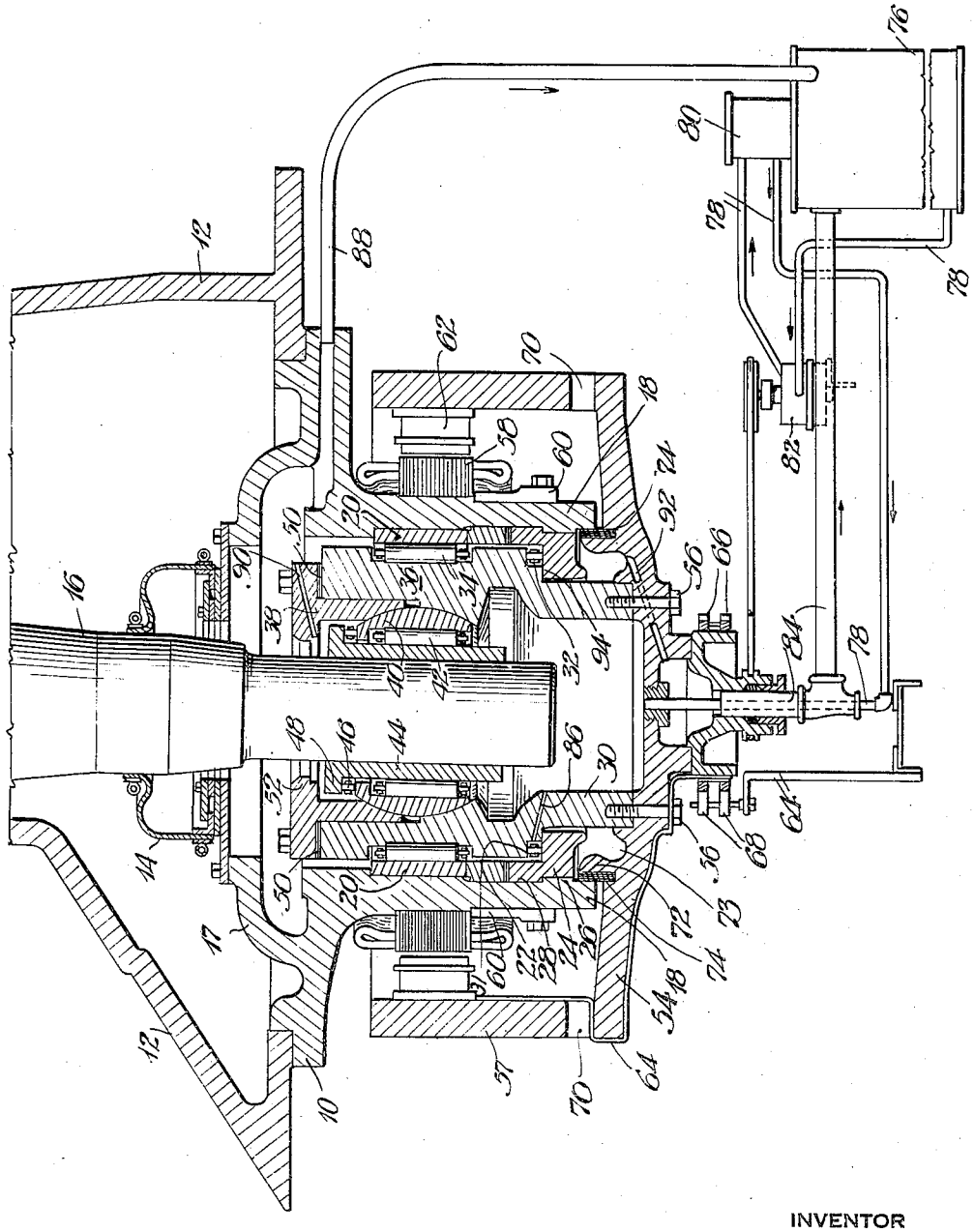
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GYRATORY CRUSHER OPERATING MECHANISM

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GYRATORY CRUSHER OPERATING MECHANISM

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This invention relates to improvements in gyratory crushers more particularly to improved mechanism for driving the main shaft of a gyratory crusher.

Crushers of this general type are disclosed in my U. S. Patents Nos. 1,754,895, 1,985,098 and 2,208,639 for example. This type of crusher includes a crushing section in which stone and other materials are crushed between a mantle and concave, the mantle being mounted on a heavy main shaft usually suspended by a frame above the crushing section. The lower portion of the main shaft extends into an enclosure below the discharge for the crushed material, and is associated with a mechanism for moving it through a circular arc or the so-called gyratory motion. The shaft is not rotated on its axis, but is moved through the circular arc by a mechanism which includes an eccentric sleeve driven by a pulley which may be operated by a belt drive from a motor or by an electric motor directly associated with the pulley. In certain forms of gyratory crushers the eccentric sleeve is driven by gears.

Crushers of the type referred to are designed and used for very heavy work and it is, therefore, important that the mounting and operating mechanism be rugged and arranged to operate the main shaft with as low a power load as possible.

The primary object, therefore, of my invention is to provide an improved driving and mounting mechanism for the lower portion of the main shaft of a gyratory crusher which is relatively simple to construct and assemble.

A further object of my invention is to provide an improved mounting mechanism which is adjustable so that any wear of the parts may be accommodated without replacing important elements.

A further object of my invention is to provide an improved driving mechanism provided with babbittless antifriction members arranged so as to give a minimum of power load and flexibility of adjustment.

Still another object of my invention is to provide an improved driving and mounting mechanism which includes special means for insuring its thorough lubrication.

According to my invention the improved mechanism includes an eccentric sleeve for gyrating the lower portion of the main shaft of a crusher all bearings of which are roller bearings. These comprise an exterior vertically mounted set of roller bearings and an interior adjustable ball

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and socket joint separated from the main shaft or from a sleeve or the outer surface of the shaft by a set of vertically mounted roller bearings.

According to a preferred form of the invention the sleeve mounted directly on the main shaft is supported on a set of horizontal roller bearings carried by an element of the ball and socket joint, and in which the eccentric sleeve is carried on a set of horizontal roller bearings.

The improved apparatus also includes means for pumping lubricating oil through the axis of the pulley into the mechanism, circulating it through various parts of the mechanism so that it is partly drained overhead and partly through a pipe at the axis of the pulley surrounding the oil inlet pipe.

Other features, objects and advantages of my improved apparatus are described in substantial detail hereinafter in connection with the accompanying drawing in which:

The single figure is a broken vertical sectional view through a mounting and driving mechanism adapted to operate the main shaft of a gyratory crusher.

Referring to the drawing the improved apparatus includes a bottom plate 10 supporting the usual casing member 12 for the crusher rock slide and a flexible dust seal 14 which is attached to the lower portion of the main shaft 16. The casting comprising the sleeve 10 includes an upwardly and inwardly projecting flange 17 to support the seal 14 and a downwardly projecting annular sleeve 18 of substantial length arranged to support the operating mechanism for gyrating the lower end of the shaft 16. The sleeve 18 is machined inside at its central section to receive a sleeve ring bearing member 20 which is carried on a supporting spacer ring 22, this in turn being carried on a locking ring 24 which is supported on the sleeve 18 by a bayonet joint and also serves as a roller bearing race ring.

It will be noted that the lower portion of the sleeve 18 includes projections 26 extending inwardly and which are spaced from each other around the ring in a conventional well-known manner while the ring 24 includes cooperating outwardly extending projections 28 which fit between the projections 26 when the ring is moved up and are then rotated over the latter projections to lock the ring 24 in place. The spacer ring 22 also includes outwardly extending projections similar to projections 28 so that it may be slipped into place under the bearing ring 20. Shims are employed as indicated between the rings 22 and 24 to hold the bearing ring 20 against the upper

shoulder on the sleeve 18. The ring 24 is held in place by studs or other key members, not shown, for preventing rotation.

The eccentric sleeve for gyrating the lower portion of the shaft 16 comprises an irregular shaped heavy annular sleeve member 30 having a horizontal shoulder 31 by which it is carried on an inwardly projecting annular shoulder or bearing race of the ring 24 by means of a set of horizontal cylindrical roller bearings 32. The sleeve 30 is machined exteriorily so that it is somewhat smaller than the inside diameter of the members 18, 20, and 22 and so that it includes a wide channel opposite the bearing ring 20 in which is mounted a set of vertical cylindrical roller bearings 34 which operate directly between the bearing ring 20 and the sleeve 30.

The sleeve 30 is made eccentric with respect to the axis of the sleeve 18 or of the ring 20 by providing an off-center ball socket as shown so that the sleeve metal is substantially thicker on the side 36 than on the opposite side of the shaft 16. The sleeve 30 proper provides only the lower or cup portion of the ball socket, while the upper portion is provided by a cooperating eccentrically mounted upper sleeve member 38 of T-shaped cross section which is vertically adjustable in a cylindrical upper section of the sleeve 30. The socket provided by these two members houses a sleeve-like ball or shell 40, the weight of which is carried in the cup portion of the socket formed in the sleeve 30. The inner portion of the ball sleeve 40 is machined as shown so as to carry a set of long vertical cylindrical roller bearings 42, directly opposite the set 34, which bear against a straight shaft sleeve 44 mounted on the lower cylindrical section of the shaft 16.

The upper portion of the ball sleeve 40 includes an inwardly projecting annular flange which extends over the set of roller bearings 42 and which forms an annular bearing race for a set of horizontal cylindrical roller bearings 46 which carry the sleeve or bearing race 44 by means of an outwardly extending horizontal annular flange 48 overlying the flange on ball sleeve 40. The arrangement of the ball and socket joint therefore is such that the weight of the bearing sleeve 44 together with the sets of roller bearings 42 and 46 are all carried by the ball sleeve 40 which in turn is supported on the socket surface of the eccentric sleeve 30. The sleeve member 38 may be moved up or down so that it properly fits the ball sleeve 40 and is held in this spaced relation by means of shims 50 between the top of the sleeve 30 and the horizontal outwardly extending flange by which the sleeve 38 is attached to the sleeve 30 as shown. The sets of roller bearings 32, 34, 42 and 46 include conventional end spacing and mounting means not shown.

The sleeve 38 also includes an annularly inwardly extending flange 52 which extends over the outwardly projecting flange 48 of the bearing sleeve 44 and which is spaced slightly therefrom as for example ¼ inch. In the operation of the crusher in accordance with the usual practice it will be understood that the main shaft 16 is usually arranged to move up and down to a certain degree effecting the crushing operation. The flange 52 therefore retains the sleeve 44 in its normal position with slight vertical movement regardless of the movement of the shaft 16.

In assembling the parts of the apparatus as described above it will be apparent that the eccentric sleeve 30 will be set in place together with the elements carried thereby around the shaft 16

prior to the placing of the locking ring 24. In this preliminary assembly therefore the ring 22 with its bayonet lock structure will hold the bearing ring 20 in a somewhat lower position until the ring 24 and the set of roller bearings 32 are moved into place and locked.

The eccentric sleeve 30 is rotated on its axis by means of a pulley 54 which is attached to the lower end of the cylindrical section of the sleeve 30 which extends down within the ring 24, by bolts 56. The pulley includes a cylindrical section 57 which surrounds substantially the entire portion of the sleeve 18. The pulley 54 may be driven by a belt or other means but it is preferably driven by a synchronous electric motor mounted between its peripheral sleeve 57 and the sleeve 18, the latter of which is machined exteriorly to carry a stator 58 held in place against a shoulder on the sleeve 18 by locks 60. The rotor 62 of the motor is mounted opposite the stator and fixed to the inner periphery of the pulley section 57 by means of studs not shown. Current is supplied to the rotor through leads 64 which are connected into collector rings 66 in the usual manner, the rings being supplied with current from brushes 68. The leads 64 extend through one or more of a plurality of side openings 70 in the lower portion of section 57 of the pulley. These openings effect circulation of air through the motor and serve as means through which any oil from the lubricating system, dust or sticky matter may be thrown from the pulley.

The lower horizontal portion of the pulley 54 includes an annular flange 72 extending upwardly inside the lower end of the sleeve 18 to provide a lubricating oil pocket or trap 73 outside the sleeve 30. A wiper 74 of suitable material is provided between the flange 72 and the sleeve 18 to prevent escape of lubricating oil.

The mounting and operating mechanism of the crusher is lubricated by practically covering all of the operating parts inside the sleeve 18 with lubricating oil supplied from a cooling tank 76 through a line 78 which includes a filter 80 and a pump 82 operated by a suitable drive from the pulley as shown. The oil line 78 extends through suitable bushings as shown, through a large oil drainage pipe 84, and through the axis of the pulley so that it discharges into the chamber directly below the lower end of the main shaft 16. This chamber is filled with lubricating oil and oil is forced by rotation and centrifugal action of sleeve 30 through one or more channels 86 (which may be inclined, from their inner end, away from the direction of rotation) into the set of bearings 32, from which the oil flows upwardly to and through the set of bearings 34, up and over the sleeve 18 into a drainage channel under the flange 17 and then into a line 88, by which the oil is returned to the tank 76 by gravity flow.

The oil is forced under pressure by the pump 82 into the space surrounding the lower portion of the shaft 16 so that it also flows through the sets of bearings 42 and 46 and through a channel 90 into the return line 88. Any oil which may work down around the outside of the eccentric sleeve 30 over the ring 24 is trapped by the flange 72 in pocket 73, conducted by one or more drainage channels or ducts 92 into a pocket under the pulley casting and drained by the pipe 84 to the cooling tank 76 by gravity flow. The ducts 92 may be inclined so that they scoop oil when the pulley is operating. The fit at the point 94 between the horizontal surfaces inside bearings 32 is such as to provide a seal against

excessive oil drainage when the crusher is operating. The oil supplied at a constant head under pressure through the line 78 and by the pumping action of the eccentric sleeve not only thoroughly lubricates the four sets of roller bearings but also lubricates the surfaces between the main shaft and the sleeve 44 as well as the surfaces between the ball sleeve 40 and the socket surfaces of the sleeves 30 and 38. When the crusher is stopped the oil in the upper part of the mechanism drains through channels 86, pocket 73, ducts 92 and pipe 84 to the tank 76, thus preventing oil from being thrown into the motor when the crusher is started.

The improved mounting and operating mechanism of the present invention is so arranged and constructed as to provide for minimum power consumption as well as for minimum wear of all parts involved. It will be noted that two substantial parallel sets of vertical cylindrical roller bearings are provided to take care of the main loads involved between the eccentric sleeve, the sleeve 18, and the shaft 16, while the roller bearings 32 and 46 take care of the remaining loads. Furthermore the provision of the ball sleeve separate from the shaft sleeve 44 makes for a substantially easier operating mechanism and for a longer life of the parts. The ball and socket joint is particularly adapted to effectively accommodate the angular differential movement between the axis of the shaft and the axis of the eccentric sleeve. The double set of roller bearings between the substantially stationary sleeve 44 and the ball and socket joint provided an effective arrangement which is readily lubricated and which contributes to the free movement of the eccentric sleeve and to the long life of the equipment. Any wear in the ball and socket joint is effectively taken care of by removing one of the shims or using a thinner shim 50. The entire operating mechanism is enclosed in a casing, not shown, attached to the member 12.

From the foregoing description it will be understood that certain changes are possible in the design and structure of some of the elements of the apparatus and such changes are contemplated as coming within the spirit and scope of the invention as defined by the appended claims.

What I claim as new is:

1. In a crusher of the gyratory type including an upright main crusher shaft the lower portion of which is surrounded by a fixed bottom plate having an annular sleeve depending therefrom and extending around the shaft in spaced relation thereto, an eccentric sleeve rotatably supported within the depending sleeve around the main shaft for gyrating the shaft, and means for driving and rotating the eccentric sleeve, the improvement comprising a supporting means for the eccentric sleeve including a roller bearing race ring attached directly to the inside of the depending portion of the annular sleeve and having a horizontal bearing surface, a set of horizontal cylindrical roller bearings on said bearing surface, an annular horizontal bearing surface on the outside of the eccentric sleeve resting directly on the set of roller bearings on said race ring, said means for driving and rotating the eccentric sleeve including a pulley attached to the lower portion of the eccentric sleeve, said pulley having a peripheral flange extending upwardly around and in spaced relation to the depending annular sleeve, an electric motor including a stator mounted between the peripheral flange of the pulley and the depending annular sleeve, the stator of the motor being supported directly on the depending annular sleeve, and a ball-and-socket joint structure between the crusher shaft and the eccentric sleeve for permitting angular movement of the shaft with respect to the axis of the eccentric sleeve, the inner portion of the eccentric sleeve having a shape providing the lower portion only of the socket of the ball-and-socket joint structure.

2. In a crusher of the gyratory type including an upright main crusher shaft the lower portion of which is surrounded by a fixed bottom plate having an annular sleeve depending therefrom and extending around the shaft in spaced relation thereto, an eccentric sleeve rotatably supported within the depending sleeve around the main shaft for gyrating the shaft, and means for driving and rotating the eccentric sleeve, the improvement comprising a supporting means for the eccentric sleeve including a roller bearing race ring attached directly to the inside of the depending portion of the annular sleeve and having a horizontal bearing surface, a set of horizontal cylindrical roller bearings on said bearing surface, an annular horizontal bearing surface on the outside of the eccentric sleeve resting directly on the set of roller bearings on said race ring, a ball-and-socket joint structure between the eccentric sleeve and said shaft, and a set of long vertical cylindrical roller bearings mounted around the eccentric sleeve between it and said depending annular sleeve opposite the position of said joint.

3. In a crusher of the gyratory type including an upright main crusher shaft the lower portion of which is surrounded by a fixed bottom plate having an annular sleeve depending therefrom and extending around the shaft in spaced relation thereto, an eccentric sleeve rotatably supported within the depending sleeve around the main shaft for gyrating the shaft, and means for driving and rotating the eccentric sleeve, the improvement comprising a supporting means for the eccentric sleeve including a roller bearing race ring attached directly to the inside of the depending portion of the annular sleeve and having a horizontal bearing surface, a set of horizontal cylindrical roller bearings on said bearing surface, an annular horizontal bearing surface on the outside of the eccentric sleeve resting directly on the set of roller bearings on said race ring, a straight sleeve on the shaft inside the eccentric sleeve, a ball-and-socket joint structure between said eccentric sleeve and said straight sleeve, and a set of vertical cylindrical roller bearings between the ball-and-socket joint and the straight sleeve.

4. In a crusher of the gyratory type including an upright main crusher shaft the lower portion of which is surrounded by a fixed bottom plate having an annular sleeve depending therefrom and extending around the shaft in spaced relation thereto, an eccentric sleeve rotatably supported within the depending sleeve around the main shaft for gyrating the shaft, and means for driving and rotating the eccentric sleeve, the improvement comprising a supporting means for the eccentric sleeve including a roller bearing race ring attached directly to the inside of the depending portion of the annular sleeve and having a horizontal bearing surface, a set of horizontal cylindrical roller bearings on said bearing surface, an annular horizontal bearing surface on the outside of the eccentric sleeve resting directly on the set of roller bearings on said race

ring, the eccentric sleeve having an annular portion extending downwardly inside the set of bearings adjacent to the race ring and forming with the race ring an oil seal adapted to substantially prevent escape of lubricating oil downwardly from the bearings when the crusher is in operation, an oil trap below the race ring, and means for draining oil from the trap to a point outside the crusher proper.

5. In a crusher of the gyratory type including an upright main crusher shaft the lower portion of which is surrounded by a fixed bottom plate having an annular sleeve depending therefrom and extending around the shaft in spaced relation thereto, an eccentric sleeve rotatably supported within the depending sleeve around the main shaft for gyrating the shaft, and means for driving and rotating the eccentric sleeve, the improvement comprising a supporting means for the eccentric sleeve including a roller bearing race ring attached directly to the inside of the depending portion of the annular sleeve and having a horizontal bearing surface, a set of horizontal cylindrical roller bearings on said bearing surface, an annular horizontal bearing surface on the outside of the eccentric sleeve resting directly on the set of roller bearings on said race ring, a driving pulley attached to the lower portion of the eccentric sleeve, an annular oil trap outside the eccentric sleeve below the race ring, an oil drainage pipe extending into the pulley at its axis, and an oil drainage channel leading from the annular trap and discharging into the pipe.

6. In a crusher of the gyratory type including an upright main crusher shaft the lower portion of which is surrounded by a fixed bottom plate having an annular sleeve depending therefrom and extending around the shaft in spaced relation thereto, an eccentric sleeve rotatably supported within the depending sleeve around the main shaft for gyrating the shaft, and means for driving and rotating the eccentric sleeve, the improvement comprising a supporting means for the eccentric sleeve including a roller bearing race ring attached directly to the inside of the depending portion of the annular sleeve and having a horizontal bearing surface, a set of horizontal cylindrical roller bearings on said bearing surface, an annular horizontal bearing surface on the outside of the eccentric sleeve resting directly on the set of roller bearings on said race ring, means for closing the lower end of the eccentric sleeve to form a chamber therein for lubricating oil, means for introducing lubricating oil under pressure into the lower portion of the eccentric sleeve, an oil passageway through the side wall of the eccentric sleeve to the set of roller bearings on the race ring, said passageway being positioned so that rotation of the eccentric sleeve forces oil by centrifugal action into the set of roller bearings on the race ring and upwardly between said sleeves, and passageways for draining oil seepage from the set of roller bearings.

7. A crusher of the gyratory type as defined by claim 1 characterized by including a straight sleeve mounted directly on the main shaft inside the eccentric sleeve and in which the shaft may move axially, and a ball sleeve between the eccentric sleeve and the straight sleeve and rotatable with respect to the straight sleeve.

8. A crusher as defined by claim 3 in which the ball-and-socket joint structure includes a lower socket portion on the inside wall of the eccentric sleeve, and a ball sleeve surrounding the straight sleeve and seated in said socket portion of the eccentric sleeve, said set of vertical roller bearings being directly between the straight sleeve and the ball sleeve.

9. A crusher as defined by claim 8 characterized by including an annular set of roller bearings on top of the ball sleeve, and an annular outwardly-projecting portion on said straight sleeve resting on said annular set of roller bearings.

10. A crusher as defined by claim 9 characterized by including an upper socket sleeve member having a portion extending within the upper part of the eccentric sleeve and engaging the ball sleeve, said socket sleeve member having an inwardly-extending annular flange projecting over the straight sleeve for preventing substantial upward movement thereof.

11. A crusher of the gyratory type including a main crusher shaft, an eccentric sleeve rotatably supported around the lower portion of the shaft for gyrating the shaft, and a ball-and-socket joint structure between the lower portion of the shaft and the eccentric sleeve, the improvement in the ball-and-socket joint structure including a lower socket portion of the inside wall of the eccentric sleeve forming the lower socket portion only of the ball-and-socket joint, a straight sleeve mounted directly on the lower portion of and fitting the shaft, a ball sleeve surrounding the straight sleeve with the lower portion of its ball surface seated in the socket portion on the inside wall of the eccentric sleeve, a separate upper socket member within the eccentric sleeve and fitting the upper portion of the ball surface of the ball sleeve, and a set of long vertical cylindrical roller bearings between the straight sleeve and the ball sleeve whereby the ball sleeve may be readily rotated relative to the straight sleeve.

12. A crusher as defined by claim 11, characterized by including an annular set of roller bearings on top of the ball sleeve, and an annular outwardly projecting portion on said straight sleeve resting upon said annular set of roller bearings whereby the straight sleeve is supported by the ball sleeve.

13. A crusher as defined by claim 12 characterized by including means for securing the upper socket member to the eccentric sleeve, and an inwardly-extending annular flange on said member projecting over the straight sleeve for preventing substantial upward movement thereof.

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