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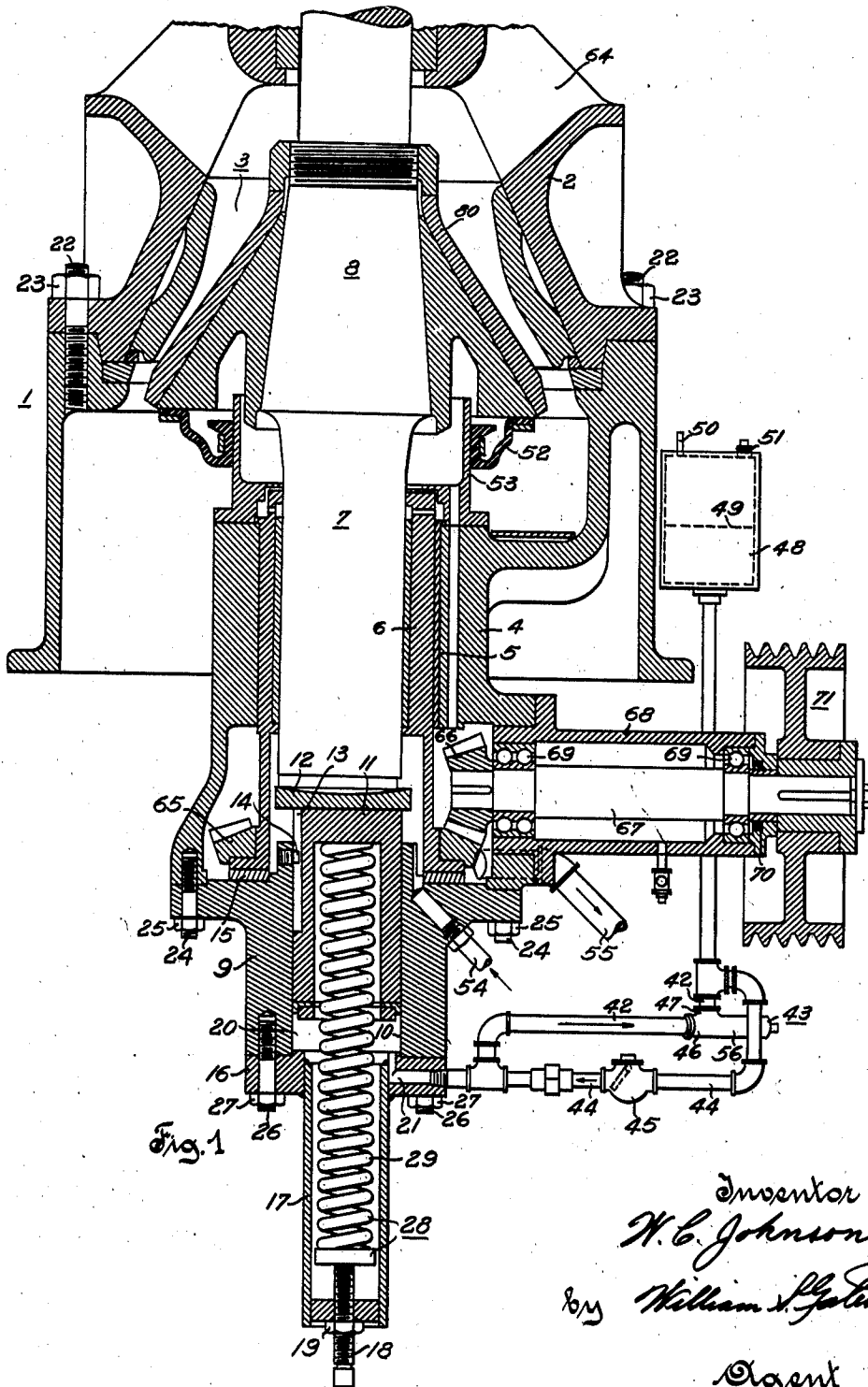
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GYRATORY CRUSHER

Filed Jan. 30, 1943

2 Sheets-Sheet 1



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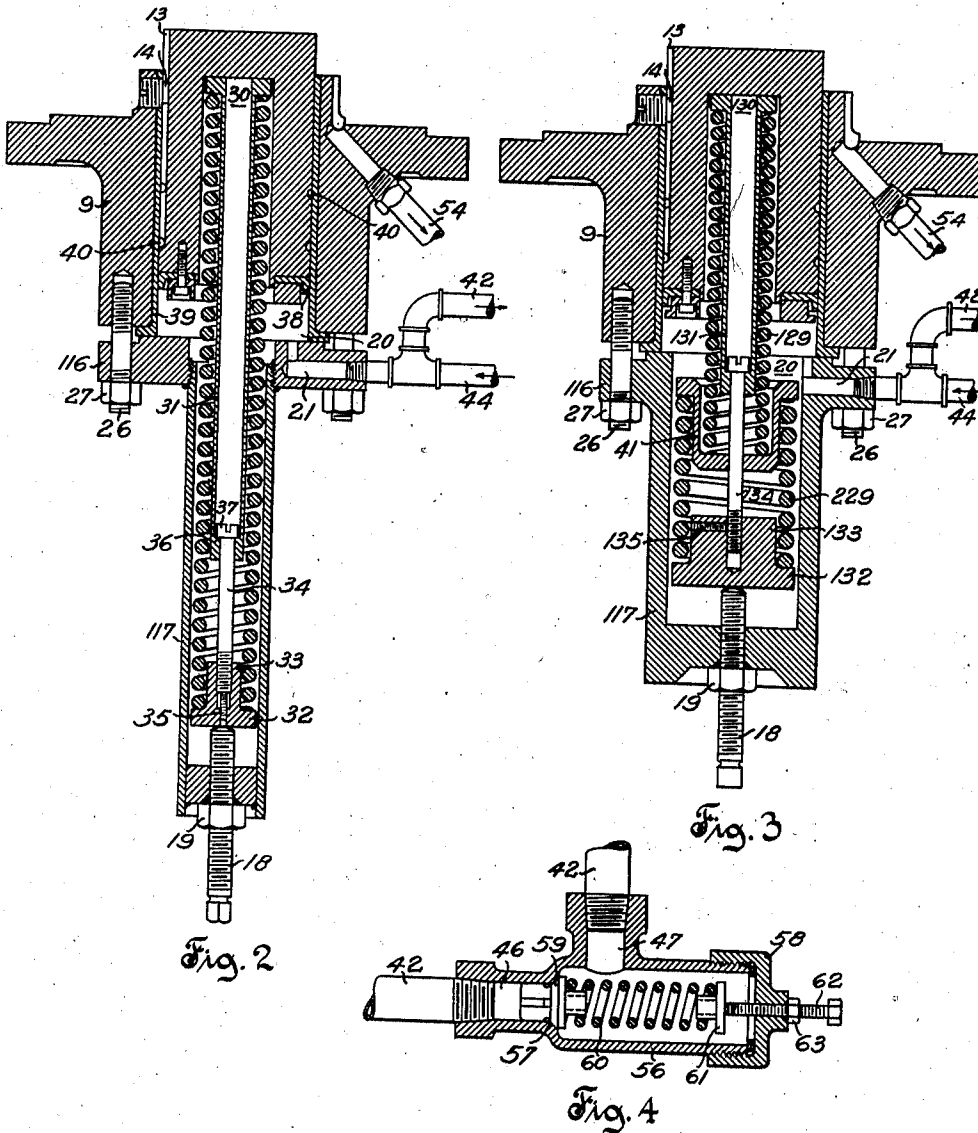
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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GYRATORY CRUSHER

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15 Claims. (Cl. 83—10)

This invention relates to improvements in the means for supporting the head of a gyratory crusher with automatic release to permit passage of uncrushable substances.

The object of the invention is to provide a hydraulic support which will support the crusher head in a set position against any normal crushing load and allow the head to drop in case pressure in the fluid increases beyond a predetermined limit with automatic return of the head to its predetermined setting upon clearance of the crushing chamber.

A further object is to provide a mechanical return independent of high pressure power driven pumps and pump controls.

A still further object is to provide a device in which the crusher may be adjusted to any desired crusher opening independent of hydraulic control.

These and further objects which will appear from the following description are obtained by the mechanism illustrated in the accompanying drawings in which:

Fig. 1 is a more or less diagrammatic vertical sectional view of a crusher embodying the invention;

Fig. 2 is a detailed view to an enlarged scale of the lower section of Fig. 1 showing details of one preferred form of spring assembly and adjusting means;

Fig. 3 is a detailed view to an enlarged scale of a modification of the lower section of Fig. 1 showing a modified form of spring assembly and adjusting means; and

Fig. 4 is a detail sectional view of a relief valve indicated in Fig. 1.

Similar numerals refer to similar parts throughout the several views.

It is well known in the prior art to use springs to support the crusher head in its proper position against the crushing load, such springs yielding upon excessive pressure between the crusher parts due to uncrushable substances such as tramp iron or steel between the crushing members. It is also well known to use fluid under pressure to support the crusher head under normal crushing pressures, relief means being provided to permit opening of the crusher upon exceeding a predetermined pressure in the supporting fluid. This invention combines the advantages of both methods, obtaining an automatic resetting without the disadvantages of the purely spring supported head, which requires extremely strong springs and has a very limited opening movement, and without the expensive

pumps, or accumulator equipment necessary to obtain purely hydraulic head supporting and automatic resetting.

The drawings show the invention as applied to a gyratory crusher in which a frame is generally indicated by the numeral 1. The frame 1 comprises of an upper section 2 supporting a concave 3 which forms one of the crushing members. A center section 4 may be the main supporting member and includes an eccentric bearing 5 in which the eccentric 6 is mounted for rotation. The crusher shaft 7 on which are mounted the crusher head 8 with its mantle 80 forms the second crushing member, and is gyrated by the eccentric 6 in a manner well known in the gyratory crusher art and which forms no part of the present invention. The lower section 9 of the frame 1 comprises a hydraulic cylinder bore 10 in which is mounted with a fluid tight sliding fit a head supporting plunger 11. On the upper surface of plunger 11 is carried a step type thrust bearing block 12 which coacts with the end of the gyrating shaft 7 to support the crusher head 8 against the crushing load caused by the reaction of the forces developed in crushing material between the head 8 and concave 3 by relative gyration thereof. Plunger 11 is held against rotation by a pin 14 mounted in lower section 9 and arranged to project into a groove 13 formed in the surface of the plunger 11. Secured to the upper part of frame section 9 is a thrust bearing 15 for the eccentric 6. The end of the hydraulic cylinder 10 is closed by end cap 16, which is formed with a cup shaped extension or spring housing 17, in the end of which is coaxially mounted a head setting screw 18 provided with a lock nut 19. Section 9, plunger 11, and end cap 16 define a fluid space 20, having a single external fluid connection 21 acting as both inlet and outlet. The sections 2, 4, 9 and 16 of the frame 1 are joined in any known suitable manner as by studs 22, 24 and 26 and nuts 23, 25 and 27. In the fluid space 20 between the head setting screw 18 and the plunger 11, is located a head setting spring assembly 28 which will be described in detail hereinafter.

A preferred form of head setting spring assembly 28 is shown in detail in Fig. 2. In this construction a helical coil spring 29 is seated at its opposite ends against an upper spring seat member 30 and a lower spring seat member 32. The seat member 30 is provided with an integral connecting sleeve 31 extending inside the coils of the spring 29 for a part of the length thereof. Lower seat member 32 is also provided with a

connecting sleeve 33 extending inside the coils of spring 28. The ends of sleeves 31 and 33 are spaced apart longitudinally of the spring. An adjustable connecting bolt 34 threadably engages sleeve 33, and slidably engages sleeve 31 to permit limited relative axial motion of said seat members 30 and 32. In the form shown in Fig. 2, the sleeve 31 is provided with an internal shoulder 35 which is arranged to engage the head 37 of bolt 34 to limit the separating movement of seats 30 and 32. A lock screw 35 is threaded in seat member 32 and arranged to operatively engage bolt 34 after adjustment of said spring assembly by operation of connecting bolt 34, to retain the same in its adjusted position. Members 30 and 32 with bolt 34 form an adjustable telescoping spring compressor deformable axially to allow further compression of spring 29.

The hydraulic fluid space 20, through passage 21, is connected by parallel conduits 42 and 44 with the bottom of a hydraulic fluid reservoir 48 provided with a conventional vent 50 and filling plug 51. In conduit 42 a relief valve 43 is arranged with its high pressure connection 46 in communication with space 20 and its discharge connection 47 in communication with reservoir 48. The internal structure of a suitable relief valve is shown in Fig. 4 and fully described hereinafter. In conduit 44 a check valve 45 is arranged to permit flow only in the direction of space 20.

Plunger 11 may be provided with any known packing as shown at 38 and with sealing grooves as at 40, and the hydraulic cylinder 10 may be provided with a replaceable liner as shown in Figs. 2 and 3 at 39. Hydraulic fluid may be maintained at some level as 49 in the reservoir 48.

As shown in Fig. 1, the crusher may be provided with a dust curtain 52 secured to head 8 and a dust collar 53 secured to center frame section 4, operatively engaged to prevent the passage of dust into the eccentric mechanism 6. Lubricating oil is supplied through a connection 54 and passed through the operating mechanism lubricating the parts and finally discharging at 55.

The eccentric 6 which imparts the gyratory motion to the crusher head 8 may be provided with a ring gear 65 meshing with a beveled drive pinion 66 on a shaft 67 rotatably supported in housing 68 on bearings 69. Shaft 67 passes out of the housing through a packing 70 which prevents the escape of lubricating oil, and is provided at its exterior end with a drive sheave 71 or other known power transmission means.

The relief valve 43 as shown in Fig. 4, may consist of a valve body 56 provided with a high pressure or inlet connection 46 and a discharge connection 47. A valve disk 59 is urged by a spring 60 against a valve seat 57, normally closing off communication from connection 46 to connection 47. Spring 60 is compressed between the valve disk 59 and a spring seat 61, the position of which may be varied by a regulating screw 62 threadably engaging the end closure cap 58 of the valve body 56. A lock nut 63 may be jammed against cap 58 to preserve any desired setting of regulating screw 62.

In Fig. 3 is shown a modified form of end cap and head setting spring assembly in which a shorter structure may be obtained by the ingenious use of two springs 129 and 229 of different diameters. The upper end of spring 129 and the lower end of spring 229 are seated on upper and lower spring seats 130 and 132, respectively, similar in nearly all respects to spring seats 30 and 32 and provided with connecting sleeves 131 and 133 and adjustable connecting bolt 134. In this mod-

ification a cup-shaped, floating intermediate spring seat member 41 engages the adjacent overlapping ends of springs 129 and 229. Spring housing extension 117 is of larger diameter to accommodate the larger spring 229. The result is a much shorter spring assembly.

The operation of the invention is as follows: Rotative power is supplied to sheave 71 causing rotation of eccentric 6 in its bearing 5 and gyration of shaft 7 and head and mantle 8 and 80 with respect to concave 3. Material passing through feed opening 64 to the crushing space between mantle 80 and concave 3 is crushed by the relative motion thereof. The crushing pressure developed reacts on the head and may be resolved into a component perpendicular to the axis of shaft 7 which is opposed by eccentric bearing 5, and a component parallel to the axis of shaft 7 which is opposed by pressure on step bearing block 12 supported by hydraulic plunger 11. Assuming that fluid space 20 and the hydraulic system are filled with a substantially incompressible fluid to level 49, fluid in space 20, and conduits 42 and 44 from passage 21 to relief valve 43 and check valve 45 is trapped and placed under a hydraulic pressure proportional to the crushing pressure by the action of plunger 11, for the check valve 45 cannot pass fluid towards reservoir 48 and relief valve 43 is regulated by screw 62 so that valve disk 59 will not allow fluid to flow through conduit 42 toward reservoir 41 until the fluid pressure exceeds that caused by reaction on the plunger 11 of maximum normal crushing pressure and the pressure of spring 60 is overcome. Spring assembly 28 is set to a predetermined normal length and the spring is thereby precompressed to an initial yielding strength preferably substantially more than that sufficient to support the weight of plunger 11, bearing block 12, shaft 7, head 8, and mantle 80, but not sufficient to withstand the full crushing load. The head setting screw 18 is set to put the head in the desired axial position for crushing to the desired fineness. With a predetermined length and strength of the spring assembly as shown in Figs. 2 and 3, any change in the setting of screw 18 will cause an equivalent change in the axial position of the head 8 relative to concave 3 under all normal conditions.

During normal crushing, the reaction on plunger 11 will act against the trapped fluid in space 20 and no substantial displacement of the head downwards or compression of spring assembly 28 can occur. The head is thus constrained by the hydraulic support to a position in a predetermined path of normal crushing movement.

If, however, a piece of uncrushable material should come between the crushing members 3 and 80, an excessive reaction on plunger 11 will cause the fluid pressure in space 20 and acting on relief valve 43 to exceed that caused by normal crushing. This excessive pressure will act to overcome the pressure of spring 60 forcing the valve disk 59 from its seat and allowing fluid under pressure to escape from space 20 to reservoir 48 through conduit 42, and plunger 11 will be allowed to descend, lowering the head of the crusher and increasing the opening between the crushing members 80 and 3 until the uncrushable substance has passed through and the excessive pressure has been relieved. During the descent of plunger 11, the spring assembly 28 will be compressed or deformed to less than its predetermined normal length, and the potential energy stored in said spring assembly will be increased in proportion to its compression. Upon the dropping

of the head due to uncrushable substance such as tramp iron, the feed to the crusher at 64 will be stopped by the attendant, and the crusher, gyrating normally, will become empty after passing the offending substance. As soon as the load on the crusher drops sufficiently, the energy stored in the spring assembly 28 will be released and, being more than sufficient to return the head to its predetermined setting, will cause the plunger 11 and head 8 to resume their proper set positions with spring assembly 28 extended to its full predetermined length and initial precompression. The action of spring assembly 28 in causing the plunger 11 to move upwards to its set position will cause a fluid pressure drop in space 20, whereupon check valve 45 will open to permit fluid to flow from reservoir 48 through conduit 44 to replace the fluid forced out of space 20 by the excessive pressure on plunger 11. The crusher will thus be returned to its proper set position and crushing may be resumed.

Any lowering of the head 8 due to possible leakage of fluid from space 20 during operation of the crusher will be corrected by the spring assembly whenever the crushing load drops sufficiently so that the total load on the plunger is less than the initial strength of spring assembly 28 and the fluid lost will be replaced from reservoir 48 by the upward motion of plunger 11. Restoration of the head is entirely automatic, being accomplished by the spring assembly 28 independently of any fluid pumping apparatus or controls. Hydraulic support by a trapped body of fluid gives steady support to the head, yieldable only upon opening of relief valve 43. This mechanism will continue to function without attention other than control of feed to the crusher after once being adjusted to the proper setting by adjusting screw 18. Adjustment for maximum normal crushing pressure by regulating screw 62 on relief valve 43 is simple and dependable. Once spring assembly 28 has been set to the desired precompression or initial yielding strength, a change in the setting of the crusher by operation of adjusting screw 18 will not alter the normal length of the said spring assembly.

In case a simple spring as shown in Fig. 1 at 28 without the precompressing, telescoping seat arrangements of Figs. 2 and 3 is used, the length of the spring assembly will be determined by the scale of the spring and the weight of the supported parts, under no load conditions, and no adjustment of limited spring assembly length will be possible, otherwise the action is the same except that there will be no available excess of spring force, over that required to balance the supported parts, to overcome any abnormal resistance of resetting of the head under no load conditions.

It will be understood that the drawings and description represent a preferred embodiment of the invention in a particular type of crusher, and that the invention may, with obvious changes, be used in crushers of different types as will be readily apparent to persons skilled in the art. The scope of invention is intended to include such modifications and equivalents as may occur to persons skilled in the art and come within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. In a crusher comprising relatively movable crushing members, means to impart a normal relative crushing movement to said members, support means including normally closed expan-

sible chamber hydraulic means supporting one of said members in relation to the other and normally constraining said one member to a position in a predetermined path of normal relative crushing movement, said support means being so constructed and arranged that the pressure in said hydraulic expansible chamber is proportional to the crushing pressure on said members, fluid pressure relief means responsive to abnormal pressure caused by uncrushable substance between said members to allow fluid discharge from and contraction of said chamber and abnormal relative movement of said members to avoid excessive pressure, a fluid reservoir, conduit means connecting said reservoir with said hydraulic chamber, means in said conduit permitting fluid flow from said reservoir to said chamber and preventing reverse flow, elastic means deformable by abnormal movement of said members and said hydraulic chamber means and tending to urge said members and said expansible chamber means towards their predetermined normal positions and causing said expansible chamber means to draw in fluid to replace fluid discharged therefrom.

2. In a crusher comprising relatively movable crushing members, means to impart a normal relative crushing movement to said members, support means including normally closed expansible chamber hydraulic means supporting one of said members in relation to the other and normally constraining said one member to a position in a predetermined path of normal relative crushing movement, said support means being so constructed and arranged that the pressure in said hydraulic expansible chamber is proportional to the crushing pressure on said members, fluid pressure relief means responsive to abnormal pressure caused by uncrushable substance between said members to allow fluid discharge from and contraction of said chamber and abnormal relative movement of said members to avoid excessive pressure, a fluid reservoir, conduit means connecting said reservoir with said hydraulic chamber, means in said conduit permitting fluid flow from said reservoir to said chamber and preventing reverse flow, elastic means deformable by abnormal movement of said members and said hydraulic chamber means and tending to urge said members and said expansible chamber means towards their predetermined normal positions and causing said expansible chamber means to draw in fluid to replace fluid discharged therefrom, said elastic means comprising a spring assembly having a spring and means engaging the ends of said spring and constraining said spring to a predetermined normal length, said assembly being deformable in length by pressure in excess of a predetermined amount, said spring urging said assembly to assume its normal predetermined length with sufficient force to cause said crushing members to resume their normal positions upon removal of said crushing pressure.

3. In a crusher comprising relatively movable crushing members, means to impart a normal relative crushing movement to said members, support means including normally closed expansible chamber hydraulic means supporting one of said members in relation to the other and normally constraining said one member to a position in a predetermined path of normal relative crushing movement, said support means being so constructed and arranged that the pressure in said hydraulic expansible chamber is pro-

portional to the crushing pressure on said members, fluid pressure relief means responsive to abnormal pressure caused by uncrushable substance between said members to allow fluid discharge from and contraction of said chamber and abnormal relative movement of said members to avoid excessive pressure, a fluid reservoir, conduit means connecting said reservoir with said hydraulic chamber, means in said conduit permitting fluid flow from said reservoir to said chamber and preventing reverse flow, elastic means deformable by abnormal movement of said members and said hydraulic chamber means and tending to urge said members and said expandible chamber means towards their predetermined normal positions and causing said expandible chamber means to draw in fluid to replace fluid discharged therefrom, said elastic means comprising a spring assembly having a spring and means engaging the ends of said spring and constraining said spring to a predetermined normal length, said assembly being deformable in length by pressure in excess of a predetermined amount, said spring urging said assembly to assume its normal predetermined length with sufficient force to cause said crushing members to resume their normal positions upon removal of said crushing pressure, in which the position of one end of said elastic means relative to one of said crushing members under normal conditions determines the normal positions of said crushing members and said hydraulic supporting means, and means to adjust the position of said one of said elastic means relative to said one of said crushing members.

4. In a crusher comprising relatively movable crushing members, means to impart a normal relative crushing movement to said members, support means including normally closed expandible chamber hydraulic means supporting one of said members in relation to the other and normally constraining said one member to a position in a predetermined path of normal relative crushing movement, said support means being so constructed and arranged that the pressure in said hydraulic expandible chamber is proportional to the crushing pressure on said members, fluid pressure relief means responsive to abnormal pressure caused by uncrushable substance between said members to allow fluid discharge from and contraction of said chamber and abnormal relative movement of said members to avoid excessive pressure, a fluid reservoir, conduit means connecting said reservoir with said hydraulic chamber, means in said conduit permitting fluid flow from said reservoir to said chamber and preventing reverse flow, elastic means deformable by abnormal movement of said members and contracting of said hydraulic chamber means and tending to urge said members and said expandible chamber means towards their predetermined normal positions and causing said expandible chamber means to draw in fluid to replace fluid discharged therefrom, said elastic means being entirely within said expandible chamber means.

5. In a gyratory crusher, a concave, a frame work supporting said concave, a gyratory shaft and crusher head, mounting means on said frame work for said shaft and head including means to gyrate said shaft and head about the axis of said concave, said mounting means comprising hydraulic means supporting said shaft in a predetermined axial position relative to said concave against axial displacement by force caused by relative motion of said head and concave to crush

material therebetween, said hydraulic means being yieldable only to abnormal forces caused by uncrushable material to permit axial movement of said shaft and head, elastic means associated with said hydraulic means and deformable by said yielding thereof to return said hydraulic means and said shaft to normal position upon removal of said uncrushable material, said hydraulic means comprising a plunger and a cylinder, said cylinder having a supply and discharge outlet normally closed by a supply check valve and a relief valve, said elastic means comprising a spring within said cylinder acting to return said plunger and said cylinder to predetermined relative position after relative axial displacement thereof.

6. In a gyratory crusher, a concave, a frame work supporting said concave, a gyratory shaft and crusher head, mounting means on said frame work for said shaft and head including means to gyrate said shaft and head about the axis of said concave, said mounting means comprising hydraulic means supporting said shaft in a predetermined axial position relative to said concave against axial displacement by force caused by relative motion of said head and concave to crush material therebetween, said hydraulic means being yieldable only to abnormal forces caused by uncrushable material to permit axial movement of said shaft and head, elastic means associated with said hydraulic means and deformable by said yielding thereof to return said hydraulic means and said shaft to normal position upon removal of said uncrushable material, said hydraulic means comprising a plunger and a cylinder, said cylinder having a supply and discharge outlet normally closed by a supply check valve and a relief valve, said elastic means comprising a spring within said cylinder acting to return said plunger and said cylinder to predetermined relative position after relative axial displacement thereof, and means to adjust said spring means to predetermined initial yielding strength and predetermined normal axial length.

7. In a gyratory crusher, a concave, a frame work supporting said concave, a gyratory shaft and crusher head, mounting means on said frame work for said shaft and head including means to gyrate said shaft and head about the axis of said concave, said mounting means comprising hydraulic means supporting said shaft in a predetermined axial position relative to said concave against axial displacement by force caused by relative motion of said head and concave to crush material therebetween, said hydraulic means being yieldable only to abnormal forces caused by uncrushable material to permit axial movement of said shaft and head, elastic means associated with said hydraulic means and deformable by said yielding thereof to return said hydraulic means and said shaft to normal position upon removal of said uncrushable material, said hydraulic means comprising a plunger and a cylinder, said cylinder having a supply and discharge outlet normally closed by a supply check valve and a relief valve, said elastic means comprising a spring within said cylinder acting to return said plunger and said cylinder to predetermined relative position after relative axial displacement thereof, means to adjust said spring means to predetermined initial yielding strength and predetermined normal axial length, and means to adjust the axial position of one end of said spring means thereby to determine the normal axial position of said shaft and head.

8. In a crusher, yieldable hydraulic bearing support means comprising a contractable hydraulic fluid containing means of normal predetermined volume, elastic means of positively limited length deformable by contraction of said fluid containing means and active when deformed to cause expansion of said fluid containing means to said predetermined volume, a discharge and intake opening in said containing means, relief valve means connected with said opening to permit discharge of fluid and contraction of said container under abnormal pressure, check valve means connected with said opening preventing discharge of fluid therefrom, fluid supply means connected with said check valve means, said check valve permitting intake of fluid from said fluid supply means upon expansion of said container, said elastic means comprising an assembly having a spring, a telescoping spring compressor, and means to adjust said compressor to precompress said spring to a predetermined initial tension and positively limit said assembly to a predetermined normal length.

9. In a crusher, yieldable hydraulic bearing support means comprising a contractable hydraulic fluid containing means of normal predetermined volume, elastic means of positively limited length deformable by contraction of said fluid containing means and active when deformed to cause expansion of said fluid containing means to said predetermined volume, a discharge and intake opening in said containing means, relief valve means connected with said opening to permit discharge of fluid and contraction of said container under abnormal pressure, check valve means connected with said opening preventing discharge of fluid therefrom, fluid supply means connected with said check valve means, said check valve permitting intake of fluid from said fluid supply means upon expansion of said container, said elastic means comprising an assembly having a spring, a telescoping spring compressor, and means to adjust said compressor to precompress said spring to a predetermined initial tension and positively limit said assembly to a predetermined normal length, means on said fluid containing means to adjust the position of said elastic assembly relative thereto to vary the predetermined volume of said fluid container, said bearing support being movable and having its normal position determined by the volume of said hydraulic means.

10. In a gyratory crusher, a crusher body, a concave supported in said body, a crushing head rigidly connected to a shaft means, mounted in said body for gyratory and axial motion relative to the axis of said concave, a bearing support member capable of movement relative to said body to determine the axial position of said shaft and head relative to said concave, said support member comprising a plunger, a cylinder rigidly connected to said body in axial alignment with said concave, said cylinder engaging said plunger in fluid sealing engagement, means comprising a volume of substantially incompressible fluid in said cylinder to determine the axial position of said plunger and resist axial displacement thereof in a direction to reduce the volume established by said plunger and cylinder, a fluid supply and discharge opening on said cylinder normally closed by a pressure responsive means permitting discharge of fluid above a predetermined pressure, a check valve permitting supply of fluid to said cylinder but preventing discharge therefrom, a fluid supply reservoir and a conduit con-

necting said reservoir to said check valve, elastic means of predetermined normal length and yielding strength deformable by axial displacement of said plunger in said cylinder, said elastic means when deformed acting to urge said plunger towards its predetermined axial position relative to said cylinder thereby causing fluid to be drawn into said cylinder from said reservoir.

11. In a gyratory crusher, a crusher body, a concave supported in said body, a crushing head rigidly connected to a shaft means, mounted in said body for gyratory and axial motion relative to the axis of said concave, a bearing support member capable of movement relative to said body to determine the axial position of said shaft and head relative to said concave, said support member comprising a plunger, a cylinder rigidly connected to said body in axial alignment with said concave, said cylinder engaging said plunger in fluid sealing engagement, means comprising a volume of substantially incompressible fluid in said cylinder to determine the axial position of said plunger and resist axial displacement thereof in a direction to reduce the volume established by said plunger and cylinder, a fluid supply and discharge opening on said cylinder normally closed by a pressure responsive means permitting discharge of fluid above a predetermined pressure, a check valve permitting supply of fluid to said cylinder but preventing discharge therefrom, a fluid supply reservoir and a conduit connecting said reservoir to said check valve, elastic means of axial displacement of said plunger in said cylinder, said elastic means when deformed acting to urge said plunger towards its predetermined axial position relative to said cylinder thereby causing fluid to be drawn into said cylinder from said reservoir, adjusting means operatively connected with the said cylinder and axially supporting said elastic means for adjusting the normal axial position of said elastic means, said plunger and said shaft.

12. In a crusher having relatively movable crushing members, precompressed elastic means operatively engaging said members to determine the normal relative position of said members under no load conditions, normally closed hydraulic means of predetermined volume operatively engaging said members to resist relative displacement thereof under maximum normal crushing load, means to permit discharge of fluid from and reduction in volume of said normally closed hydraulic means when said load exceeds said maximum normal crushing load, said elastic means urging said hydraulic means to resume said predetermined normal volume, a source of fluid, and means to automatically connect said source of fluid to said hydraulic means for flow of fluid to said hydraulic means in response to an increase in volume of said hydraulic means.

13. A yieldable bearing support comprising a hydraulic means having a predetermined normal volume, said hydraulic means being yieldable under predetermined excessive pressure by discharge of fluid therefrom, a fluid supply reservoir, check valve means permitting flow of fluid from said supply reservoir to said hydraulic means and preventing reverse flow at least at a pressure below said predetermined pressure, and means operatively connected with said hydraulic means to urge said hydraulic means to resume its predetermined normal volume after a yielding movement, said hydraulic means upon such resumption of normal volume acting to suck in fluid to replace fluid discharged therefrom,

said hydraulic means comprising relatively movable plunger and cylinder means defining a closed hydraulic fluid chamber, said means to urge said hydraulic means to resume its normal predetermined volume comprising a spring assembly axially arranged within said hydraulic fluid chamber and operatively engaging said plunger and cylinder means, said assembly including deformable means positively limiting the axial length and initial yielding strength of said assembly.

14. A yieldable bearing support comprising a hydraulic means having a predetermined normal volume, said hydraulic means being yieldable under predetermined excessive pressure by discharge of fluid therefrom, a fluid supply reservoir, check valve means permitting flow of fluid from said supply reservoir to said hydraulic means and preventing reverse flow at least at a pressure below said predetermined pressure, and means operatively connected with said hydraulic means to urge said hydraulic means to resume its predetermined normal volume after a yielding movement, said hydraulic means upon such resumption of normal volume acting to suck in fluid to replace fluid discharged therefrom, said hydraulic means comprising relatively movable plunger and cylinder means defining a closed hydraulic fluid chamber, said means to urge said hydraulic means to resume its normal predetermined volume comprising a spring assembly axially arranged within said hydraulic fluid chamber and operatively engaging said plunger and cylinder means, said assembly including deformable means positively limiting the axial length and initial yielding strength of said assembly, adjusting means operatively engaging a part of said hydraulic means and said spring assembly to ad-

just the relative predetermined axial positions of said plunger and cylinder.

15. A yieldable bearing support comprising a hydraulic means having a predetermined normal volume, said hydraulic means being yieldable under predetermined excessive pressure by discharge of fluid therefrom, a fluid supply reservoir, check valve means permitting flow of fluid from said supply reservoir to said hydraulic means and preventing reverse flow at least at a pressure below said predetermined pressure, and means operatively connected with said hydraulic means to urge said hydraulic means to resume its predetermined normal volume after a yielding movement, said hydraulic means upon such resumption of normal volume acting to suck in fluid to replace fluid discharged therefrom, said hydraulic means comprising relatively movable plunger and cylinder means defining a closed hydraulic fluid chamber, said means to urge said hydraulic means to resume its normal predetermined volume comprising a spring assembly axially arranged within said hydraulic fluid chamber and operatively engaging said plunger and cylinder means, said assembly including deformable means positively limiting the axial length and initial yielding strength of said assembly, adjusting means operatively engaging a part of said hydraulic means and said spring assembly to adjust the relative predetermined axial positions of said plunger and cylinder, said adjusting means being of sufficient strength to support the maximum deformed pressure of said spring assembly, and said initial yielding strength of said spring assembly being at least sufficient to support the no-load weight on said bearing support.

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