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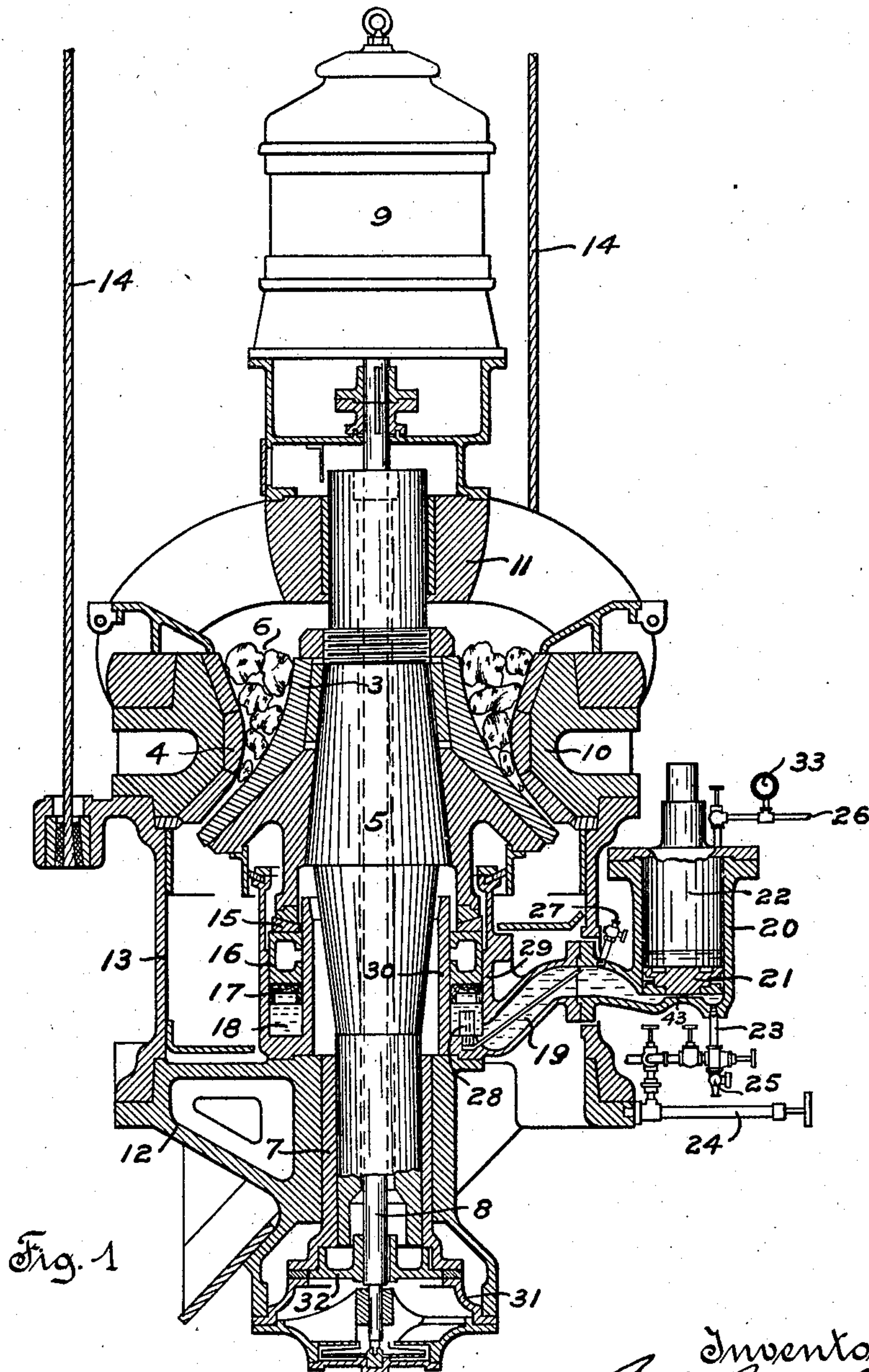
R. C. NEWHOUSE ET AL

2,021,895

CRUSHER

Filed May 24, 1930

2 Sheets-Sheet 1



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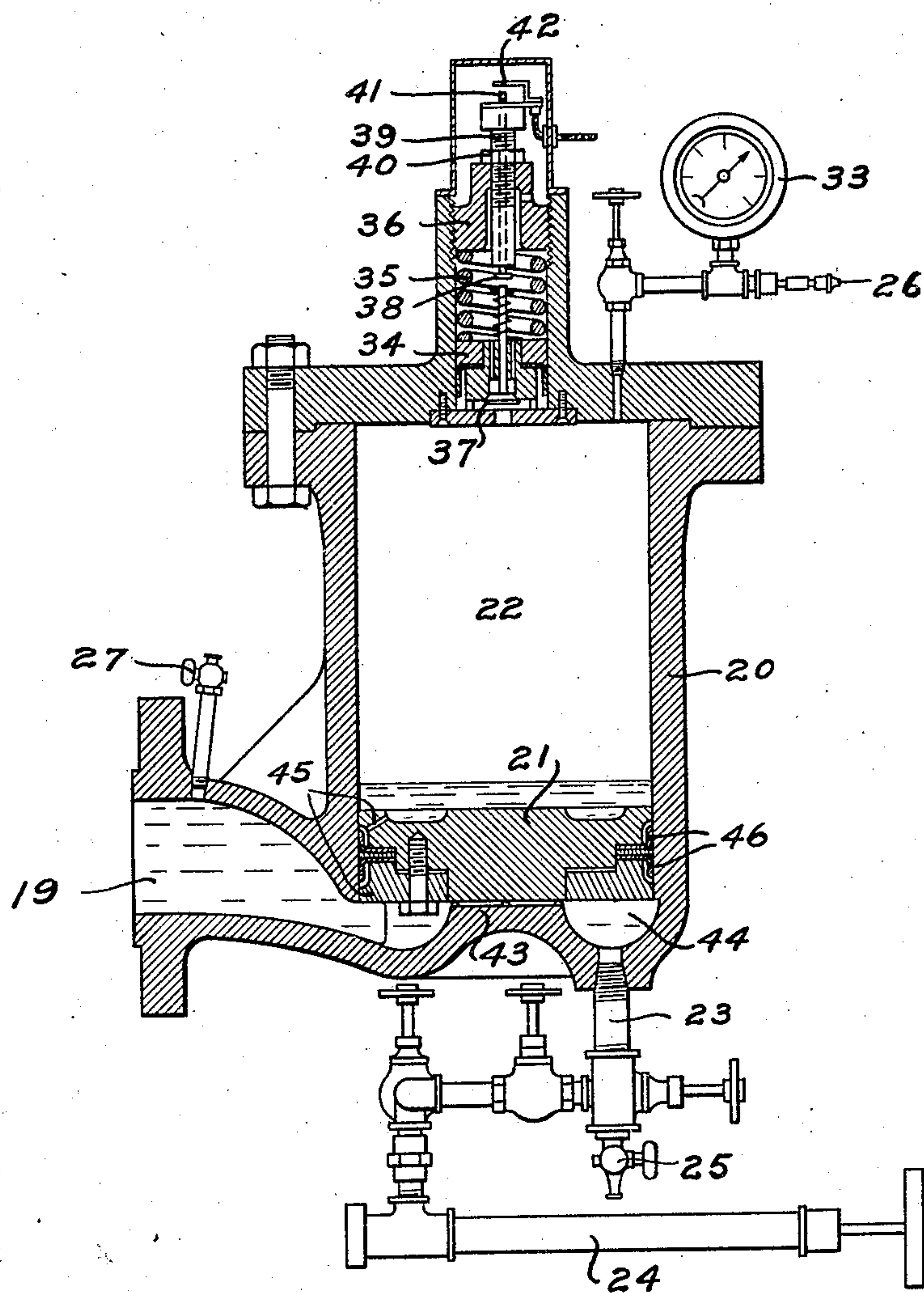


Fig. 2

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UNITED STATES PATENT OFFICE

2,021,895

CRUSHER

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Application May 24, 1930, Serial No. 455,199

27 Claims. (Cl. 83—10)

The present invention relates in general to improvements in the art of supporting movable machine elements, and relates more specifically to improvements in the construction and operation of thrust bearings especially adapted for use in connection with crushers or the like.

An object of the invention is to provide an improved bearing structure which is capable of effectively resisting relatively high and variable pressures. Another object of the invention is to provide simple and efficient means for effecting adjustment of a thrust bearing or the like. Still another object of the invention is to provide improved means for protecting the elements of a machine against damage due to abnormal conditions of operation. A further object of the invention is to provide an improved elastic fluid reaction bearing for crushers or the like, that may be adjusted quickly and conveniently to vary the relative position of cooperating crushing members, and that functions to render the crushing members relatively movable when they are subjected to abnormal crushing conditions which tend to cause breakage of parts. These and other objects and advantages will appear from the following detail description.

Novel features of the crusher supporting and driving structure, disclosed but not claimed herein, form the subject of the copending application of Ray C. Newhouse, Serial No. 452,864, filed May 16, 1930, for Crusher.

A clear conception of an embodiment of the invention and of the mode of manipulating and manner of operating devices constructed in accordance therewith, may be had by referring to the drawings accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the several views.

Fig. 1 is a central vertical section through a gyratory crusher embodying the improvement.

Fig. 2 is an enlarged central vertical section through the thrust bearing adjusting and cushioning means constituting a feature of the invention.

The gyratory crusher shown in Fig. 1 by way of illustration, comprises in general a pair of relatively movable inner and outer crushing members 3, 4 normally disposed in predetermined spaced cooperating crushing relationship to form an annular crushing chamber 6 having a discharge opening at its lower extremity; a hollow main shaft 5 movably supporting the head or inner member 3; a rotary eccentric 7 cooperating with the lower extremity of the main shaft 5 to

produce gyration of the member 3 relative to the member 4; a motor 9 for rotating the eccentric 7 at high speed; a drive shaft 8 directly connected at its upper end to the motor 9 and drivingly connected at its lower end to the eccentric 7 by means of a drive plate 32; upper, intermediate and lower frames 10, 13, 12, respectively, providing supports for the various elements of the crusher; and suspension cables 14 associated with the intermediate frame 13 for yieldingly supporting the crusher structure.

The upper extremity of the main shaft 5 is fulcrumed in a spider 11 supported upon the upper frame 10 which also provides a fixed support for the concave or outer crushing member 4. The discharge opening of the crushing chamber 6 is directed into the interior of the intermediate frame 13 from which the final product is delivered by gravity along the usual discharge chute. The eccentric 7 is rotatably supported in a guide bearing formed in the lower frame 12, and rests upon a thrust bearing 31 secured to the lower extremity of the frame 12.

The crushing head or inner member 3 rests directly upon an annular floating thrust ring 15 which is supported by means of a fluid support comprising an annular plunger 16 and a confined body 18 of incompressible fluid such as oil. The annular plunger 16 is vertically movable between inner and outer walls 30, 29 respectively, which form an annular recess within the bottom of which the oil body 18 is confined, and the lower portion of which is provided with a stop 28 for supporting the member 3, shaft 5 and the movable thrust bearing elements, when the oil body 18 has been removed or the pressure thereon released. The lower portion of the annular plunger 16 may furthermore be provided with suitable packing 17 for preventing escape of oil from the confined body 18.

Disposed laterally adjacent to the thrust bearing structure, is a cylinder 20 within which a displaceable piston 21 is slidably disposed. The oil body 18 extends through a passage 19 and through an annular chamber 44 into direct contact with the lower face of the piston 21, so that any motion imparted to the plunger 16 will be transmitted to the piston 21 and vice versa. The lower face of the piston 21 normally coacts with an abutment or stop member 43 formed integral with the cylinder 20, and the upper face of the piston 21 is exposed to a cushion 22 of elastic fluid such as air under pressure. In order that it may effectively separate the oil body 18 from the air in the cylinder 20, the piston 21 is provided

with cup-shaped packings 46 to the interiors of which pressure may be admitted through ports 45, as shown in Fig. 2.

A pipe 23 communicating with the annular conduit 44 beneath the piston 21, serves to either admit oil to or to withdraw oil from the oil body 18. This pipe 23 may be interchangeably connected with an oil supply pump 24, or with the atmosphere through a drain cock 25, to either increase or decrease the quantity of oil in the body 18. A pet-cock 27 may also be provided for the purpose of removing air from the space within which the oil body 18 is confined, this air release communicating with the highest portion of the oil confining space. The upper surface of the piston 21 may also be covered with a bath of oil in order to prevent air from working past the piston packings.

Associated with the top cover of the cylinder 20, is an air admission and release pipe 26, this pipe being provided with a gage 33 in order to permit establishment of a predetermined pressure in the elastic fluid cushion 22. The cylinder top cover is also provided with a bore within which an auxiliary piston 34 is slidably disposed. The piston 34 is normally urged downwardly by means of a coil spring 35 having one end engaging the piston 34 and having its opposite end reacting against an adjustable plug 36. The plug 36 carries a vertically adjustable central guide 39 which may be raised or lowered with respect to the plug 36 and locked into adjusted position by means of a nut 40. Snugly fitting the bore of the guide 39 but vertically movable therein, is a plunger 38 having a movable contact 41 associated with the upper extremity thereof. An air release valve 37 carried by the auxiliary piston 34 has a stem movable in alinement with the plunger 38. The movable contact 41 which is carried by the plunger 38 is adapted under certain conditions which will be hereinafter described, to engage a fixed contact 42 carried by the vertically adjustable guide 39. The contacts 41, 42 control mechanism for stopping the motor 9 when these contacts come into engagement with each other.

When the crusher is operating normally, a predetermined pressure is established in the air cushion 22, sufficient to hold the piston 21 against the abutment 43 and to maintain the oil body 18 under such pressure as will prevent the annular plunger 16 from moving under normal crushing conditions. The main shaft 5 is normally being gyrated at relatively high speed by the eccentric 7 which is driven by the motor 9 through the drive shaft 8 and the connecting plate 32, and material is being crushed in the chamber 6 by virtue of this gyration of the shaft 5. Gyration of the shaft 5 is imparted to the inner member 3 which imparts a rapid succession of blows to the material advancing by gravity through the chamber 6, and the vertical crushing reaction is taken by the thrust bearing located directly beneath the head or inner member 3.

If an abnormally hard piece of material such as a piece of steel is admitted to the crushing chamber 6 between the members 3, 4, the pressure upon the thrust bearing becomes abnormal, thereby subjecting the fluid body 18 to abnormal pressure which is transmitted through the passage 19 and conduit 44 to the lower face of the piston 21. If the abnormal pressure becomes sufficient to overcome the resistance set up by the elastic cushion 22, the piston 21 moves upwardly thereby increasing the pressure in the

cushion 22. If the abnormal condition continues to prevail and to move the piston 21 upwardly, the pressure within the cushion 22 eventually increases to such an extent that the auxiliary piston 34 is moved upwardly against the resistance offered by the spring 35, causing the stem of the valve 37 which is held shut by the pressure prevailing in the cushion 22, to engage the plunger 38 and to move the contact 41 into engagement with the contact 42. This engagement of the contacts 41, 42 causes the motor 9 to stop. If, however, the pressure within the chamber 22 continues to rise sufficiently to cause the auxiliary piston 34 to travel upwardly beyond a position corresponding to closing of the contacts 41, 42, then the valve 37 will be opened by the plunger 38 and the pressure within the cushion 22 will be relieved by virtue of air escaping past the open valve 37 to the atmosphere. If the pressure within the cushion 22 is thus relieved, this pressure must be re-established by admission of air through the connection 26 after the abnormal condition of operation has been removed. The air connection 26 also serves to relieve the pressure in the cushion 22 whenever desired, and the weight of the inner member 3, shaft 5 and movable thrust bearing elements is supported upon the stop 28 when the air has been thus released from the cushion 22.

If it becomes desirable to change the spaced relationship of the cooperating crushing members to vary the size of the discharge opening associated with the crushing chamber 6, this may be readily accomplished. By opening the drain cock 25 and removing some of the oil from the body 18, the inner crushing member 3 may be lowered thereby increasing the size of the discharge opening. If it is desired to decrease the size of this discharge opening, the pump 24 may be operated to increase the quantity of oil in the body 18 thereby raising the inner member 3. An indicator such as shown at the upper end of the crusher shaft 5 may be provided in order to determine the degree of adjustment of the thrust bearing. It is important to remove all air from direct contact with the oil body 18, and such removal of air may be readily effected with the aid of the pet-cock 27.

From the foregoing description it will be apparent that the present invention in fact provides improved bearing structure comprising a confined fluid body, which is capable of effectively resisting relatively high and variable pressures. The size of the discharge opening of the crushing chamber 6 may be readily varied in a relatively short period of time, to suit any desired degree of reduction of the material demanded by the operator. The elastic cushion 22 provides simple and effective means for protecting the elements of the machine against damage due to abnormal conditions of operation. If the piece of abnormally hard material admitted to the crushing chamber 6 is of such size that it is capable of passing through the discharge opening, then the operation of the machine will not be stopped, but the cushion 22 will function to automatically permit passage of the abnormally hard piece without damaging the structure. If the abnormally hard piece of material is so large that it will not pass through the discharge opening, then the operation of the machine will be stopped, as hereinabove described, before damage of parts results.

While the improvement is especially applicable to machines such as crushers of various types, it will be apparent that the novel features are

more generally applicable to machines of any type which are liable to be subjected to similar abnormal conditions of operation, or wherein an adjustable thrust bearing structure is desired.

5 The invention has proven to be highly successful in commercial use in connection with gyratory crushers, and the practicability of the principles involved has been thoroughly demonstrated.

10 It should be understood that it is not desired to limit the invention to the exact details of construction and to the precise mode of manipulating and of operating mechanisms built in accordance therewith, for various modifications within the scope of the claims may occur to persons skilled in the art.

15 It is claimed and desired to secure by Letters Patent:

1. In combination, a pair of members cooperating to form a crushing chamber, means for causing relative movement of said members to crush material, a liquid support for carrying one of said members, means forming a chamber, a piston in said chamber having one face exposed to the liquid constituting said support and having its opposite face exposed to a source of elastic fluid under pressure and a stop for said piston disposed to limit its movement under the influence of said elastic fluid.

2. In combination, inner and outer members cooperating to form a crushing chamber having a discharge opening, an eccentric for gyrating said inner member relative to said outer member to crush material, a fluid support for said inner member, and a fluid cushion cooperating with said support to permit movement of said inner member relative to said outer member to vary the size of said opening.

3. In combination, inner and outer members cooperating to form a crushing chamber, an eccentric for gyrating said inner member relative to said outer member to crush material, a fluid support for said inner member, and a fluid cushion cooperating with said support to establish a predetermined normal supporting resistance at said support.

4. In combination, inner and outer members cooperating to form a crushing chamber, an eccentric for gyrating said inner member relative to said outer member to crush material, a fluid support for said inner member, and a fluid cushion cooperating with said support to permit displacement thereof upon attainment of an abnormal condition in said chamber.

5. In combination, inner and outer members cooperating to form a crushing chamber having a discharge opening, an eccentric for gyrating said inner member relative to said outer member to crush material, a fluid support for said inner member, a fluid cushion coacting with said support, and means for varying the quantity of fluid in said support to effect variation of the size of said discharge opening.

6. In combination, inner and outer members cooperating to form a crushing chamber having a discharge opening, an eccentric for gyrating said inner member relative to said outer member to crush material, a liquid support for said inner member, means forming a chamber, and a piston in said chamber having one face exposed to the liquid constituting said support and having its opposite face exposed to a source of elastic fluid under pressure.

7. In combination, inner and outer members cooperating to form a crushing chamber having a discharge opening, an eccentric for gyrating

said inner member relative to said outer member to crush material, a liquid support for said inner member, means forming a chamber communicating with said support, a piston in said chamber having one face exposed to the liquid constituting said support and having its opposite face exposed to a source of elastic fluid under pressure, and means for varying the quantity of liquid in said support to effect variation of the size of said discharge opening.

8. In combination, a pair of members cooperating to form a crushing chamber, means for causing relative movement of said members to crush material, a liquid support for one of said members, means forming a chamber communicating with said support, a piston in said chamber having one face exposed to the liquid constituting said support and having its opposite face exposed to a source of elastic fluid under pressure, and means operable by movement of said piston for stopping the movement of said member moving means.

9. In combination, inner and outer members cooperating to form a crushing chamber having a discharge opening, an eccentric for gyrating said inner member relative to the outer member to crush material, a liquid support for said inner member, means forming a chamber communicating with said support, a piston in said chamber having one face exposed to the liquid constituting said support and having its opposite face exposed to a source of elastic fluid under pressure, and means operable by movement of said piston to stop the movement of said eccentric.

10. In combination, inner and outer members cooperating to form a crushing chamber, an eccentric for moving said inner member relative to said outer member to crush material, a thrust bearing for said inner member comprising a body of oil, and an air cushion cooperating with said oil to establish a predetermined normal supporting resistance at said thrust bearing.

11. In combination, inner and outer members, an eccentric for gyrating said inner member relative to said outer member, a fluid support for said inner member, a fluid cushion coacting with said support to relieve excessive thrust on said inner member, and means for varying the quantity of fluid in said support to effect variation in the relative position of said members.

12. In combination, inner and outer members, an eccentric for moving said inner member relative to said outer member, a thrust bearing for said inner member comprising a body of oil, and an air cushion cooperating with said body of oil to establish a predetermined normal supporting resistance at said thrust bearing.

13. In combination, a pair of relatively movable crushing members arranged in spaced relation so as to form a crushing chamber having a discharge opening, a reaction support comprising a confined body of liquid and a piston member, one of said crushing members floating on said support so as to normally maintain a predetermined discharge opening, elastic fluid cushioned means for normally opposing the pressure within the liquid of said support and operable in response to a reaction thrust in excess of a predetermined value for permitting said floating crushing member to move and increase said discharge opening, and means for varying the quantity of liquid in said reaction support to effect a variation in the size of said discharge opening.

14. In a crusher having a pair of crushing

members arranged in spaced relation so as to form a crushing chamber having a discharge opening, the combination of a liquid supported thrust bearing for normally supporting one of
 5 said members so as to maintain a predetermined discharge opening, means for moving said one of said crushing members relative to the other to crush material, and means for relieving excessive crushing reaction on said thrust bearing comprising a piston member having one face in contact with the liquid in said thrust bearing and another face in contact with a body of elastic fluid, and also comprising a stop member against which said elastic fluid normally biases said piston member.
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15. In a crusher having a pair of relatively movable crushing members arranged in spaced relation so as to form a crushing chamber having a discharge opening, the combination of a
 20 liquid supported thrust bearing for normally supporting one of said members so as to maintain a predetermined discharge opening, means for moving said crushing members relative to crush material, and means operable upon occurrence of
 25 an excessive crushing reaction on said thrust bearing to increase said discharge opening, said last mentioned means comprising a piston member having one face in contact with the liquid in said thrust bearing and having another face
 30 in contact with a body of elastic fluid normally under greater pressure than said liquid, and also comprising a stop member against which said body of fluid normally biases said piston member.

16. In combination, a pair of crushing members arranged to form a crushing chamber, means for causing one of said members to revolve relative to the other to crush material, means for resisting the crushing thrust on said revolvable member, said last mentioned means comprising
 40 a body of liquid under pressure and also comprising a piston having a face in contact with said body of liquid and another face in contact with a confined body of elastic fluid under normally greater pressure than the pressure of said
 45 liquid whereby said piston is displaceable upon occurrence of a crushing reaction on said thrust bearing in excess of a predetermined value to permit a separation of said crushing members, stop means disposed to so limit movement of said
 50 piston that greater pressure may be maintained in said elastic fluid than in said liquid, and means responsive to a pressure within said body of elastic fluid in excess of a predetermined value for discharging a portion of said body of fluid to
 55 atmosphere.

17. In a crusher the combination of a crushing member, a second crushing member, means arranged to normally hold said second crushing member in spaced relation with said first mentioned crushing member so as to form a discharge opening therebetween, said holding means comprising a reaction thrust support having a body of liquid normally under a predetermined pressure, means for causing said second crushing member to move relative to said first mentioned crushing member to crush material, a fluid cushion normally under greater pressure than said predetermined pressure, and a displaceable member interposed between said body of liquid and said fluid cushion, said fluid cushion normally biasing said displaceable member to a limiting position, whereby said second crushing member and said displaceable member are displaced from their normal positions to increase
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said discharge opening upon occurrence of excessive crushing reactions.

18. In a crusher having a stationary crushing member and a movable crushing member cooperating therewith to form a crushing chamber
 5 having a discharge opening, the combination of an oil support arranged to support said movable crushing member, means forming a chamber communicating with said oil support, a piston slidable in said chamber and having one face thereof exposed to the oil of said support, an air cushion within said chamber in contact with the opposite face of said piston, and a stop member associated with said chamber, the pressure of said air cushion normally being greater than the pressure of
 10 15 said oil so that said piston is normally biased against said stop member.

19. In combination, a movable member normally subject to thrusts varying within permissible limits, a thrust bearing device arranged to
 20 support said movable member and comprising a body of liquid normally varying in pressure within limits due to said varying thrusts, a chamber in communication with said body of liquid, a piston within said chamber having one face subject to the pressure of said body of liquid, a stop member associated with said chamber and a body of elastic fluid within said chamber arranged to exert a force on the opposite face of said piston greater than the force exerted by said body of
 25 30 liquid so as to normally bias said piston into engagement with said stop member, the pressure of said body of elastic fluid being so predetermined with respect to the upper limit of said limits of liquid pressure that said movable member is displaceable only upon occurrence of a thrust in excess of said permissible limits.

20. In combination, a pair of members, means for moving one of said members relative to the other, a thrust support for resisting variable
 40 thrusts on said movable member, said thrust support comprising a body of liquid subject to variable pressures, a fluid cushion comprising a body of elastic fluid normally under greater pressure than the pressure of said body of liquid, a displaceable element interposed between said body of liquid and said body of fluid, said body of fluid normally biasing said displaceable element to a limiting position, and means for varying the normal pressure of said body of fluid so as to vary
 45 50 the maximum thrust said thrust support is capable of resisting.

21. In combination, inner and outer members, means for imparting a rotary motion to said inner member relative to said outer member, a
 55 thrust bearing device arranged to support said inner member, said device comprising a body of liquid under pressure, a displaceable piston having one face subject to the pressure of said liquid, means arranged to limit the displacement of said
 60 piston, and resilient cushioning means comprising a body of compressible fluid arranged to urge said piston against said limiting means in opposition to the force on said piston caused by said liquid, whereby displacement of said inner member relative to said outer member is permitted only when the thrust on said inner member exceeds a predetermined amount.

22. A crusher comprising relatively movable crushing members, means including a confined
 70 body of liquid disposed to restrain said crushing members in cooperating crushing relationship, means including a confined body of elastic fluid disposed to exert pressure upon said liquid to yieldingly urge said crushing members into
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crushing relationship in such manner as to permit relative displacement thereof under abnormal crushing conditions, means separating said elastic fluid from said liquid, and means acting upon said separating means to limit the movement thereof under the influence of said elastic fluid to normally relatively position said cooperating crushing members in predetermined crushing relationship.

23. A crusher comprising relatively movable crushing members, means including a confined body of liquid disposed to restrain said crushing members in cooperating crushing relationship, means including a confined body of elastic fluid disposed to exert pressure upon said liquid to yieldingly urge said crushing members into crushing relationship in such manner as to permit relative displacement thereof under abnormal crushing conditions, means separating said elastic fluid from said liquid, means acting upon said separating means to limit the movement thereof under the influence of said elastic fluid to normally relatively position said cooperating members in predetermined crushing relationship, and means for varying the quantity of liquid in said crushing member supporting means to adjust the normal crushing relationship of said crushing members.

24. A crusher comprising relatively movable crushing members, means including a confined body of liquid disposed to restrain said crushing members in cooperating crushing relationship, means including a confined body of elastic fluid disposed to exert pressure upon said liquid to yieldingly urge said crushing members into crushing relationship in such manner as to permit relative displacement thereof under abnormal crushing conditions, means separating said elastic fluid from said liquid, means acting upon said separating means to limit the movement thereof under the influence of said elastic fluid to normally relatively position said cooperating crushing members in predetermined crushing relationship, and means for changing the normal crushing relationship of said crushing members including means for changing the relative position of said separating means and one of said crushing members.

25. A crusher comprising relatively movable cooperating crushing members, means including a confined body of inelastic fluid disposed to maintain said crushing members in normal crushing relationship, yielding means including

a confined body of elastic fluid disposed to exert pressure on said confined body of inelastic fluid to tend to move said crushing members toward each other and adapted to yield to permit movement apart of said crushing members under abnormal crushing conditions, means separating said elastic fluid from said inelastic fluid, and means acting on said fluid separating means for limiting the movement of said yielding means in moving said crushing members toward each other to position said crushing members normally in predetermined spaced relationship.

26. Apparatus comprising relatively movable cooperating members, means including a confined body of inelastic fluid disposed to maintain said members in normal cooperating relationship, yielding means including a confined body of elastic fluid disposed to exert pressure upon said confined body of inelastic fluid to tend to cause relative movement of said members in one direction and adapted to yield to permit relative movement thereof in another direction under abnormal conditions, means separating said elastic fluid from said inelastic fluid, and means acting on said fluid separating means for limiting the movement of said yielding means under the influence of said elastic fluid to thereby position said cooperating members normally in predetermined spaced relationship.

27. Apparatus comprising relatively movable cooperating members, means including a confined body of inelastic fluid disposed to maintain said members in normal cooperating relationship, yielding means including a confined body of elastic fluid disposed to exert pressure upon said confined body of inelastic fluid to tend to cause relative movement of said members in one direction and adapted to yield to permit relative movement thereof in another direction under abnormal conditions, means separating said elastic fluid from said inelastic fluid, means acting on said fluid separating means for limiting the movement of said yielding means under the influence of said elastic fluid to thereby position said cooperating members normally in predetermined spaced relationship, and means for changing the normal spaced relationship of said cooperating members including means to change the position of said fluid separating means relative to one of said cooperating members.

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