March 20, 1962 R. S. SAARI 3,026,051

HYDRAULIC SUPPORT ASSEMBLY FOR GYRATORY CRUSHERS

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Fig. 1.

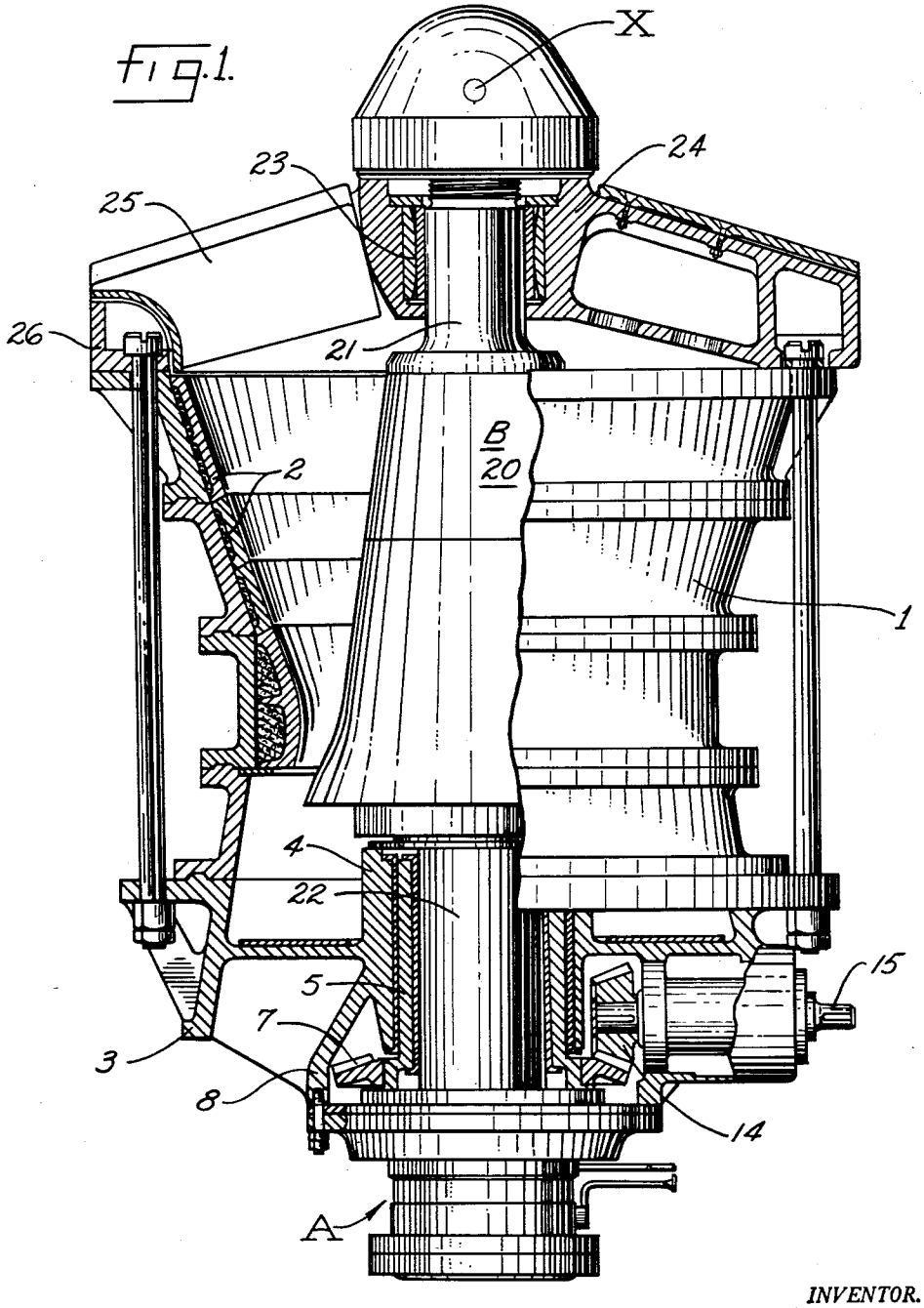

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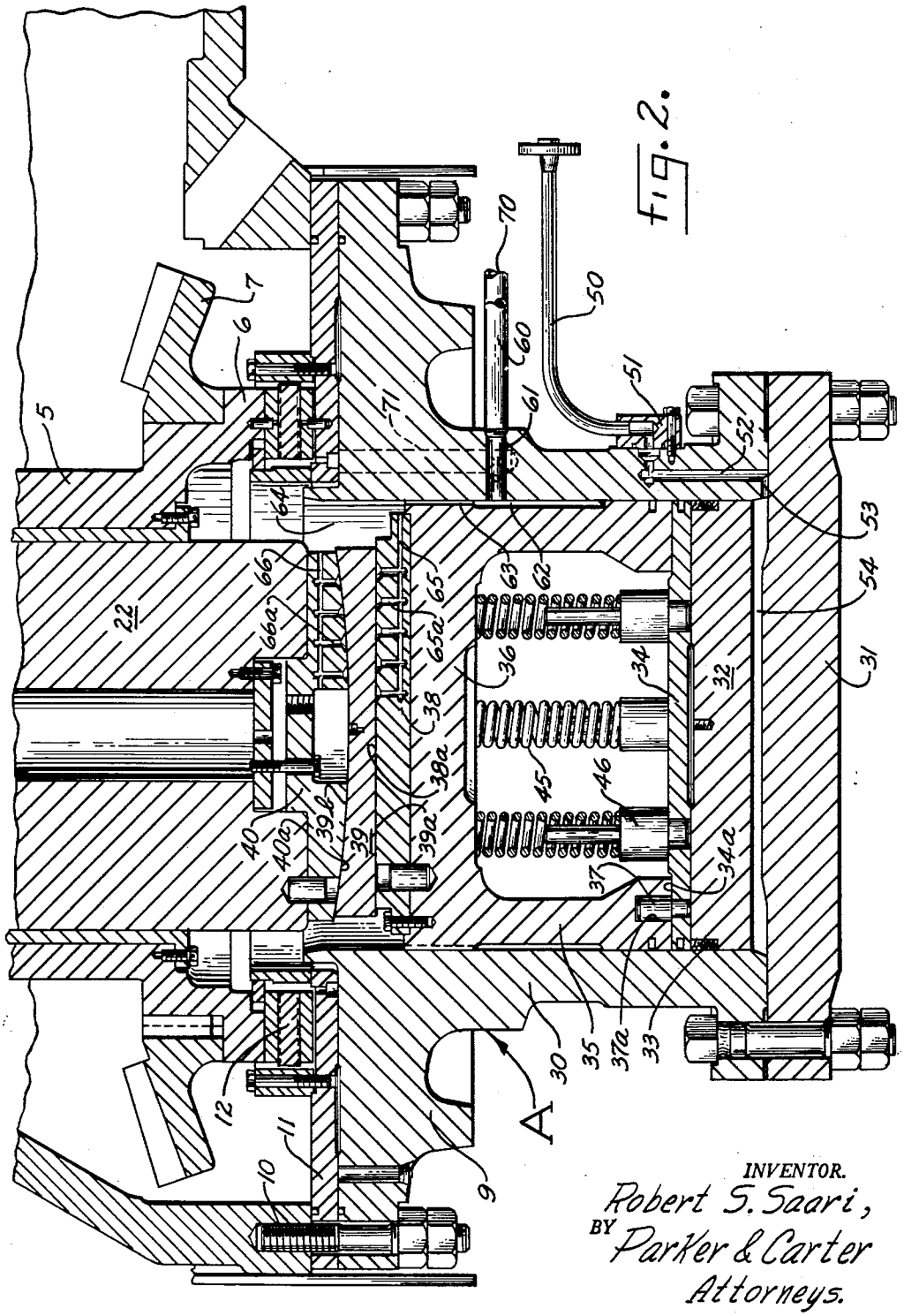
Fig. 2.



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3,026,051

HYDRAULIC SUPPORT ASSEMBLY FOR GYRATORY CRUSHERS

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My invention relates to an improvement in bearing and lubricating means for gyratory crushers. One purpose is to provide improved lubricating and cooling means for the step bearing of a gyratory crusher shaft.

Another purpose is to provide an improved step bearing assembly for such a shaft.

Another purpose is to provide means for maintaining all components of the step bearing assembly in contact at all normal times.

Other purposes will appear from time to time in the course of the specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawings, wherein:

FIGURE 1 is a side elevation of a typical gyratory crusher to which the invention may be applied, with parts in section and parts broken away to indicate the crusher; and

FIGURE 2 is an axial section, on an enlarged scale, illustrating the step bearing assembly and adjacent parts.

Referring to the drawings, **1** generally indicates the outer frame of a gyratory crusher within which is positioned a plurality of members **2** forming a bowl liner which defines the exterior of the crushing cavity. The frame **1** includes a lower portion **3** which has a central hub **4** within which rotates an eccentrically apertured sleeve **5**. The sleeve **5** has a bottom enlargement **6**, best seen in FIGURE 2, to which is secured a bevel gear **7**. Extending downwardly and outwardly from the hub **4** is an apron or flared sleeve **8**, to the lower edge of which is secured the bottom closure assembly, generally indicated at A. This assembly has an outer flange **9** secured by bolts **10** to the lower edge of the sleeve **8**. **11** indicates a bearing plate carrying any suitable bearing assembly **12**, the details of which do not form part of the present invention, for rotatably supporting the enlargement **6** of the eccentric sleeve **5**. The eccentric sleeve is rotated, for example, by a pinion **14** on a drive shaft **15** connected with any suitable power source.

B generally indicates a crusher head and shaft assembly, including the crusher head **20**, an upper shaft extension **21**, and a lower shaft extension **22**. The upper shaft extension **21** is centered in any suitable bearing assembly **23** in a central hub **24**, from which extend spider arms **25** to the member **26** resting upon and secured to the upper edge of the circumferential main frame **1**. The lower shaft extension **22** extends into the eccentric aperture of the sleeve **5**. It will be understood that in response to rotation of the pinion **14** in mesh with the bevel gear **7** the eccentric sleeve is rotated, and its rotation imparts a gyratory movement to the lower end of the head and shaft assemby. The gyration of the lower shaft extension **22** by the rotation of the eccentrically apertured sleeve **5** imparts a crushing movement to the head **20** which gyrates within the bowl liner structure **2**.

The present invention is directed primarily to the bearing assembly for the lower end of the shaft. The member A has a central, generally cylindrical, downwardly extending portion **30** to which is secured the bottom closure plate **31**. Within the cylindrical space thus formed is movably positioned a composite piston assembly. It may include, for example, a bottom plate **32** suitably sealed as at **33**. On it rests an intermediate plate **34**. Upon it, in turn, rests an upper piston component having a side wall **35** and a unitary top wall **36**. The side wall **35** normally engages the bearing surface **34***a* about the outer edge of the upper surface of the plate **34**. Guide pins **37** are mounted on the plate **34** and extend into appropriate apertures **37***a* in the lower edge of the circumferential wall **35**. The top of the piston component thus formed carries a bearing plate **38** having a generally horizontal plane bearing surface **38***a*. The plate **38** is suitably secured to or held against movement in relation to the piston wall **36**. Slidable upon the surface **38***a* of the plate **38** is a washer **39** having a bottom plane surface **39***a* and a top spherical concave surface **39***b*. Suitably secured to the bottom of the shaft extension **22** is a bearing plate **40** having a lower spherical bearing surface **40***a* normally engaging and conforming to the concave upper surface **39***b* of the washer **39**. It is suitably secured to and held against movement in relation to the lower end of the shaft **22**.

Within the space in the piston surrounded by the circumferential piston wall **35** are springs **45**. Any suitable number may be employed. I find four to be convenient. Each of the springs **45** is guided on a centering member **46**, shown as mounted on the plate **34**. It will be understood that the springs **45** are normally under compression, and that they are effective to keep all parts of the above described bearing assembly in contact. The importance of this will be described in detail below.

The gyratory crusher herein described and shown is of the type in which the crusher head and shaft assembly is supported from below by a unit which may be raised and lowered by hydraulic pressure. The details of the hydraulic system do not of themselves form part of the present invention. It will be understood, however, that suitable means may be employed to admit a fluid, preferably a liquid, under pressure in the space below the piston assembly and, specifically, below its bottom plate **32**. I illustrate, for example, the pipe **50** extending from any suitable source of pressure to a fitting **51** through which it communicates with a duct **52** formed in the thickness of the downwardly extending portion or wall **30**. This duct connects, as at **53**, to the compression space **54** below the bottom piston plate **32**. It will be understood that upon the admission of a liquid under pressure to the pressure space **54** the entire piston structure may be elevated, thus raising the crusher head and shaft assembly. It is elevated by the elevation of the above described piston structure. At all positions, of elevation the weight of the crusher shaft and head is supported on the bearing plate **40** which rests on, conforms to, and is movable across the upwardly concave spherical bearing surface **39***b* of the washer **39**. It will be understood that the parts are so proportioned that the shaft and head assembly B acts as if suspended at the point X in FIGURE 1, and as the lower end of the shaft **22** is gyrated the opposed spherical surfaces **39***b* and **40***a* maintain their contact, and the washer **39** slides across the plane surface **38***a* of the bear-

ing plate 38 of the piston structure. The springs 45 maintain all parts in engagement even though occasional abnormal movements of the shaft, as will later appear, might tend to withdraw the shaft upwardly from the washer 39.

In order to lubricate and cool the above described structure I provide the following arrangement: An oil pipe 60 delivers oil through the duct 61 about the wall 35 of the piston. The duct 61 is in line with a circumferential channel or reduction 62 in the outer surface of the piston wall 35 which is of sufficient length as to be in communication with the duct 61 at all normal positions of the piston. A plurality of openings 63 permit the lubricant to escape upwardly into a circumferential lubricating space 64, which surrounds and is in communication with the outer edges of the bearing plate 38, the washer 39 and the bearing plate 40. I find it advantageous to employ generally radial oil passages 65 in the bearing plate 38, and 66 in the bearing plate 40. These are provided with branches or extensions 65*a* and 66*a*, which extend, respectively, to communicate with the lower and the upper bearing surfaces of the washer 39, as shown in FIGURE 2. Thus a lubricant under pressure is directed inwardly into both pressure plates, and through such pressure plates reaches the bearing surfaces between the pressure plates and the washer 39 which lies between them. A second lubricant pipe 70 delivers a lubricant under pressure through the duct 71 to the bearing assembly 12.

It will be realized that, whereas, I have described and illustrated a practical and operative device, nevertheless many changes may be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative or diagrammatic, rather than as limiting me to my precise showing.

The use and operation of the invention are as follows:

I illustrate a gyratory crusher in which the crusher shaft and head assembly, shown generally at B in FIGURE 1, is centered at its upper end and is supported and gyrated at its lower end. Normally, the piston assembly is maintained at a satisfactory level or height by liquid in the pressure chamber 54 and in the system in communication with it. Normally, the only relative motion of the various parts of the step bearing assembly is that caused by the rotation of the eccentric sleeve 5, namely, the gyration of the lower shaft extension 22. This causes merely a slight movement of the bearing plate 40 in relation to the upper surface of the washer 39, and a slight movement of the washer 39 on the bearing plate 38.

Lubrication is maintained, and a cooling flow of oil is provided, through the above described passages 65 and 66. However, from time to time, pieces of material, rock, tramp iron, or the like, may go through the crushing cavity between the head 20 and the liners 2, which cause a different motion. Such an odd piece, instead of depressing the crusher shaft, may form a fulcrum or pivot about which the crushing head rotates. The result may be a lifting of the main shaft which will actually withdraw the lower shaft extension 22 and its bearing plate 40 from the washer 39. I therefore rely upon the springs 45, or other suitable equivalent, to maintain a following action, to force the upper component of the piston, and thus its top bearing plate 38, to follow the upward movement of the shaft. Thus the springs 45 are effective to hold the bearing plate 38 always in contact with the lower flat surface of the washer 39, and to hold the upper concave surface of the washer 39 at all times in contact with the downwardly spherical convex lower surface of the bearing plate. This is important, since, otherwise, if the shaft gyrates or moves somewhat before it descends, and the socket plate or washer 39 is out of contact with it, it will not thereafter contact the washer in a proper seating position. These irregular movements may cause damage to the lower end of the shaft. During normal operation my spring 45 are somewhat compressed and provide an upward thrust or bias, due to the stored energy in the springs. Thus all parts of the step bearing assembly are maintained in contact and no opportunity is given for displacement or undesired and damaging relation movement.

I claim:

1. In a step bearing structure for gyratory crushers, and in combination with an axially adjustable crusher shaft and means for gyrating it, a circumferential wall defining a generally cylindrical pressure chamber, a piston in said chamber, means for supplying fluid under pressure to said chamber and beneath said piston, an upwardly plane surfaced bearing plate at the top of said piston, a plano-concave washer having a plane lower bearing surface slidably opposed thereto, a bearing plate secured to the lower end of the crusher shaft and having a downwardly convex spherical bearing surface slidably conforming to the concave spherical upper surface of said washer, said piston including an upper and a lower component, yielding means between said components and tending to thrust the upper component and bearing plate at the top of the piston against the plane surface of the washer and to maintain the washer in snug contact with the bearing plate at the lower end of the crusher shaft during movement of the crusher shaft, means for supplying a lubricating and cooling liquid to said bearing plates and washer including a lubricating duct extending through the circumferential wall intermediate the ends of the piston, the piston being formed with a space in communication with said pipe at all normal positions of the piston, the piston being also formed to permit passage of lubricant upwardly to a space above the piston and about said plates and washer, and generally radial cooling passages in each of said bearing plates extending inwardly from said space and in communication with the bearing surfaces of said washer.

2. The structure of claim 1 characterized in that at least one of the bearing plates is formed with cooling passages transverse to said last mentioned cooling passages and communicating with a bearing surface of the washer.

3. The structure of claim 1 characterized in that both bearing plates are formed with cooling passages transverse to said last mentioned cooling passages and communicating with opposed bearing surfaces of the washer.

4. In a step bearing structure for gyratory crushers, and in combination with an axially adjustable crusher shaft and means for gyrating it, a circumferential wall defining a generally cylindrical pressure chamber, a multi-part piston assembly in said chamber, means for supplying fluid under pressure to the lower end of said chamber and beneath said piston assembly, said piston assembly supporting a plano-concave washer having a plane lower bearing surface slidably opposed to an underlying element of the piston assembly and having a concave spherical upper bearing surface opposed to and supporting a downwardly convex spherical bearing surface at the lower end of the crusher shaft, and means for maintaining normally continuous contact between the plane bearing surface of the washer and the piston assembly and between the concave bearing surface of the washer and the crusher shaft, and to allow the piston assembly and washer to follow the crusher shaft upon upward movement thereof, including one or more springs positioned within the piston assembly and normally under compression between adjacent elements of the piston assembly.

5. In a step bearing structure for gyratory crushers, and in combination with an axially adjustable crusher shaft and means for gyrating it, a circumferential wall defining a generally cylindrical pressure chamber, a piston in said chamber, means for supplying fluid under pressure to said chamber and beneath said piston, an upwardly plane surfaced bearing plate at the top of said piston, a plano-concave washer having a plane lower bearing surface slideably opposed thereto, a bearing plate

secured to the lower end of the crusher shaft and having a downwardly convex spherical bearing surface slideably conforming to the concave spherical upper surface of said washer, said piston including an upper and a lower component, normally compressed yielding means between said components thrusting the upper component and bearing plate at the top of the piston against the plane surface of the washer to maintain the washer in snug contact with the bearing plate at the lower end of the crusher shaft during all movement of the crusher shaft.

6. The structure of claim 5 further characterized in

that said yielding means include one or more springs in generally permanent compression.

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