of Fig. 1.

Fig. 5 is an enlarged fragmentary section taken as indicated by the line 5—5 of Fig. 3.

Fig. 6 is a fragmentary cross-section showing an alternative embodiment of my invention.

In the embodiment of my invention shown in Figures 1 to 4 inclusive, I employ a standard type of crusher frame 10 having a base flange 11 adapted to be mounted on a suitable concrete foundation, not shown. This frame has a side wall 9 which at its upper end supports an annular wall 12 providing an upwardly diverging conical seat 13 adapted to receive the lower end 14 of an outer crushing member 15 made in annular form in accordance with accepted practice and having an opening 16 therethrough. Formed at the upper end of the frame 10, outside the annular wall 12, there is a flange 17 through which bolts 18 are passed as shown. Extending through the outer crushing member 15 there is a swingable crushing member 19 which includes a shaft 20 and a crushing cone 21 of hard metal alloy mounted on the shaft in such position that it will lie within said crushing member 15 and will be swung back and forth relative to the outer crushing member, preferably with a gyratory motion, as the lower end of the shaft 20 is swung by a power means 22 disposed at the lower end of the frame 10.

The power means 22 shown includes an eccentric sleeve 23 which is rotated in a vertical bearing 24 by means of a drive connection 25 with a pulley 26 supported for rotation on a cylindrical wall 27, which extends downwardly from the base of the frame 10. This pulley 26 may be driven by any suitable means such as a belt, not shown, and rotation is transmitted therefrom to the drive connection 25 by means of a plate 28 which is secured to the lower end of the pulley 26. The eccentric sleeve 23 has a socket 29 which received a ball 30 formed on a sleeve 31 which is rotatable and axially movable on the lower portion of the shaft 20. Rotation of the sleeves 23 and 31 will cause the lower end of the shaft 20 to swing through a circular orbit with the result that circumduction of the shaft 20 relative to a point P of circumduction, is caused. As the result of the gyration of the secondary crushing member or cone 21 within the primary or annular crushing member 15 material, such as ore which is fed downwardly into the space 32 between the crushing members 15 and 21, is crushed to a size depending upon the spacing of the cone 21 within the annular crushing member 15.

The upper end of the swingable member 19 is supported by a suspension bearing 33 which is adjustably secured to the upper end 34 of the shaft 20 in such a manner that through raising and lowering of the shaft relative to the bearing means 33 a desired position of adjustment of the conical crushing member 21 within the annular crushing member 15 may be secured. The suspension bearing 33 is of the plug and socket type. It includes a plug part comprising an annular wall or ring 34*a* carried by arms 35 which extend radially outwardly from a hub 36 having a bore 37 of such diameter as to be a sliding fit on the upper end 34 of the shaft 20. The hub 36 has a vertical slot 38 which extends into one of the arms 35 and has clamping bolts 40 extended thereacross which may be tightened to constrict the hub and thereby clamp the same tightly on the shaft portion 34. The upper extremity of the shaft 20 is provided with threads 41 to receive an adjustment nut 42 which is locked in a desired position of adjustment by means of a key 43. The upper end of the nut 42 is provided with upwardly projecting posts 44, of which three are shown, for supporting a cupshaped shield 45 over the upper end of the shaft 20 and the nut 42, and in overlapping relation at 47 to the upper end of the hub 36.

In Figures 1 and 2, I have shown the plug bearing member 34*a* with a downwardly and outwardly faced spheroidal face 48 generated on the point P. The spheroidal face 48 of the plug bearing member 34 seats against an inwardly and upwardly directed spheroidal face 49 of a socket bearing member 50 which is annular in form and is secured at the upper end of the crusher frame 10 by means of the bolts 18. This socket bearing member 50 provides a wall 51 which engages the upper end 52 of the annular crushing member 15 and has an upper annular wall 53 carrying a layer of bearing metal 54 on which the socket bearing surface 49 is formed. Within the lower portion of the annular wall 53 there is an upwardly projecting lip 55 which forms an oil drainage channel 56 along the lower edges of the bearing faces 48 and 49. The lip 55 has an inwardly and upwardly presented conoidal face 57 against which the lower portion of an inner annular flexible guard member 58 rests. The annular wall 53 has a lip 59 projecting upwardly from the outer portion thereof to form the outer wall of an oil-receiving channel 60 communicating with the upper edges of the bearing surfaces 48 and 49. The inner wall of this oil channel 60 is formed by a lip 61 which projects upwardly and outwardly from the annular wall 34*a*.

A feature of the invention is that the suspension bearing 33 is made of such large diameter that openings 62 are accommodated within the confines thereof through which ore to be ground may be passed downwardly into the space or grinding zone 32. These openings 62 exist between the arms 35 which form part of a spider including the annular wall 34*a* which carries the spheroidal bearing face 48. To direct the material to be ground through the openings 62, I provide a downwardly converging conical feed member or hopper 63 which includes a permanent wall 64 and a replaceable wall 65. The permanent wall 64 has the lower edge thereof secured to the lip 61 by means of bolts 66. The upper edge of the permanent wall 64 is comprised of a relatively narrow cylindrical band 67. The replaceable wall 65 is of essentially the same general shape as the permanent wall 64 and is supported inside the permanent wall 64 by means of bolts 68 which extend through the upper cylindrical edge portion 67 of the permanent wall 64.

A guard 69 is provided to keep abrasive materials out of the channel 60 and likewise out of the suspension bearing. This guard 69 consists of a flexible cylindrical wall, as shown, which is preferably made from a strip of rubber belting curved to cylindrical form and having the abutting ends 70 thereof, Fig. 4, connected by means of a plate 71 secured by rivets 72 in overlapping relation to the ends 70 of the member 69. The upper edge of the member 69 is secured to the upper cylindrical edge 67 of the conical member 63 and the lower edge 73 thereof projects down over the spheroidal outer face 74 of the lip 59.

As shown in Figures 3 and 5, the inner guard member 58 comprises a wall of flexible material having an upper cylindrical portion 75 and a lower downwardly converging conical portion which overlies the conical surface 57 of the lip 55. A metal band 77 may be molded into the upper edge member 58 to reinforce the same and openings 78 may be provided therein through which screws 79 may be passed into threaded openings 80 in the member 34*a* to secure the guard member 58 in a position wherein the upper cylindrical portion 75 thereof will lie against an inwardly faced cylindrical wall 77*a* formed within the lower part of the annular member 34*a*. To prevent rotation of the screws 79 as the result of vibration during the operation of the crusher, locking means is employed in the form of a split ring 81 of such size that it will fit into the space 82 above the heads of the screws 79 when such heads are all positioned so that the upper faces 83 thereof are parallel to the downwardly presented radial face or shoulder 84 positioned at the upper edge of the cylindrical face 77*a*. As the swingable member 19 gyrates the lower conical portion 76 of the guard 58 slides upon the face 57 of the lip 55. Materials which are fed downwardly through the conical feed member 63 and the opening 62 toward the grinding zone 32 are deflected radially inwardly by the flexible guard wall 58 which prevents entry into the channel 56 of any of the material fed to the crusher.

In the spheroidal face 49 of the outer bearing part 50, there is an annular oil distributing channel or groove 87 positioned intermediate the upper and lower edges of the surface 49, and branch lubricant channels 88 and 89 are extended upwardly and downwardly from the groove 87 at suitably spaced intervals around the bearing surface 49. As shown diagrammatically in Fig. 1, a pump 90 forces lubricant from a reservoir 91 through a filter 92 and piping 93 to radial openings 94 which deliver into the annular oil distributing groove 87 from whence the lubricant passes into the branch channels 88 and 89 and is finally distributed substantially equally to all parts of the bearing faces 48 and 49, the upward force exerted by the lubricant raising the plug bearing member 34*a* from the socket bearing surface 49 and providing a floating suspension bearing for the crusher which operates with minimum friction and minimum wear. The oil which passes downwardly from the lower edges of the bearing surfaces 48 and 49, flows through the oil drainage channel 56 to radial outlet ports 96 to which piping 97 is connected to carry such oil to the reservoir 91. The oil which passes from the upper edges of the bearing surfaces 48 and 49 flows through the channel 60 to vertical openings 99 which connect the channel 60 with the passages 96, thereby combining the overflow from the channel 60 with the return flow of oil through the piping 97 to the reservoir 91. In the construction described hereinabove it is possible to make that portion 100 of the shaft 20 between the upper end of the conical grinding member 21 and the hub 36 of the suspension bearing spider very massive and of sufficient durability to withstand the severe strains and reversal force tending to produce crystallization. Also, a suspension bearing is provided in which the bearing surfaces are of such extent that the unit bearing pressure is kept well within safe limits, and which bearing will not break down even though the crusher is subject to continued periods of heavy crushing service. A further feature of the invention is that wear on the upper portion on the gyratory shaft is avoided, it being noted that the hub 36 is clamped tightly upon the upper portion of the shaft 20 so that there is no relative movement between these parts.

In Figures 1 to 5 I have disclosed a form of my invention in which the plug and socket suspension bearing is of spheroidal or ball and socket character. In Fig. 6 I show how the plug and socket principle may be employed in forms other than the spheroidal. Therein I show connected to the upper end 34 of the shaft 20 a suspension bearing 110 comprising an annular plug bearing element 111 which is substantially cylindrical in form and which is received in a substantially cylindrical socket 112 formed in an annular member 113 supported in a position adjacent the upper edge of the outer crushing member 15. The plug bearing element 111 may be connected to a hub 114 by means of spokes 115, this hub 114 being adjustably secured on the shaft 20. In the form shown, the socket 112 has a cylindrical face 118 and a radial face 119. The plug bearing element 111 has, to cooperate with the cylindrical face 118, an upwardly converging conical face 116 and a conical lower face 117 to cooperate with the bottom face 119 of the socket 112. Oil under pressure is fed inwardly through a number of radial passages 120 to an intermediate plane in the bearing surfaces 116 and 118 so as to provide a continuous wall of lubricant between such surfaces. As the shaft 20 and the conical grinding member 21 thereon are gyrated, the plug element 111 gyrates with a rolling motion in the socket 112. In Fig. 6 the lower portion of the shaft 20 and the conical crushing member 21 are shown swung to the left. At this time the rightward portion of the face 116 will be in engagement with the cylindrical side wall 118 of the socket 112 and the rightward portion of the bottom surface 117 of the plug bearing element 111 will be in engagement with the radial bottom wall 119 of the socket 112. At this time the leftward portion of the bottom wall 117 will be raised from the bottom wall 119 and the leftward portion of the face 116 will be spaced from the side wall 118. In this embodiment of the invention oil drainage channels 56*a* and 60*a* may be provided which are similar in form to the channels 56 and 60 of Fig 1 and the overflow oil from the suspension bearing may be carried from the channels 56*a* and 60*a* through passages 96*a* and 99*a*.

Although I have shown simple and practical forms of my invention it will be recognized that certain parts and elements thereof may be replaced by other parts of equivalent function without departing from the principles of the invention; accordingly the invention is not to be limited to the hereinbefore disclosure but should be

accorded the full scope of the hereto appended claims.

I claim as my invention:

1. In a device of the character described, the combination of: an outer crushing member having an opening therethrough; a swingable crushing member extending through said outer crushing member; power means connected to one end of said swingable crushing member to swing the same relative to said outer crushing member; a plug bearing member on said other end of said swingable crushing member in a position facing toward said outer crushing member; a socket bearing member to cooperate with said plug bearing member, said socket bearing member being supported in outwardly facing position, there being a passage for material through both of said bearing members, said passage communicating with said opening in said outer crushing member; means for feeding lubricant under pressure into the space between said bearing surfaces of said bearing members; and means for taking off said lubricant as it leaves said bearing surfaces.

2. In a device of the character described, the combination of: an outer crushing member having an opening therethrough; a swingable crushing member extending through said outer crushing member; power means connected to one end of said swingable crushing member to swing the same relative to said outer crushing member; a plug bearing member on said other end of said swingable crushing member in a position facing toward said outer crushing member; a socket bearing member to cooperate with said plug bearing member, said socket bearing member being supported in outwardly facing position, said bearing members having cooperating spheroidal bearing surfaces generated about a point on an axis passing through said swingable crushing member, there being a passage for material through both of said bearing members, said passage communicating with said opening in said outer crushing member; means for feeding lubricant under pressure into the space between said bearing surfaces of said bearing members; and means for taking off said lubricant as it leaves said bearing surfaces.

3. In a device of the character described, the combination of: a primary crushing member; a secondary crushing member extending across said primary crushing member and being swingable relative to said primary crushing member; power means connected to one end of said secondary crushing member so as to apply a swinging movement thereto; a spider connected to the other end of said secondary crushing member, said spider comprising radial arms and an annular wall forming a plug bearing member faced toward said primary crushing member, the openings between said arms forming a passage communicating with the crushing face of said primary crushing member; an annular socket bearing member supported in outwardly facing relation from said primary crushing member and receiving said plug bearing member of said spider; means for feeding oil under pressure into the bearing space between said plug and socket bearing members to substantially float said plug bearing member in oil; means for conducting away said oil as it leaves said bearing space; and guard means placed so as to restrain abrasive material from entering said bearing space.

4. In a device of the character described, the combination of: a primary crushing member; a secondary crushing member extending across said primary crushing member and being swingable relative to said primary crushing member; power means connected to one end of said secondary crushing member so as to apply a swinging movement thereto; a spider connected to the other end of said secondary crushing member, said spider comprising radial arms and an annular wall forming a plug bearing member faced toward said primary crushing member, the openings between said arms forming a passage communicating with the crushing face of said primary crushing member; an annular socket bearing member supported in outwardly facing relation from said primary crushing member and receiving said plug bearing member of said spider; means for feeding oil under pressure into the bearing space between said plug and socket bearing members to substantially float said plug bearing member in oil; means for conducting away said oil as it leaves said bearing space; an outwardly expanding conical feed member connected to said spider in a position to feed materials through said opening of said spider to the crushing face of said outer crushing member; and guard means placed so as to restrain abrasive material from entering said bearing space.

5. In a gyratory crusher of the character described, the combination of: a ringlike crushing member disposed on an upright axis, said member having an opening therethrough and having an outwardly faced bearing socket in the upper end thereof of larger diameter than said opening; a swingable crushing member passing through said ringlike crushing member; power means on the lower end of said swingable crushing member operative to gyrate the same; an annular bearing member fitting into said bearing socket; arms connecting said annular bearing member with the upper end of said swingable crushing member; an annular wall extending downwardly from said annular bearing member so as to conceal the inner end of said bearing socket; means for feeding oil under pressure to an intermediate portion of said socket; and walls forming passages connecting with the upper and lower portions of said bearing socket to carry off oil therefrom.

6. In a gyratory crusher of the character described, the combination of: a ringlike crushing member disposed on an upright axis, said member having an opening therethrough and having an outwardly faced bearing socket in the upper end thereof of larger diameter than said opening; a swingable crushing member passing through said ringlike crushing member; power means on the lower end of said swingable crushing member operative to gyrate the same; an annular bearing member fitting into said bearing socket; arms connecting said annular bearing member with the upper end of said swingable crushing member; an annular wall extending downwardly from said annular bearing member so as to conceal the inner end of said bearing socket; a downwardly extending annular guard wall carried by the upper portion of said annular bearing member to conceal the outer end of said socket bearing; means for feeding oil under pressure to an intermediate portion of said socket; and walls forming passages connecting with the upper and lower portions of said bearing socket to carry off oil therefrom.

7. In a gyratory crusher of the character described, the combination of: an annular structure disposed on an upright axis and having an internal crushing face, there being an upwardly

faced socket bearing face at the upper end of said annular structure; a shaft extending through said annular structure and having an inner crushing member thereon in position to cooperate with said internal crushing face; power means at the lower end of said shaft to gyrate the same; a plug bearing member adjustably secured on the upper end of said shaft, said plug bearing member having a hub arranged to be rigidly clamped on said shaft, arms extending from said hub and an annular wall connected to said arms having a plug bearing face to cooperate with said socket bearing, there being feed openings through said plug bearing member between said arms and communicating with the interior of said annular structure; means operative to continuously circulate oil through the space between said bearing faces at sufficient pressure to substantially float said plug bearing member during the operation of said crusher; and hopper means supported on said plug bearing member in position to direct material to be ground to said feed openings of said plug bearing member.

8. In a gyratory crusher of the character described, the combination of: an annular structure disposed on an upright axis and having an internal crushing face, there being an upwardly faced socket bearing face at the upper end of said annular structure; a shaft extending through said annular structure and having an inner crushing member thereon in position to cooperate with said internal crushing face; power means at the lower end of said shaft to gyrate the same; a plug bearing member adjustably secured on the upper end of said shaft, said plug bearing member having a hub arranged to be rigidly clamped on said shaft, arms extending from said hub and an annular wall connected to said arms having a plug bearing face to cooperate with said socket bearing, there being feed openings through said plug bearing member between said arms and communicating with the interior of said annular structure; means operative to continuously circulate oil through the space between said bearing faces at sufficient pressure to substantially float said plug bearing member during the operation of said crusher, said socket bearing face facing toward the axis of said annular structure and at the same time outward with respect to said annular structure so that both the downthrust and radial loads transmitted from said inner crushing member to the upper end of said shaft will be carried by said socket bearing face; and hopper means supported on said plug bearing member in position to direct material to be ground to said feed openings of said plug bearing member.

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