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GYRATORY CRUSHER WITH VERTICALLY ADJUSTABLE HEAD

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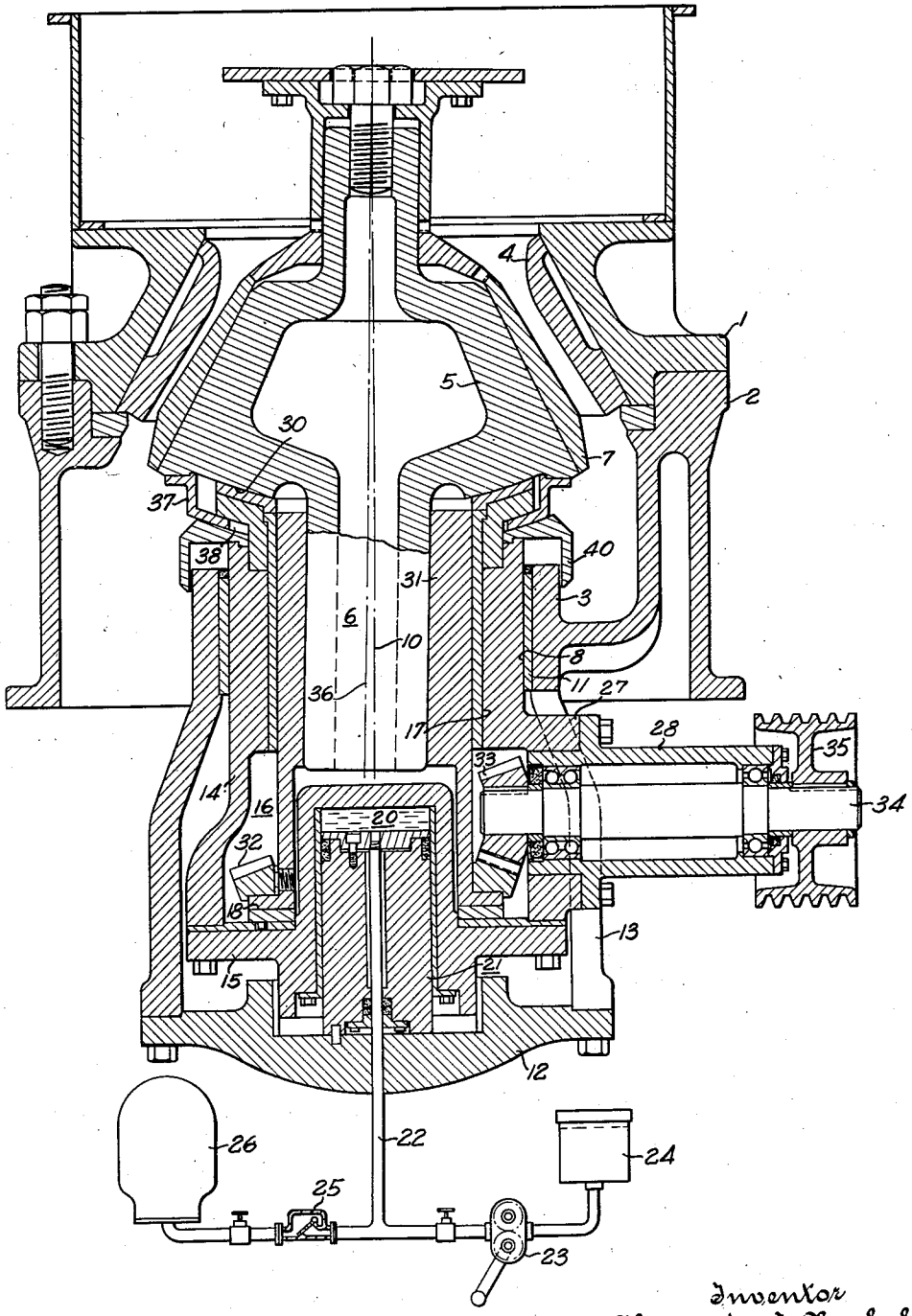

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GYRATORY CRUSHER WITH VERTICALLY ADJUSTABLE HEAD

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10 Claims. (Cl. 241—215)

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This invention relates in general to crushers of the gyratory type and more particularly concerns crushers having provisions for adjustment of the head axially or up and down relative to the crushing shell or concave.

It has been previously known to support the crushing head on a spherical thrust bearing engaging a mating surface on the lower part of the head so that the downward thrust on the head during crushing will be transmitted to the bearing surface, most generally formed on a frame part. It is also known to make the crushing shell adjustable up and down on the frame. However, the known modes of adjustment are objectionable in that annular adjusting means of large diameter have been required.

The applicant has by the present invention made possible adjustment by a simple hydraulic jack arrangement operating between a lower frame part and a movable bearing element by providing for an eccentric drive sleeve movable axially with the bearing element. By doing this he has achieved a simple adjusting structure while preserving all the benefits of a large gyrating thrust bearing directly under the head and the attendant simplification of the problem of dust seal bearing protection.

An object of the present invention is to provide for a simple improved adjustable support of a gyratory crusher head on a large diameter end thrust bearing.

A second object of the invention is to simplify the dust seal problem as compared with that in prior adjustable head gyratory crushers.

Another object of the invention is to provide an improved and simplified gyratory crusher actuating mechanism with provision for axial movement of the head and actuating mechanism relative to the frame.

Applicant has achieved the objects and advantages enumerated above and others that will be apparent from a reading of this specification by providing for support of the gyratory head on a large diameter thrust bearing formed on a bearing element movable up and down relative to the frame and designed to carry within it the entire head actuating means.

The following is a full, clear and exact description of a particular embodiment of the invention describing the nature of the invention and the best mode devised by the inventor for carrying the same into practical effect. Reference is had hereinbelow to the accompanying drawing, in which:

The single figure is a view of a crusher embodying the invention, shown in section on a vertical plane through the central axes of the frame and driving shaft.

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In the device illustrated in the drawing, the invention is embodied in an improved gyratory crusher, the crushing action of which may be considered substantially the same as that of the crusher illustrated in Newhouse U. S. Patent No. 2,022,135, but which has an improved head supporting and operating mechanism.

The illustrated crusher has a frame, having an upper portion or crushing shell 1, and a lower portion 2 with a stationary hub 3. The upper frame portion 1 may have a removable liner or concave 4, taking the crushing wear, which is fixed with relation to the frame parts 1 and 2 in any suitable known manner.

A crushing head 5 has a shaft portion 6 and may be equipped with a removable crushing mantle 7 of any known style.

The hub 3 has internal guide surfaces 8 arranged in parallelism with the vertical central axis of the crushing shell 1, this axis being represented in the drawing by a line 10. Surfaces 8 preferably will be formed on a removable hub liner 11. The bottom of hub 3 is closed by a preferably removable bottom plate 12, rigidly secured to the frame in any suitable known manner. The hub 3 is provided at one side with a slotlike opening 13 for a purpose to be described hereinbelow.

Within, and slidably guided by surfaces 8 of hub 3, is a movable bearing member 14 of generally cuplike form, having a bottom plate portion 15. The upper part of the cup cavity 16 is formed with a cylindrical internal bearing surface 17; and, at the bottom of cavity 16, the inner side of bottom plate portion 15 is formed as an annular end thrust bearing surface 18 for a purpose described hereinbelow. Bottom plate portion 15 is formed with a downwardly opening cylinder space 20, preferably coaxial with the internal bearing surface 17, this cylinder space 20 accommodating, in fluidtight slidable relation, a piston 21 which is rigidly fixed in any suitable known manner to frame bottom plate 12.

A conduit 22 connects the expansible chamber formed between the piston 21 and the inner or upper end of cylinder space 20, through a reversible high pressure hydraulic fluid pump 23 of known type, with a reservoir 24 for hydraulic fluid. Conduit 22 is also connected, through a check valve 25 having a return flow restricting orifice, with a hydraulic fluid pressure accumulator 26 of known type which has an initial hydraulic fluid admission pressure resistance sufficient to resist entry of hydraulic fluid at pressures below

a predetermined normally safe pressure which will resist normal crushing forces tending to move the head 5 downwardly in crushing operation.

Cuplike bearing member 14 is provided at one side with a lateral extension 27 and a pinion shaft bearing housing extension 28 extending laterally through frame opening 13 in movable relation to the frame for movement parallel to the vertical central axis 10 of the frame. The rim or upper end of member 14 is formed with a large diameter annular, upwardly concave, spherical, end thrust bearing surface 30 fitting a complementary surface formed on the underside of head 5. Surface 30 fixes the axial position of head 5 relative to member 14 and supports the same for gyratory movement relative to member 14 about the vertical central axis 10 of the crusher.

An eccentrically bored, externally cylindrical eccentric sleeve 31, known in the art as an "eccentric," is journaled in internal bearing surface 17 of member 14 and is supported in end thrust transmitting relation, at its lower end, on bearing surface 18 of member 14. A ring gear 32 is fixed to eccentric sleeve 31 within cavity 16 of member 14 and meshes with a pinion 33 on pinion shaft 34 which is rotatably journaled in laterally extending bearing housing 28 of member 14. Shaft 34 can be rotated by any suitable known driving means such as grooved pulley 35 located outside the crusher frame. The eccentric bore of the eccentric sleeve 31 has a longitudinal central axis represented by line 36 which, in the device illustrated, is eccentric to the external cylindrical surface of the sleeve at all points between the axial limits of the sleeve, and which intersects the axis 10 at a point well above the uppermost end of the sleeve, the point of intersection being coincident with the center of the spherical bearing surface 30 of member 14 with the sleeve 31 supported by internal bearing surfaces 17 and 18 of said member 14.

It will be understood, of course, that the angle between axes 10 and 36 may be made smaller or larger than in the illustrated example, and that if it approaches zero degrees, the radius of the sphere determining the concavity of annular bearing surface 30 will approach infinity. It will also be understood that the axis 36 may even be made to intersect the axis 10 below the crushing chamber formed between head 5 and shell liner 4, in which case the bearing surface 30 would become upwardly convex (not shown).

Suitable dust seal means (such as, for example, dust ring 37 secured to head 5 and operating in a suitable groove 38 in member 14, and dust skirt 40 closely surrounding an upper part of hub 3 in axially movable relation) will keep crushed material out of the bearing between head 5 and surface 30 and out of the bearing between cuplike element 14 and guide surfaces 8 of hub 3, while permitting gyratory movement of head 5 on surface 30 and movement of the head 5 and member 14 as a unit, axially up and down with relation to the crusher frame and shell.

Rotation of pinion shaft 34 will cause rotation of eccentric 31 in the bearing element 14.

To place the machine in condition for operation, hydraulic fluid will be pumped into space 20 by operation of pump 23 until the member 14 is raised a considerable distance above its lowest limiting position of physical contact with frame bottom plate 12; and head 5 is thereby placed in the desired setting for crushing in coaction with the concave or crushing shell liner 4.

Crushing will then occur upon rotation of shaft 34, when material is placed in the crushing chamber, and this crushing will result in a downward thrust reaction on the head 5, acting through bearing surface 30 to force the member 14 downwardly. So long as the resulting pressure on the hydraulic fluid in space 20 is not sufficient to overcome the initial hydraulic fluid admission pressure resistance of accumulator 26, normal crushing may continue.

Upon the occurence, during crushing, of abnormal crushing reactions, such as when uncrushable material enters the crushing chamber or when "packing" conditions occur, the hydraulic fluid in chamber 20 may be under a pressure higher than the initial hydraulic fluid pressure resistance of accumulator 26 and may be forced to enter the accumulator 26 through check valve 25, permitting the member 14 to be moved downwardly in the frame hub 3 by the pressure of the head on surface 30. Upon clearance of the abnormal condition the excessive pressure in the accumulator 26 will force the member 14 to rise, returning head 5 to its set position, the return flow restricting orifice in valve 25 restricting this return to a desirably slow rate.

Pump 23 may be operated in either direction to change the vertical setting of head 5.

It will be seen that the head 5 is supported in axially fixed relation to member 14, the axial setting of which in relation to the frame is controlled by the adjustable hydraulic mechanism constituted by the piston 21 operating in cylinder space 20. This hydraulic mechanism therefore constitutes a control means for the crusher by means of which the head may be set to give the desired normal crushing chamber and retained in the set position against all normal crushing forces. Accumulator 26 will permit axial yielding of the member 14 relative to the frame and will automatically return the head to its normal setting upon the occurrence and disappearance of abnormal crushing conditions. The confined body of hydraulic fluid in space 20 is adjustable and is interposed between the fixed frame and member 14, interconnecting the same in end thrust transmitting relation.

The entire assembly of head shaft portion 6, member 14, eccentric sleeve 31, gear 34, pinion 33, shaft 34, and driving pulley 35 constitutes a head gyrating mechanism movable as a unit up and down in the frame hub 3 by the hydraulic mechanism 20—21—22—23—24 and protected by the automatically operating accumulator 26 and return throttling check valve 25.

It will be understood that the specific structural features illustrated in the drawing are by way of example only and that the invention includes such modifications and equivalents as may lie within the spirit and scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. In a gyratory crusher of the type having a frame carrying a crushing shell, a hub on said frame axially aligned with and below said crushing shell, a gyratory head cooperating with said shell and having a shaft portion extending downwardly into said hub and a rotary eccentric sleeve rotatably engaging said shaft portion for gyrating said head, the combination comprising a bearing element adjustable up and down in said hub and having bearing surfaces supporting said eccentric sleeve in axially fixed rotatable relation and said head in axially fixed gyratable rela-

tion, respectively, adjustable means interconnecting said hub and said bearing element in axial thrust transmitting relation and actuable to move said bearing element up and down in said frame, and means for rotating said eccentric in said bearing element.

2. In a gyratory crusher having a frame, a crushing shell rigidly carried in said frame, a gyratory crushing head having a shaft extending downwardly into said frame, and means for supporting and gyrating said head in crushing chamber forming relation to said shell, the combination comprising: a cuplike bearing member below said shell and guided in axially slidable nonrotatable relation to said frame, having a cylindrical cavity coaxial with said shell and an upwardly facing bearing at its upper end engaging said head in axially fixed relatively gyratable supporting relation; an eccentric sleeve rotatably journaled in axially fixed relation within said cavity and having an eccentric bore rotatably engaging said shaft, driving means for rotating said eccentric; and control means interposed between said frame and said cuplike member to transmit thrust therebetween and actuable to move said cuplike member with said head and eccentric axially of said frame for adjustment of the crushing chamber.

3. In the combination of claim 2, said driving means comprising a ring gear on said eccentric sleeve within said cavity of said cuplike member, a pinion shaft having a pinion in rotary driving engagement with said gear within said cavity, said pinion shaft beng journaled for rotation in said cuplike member and having a portion extending through a suitable opening in said frame in axially movable relation thereto whereby rotary driving force may be applied to said pinion shaft outside said frame for driving said eccentric.

4. In the combination of claim 2, said control means comprising hydraulically operable expansible chamber jack means engaging said frame and said cuplike member and fluid supply and discharge means for actuating said jack means.

5. In a gyratory crusher having a crushing shell rigidly attached to and supported by a fixed frame member: a crushing head gyrating and supporting unit comprising a bearing element slidably guided in axially movable nonrotatable relation to said frame below said shell and having relatively fixed bearing portions; an eccentric sleeve journaled for rotation in and supported in axially fixed relation to said bearing element; a crushing head supported in axially fixed relatively gyratable relation by said bearing element and having a downwardly extending shaft engaging said eccentric sleeve in relatively rotatable relation; means for rotating said eccentric sleeve relative to said bearing element; and adjustable axial thrust transmitting means interposed between said bearing element and said frame and actuable to variably position said bearing element and said eccentric sleeve relative to said frame.

6. In the structure defined in claim 5, said adjusting means being a hydraulic mechanism comprising axially slidably engaged piston and cylinder means interposed between said bearing element and said frame, and means for supply and exhaust of hydraulic fluid under pressure to and from said piston and cylinder means.

7. In a gyratory crusher: a frame having guided surfaces parallel to a frame axis; a bearing member axially slidable and nonrotatable in said guide surfaces and having an annular end thrust bearing surface at one end and internal bearing surfaces in fixed relation thereto; an eccentric sleeve journaled in and axially supported by said internal bearing surfaces for rotation in axially fixed relation to said bearing member on an axis substantially parallel with said guide surfaces; a crushing head having a downwardly extending shaft rotatably engaging the eccentric bore of said eccentric sleeve and having a thrust bearing surface gyratably engaging said annular end thrust bearing surface; means actuable from outside said frame for rotating said eccentric sleeve relative to said bearing member; and adjustable axial thrust transmitting mechanism interconnecting said bearing member and said frame and actuable to vary the axial position of said bearing member eccentric sleeve and head as a unit relative to said frame.

8. In a gyratory crusher having a crushing shell in an upper frame portion, and a lower frame portion containing means for supporting and gyrating a gyratory crushing head in crushing chamber forming relation to said shell and adjusting said crushing head axially relative to said shell, the combination comprising: guide surfaces in said lower shell portion extending parallel to the axis of said shell; a cuplike bearing member held in axially slidable relation to said frame by said guide surfaces and provided at its rim with an annular upwardly facing end thrust bearing surface for supporting said crushing head in relatively gyratable axially fixed relation; said head having a shaft portion extending downwardly into said cuplike element; an eccentric sleeve journaled in said cuplike element for rotation coaxial with said shell and having an eccentric bore engaging said shaft in relatively rotatable relation, said eccentric sleeve being supported in axially fixed relation to said cuplike element; means for rotating said eccentric; and adjustable means interposed between the bottom of said cuplike element and said lower frame portion for supporting said cuplike element in axially variable relation to said frame.

9. In a gyratory crusher of the type described having a frame, a crushing shell and a relatively gyrating crushing head coacting therewith: a lower frame portion below said head and shell and having a bottom plate rigidly connected with said shell, a piston connected in fixed relation with said bottom plate and extending upwardly therefrom into said frame coaxially with relation to said shell; a bearing element having a downwardly open cylinder engaging said piston to define an expansible chamber therebetween, said bearing member extending upwardly to form an upwardly open cuplike formation coaxial with said cylinder; guide means on said frame externally engaging said cuplike formation and guiding said bearing element for movement up and down in said frame; an eccentric sleeve and eccentric sleeve drive journaled in said cuplike formation; an end thrust bearing for gyratably supporting said head on said cuplike formation; and means for supplying fluid to and exhausting fluid from said expansible chamber whereby to move said eccentric sleeve drive and head up and down as a unit relative to said frame.

10. In a gyratory crusher having a crushing shell in an upper frame portion, and a lower frame portion containing means for supporting and gyrating a gyratory crushing head in crushing chamber forming relation to said shell and adjusting said crushing head axially relative to said shell, the combination comprising: a first

annular spherical thrust bearing surface on said head; guide surfaces in said lower shell portion extending parallel to the axis of said shell; a cuplike bearing member held in axially slidable relation to said frame by said guide surfaces and provided at its rim with a second annular spherical thrust bearing surface for engagement with said first spherical surface for supporting said crushing head in relatively gyratable axially fixed relation; said head having a shaft portion extending downwardly into said cuplike element; an eccentric sleeve journaled in said cuplike element for rotation coaxial with said shell and having an eccentric nonparallel bore engaging

said shaft in relatively rotatable relation, said bore having a longitudinal central axis intersecting the axis of said sleeve at a point coincident with the center of said spherical surfaces, said eccentric sleeve being supported in axially fixed relation to said cuplike element; means for rotating said eccentric; and adjustable means interposed between the bottom of said cuplike element and said lower frame portion for supporting said cuplike element in axially variable relation to said frame.

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No references cited.