ADJUSTABLE CRUSHER SHAFT SUPPORT

Inventor

Henry Behr

by Parker & Carter
Attorneys
This invention relates generally to crushers and has for one purpose the provision of an adjustable support for the crusher shafts employed therein.

Another purpose is to provide improved yielding means for maintaining certain crusher parts normally fixed.

Another purpose is the provision of improved releasing means effective to permit the axial adjustment of a crushing head and shaft relative to an opposed crushing member.

Another purpose is to provide a yielding support for a crusher shaft and head whereby, upon the trapping of foreign objects between said head and its opposed crushing member, the crushing head is permitted to move away from the said opposed member a distance sufficient to permit said foreign materials to pass therebetween, and a further purpose is to provide means effective to return said head to its original, predetermined position with relation to said member upon the passing of said foreign material.

Another purpose is to provide means whereby a hydraulic fluid which escapes beyond a set of piston rings may be automatically returned to a hydraulic system of which said piston rings are part. Other purposes will appear from time to time during the course of the specification and claims.

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

Figure 1 is a vertical axial section; Figure 2 is a section on a line 2—2 of Figure 1; Figure 3 is a side view of a supply and control system; and Figure 4 is a side view in partial cross-section of the entire crushe structure.

Like parts are indicated by like symbols throughout the specification and drawings.

Referring now to the drawings, and particularly to Figure 4, a crusher frame is generally indicated at 1. The numeral 2 generally indicates a support for the crushe frame 1, and 3 illustrates securing means adapted to secure the frame 1 to the support 2. As will be seen in Figure 4, the frame 1 rests upon an upper portion of the support 2. Secured, as by one or more of the securing means 3, to an upper portion of the frame 1 is the spider or web 4. As below-described, the spider 4 has a central hub 30.

The frame 1 may be inwardly and downwardly conical in shape and may support, as illustrated in Figure 4, an inwardly and downwardly conical outer crushing member 5. An inner crushing member 6, downwardly and outwardly conical in shape is supported upon a downwardly, outwardly conical head 7, which is secured on the below-described central rotating shaft 20. A driving gear 8 may be rotatably mounted in a housing 8a which may itself be secured to the support 2. The driving gear 8 is in mesh with a driven gear 9 on the eccentrically bored sleeve 10 which surrounds a lower portion 20a of the shaft 20.

As will be further described, a central portion of the shaft 20 may be downwardly and outwardly conical in order to support the head 7, and the lower portion 20a of the shaft 20 may be, as illustrated, straight in order to permit free movement upwardly and downwardly within the sleeve 10.

Figure 1 illustrates a structure found generally in the upper portion of the crusher assembly.

The numeral 20b indicates the upper end of the vertical shaft 20. 40 indicates a sleeve or bushing for the shaft portion 20a. A bearing for the sleeve 40 is illustrated in 40a. It will be realized that the hub 30 of the spider 4 is hollow to permit the extension therethrough of the upper end of the shaft portion 20b.

The hub 30 of the spider 4 is apertured as at 30b to permit the passage of the shaft portion 20b. The aperture 30b is enlarged as at 11 to create a seat for the sleeve bearing or hub lining 40a and is further recessed or enlarged as at 12 in order to receive a main shaft support plate 15. The support plate 15 has a diameter substantially equal to the diameter of the recess 13. The hub 30, but the plate 15 has a thickness substantially less than the depth of said aperture. The plate 15 has an annular upwardly and downwardly extending skirt 16 which provides a substantially bearing surface against the wall of the aperture 12. A key 17 extends into the plate 15 and into the wall of the aperture 12 in the hub 30 in order to prevent relative rotation between the plate and the hub.

The upper surface of the plate 15 within the skirt 16 is generally domed as indicated at 15a. The lower surface 18 of the plate 15 may be generally flat. The plate 15 is centrally apertured as at 22 to permit the passage therethrough of the upper end of the shaft portion 20b. The aperture 22 is of sufficient diameter to provide substantial clearance between the walls thereof and the outer diameter of the shaft 20b. The upper end of the shaft portion 20b carries the threads 25 which is threaded main shaft nut 26. The shaft nut 26 has the generally upwardly, inwardly conical lower surface 27 adapted to seat upon the dome portion 15c of the plate 15, as shown in Figure 1. 26a indicates a key, shown in dotted lines, between the nut 26 and the threaded end 25 of the upper shaft portion 20b.

Secured to an upper portion of the hub 30, as by the securing members 28, is a cylinder 31 having an outer cylindrical wall 32 and an inner cylindrical wall 33 spaced inwardly from the wall 32. The walls 32 and 33 are adjacent by circumferentially spaced radial ribs 34. The outer wall 31 is generally cylindrical and, except for the ribs 34 and inwardly spaced wall 33, is open at both ends. The inner cylindrical wall 33, however, is upwardly open but carries the lower bottom wall 35 which closes the inner cylinder formed by the wall 33.

One of the ribs 34, if deemed necessary, may be made substantially wider than the others as illustrated in Figure 2 at 34a. Through the ribs may extend the passages 41 and 42 which are of sufficient extension to place the area within the cylinder formed by the wall 33 in communication with the area outside the cylinder 31. The passage 41 is located immediately adjacent the bottom wall 35 of the cylinder 33, and the passage 42 is located upwardly of the passage 41. 41a and 42a illustrate suitable fittings secured to the wall 32 to connect the passages 41 and 42 respectively to the appropriate structure described hereinbelow.

Slidably mounted within the cylinder 33 is a piston 50, having the piston rings 51 secured around the lower outer surface thereof and adapted to wipe the inner wall of the cylinder 33. The piston 50 has a lower bottom wall 52 and may be upwardly open as shown in Figure 1. The cylindrical wall 53 of the piston 50 has an upper edge an outwardly extending annular flange 54. The flange 54 carries a plurality of circumferentially
spaced apertures generally shown at 55. It will be realized that the flange 54 is of sufficient extension to overlie the ribs 34 of the cylinder 31. It will be further realized that the piston 50, when in operative position, extends upwardly above the walls of the cylinders 31 and 33. The apertures 55 are so spaced in the flange 54 as to lie between the ribs 54 as illustrated in Figure 2. For example, there may be two apertures between any two adjacent ribs 34. A plurality of apertures 65 is similarly spaced about the circumference of the plate 15 within the skin 9 shown in Figure 1. The apertures 65 may be inwardly screw-threaded as shown at 66. A plurality of tie rods 67 extend through the apertures 65 and are threaded into the apertures 65 as shown in Figure 1. Securing means, such as a nut 68 may be threaded upon the upper ends 69 of the tie rods 67 and may be brought up thereto against the upper face of the flange 54 on the piston 50. Thus it is seen that the piston 50 is secured rigidly to the main shaft support plate 15 at a plurality of points about the circumferences of the two elements.

Secured to an outwardly extending annular flange 70 adjacent the upper wall 32 of the cylinder 31, as by the securing means generally illustrated at 71, is a cover or closing cap 72 which has the generally horizontal top wall 73 and which generally surrounds the upper portion of the piston 50 to serve as a seal for the cylinder 31 and the elements therein.

It will be realized that the stroke to be brushed is normally fed from above through and between the arms of the spider 4. In order to protect the structure above-described from impingement of such stone, I illustrate a curtain 80 which depends from the closing cap 72 and which substantially surrounds the structure within and above the hub 30 of the spider 4. The curtain 80 may be formed of link chain as illustrated in Figure 4.

Figure 3 illustrates, more or less diagrammatically, a fluid supply and control system for the cylinder 33 and piston 50. In Figure 1, I illustrate the line generally shown at 85 as being connected to the fitting 41a. The line 85 may be comprised of a tubing 85a, a passage 85b in the hub 30 and additional tubing 85c. In Figure 3 the cylinder 33 and piston 50 are illustrated diagrammatically as is the line 85, and the fittings 41a—42a are not shown therein. It will be realized that while oil is shown and described herein, any suitable fluid medium may be similarly employed without departing from the nature and scope of my invention.

Continuing to refer to Figure 3, 90 indicates an oil reservoir, and 90a indicates a vent therefor. From an area adjacent the lower portion of the reservoir the oil line 85 extends through a series of elements to the cylinder 33. 91 illustrates a pump, which may be of a gear type, in the line 85. A relief valve and oil return line are illustrated at 92 and 93, respectively. 94 is a solenoid-operated check valve. A return line to the reservoir is illustrated at 95. 96 illustrates a valve in the line 95. 97 is a line leading from the line 85 to an oil receiver or pressure accumulator 98 which has an air space A and an oil space B. 99 indicates a line leading from the air space A of the accumulator 98, and 100 illustrates a charging valve therefor.

A pressure gauge is illustrated at 105 and is arranged to be actuated by the pressure in the line 85 at a point downstream from the accumulator 98 as shown at 106. A valve 110, which may be a diaphragm type and spring loaded, is located in the line 97 between the pressure line 112 and the accumulator 98. A line 111 runs from the valve 110 to the pressure line 85.

The numeral 120 indicates an oil return line connected at one end to the fitting 42a, as illustrated in Figure 1 adjacent the upper limit of the cylinder 33, and leading therefrom to an upper portion of the hydraulic reservoir 90. A pressure actuated valve and switch is illustrated at 121 and is located in the line 120 at a point substantially downstream from the cylinder 33. It will be noted that the line 120 has a vertical leg or portion 120a. The switch 121 is located downstream of the vertical portion 120a, the purposes of which will appear hereinbelow.

A motor 125 is suitably connected to the pump 91. 130 generally indicates an electrical circuit joining the solenoid valve 94 with the motor 125. 140 generally indicates an electrical circuit joining the pressure actuated valve and switch 121 with the motor 125. 141 generally indicates the electrical circuit for the motor 125, and 142 indicates a switch in the circuit 141.

The circuit 141 is suitably connected with a crusher motor (not shown) which drives the gear 8, shown in Figure 4. Thus the crusher is rendered inoperative when the pump motor 125 is operating, i.e. when the hydraulic system pressure is below the desired level and the crusher is again rendered operative when the pump motor stops after having brought the pressure up to operating range and the main shaft 20 to positioning.

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

The use and operation of my invention are as follows: I provide means for positioning, supporting and releasing a crusher shaft and head from above, which means employs a fluid. The shaft assembly and all vertical crushing forces imparted thereto are supported upon a spherical seated plate which is in turn secured to a piston through tie-rods. The piston is positioned by the fluid within a hydraulic cylinder. The horizontal thrust due to crushing is imparted to the spider 4 through the sleeve 40 in the spider hub. The gyrotary or eccentric action is compensated for by the spherical seat between the main shaft nut and the main shaft support plate.

Referring specifically to the hydraulic system, which is shown diagrammatically in the drawings, I employ a pressure of the order of about three hundred pounds p. s. i. to raise and maintain the dead load of the main shaft assembly in a predetermined position. The required pressure is provided by the pump 91, which may be of a gear type and which may have a capacity of about 10 gallons per minute and which may produce a pressure to the order of a thousand p. s. i. The solenoid-operated valve 94 is suitably connected with the pump motor 125, so that the valve will be open when the pump motor is operating and will close the system to maintain the system pressure when the pump motor is inoperative. Thus a closed system is provided, having therein a pressure of the order of three hundred p. s. i. before a crushing operation is begun. The vertical forces, due to crushing, are transmitted into the cylinder 33, proportionately raising this hydraulic system pressure and thus causing the main piston area to maintain the shaft in its predetermined position to accomplish the crushing operation.

As is well known, the entry of foreign material, such as a piece of tramp iron, into the crushing cavity creates extremely heavy forces tending to crush the crushing head from its opposed crushing member. These forces are such as to create extremely high pressures. I therefore provide the pressure storage device or accumulator 98 in the hydraulic system. The accumulator 98 is separated from the main system by the diaphragm-type spring loaded valve 110, which is normally closed. The accumulator 98 is charged at 110 so that it will open, allowing oil from the system to enter the accumulator, upon the occurrence of the predetermined pressure of, say, between 800 and 1000 p. s. i. The air space A in the accumulator 98 is precharged, for example, with air or nitrogen, to a predetermined pressure. When the dia-
phragm valve 110 opens and oil enters the accumulator, the air or nitrogen is compressed and the piston 50 and main shaft 20 are then allowed to lower due to the change in oil volume in the system. A lowering of the shaft 20 permits the foreign particle to pass through the crushing cavity and the conditions are then immediately reversed, i.e., the oil will flow from the accumulator back to the system until the point is reached at which the diaphragm valve 110 will close, at which time the normal operation will resume.

Provision is made for oil leakage at the piston rings 51. Should any such leakage occur the oil passing above the upper piston ring would be carried up to the passage 42 and into the oil return line 120 and thence back to the oil reservoir 90. While the passage 42 is shown as located adjacent the upper edge of the cylinder 33 it will be realized that the passage 42 could be located in whatever position desired above the piston rings 41. The passage 42 and oil return line 120 can be seen to function as an upper limit for oil leakage.

I provide means for replacing the oil which has leaked around the piston rings 51, which consists of a vertical leg 120a in the pipe 120 and a valve and limit switch 121 which is electrically interconnected with the pump motor 125. When a predetermined volume of oil collects and the pressure resulting therefrom will open the valve 121 and will close a switch whereby starting the pump motor 125 and pump 91, and thus causing more oil to enter the main system. When the oil column in the leg 120a drops to the lower limit of the pressure switch 121, the pump 91 will stop. Thus in this short interval of operation the pump will have returned to the main system the same volume of oil as that which has leaked around the piston rings 51.

On occasion, a power failure may occur and it may be desired at that time to lower the main shaft and head in order to clear the crushing cavity. To provide for this contingency I provide the line 95 and valve 96, which may be considered a by-pass valve. It is necessary merely to open the valve 96 which would cause all of the oil in the main system to be returned to the oil reservoir 90, thus allowing the piston 50 to drop in the cylinder 33 and thus lowering the main shaft and head. After the crushing cavity has been cleared the valve 96 can be closed and the pump may be started up, thus resuming normal operation.

1. In a gyratory crusher, a main frame, a shaft positioned for gyratory motion within said frame, a head on said shaft, opposed crushing elements on said frame and said head, a spider secured to said frame above said head, said spider having a centrally located hollow hub, a portion of said shaft extending upwardly into said hub, a supporting plate positioned within and vertically movable in relation to said hub, a member secured to the upper end of said shaft, said member having a lower surface in engagement with the upper surface of said plate, said surfaces being formed to permit gyratory rotation of said member on said plate in response to gyratory movement of said shaft, a cylinder secured to said hub above said shaft, said cylinder being upwardly open, a piston movable in said cylinder, and means for supplying fluid under pressure to said cylinder below said piston, said piston having an outwardly extending annular flange adjacent its upper edge outside said cylinder, and means for connecting said piston to said supporting plate, including a plurality of tension members each secured at one end to said flange and at the opposite end to said supporting plate.

2. In a gyratory crusher, a main frame, a shaft positioned for gyratory motion within said frame, a head on said shaft, a spider secured to said frame above said head and having a centrally located generally cylindrical hollow hub, said shaft having an upper portion extending upwardly into said hub, a supporting plate positioned within and vertically movable in relation to said hub, a securing member connected to the end of said shaft above said supporting plates, said member having a lower surface in engagement with the upper surface of said plate, said surfaces being formed to permit gyratory rotation of said member on said plate in response to the gyratory movement of said shaft, a substantially cylindrical extension for said hub, said extension being connected to the upper edge of said hub and extending upwardly therefrom, the outer diameter of said extension being substantially equal to the outer diameter of said hub, an upwardly open cylinder positioned within said extension above the upper end of said shaft, said cylinder being connected to said extension by a plurality of circumferentially spaced radially extending ribs, a piston movable in said cylinder, means for supplying fluid under pressure to said cylinder beneath said piston, said piston having a portion extending outwardly above said cylinder, said piston portion having an outwardly extending annular flange, and means for connecting said piston to said supporting plate, including a plurality of tension members, each of said tension members being secured at one end to said flange and at the opposite end to said supporting plate, said tension members extending through the spaces between said circumferentially spaced ribs.

3. The structure of claim 2, characterized by including a protective housing for said piston comprising a closure member for said hub extension secured to the upper edge of said hub extension and having a generally horizontally disposed outwardly extending top plate, and means for protecting said hub extension against the impact of material fed to said crusher, said protecting means including a plurality of linked chains connected to the outer edge of said horizontally disposed top plate and depending therefrom to a point adjacent the upper surface of said spider.

4. In a yielding release assembly for crushers having a frame and a shaft rotatable therein, a cylinder, a piston movable in said cylinder, means connecting said piston to said shaft and a portion extending outwardly above said cylinder, said piston having an outwardly extending annular flange, and means for connecting said piston to said supporting plate, including a plurality of tension members, each of said tension members being secured at one end to said flange and at the opposite end to said supporting plate, said tension members extending through the spaces between said circumferentially spaced ribs.

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