May 22, 1951 R. W. STEVENS 2,553,987

GYRATORY CRUSHER

Filed Nov. 29, 1946 3 Sheets-Sheet 1

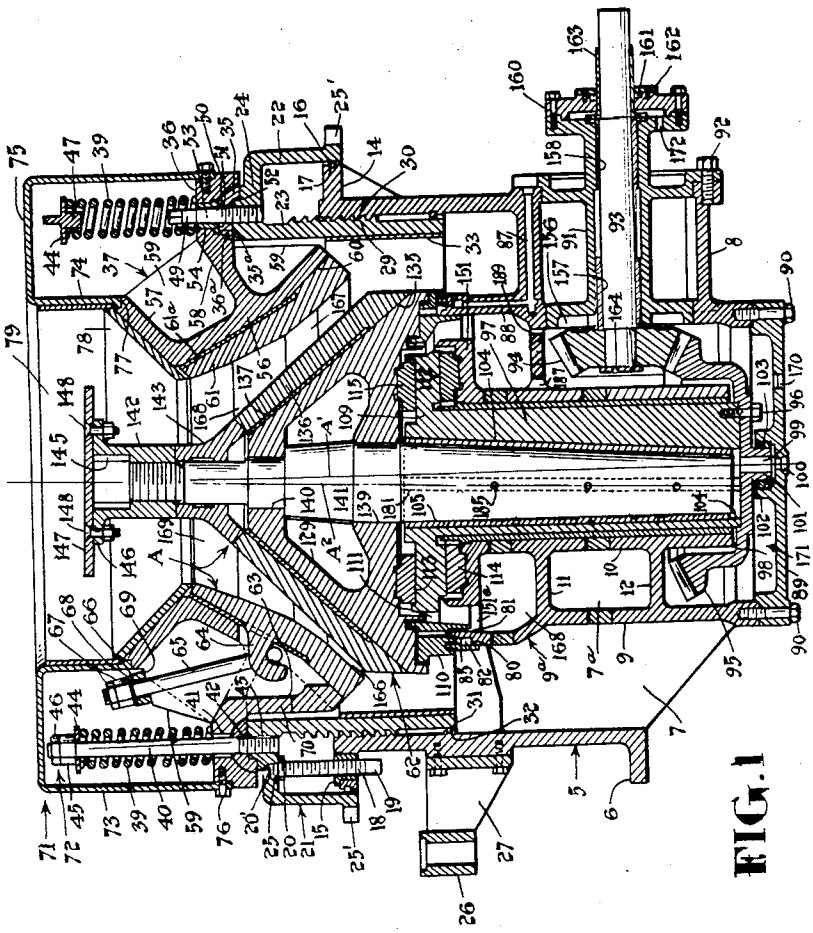


FIG. 1

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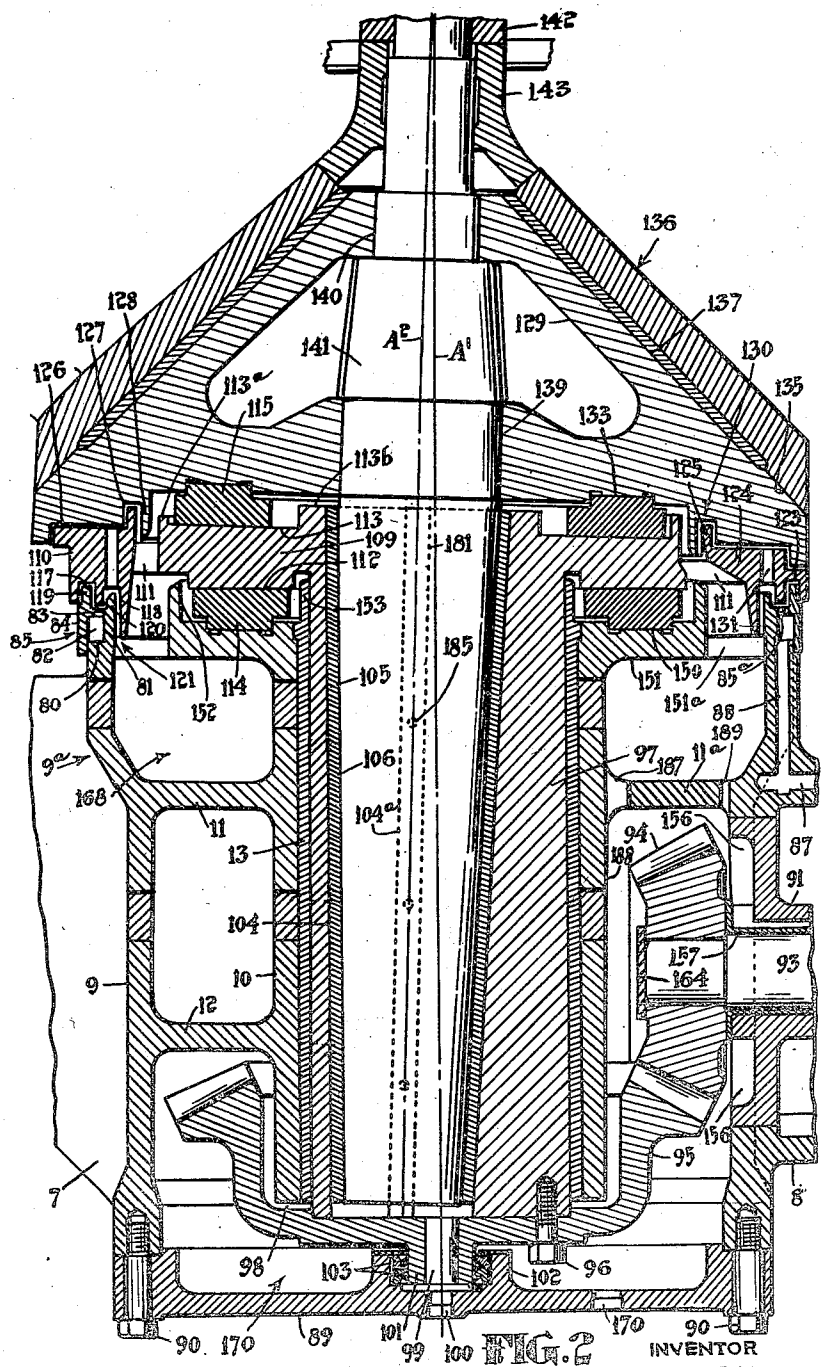


FIG. 2

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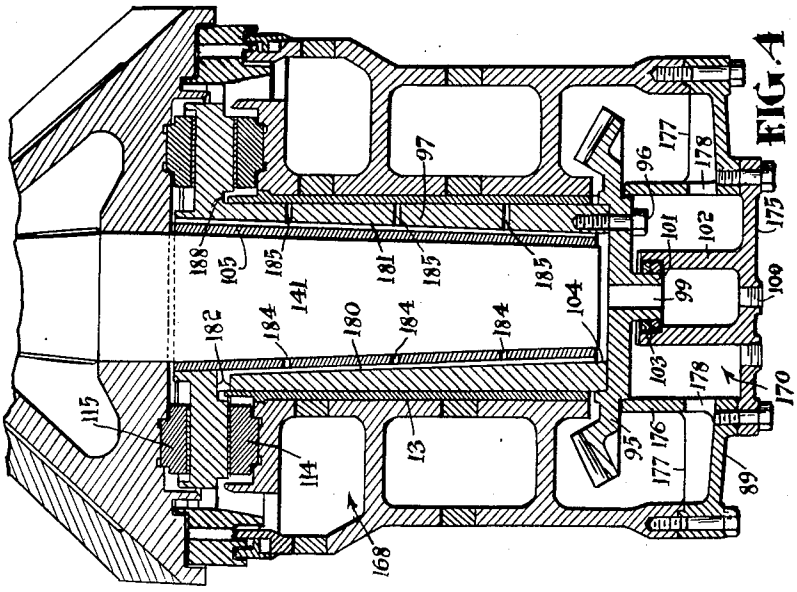


FIG. 4

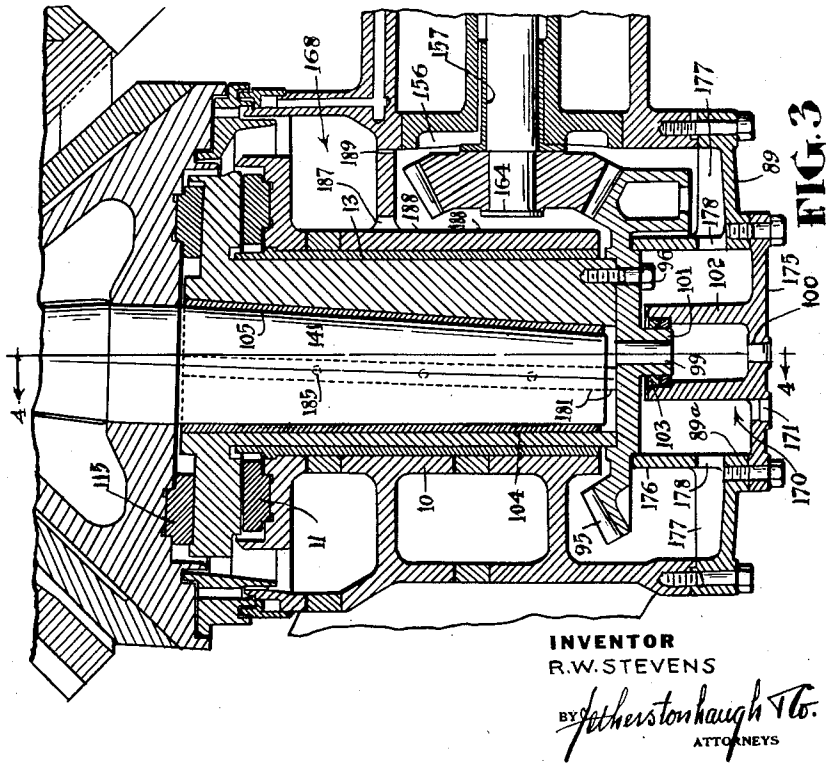


FIG. 3

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Patented May 22, 1951 2,553,987

UNITED STATES PATENT OFFICE

2,553,987

GYRATORY CRUSHER

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Application November 29, 1946, Serial No. 712,841

4 Claims. (Cl. 241—215)

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This invention relates to improvements in gyratory crushers in which the crusher-head is gyrated by rotation of an eccentric comprising a cylindrical member rotatably journalled in the frame structure of the crusher and provided with an inclined shaft-receiving bore in which the crusher-head shaft is rotatably journalled.

According to one feature of this invention, the crusher-head and eccentric are supported by an improved arrangement of thrust-bearings comprising an eccentric supporting thrust-bearing interposed between a downwardly facing bearing surface at the upper portion of the eccentric and an opposing upwardly facing bearing surface of the frame structure; and a second crusher-head supporting thrust-bearing interposed between an upwardly facing bearing surface provided at the upper portion of the eccentric and an opposing downwardly facing bearing surface of the crusher-head.

Another feature of the invention consists in the provision of an improved lubricating system including provision for flooding said thrust-bearings with oil when the crusher is in operation and for maintaining a pool of oil in contact with said thrust-bearings when the crusher is at rest, to thereby ensure adequate lubrication of the thrust-bearings when the crusher is started up.

Another feature of the invention consists in taking advantage of the location of said thrust-bearings at the upper portion of the eccentric by providing an improved gear drive comprising a gear secured against the lower end of the eccentric and meshing with a pinion carried by a drive shaft journalled in said frame structure, the location of the gear at the lower end of the eccentric making said gear easily accessible so that shims may conveniently be interposed between said gear and eccentric, when relative adjustment of the gear and pinion is necessary to ensure proper meshing thereof.

Another feature of the invention consists in collecting the overflow oil from said thrust-bearings in a sump provided with an opening through which the oil drops onto said gear and pinion while passing downwardly to a lower sump located at the bottom of the frame structure.

Another feature of the invention consists in the provision of a novel arrangement of oil passages through which oil is fed to lubricate (*a*) a bearing liner fitted in the inclined shaft-receiving bore of the eccentric and (*b*) a bearing bushing by means of which the eccentric is journalled in said frame structure.

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A further feature of the invention consists in the provision of a novel air seal arrangement for protecting movable parts of the crusher against dust infiltration.

A further feature consists in the provision of novel means for mounting a mantle assembly with which the crusher-head cooperates.

Other characteristic features and advantages of the invention are described or made apparent in the following detailed description of the accompanying drawings, in which—

Figure 1 is a vertical sectional view of a gyratory crusher embodying my invention.

Figure 2 is an enlarged vertical sectional view of a portion of the crusher assembly, comprising the crusher-head, the eccentric, and the portion of the frame structure in which the eccentric is journalled.

Figure 3 is a view similar to Figure 2 but showing certain modifications.

Figure 4 is a sectional view along section line 4—4 of Figure 3.

As shown in these drawings, the main frame structure of the crusher includes a generally cylindrical outer frame member 5 provided, at its lower end, with an outwardly directed flange 6 forming a square base which supports the crusher on its foundations. Member 5 is connected, by radial vertical ribs 7 and horizontal tubular member 8, to a generally cylindrical intermediate frame member 9. The last mentioned member 9 is connected to an inner cylindrical frame member 10 by horizontal ribs 11 and 12 and also by inward continuations 7*a* of vertical ribs 7. Member 10 is bored to receive a bronze bearing 13.

An outwardly directed flange 14 is provided at the upper end of member 5. This member is bored to receive a number of inserts 15 and carries a packing 16 fitted in groove 17. Locking studs 18 extend upwardly through inserts 15 in screw threaded engagement therewith. These locking studs are provided with non-circular lower ends 19 so that they may be turned to jam their upper ends against wearing rings 20 carried by an adjusting ring 21.

Ring 21 comprises outer and inner cylindrical portions 22 and 23 having their upper edges joined by an integral horizontal section 24 provided with tapped openings 25 into which the cap screws 20' are screwed to support wearing ring 20.

The outer cylindrical portion 22 of ring 21 constitutes a dust guard which overlies the outer edge of frame flange 14 in sliding contact with packing 16 and is provided with a circular series of outwardly directed projections 25'. These pro-

jections 25' are adapted to be engaged by a ring-turning lever (not shown) which is removably fulcrumed in a fulcrum bearing 26 carried by a bracket 27 which is bolted to frame member 5.

The inner cylindrical portion 23 of ring 21 is provided with a threaded section 29 engaging a correspondingly threaded section 30 of frame member 5. A packing 31 is arranged in groove 32 provided in frame member 5 below threaded section 29 and engages the inner cylindrical portion 23 of ring 21 to exclude dust and foreign material from the interior of said ring. The inner cylindrical portion 23 of ring 21 also carries a plate steel liner 33 suitably fastened thereto.

A wear ring 35 is arranged on horizontal section 24 of adjusting ring 21 and supports the outwardly directed flange 36 of bowl member 37. Wear ring 35 presents a convex, toroidal bearing surface 35a engaging and supporting a complementary concave toroidal bearing surface 36a of bowl flange 36.

Flange 36 of bowl member 37 is yieldingly held down on wear ring 35 by the lower ends of compression springs 39 arranged in groups of three each. The outer springs 39 of each group encircle studs 40 which extend through holes 41 in flange 36 and holes 42 in wear ring 35 into tapped openings 43 provided in section 24 of ring 21. The upper ends of the three springs of each group bear against a pressure applying plate 44 which is slidably mounted on the studs 40 beneath the spring adjusting nuts 45 and locking nuts 46. The upper end of the central spring 39 of each group is held in position by a downward projection 47 of plate 44. The openings 41 of bowl flange 36 are made large enough to permit the flange to have a certain degree of tilting or angular movement relative to studs 40.

The intermediate spring 39 of each group is held in place at its lower end by the upper portion of a dowel 49 having its lower portion screwed into a tapped hole 50 provided in adjusting ring 21. The principal functions of dowel 49 are to guide bowl flange 36 and to hold the wear ring 35 down on adjusting ring 21. In this connection it will be noted that each dowel is provided with a hold down flange 50 countersunk in a recess 51 formed by enlarging the upper end of a dowel-receiving opening 52 provided in wear ring 35. It will also be noted that a conical portion 53 of each dowel located immediately above flange 51 is slidably fitted in a complementary conical bore provided in a hardened steel bushing insert 54 carried by bowl flange 36. Bowl 37 comprises three conical sections 56, 57 and 58 which are stiffened by a plurality of ribs 59 formed integral therewith. The bowl flange 36 is formed as a horizontal continuation of bowl section 58. The main bowl section 56 is a downwardly and outwardly flaring conical annulus having the lower portion of its inner surface machined to provide a seat 60 for the lower portion of the bowl liner 61. Bowl section 56 and liner 61 are designed to leave an intervening space which is filled with ductile metal 61a to provide a yieldable seat for the liner.

At each of a plurality of points around its circumference bowl 37 is cored out to provide a pocket 63 receiving therein a hook-shaped lug 64 projecting outwardly from bowl liner 61. Each lug 64 is supported on the central portion of a U-bolts 65, the side legs of which extend upwardly through supporting bar 66 and are equipped with adjusting nuts 67 bearing on washers 68 carried by said bar. The ends of bar 66 rest on seats 69 provided at the upper edges of two ribs 59 between which the pocket 63 is formed. Each pocket 63 includes an outer dust excluding wall 70 which prevents dust passing upwardly through the pocket 63 into the spring housing hereinafter referred to.

A cover 71 is preferably secured to bowl member 37 to provide a spring housing 72 enclosing the springs 39. This cover comprises an outer cylindrical portion 73 and an inner cylindrical portion 74 having their upper edges integrally joined to a horizontal connecting portion 75. The lower edge of the outer portion 73 of cover 71 is fastened to the outer periphery of bowl flange 36 by cap screws 76. The lower edge of the inner cylindrical portion 73 of cover 71 is supported on a seat 77 provided at the upper edge of bowl section 57.

The conical section 57 of bowl 37 is an upwardly and outwardly flaring section which provides a hopper from which the material to be crushed is fed into the crushing zone A between the bowl liner 61 and the crusher head assembly generally indicated at 62. A suitable one-piece lining 78 is preferably arranged on the upper surface of the hopper section 57 of bowl 37 so that the lower edge of hopper lining 78 overlies the upper edge of bowl lining 61.

When cover 71 is used the inner cylindrical portion 74 thereof forms a cylindrical side wall extension of the hopper provided by bowl section 57 and is preferably equipped with a removable liner 79.

The portion of cylindrical frame member 9 which extends above horizontal rib 11 is expanded outwardly to form a larger cylindrical portion 9a which is machined to form the bottom wall 80 and inner side wall 81 of an annular air chamber 82. The top wall 83 and outer side wall 84 of air chamber 82 (see Fig. 2) are formed by machined surfaces of an air chamber ring 85. Air is admitted to air chamber 82 through a horizontal air inlet bore 87 provided in tubular frame member 8 and connecting vertical bore 88 provided in frame member 9. A cover 89 is fastened to the lower end of frame member 9 by bolts 90.

Tubular frame member 8 is bored to receive pinion shaft housing 91 and is also tapped to receive the shaft housing fastening bolts 92. A pinion shaft 93 extends inwardly through housing 91 and has a bevel pinion 94 fixed to its inner end. This pinion drives a bevel gear 95 which is fastened by bolts 96 to the lower end of an eccentric 97 journalled in the bronze bearing 13 fitted in frame member 10. Gear 95 is spaced from the lower portion of frame member 10 to provide an intervening oil passage 98. Gear 95 is also provided with central oil hole 99 to which oil is delivered through central oil inlet opening 100 provided in cover 89. The hole 99 in gear 95 is surrounded by a depending annular wall 101 which extends downwardly with an annular wall 102 rising from cover 89. A suitable oil seal 103 is interposed between annular walls 101 and 102 to force the oil supplied to oil inlet opening 100 to flow upwardly through the oil hole 99 whence it is distributed as hereinafter described.

That portion of eccentric 97 which is journalled in bearing 13 is a cylinder on axis A' and is provided with an inclined conical shaft receiving bore 104 on axis A^2, which makes a small angle

with axis A'. A bronze bearing liner 105 is pressed into conical bore 104.

The upper portion of eccentric 97 (Fig. 2) is expanded to provide a flange-like portion including a central section 109 and a rim section 110 connected to central section 109 by a plurality of connecting ribs 111. The central section 109 is machined to provide bearing surfaces 112 and 113 for bearing pads 114 and 115 which serve as thrust bearings. The downwardly facing bearing surface 112 is perpendicular to axis A' while the upwardly facing bearing surface 113 is perpendicular to axis A^2. Bearing pads 115 are positioned between and in spaced relation to outer and inner oil-retaining lips 113*a* and 113*b* projecting upwardly from bearing surface 113. Annular grooves 117 and 118 are machined in the underside of rim section 109 of eccentric 97. These grooves are machined on axis A. An upwardly directed projection 119 of an air chamber ring 85 extends into groove 117. A similar upwardly directed projection 120 of cylindrical portion 9*a* of frame member 9 extends into groove 118. The grooves 117 and 118 serve, in conjunction with the projections 119 and 120, to form a labyrinth 121. Suitably placed holes 85*a* are provided in ring 85 to allow passage of air from air chamber 82 to labyrinth 121.

The upper portion of rim section 110 of eccentric 97 is machined on axis A^2 to provide labyrinth forming portions 123, 124 and 125 mating with complementary machined portions 126, 127 and 128 of a conical crusher head 129 to provide a second labyrinth 130. A series of holes 131 are drilled in rim portion 110 of eccentric 97 to provide for passage of air from the lower labyrinth 121 to the upper labyrinth 130.

The lower portion of crusher head 129 is machined to provide groove 133 in which the upper bearing pads 115 are fitted. The bottom wall of groove 133 provides a downwardly facing bearing surface opposing the upwardly facing bearing surface 113. The outer conical surface of the crusher head is machined to provide a seat 135 for the manganese steel mantle 136. The portions of crusher head 129 and mantle 136 which lie above seat 135 are designed to leave an intervening space which is filled with ductile metal 137, such as zinc, to provide a yieldable seat for the mantle.

Cylindrical shaft bores 139 and 140 are provided in crusher head 129 to receive the upper portion of crusher head shaft 141. The portion of shaft 141 which extends downwardly from crusher-head 129 is conical and is fitted in conical liner 105 of eccentric 97 so that the crusher head is aligned with axis A^2. Mantle 136 is held firmly against crusher head 129 by a nut 142 on the upper end of shaft 141, the pressure of the nut being transmitted to the mantle through sleeve 143.

The upper portion of nut 142 is formed with inside vertical grooves 145 to provide for insertion of a suitable wrench for initial tightening. The upper end of nut 142 is also expanded to provide a supporting flange 146 to which a feed distributing plate 147 is fastened by bolts 148.

The eccentric 97 and crusher head 129 are supported by the lower bearing pads 114 which are fitted in groove 150 provided in horizontal frame portion 151 extending between the expanded portion 9*a* of frame member 9 and the upper portion of frame member 10. The bottom wall of groove 151 provides an upwardly facing bearing surface opposing the downwardly facing bearing surface 112. Bearing pads 114 are positioned between an outer oil-retaining lip 152 rising from frame portion 151 and an inner oil-retaining lip 153 formed by a portion of bearing 13 which projects above frame portion 151.

Reverting to the previously mentioned crushing zone A it will be noted that the outer and inner walls of this zone are formed, respectively, by the bowl liner 61 and the crushing head mantle or liner 136. Beginning at the lower end of the crushing zone these liners are arranged to provide a parallel section 166 when they are in a position of closest approach. Above this parallel section the crushing zone widens out by reason of the fact that one of the liners is built in a series of conical steps 167, 168 and 169, the angle between the conical sections of the liners at the top being not larger than that which will nip the rock to be crushed without forcing it from the crushing zone.

The bore 104 of eccentric 97 is provided with an oil groove 180 (see Fig. 4) extending from the lower end of the bore to a radial opening 182 and with a second oil groove 181 diametrically opposite extending to the upper end of said bore. Opening 182 extends radially from bore 104 to the outer surface of the eccentric. Grooves 180 and 181 are covered by liner 105.

Holes 184 are drilled radially in bronze bearing liner 105 to allow oil to pass from groove 180 to lubricate this bearing. Similarly, holes 185 are drilled radially in the eccentric to meet groove 181 and allow oil to pass from this groove to lubricate bronze bearing 13.

A pocket 156 is provided at the inner end of pinion shaft housing 91 to pick up oil and lead it to the combined radial and thrust bronze bearings 157 and 158. If desired, the bearings 157 and 158 may be replaced by anti-friction bearings which take care of both radial and thrust loads. The end cover 160 of shaft housing 91 is provided with a seal 161 and a seal cover 162.

Power is transmitted to pinion shaft 93 through a coupling (not shown) which is fitted on the shaft so that it is pressed against a spacer sleeve 163 extending outwardly through end cover 160 and seal 161. Pinion 94 is pressed on shaft 93 and held against endwise displacement by retaining plate 164 which is held in place by cap screws (not shown).

Operation

Rotation of pinion shaft 93 by an electric motor or other prime mover serves to rotate eccentric 97 about axis A' through the agency of pinion 94 and gear 95. This rotation of eccentric 97 imparts a conical motion to crusher head shaft 141 and gyrates the crusher head 129. The crusher head must be free to rotate about axis A^2 independently of eccentric 97 and this is provided for by the fitting of the conical portion of shaft 141 in the conical bearing liner 105 of eccentric 97.

Lubrication

Oil is pumped to central oil inlet opening 100 provided in cover 89 and is directed through oil hole 99 of gearing 95 by the constraining effect of oil seal 103. The oil is then free to divide itself between oil grooves 180 and 181 in bore 104 of eccentric 97 (see Fig. 4). Oil following oil groove 180 of eccentric 97 passes outwardly through radial openings 182 to flood the lower bearing pad 114. Oil following the oil groove 181 of eccentric 97 floods the upper surface of the eccentric to lubricate the upper bearing pad 115.

The oil which floods the thrust bearing pads 114 and 115 is thrown downwardly and outwardly into an oil sump 168 which lies in the upper part of the central section of the frame structure and is bounded by the horizontal frame portion 151, the upper portions of the frame members 8 and 9 and the horizontal rib 11. The upper horizontal frame portion 151 is provided with openings 151a through which the oil passes. The rib 11 forming the bottom wall of the oil sump 168 is provided with an opening 187 through which oil drops, passing along wall 188 and onto bevel gear 95 at the point where it meshes with bevel pinion 94, to be thrown outwardly, a large portion of it passing through the gear mesh.

Rib 11 is also provided with a small opening 189 through which a small quantity of oil passes to collect in pocket 156 whence it is led to the pinion shaft bearings. Suitable arrangements are made to return oil from these bearings to sump 170 or, alternately, direct to external sump (not shown). Oil thrown outwardly by the gear falls into sump 170 formed in cover 89 from which it is removed through hole 171.

In the modified arrangement shown in Figures 3 and 4, the bottom cover 89 of the frame is formed with a relatively large opening 89a normally closed by a relatively light auxiliary cover 175. In this case the openings 190 and 171 are formed in the auxiliary cover 175 which also carries the parts 102 and 103. The main cover 89 is formed with an upstanding annular wall 176 surrounding opening 89a and with ribs 177 extending outwardly from said wall. The wall 176 is provided with oil holes 178 through which oil enters sump 170 from the oil spaces provided between adjacent ribs 177. Ribs 177 will stop any swirl caused by the rotating gear.

The advantage of the double cover arrangement shown in Figures 3 and 4 is that the removal of the light auxilary cover 175 enables the eccentric 97 to be detached from gear 95 and removed for examination or replacement without removing the gear 95 which is too heavy for man handling. When cover 175 and the gear fastening bolts 96 are removed, the gear 95 will be supported and retained in position for re-attachment to the eccentric by the gear supporting annular wall 176 of main cover 89.

Some of the excess oil from bearing 13 will join the oil flowing from passage 182 to the lower bearing pad and some of such excess oil will drop onto gear 95.

An external oil sump (not shown) is provided for collecting and, if necessary, cooling the oil. The oil is led to this sump by suitable piping including a pipe (not shown) connected to an oil hole 171 in the bottom wall of oil sump 170 and a second piping (not shown) connected to an oil hole 172 provided at the outer end of the pinion shaft housing 91.

In order to protect the bearings 114 and 115 from starting without oil, means are provided for retaining a pool of oil at the contacting surfaces after the oil pump is shut off. This is accomplished by means of the oil retaining lips 113a and 113b arranged at opposite sides of the upper bearing pad 115 and the oil retaining lips 152 and 153 provided at opposite sides of the lower bearing pad 114.

The oil pump will preferably be driven separately from the main motor (not shown) but will be interlocked with the main motor in such a way as to start before the main motor and to run for a short time after the main motor is shut off.

Seal

As previously noted, air under suitable pressure is forced through the air inlet bores 87 and 88 into air chamber 82 from whence it passes into labyrinth 121 through holes 85a and from labyrinth 121 through holes 131 into the upper labyrinth 130. In this way air pressure is maintained in the air chamber 82 and in the labyrinthine air passages so that there will be a constant flow of air outwardly and inwardly from said air chamber through passages, the outward flow providing protection against dust and the inward flow toward the sump 168 tending to prevent the entrance of oil to these passages. A suitably placed and protected air vent (not shown) is provided to permit the air to flow freely out of the sump.

Having thus described the important characteristics of my invention and a preferred embodiment thereof, it will be understood that various modifications may be resorted to within the scope and spirit of the invention as defined by the appended claims.

I claim:

1. In a gyratory crusher of the kind described, a stationary vertically extending frame member provided with a vertical cylindrical bore, a horizontal frame member surrounding and integrally joined to the upper end of said vertical frame member, said horizontal frame member presenting an upwardy facing bearing surface bounded on its outer side by an integral upwardly projecting oil retaining lip, a bearing sleeve fitted in the bore of said vertical frame member with the upper end of the bearing sleeve projecting above said bore to provide an oil retaining lip at the inner side of said bearing surface, a vertically disposed eccentric rotatably journalled in said bearing sleeve, said eccentric comprising a cylindrical member provided with a shaft receiving bore having an axis which is inclined to intersect the central vertical axis of the eccentric at a point above the latter, a crusher head shaft journalled in and projecting above the bore of said eccentric, a crushes head rigidly secured to the upper end of said shaft in co-axial relation therewith, an integral flange projecting outwardly from the upper portion of said eccentric in spaced relation to said upwardly facing bearing surface and the bottom of said crusher head, said flange presenting downwardly and upwardly facing bearing surfaces, the downwardly facing bearing surface of the flange being perpendicular to the central axis of the eccentric and the upwardly facing bearing surface of said flange being perpendicular to the inclined axis of said shaft receiving bore and being bounded at its inner and outer sides by integral upwardly projecting oil retaining lips, a thrust bearing interposed between the downwardly facing bearing surface of said flange and the upwardly facing bearing surface of the horizontal frame member, a second thrust bearing interposed between the upwardly facing bearing surface of said flange and a downwardly facing bearing surface of said crusher head, said eccentric being provided with oil passages through which oil is conducted to and over the upper edges of the inner oil retaining lips bordering the inner sides of the upwardly facing bearing surface of said flange and said horizontal frame member and means for rotating said eccentric.

2. In a gyratory crusher of the kind described, a stationary vertically extending frame member provided with a vertical cylindrical bore, a hori-

zontal frame member surrounding and integrally joined to the upper end of said vertical frame member, said horizontal frame member presenting an upwardly facing bearing surface bounded on its outer side by an integral upwardly projecting oil retaining lip, a bearing sleeve fitted in the bore of said vertical frame member with the upper end of the bearing sleeve projecting above said bore to provide an oil retaining lip at the inner side of said bearing surface, a vertically disposed eccentric rotatably journalled in said bearing sleeve, said eccentric comprising a cylindrical member provided with a shaft receiving bore having an axis which is inclined to intersect the central vertical axis of the eccentric at a point above the latter, a crusher head shaft journalled in and projecting above the bore of said eccentric, a crusher head rigidly secured to the upper end of said shaft in co-axial relation therewith, an integral flange projecting outwardly from the upper portion of said eccentric in spaced relation to said upwardly facing bearing surface and the bottom of said crusher head, said flange presenting downwardly and upwardly facing bearing surfaces, the downwardly facing bearing surface of the flange being perpendicular to the central axis of the eccentric and the upwardly facing bearing surface of said flange being perpendicular to the inclined axis of said shaft receiving bore and being bounded at its inner and outer sides by integral upwardly projecting oil retaining lips, a thrust bearing interposed between the downwardly facing bearing surface of said flange and the upwardly facing bearing surface of the horizontal frame member, a second thrust bearing interposed between the upwardly facing bearing surface of said flange and a downwardly facing bearing surface of said crusher head, the bore defining wall of said eccentric being provided with a vertical groove through which oil is fed to and over the upper edge of the oil retaining lip bordering the inner side of the upwardly facing bearing surface of said flange and with a second vertical groove through which oil is delivered to an intermediate radial passage of the eccentric which delivers the oil to and over the upper edge of the oil retaining lip provided by the upper end of said bearing sleeve, and means for rotating said eccentric.

3. A gyratory crusher as set forth in claim 1, including a second vertical frame member surrounding and spaced from the first mentioned vertical frame member and having its upper portion integrally joined to the outer portion of said horizontal frame member, and a horizontal web connecting the vertical frame members below the horizontal frame member and forming the bottom wall of an oil sump having its side walls formed by portions of the vertical frame members extending above said web and having its top wall formed by said horizontal frame member, the last mentioned frame member and the flange of said eccentric being provided with vertical oil openings through which oil overflowing the outer oil retaining lips bordering the upwardly facing bearing surfaces of said flange and said horizontal frame member is delivered to said sump.

4. A gyratory crusher as set forth in claim 1, including a second vertical frame member surrounding and spaced from the first mentioned vertical frame member and having its upper portion integrally joined to the outer portion of said horizontal frame member, and a horizontal web connecting the vertical frame members below the horizontal frame member and forming the bottom wall of an oil sump having its side walls formed by portions of the vertical frame members extending above said web and having its top wall formed by said horizontal frame member, the last mentioned frame member and the flange of said eccentric being provided with vertical oil openings through which oil overflowing the outer oil retaining lips bordering the upwardly facing bearing surfaces of said flange and said horizontal frame member is delivered to said sump, the second mentioned vertical frame member including an air chamber extending around the upper portion thereof, said air chamber including a top wall having air discharge openings bounded by upwardly directed projections extending into downwardly facing grooves in the outer portion of the eccentric flange and forming, with the walls of said grooves, a labyrinthian air passage open at its outer side to the atmosphere and at its inner side to said sump, the said outer portion of the eccentric flange and the bottom portion of the crusher head being formed with interfitting parts defining a second labyrinthian air passage open at its outer side to the atmosphere and at its inner side to the oil passages of said flange, said outer portion of the flange being also provided with vertical air ports connecting the aforesaid labyrinthian air passages and means for supplying air under pressure to said air chamber for delivery to the labyrinthian air passages through the top openings of the air chamber and the air ports of said flange.

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