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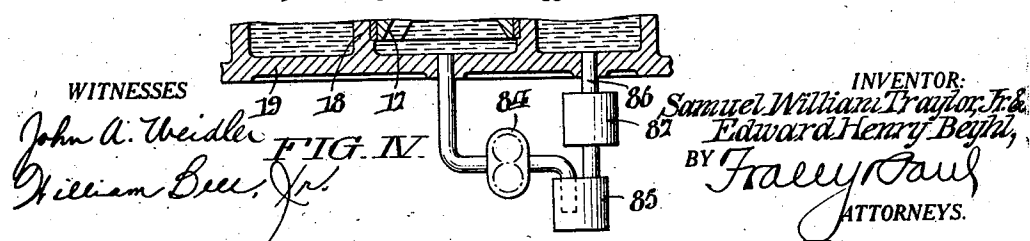
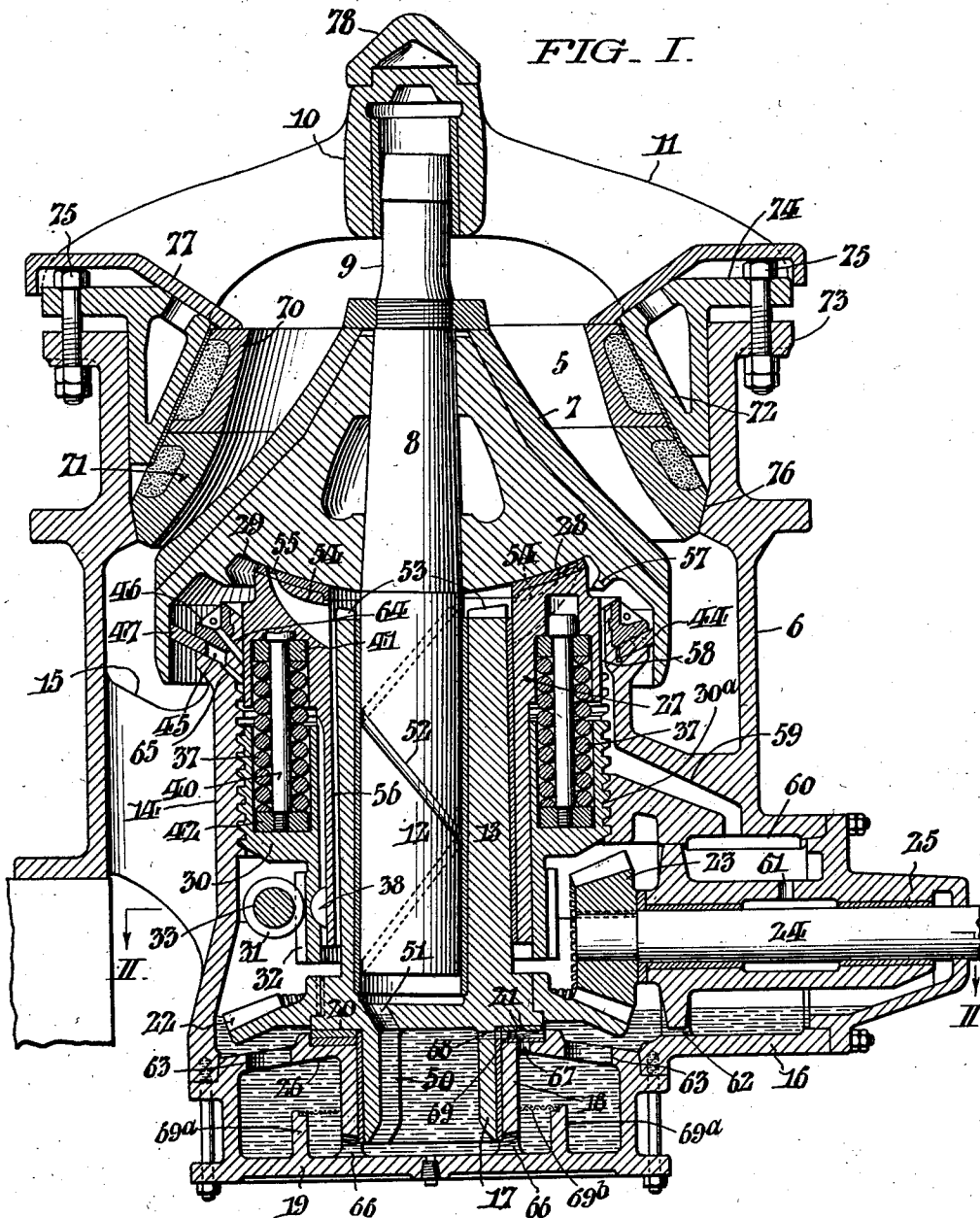
S. W. TRAYLOR, JR., ET AL

2,066,281

GYRATORY CRUSHER

Filed March 11, 1931

2 Sheets-Sheet 1



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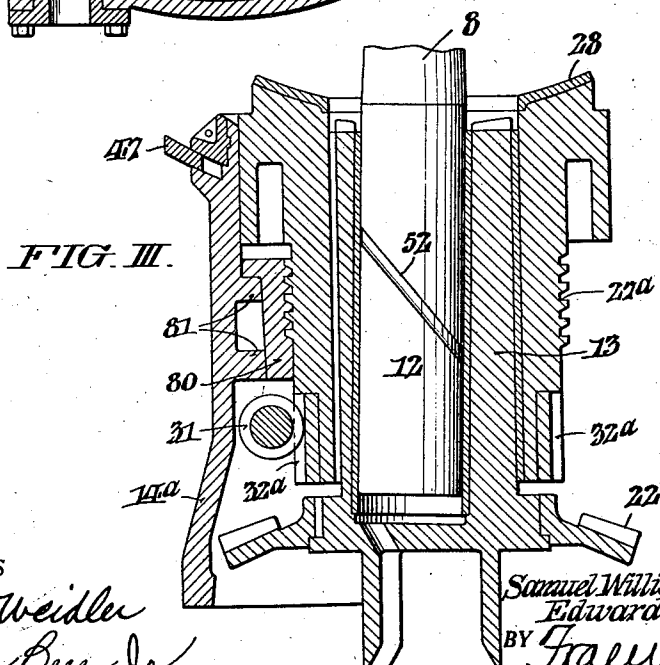
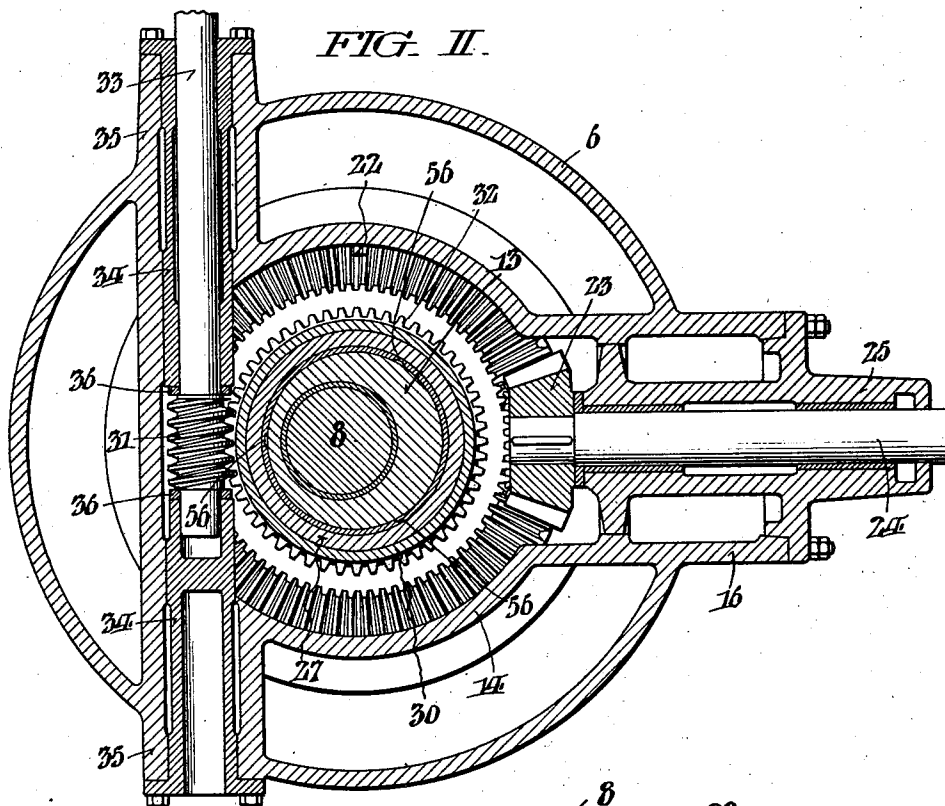
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2 Sheets-Sheet 2



WITNESSES

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GYRATORY CRUSHER

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15 Claims. (Cl. 83—10)

Our invention relates to gyratory crushers, our object being to provide a novel crusher affording various advantages that will appear hereinafter. We aim to provide a compact machine with yielding head support that can be easily adjusted to vary the size of the crushed product, even while the machine is running. We aim to provide for easy replacement of the inner, working surface of the crushing shell; to provide for effective lubrication of working parts, in a novel and advantageous manner; and to provide for enclosing and sealing the bearings against entrance of grit or escape of oil. In employing an eccentric to operate the crushing head, we aim to improve the eccentric bearings, especially the step bearing and its lubrication.

How any and all of these advantages can be realized through the invention will appear from the description hereinafter of selected and preferred forms of embodiment.

In the drawings, Fig. I shows a vertical mid-section through a gyratory crusher conveniently embodying our invention.

Fig. II shows a horizontal section taken as indicated by the line and arrows II—II in Fig. I.

Fig. III is a fragmentary vertical section taken similarly to Fig. I, but showing a modification of certain parts.

Fig. IV is a fragmentary vertical section illustrating provisions for lubricant circulation from outside the crusher.

The crusher here shown comprises an outer crushing shell 5 located in the upper portion of the hollow frame or casing 6 and a gyratory crushing head 7 mounted within the shell 5 and casing 6, and cooperating with them in a manner well understood in this art. The crushing head 7 is mounted on a conical portion of a shaft 8, which in the present instance extends up above the head at 9 and has a slightly conical enlargement that engages in a bearing 10 mounted over the crushing shell 5, in the hub of a spider 11. The shaft 8 also extends downward below the head 7 at 12. In the present instance, the gyratory head 7 is operated by a subjacent rotary eccentric 13, that actuates the downward projecting lower portion 12 of the shaft 8. Within the frame 6 is a hollow hub-like structure 14, connected to the frame 6 by suitable spoke-like webs 15 and by a bored countershaft bearing boss 16,—all preferably cast integral with the frame 6. The lower end portion or extension 17 of the eccentric 13 is journaled in a bearing boss 18 in a hollow drum-like bottom structure 19 bolted fast to the lower end of the hub 14. The eccentric

13 has an external step bearing shoulder 20 that rests on a step bearing shoulder formed by one or more bronze wearing rings 21 seated in a rabbet at the upper end of the bearing 18. On the eccentric 13 (just above the step bearing 20) is a beveled driving gear 22 which meshes with a bevel pinion 23 on the inner end of a countershaft 24 mounted in a bearing bracket 25, which is mounted and secured in the bore of the boss 16. The countershaft 24 may be driven by an electric motor (not shown) or any other suitable source of power, to rotate the eccentric 13. The eccentric journal bearing at 17, 18, below the gear 22, supplements its journal bearing above the gear (hereinafter described) very effectively in taking the lateral thrust due to the crushing stresses. An apertured annular web 26 connects the upper end of the boss 18 to the outer drum wall.

The crushing head 7 is supported by an annular bearing member 27 located within the hub 14 around the eccentric 13, and preferably also affording a journal bearing for said eccentric 13 above the gear 22. As here shown, the member 27 has a replaceable wearing surface 28 with which the finished bottom surface 29 of the head engages. These surfaces 28, 29 are spherical surfaces whose center lies at the point of engagement of the upper shaft element 9 in its bearing 10. The head-supporting member 27 is adjustable up and down in the hub 14, to raise and lower the crushing head 7 relative to the crushing shell 5, so as to vary the clearance between these parts and the size of the crushed product. For this purpose, there is shown an annular "nut" member 30 in screw threaded engagement at 30a with the interior of the hub 14, so that it can be raised and lowered by turning it in the hub. Preferably, the thrust-transmitting surfaces of the threads 30a are bevelled so as to be everywhere substantially parallel with the diametrically opposite active crushing surface of the head 7 which creates the thrust. Thus the nut 30 is self-centering, and the crushing thrust does not tend to tilt or "cock" it. As shown, the threads at 30a are "buttress" threads. The nut member 30 can be turned by means of a worm 31 engaging a worm wheel or set of teeth 32 on the reduced lower end of said member 30. As shown in Fig. II, the shaft 33 of the worm 31 is journaled in bearing sleeves 34, 34 inserted and secured in bosses 35 cast integral with the frame 6 and hub 14, and friction washers 36, 36 are interposed between said bearing sleeves and the ends of the worm to take the worm thrust.

The annular member 27 is supported by the nut

30 through an interposed nest of helical compression springs 37 accommodated in corresponding bores in said parts 27, 30. The parts 27, 30 may be anti-turningly engaged with freedom for relative vertical movement, as by a keyway and feather connection 38. Each of the springs 37 is mounted around a bolt 40, between a washer ring 41 and a nut ring 42, so that the springs are held under definite initial tension and afford solid support for the bearing 27 until an excessive force is brought to bear on the crushing head 7,—as by a piece of metal getting into the crusher. In other words, the parts 27, 30 behave as a single structure until necessity arises for the yielding of the spring cushion. The member 27 has a sliding fit in the member 30, as well as in the upper part of the hub 14.

As here shown, the lower end of the crushing head 7 has a cylindrical surfaced internal shoulder or cavity formed by a depending skirt or flange 44. The corresponding portion of the hub 14 has an external annular groove 45 formed by a shoulder or flange on the hub and a split cover ring 46, held in definite position by an internal rib or tongue engaged in a corresponding external groove in the hub 14. In the groove 45 is a sealing ring 47 whose cylindrical periphery engages with the cylindrical inner surface of the head 7 at 44. The coating surfaces of the ring 47 and of the sides of its groove 45 are preferably spherical, and concentric with the surface 29 of the head 7. The ring 47 permits free gyratory movement of the head 7, and does not interfere with its vertical adjustment, but nevertheless forms a tight seal between the head 7 and the hub 14 against ingress of dust or dirt and against egress of oil or lubricant. This and the thorough lubrication hereinafter described permits vertical adjustments of the head 7 to be made (by means of the worm and nut 31, 30) while the crusher is running. The great reduction possible in the threads 30a and between worm 31 and gear 32 permits correspondingly easy adjustment, notwithstanding the weights and stresses involved.

From the foregoing description, it will be seen that the head-supporting means 27, adjusting means 30, 31, 32, and spring cushion means 37, etc., as well as the head-operating mechanism (eccentric 13, etc.), are all inside the crusher, between the head 7 above and the driving gear 22 beneath, and completely enclosed and sealed off in the hollow hub 14 with its bottom 19 and boss 16, etc. Thus all the working and wearing parts and surfaces (except the bearing at 10) are enclosed and included in the main lubricating system of the crusher which lubricates the head-operating mechanism, and are also thereby lubricated. When the crusher is at rest, the oil supply in the enclosure forms a pool that extends upon the teeth of gear 22. The lower bearing portion 17 of the eccentric 13 is hollow, and is provided with an inclined oil raising scoop rib 50. At the upper end of this rib is a port 51 into the interior of the eccentric 13, below the lower end of the crusher head shaft portion 12. In the external surface of the shaft 12 is a helical groove 52, of comparatively large pitch. When the crusher is in operation, oil is lifted into the interior of the eccentric 13 by the rib 50, aided by centrifugal force, and is thence raised or wiped upward in the groove 52, by the combined action of centrifugal force and of friction between the interior of the revolving eccentric and exterior of the shaft 12,—which does not re-

volve,—thoroughly lubricating the interior of the eccentric. The oil issues from the upper end of the groove 52 into the interior of the annular member 27. On the upper end of the eccentric 13 are a number of upstanding radial vanes or wings 53 that act centrifugally to pass or propel the oil outward and upward through upward-sloping curved ports or passages 54 in the member 27 into an annularly extending oil groove 55 in the contact surface 28 of said member, so as to lubricate its contact with the head 7. The lower ends of the passages 54 are shown of sufficient vertical width to receive the oil thrown out by the vanes 53 in all vertical adjustments of the member 27. Some of the oil at the upper end of the eccentric 13 descends in grooves 56 in the outer bearing surface of the eccentric, thoroughly lubricating it, and then flows outward over the teeth of gear 22, lubricating its contact with pinion 23.

From the groove 55 in the head-supporting contact surface 28 of the member 27, some of the oil works its way out around the member 27, and strikes an annular inturned flange 57 on the bottom of the head 7, and drips down into an annular V trough between the periphery of the member 27 and the inward-bevelled upper end of the hub 14 and collar 48. This oil works down between these parts, and in grooves 58 in the hub 14, to the screw threads between the nut member 30 and the hub 14, and some of this descends through a port or passage 59 in hub 14 and flows outward to a chamber 60 in the bearing bracket 25. From this chamber 60, the oil runs through a port 61 to the countershaft 24, and works its way inward and outward through its bearings. The outflowing oil returns through ports 62, 63 to the pool beneath the gear 22. Some oil may also be thrown off from the crushing head flange 57 and reach the seal ring 47, lubricating its contacts with the shoulder at 44 and the sides of groove 45. From the top of cover ring 46 and from the bottom of groove 45, oil passes inward and downward through sloping ports 64, 65 and works on down between the interior of the hub and the members 27, 30. The "trough" in cover ring 46 and the port or ports 64 largely prevent oil from reaching the sealing ring 47, and thus protect it from grinding wear by dust particles retained by the oil. All of the descending oil finally finds its way back to the pool beneath the gear 22 and through ports 62 and 63 into the hollow eccentric portion 17. Some of the oil of this pool also rises through a port 67 to the supporting bearing 21 of the eccentric 13.

As shown in Fig. I, there are one or more oil ports 68 leading from the interior of the eccentric portion 17 outward to the step bearing rings 21, which have radial grooves or channels 69 in their wearing surfaces. Thus oil is delivered between the wearing surfaces of the step bearing, passing out through the ports 68 and into the grooves 69, by centrifugal force, whenever the grooves and ports register, and thoroughly lubricating the step bearing. This is of great practical importance, inasmuch as heretofore such bearings have lacked adequate lubrication and so worn badly, or even burned out.

The pool of oil in the outer annular chamber 70 of the bottom drum 19, below the step bearing 20, 21 and around the central hollow journal boss 18, is quiescent, so that dirt has a chance to settle out there. As shown, there is an annular dam 69a upstanding from the bottom of the 75

drum 19, around the boss 18, with an annular strainer 69b over the space between the top of the dam and the boss. Thus dirt settling out is prevented from finding its way back into circulation through the ports 66. The step bearing 20, 21, it will be seen, is elevated well above the dirt in the bottom of the lubricating system, so that it runs in and receives only clean oil.

The downward-flared crushing shell or rock-engaging lining 5 is mounted in the upper end of the hollow frame or casing 6, and is removable upward without breaking joints in either the frame or the shell,—which allows the frame 6 to be made in one piece, increasing its strength, and greatly reducing its cost. The shell 5 can also be made in one piece or without vertical division: as here shown, it comprises two annular members or "concaves" 70, 71 (as they are commonly termed), divided horizontally, and held in place 20 in the frame 6 by superjacent annular securing means 72, suitably secured to the frame. The concaves 70, 71 being flared externally as well as internally, the securing means 72 is shown of a corresponding wedge section, so as to fit in the 25 frame 6 around (and above) the concaves, and hold them in definite axial alignment. The frame 6 and the wedge means 72 are shown with external flanges 73, 74, through which extend securing bolts 75. The spider 11 (when a spider 30 11 and an upper shaft bearing 10 are employed) may be cast integral with the wedge means 72, which thus becomes, in effect, a spider rim. The frame 6 is internally shouldered at 76, as a means of seating and sustaining the crushing 35 shell 5 in the frame. The circular wedge 72 has a sliding fit in the frame 6, and has its inner conical surface machined to fit the concaves 70, 71, which may be a ground machined fit in said part 72, or may have a supporting filler of spelter 40 or any other means of making a joint. The frame 6 is bored to receive the circular wedge 72, and taper board at 76 in conformity to the conical edge of the lower concave 71.

By pulling up the bolts 75 tightly, the wedge 45 flange 74 is drawn to the frame flange 73, the wedge 72 is clamped in the frame 6, and the concaves 70, 71 are forced home and held securely against movement due to the crushing stresses. If desired, the wedge means 72 may be split at 50 several points, to facilitate its removal from the frame 6 after the bolts 75 are taken out. The rim 72 may be protected from wear by wearing plates 77, and the spider hub, containing bearing 10, by a wearing cap 78.

By operating the crusher after loosening the 55 bolts 75, the wedge means 72 and the concaves 70, 71 will be loosened in the frame 6, so as to be easily lifted out. Then the crushing head 7 with its shaft 8 can be lifted out, and after it the bearing 27 and the springs 37. The bottom 19 may 60 be detached and removed downward, with (or followed by) eccentric 13 and gear 22. Counter-shaft bearing 25, pinion 23, and shaft 24 may be withdrawn sidewise together. Worm bearings 65 34, 34 may be withdrawn from opposite sides of the casing 6, and worm 31 then disengaged from gear 32 and withdrawn, along with thrust rings 36. The nut 30 may be screwed downward until freed from its threads 30a, and removed down- 70 ward.

Fig. III shows a slightly modified construction, in which spring cushion support of the crushing head is dispensed with, and also the separate adjusting nut member 30. Accordingly, 75 the head-supporting member 27a alone forms the

vertically adjustable structure, and has direct screw threaded engagement in the hub 14a. For this purpose, the reduced lower portion of this member 27a is externally screw threaded, and is provided with a worm gear or toothed portion 5 32a for engaging the adjusting worm 31. To facilitate assemblage, the screw threads of the hub 14a may be on a separate flanged collar 80, seated in internal shoulders 81, 81 in the hub with a taper fit, and suitably engaged or other- 10 wise secured against turning.

Fig. IV shows how the crusher of Figs. I—III may be lubricated by circulation of oil under pressure from an outside source, represented as a gear pump 84 drawing from a supply tank 85 and 15 delivering through the bottom 19 directly into the interior of bearing boss 18 and eccentric portion 17. From this point, the oil passes upward inside the eccentric 13, etc., and returns downward into the drum 19 as already described,— 20 although the inner eccentric-lubricating groove 52 need not, of course, be spiral, since the pump 84 can be relied on to force the oil upward as desired. The boss 18 is shown without the ports 66 of Fig. I; and the oil returning to the drum 25 19 through the ports 63 passes out through a discharge connection 86 from the annular outer chamber of the drum and returns to the supply tank 85. As shown, a filtering or other purifying apparatus 87 of any suitable type may be inter- 30 posed in the return connection 86.

Having thus described our invention, we claim:

1. In a gyratory crusher, the combination of a frame provided with a crushing shell, a gyratory member having a crushing head for coacting with 35 said shell, a rotary eccentric below said head for actuating said gyratory member, and supporting means under said head including a support bearing engaging the head and sustaining spring means for said bearing around said eccentric, di- 40 rectly sustaining said bearing and head against normal crushing stresses, but permitting them to yield relative to said shell and frame under excessive stress.

2. In a gyratory crusher, the combination of a 45 frame with a crushing shell and an internal hub beneath said shell, a gyratory crushing head coacting with said shell, a support bearing for said head underneath the same in said hub, and means in said hub for adjusting said bearing up 50 and down and resiliently supporting it, including spring means in the hub directly sustaining said bearing and head.

3. In a gyratory crusher, the combination of a 55 frame with a hub and a crushing shell, a gyratory crushing head coacting with said shell and having a downward extending shaft, a rotary eccentric below said head for actuating said shaft, an annular support bearing for said head movable 60 up and down in said hub around said eccentric, and also journalling the eccentric; and means for resiliently supporting said bearing and adjusting it up and down in the hub, including resilient means in the hub normally sustaining the bear- 65 ing, but permitting it to yield under excessive crushing stress.

4. A gyratory crusher comprising a frame with a hub and a crushing shell, a gyratory crushing head cooperating with said shell and having a 70 downward extending shaft, a rotary eccentric for actuating said shaft, an annular member in said hub affording bearing support for the head and journal bearing for the eccentric, an annular member in screw threaded engagement in said 75

hub below said first-mentioned member, and spring cushion means interposed between said members.

5 5. In a gyratory crusher, the combination with the gyratory crushing head and its operating mechanism, and a lubricating system for the latter having an enclosure around the same below the head, of a bearing support for the head at its lower side and spring means supporting said bearing support, all enclosed inside the crusher in the said enclosure of its lubricating system and lubricated by said lubricating system.

15 6. In a gyratory crusher, the combination with the gyratory crushing head and its operating mechanism, and a lubricating system for the latter having an enclosure around the same below the head, of spring mounted supporting means for the head and means for vertically adjusting said means to raise and lower the head, all enclosed inside the crusher in the said enclosure of its said lubricating system and lubricated by said lubricating system.

25 7. In a gyratory crusher, the combination of a frame with a hub and a crushing shell, a gyratory crushing head coacting with said shell and having a downward extending shaft, a rotary eccentric for actuating said shaft, means in said hub around and journalling said eccentric for supporting and vertically adjusting said head, and a lubricating system for said eccentric and said supporting and adjusting means enclosed in said hub and including means for circulating oil up and down within said hub, one way inside the eccentric and the other way outside the same, to lubricate the wearing surfaces of said eccentric and said supporting and adjusting means.

30 8. In a gyratory crusher, the combination of a frame with a hub and a crushing shell, a gyratory crushing head cooperating with said shell having a downward extending shaft, a rotary eccentric for actuating said shaft, an annular structure adjustable up and down in said hub around said eccentric, journalling the eccentric and affording a supporting bearing for said head, and means for circulating oil in a closed system up and down within said hub, one way inside the eccentric and the other way outside the same, so as to lubricate the wearing surfaces within the hub.

50 9. In a gyratory crusher, the combination of a gyratory crushing head with a downward extending shaft, a rotary eccentric below said head for actuating said shaft, a bearing around said eccentric for supporting said head having passage therein for oil outward and upward from the upper end of said eccentric to the space or area of contact between the contact surfaces of said bearing, means for supplying oil at the top of said eccentric, and means on said eccentric for throwing the oil outward into the oil passage of said bearing to lubricate its contact with said head.

60 10. In a gyratory crusher, the combination of a gyratory crushing head with a downward extending shaft, a rotary eccentric below said head for actuating said shaft, a bearing around said eccentric for supporting said head, said head and said bearing having spherical coacting wearing

surfaces with an annularly extending oil distributing channel open directly to the space or area of contact between said surfaces and oil ports in the bearing open into its interior at the top of said eccentric and extending outward and upward to said channel, means for supplying oil to the interior of said bearing, and centrifugal vanes at the top of said eccentric for throwing the oil into said ports and thereby supplying said channel.

10 11. In a gyratory crusher, the combination with a gyratory crushing head and its shaft and a rotary eccentric for actuating said shaft, of an annular step bearing supporting said eccentric, with centrifugal means carried by and within the eccentric and a duct through the eccentric wall delivering oil from said centrifugal means outward between the coacting supporting surfaces of said eccentric and step bearing.

15 12. In a gyratory crusher, the combination with the gyratory crushing head and its shaft and a rotary eccentric for actuating said shaft, of an annular external step bearing supporting said eccentric at an intermediate point in its length, with oil passage upward through said eccentric and outward through its wall for conducting oil between the coacting supporting surfaces of said eccentric and step bearing, and means for supplying oil under pressure to the interior of the eccentric.

20 13. In a gyratory crusher, the combination with the gyratory crushing head and its shaft and a hollow rotary eccentric for actuating said shaft, of means affording an annular step bearing for said eccentric at an intermediate point in its length and a journal bearing for its portion below said step bearing, and means for supplying lubricant to the interior of said eccentric, with an oil opening outward through its wall for delivering the oil between the wearing surfaces of said step bearing.

25 14. In a gyratory crusher, the combination with a gyratory crusher head and its downward extending shaft, of an eccentric for actuating said shaft including a hollow journal portion extending downward below the shaft, and a step bearing for the eccentric above said hollow journal portion, with oil passage from the interior of said eccentric outward for delivering oil between the wearing surfaces of said step bearing, and means for introducing oil under pressure into said lower hollow portion of the eccentric.

30 15. In a gyratory crusher, the combination of a frame provided with a crushing shell, a gyratory crushing head coacting with said shell and having a downward extending shaft, a rotary eccentric below said head for actuating said shaft, an annular support bearing for said head in said frame, around and journalling said eccentric, and supporting means for said bearing operatively interposed between the latter and said frame and including resilient means normally sustaining the bearing, but permitting it to yield relative to said shell and frame under excessive crushing stress.

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