

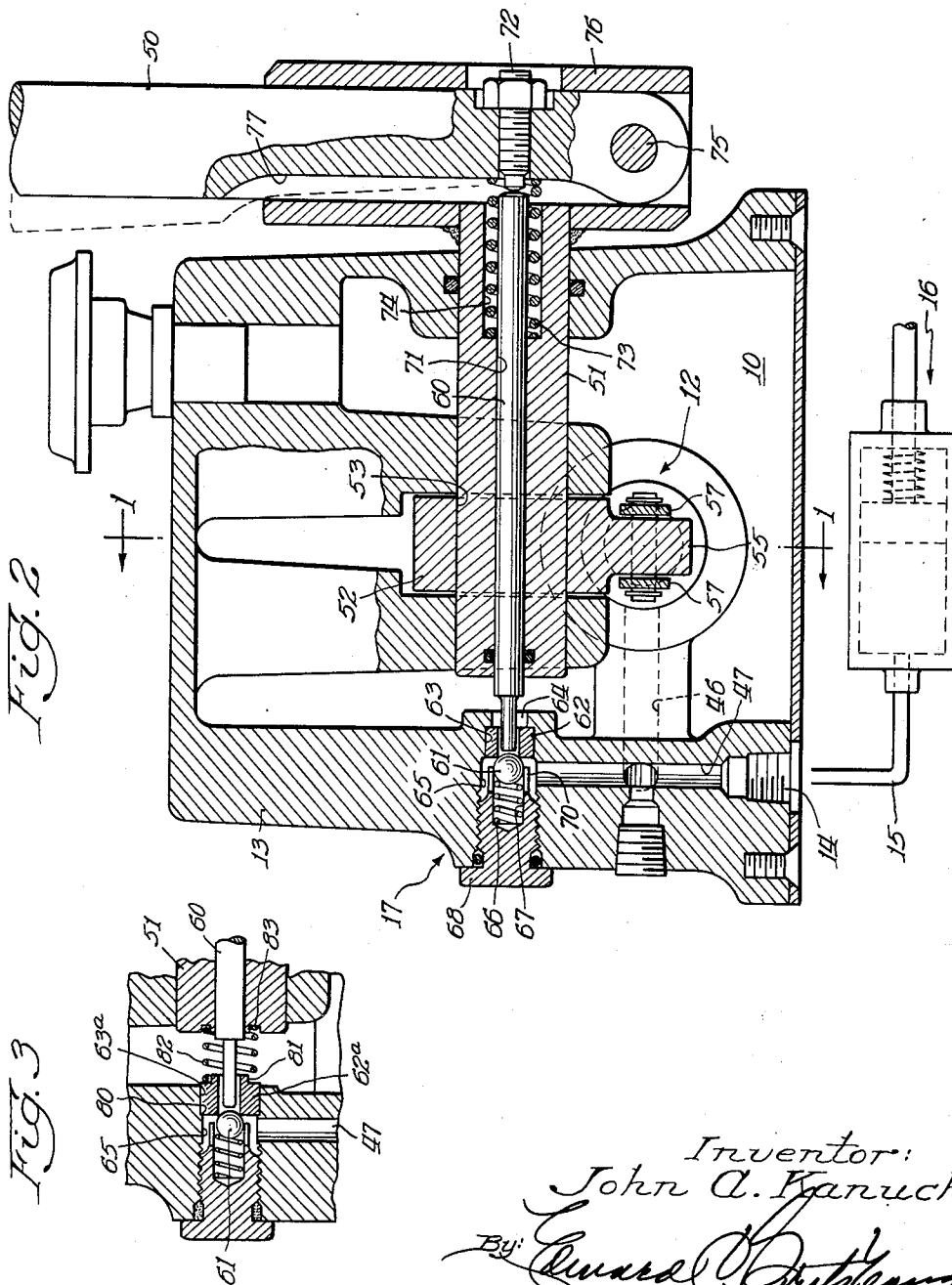
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J. A. KANUCH
HYDRAULIC JACK

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HYDRAULIC JACK

John A. Kanuch, South Euclid, Ohio, assignor to
Borg-Warner Corporation, Chicago, Ill., a cor-
poration of Illinois

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This invention relates to a hydraulic power unit, and more particularly to a manually operated hand pump incorporating a return valve operated by pivoting the pumping lever at right angles to its normal path of reciprocation.

In certain applications, it is sometimes desirable to employ a manually actuated hydraulic pump rather than a motor actuated pump. Thus, a manually operated hydraulic pump may be employed in conjunction with a light weight portable lift truck where it is not feasible or economical to provide a motor driven unit. In such applications, it is desirable to provide readily operable means for pumping and then releasing the hydraulic pressure. Heretofore, a common practice has been to provide a manual valve which is turned by the operator to release pressure. Such manual valve is separate from the pumping unit, and its operation requires that the operator release the hand pumping lever in order to grasp the manual valve. For obvious reasons, this is undesirable.

An object of the present invention is to provide a new and improved hydraulic power unit, and more particularly a manually operated hydraulic power unit wherein operation of the pressure release valve is effected merely by pivoting the pumping lever substantially at right angles to its normal path of reciprocation.

A further object of the present invention is to provide a hydraulic power unit incorporating a relief valve in conjunction with the pressure release valve.

In accordance with one embodiment of this invention, a hydraulic power unit may be provided comprising a double acting piston type pump wherein the pump lever is reciprocated in one plane to cause pumping movement of the pistons and is moved at right angles to this plane to unseat a ball type release valve whereby hydraulic pressure in the system is released.

In accordance with a second embodiment of this invention, a relief valve may be provided for the hydraulic power unit control valve by employing a floating valve seat for the control or release valve, the valve seat being arranged to move to cause, in effect, opening of the control valve in response to the system pressure exceeding a predetermined desired maximum value.

Other objects and advantages of the present invention will be apparent from the following detailed description thereof taken in conjunction with the drawings, wherein:

Fig. 1 is a transverse, sectional view taken substantially along the line 1—1 of Fig. 2, and showing a double acting hydraulic power unit con-

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structed in accordance with one embodiment of this invention;

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1, and

Fig. 3 is a detail view of the return control valve of Fig. 2 showing this valve modified to serve also as a relief valve.

The double acting hydraulic power unit shown in Figs. 1 and 2 is a substantially self-contained system designed to be sold as a package and comprises a housing 13 enclosing an oil sump or reservoir 10 and a pair of oppositely acting piston pumps 11 and 12. Operation of the piston pumps 11 and 12 causes hydraulic fluid to be withdrawn from the reservoir 10 and discharged through a common outlet port 14 formed in the mid portion of the housing 13, as viewed in Fig. 1. The discharge port 14 may be connected by a suitable line 15 to a pressure responsive device such as a piston type hydraulic motor 16 and return pressure from the plunger is communicated back to the power unit through the outlet port 14 to a return control valve 17 operated by the pump operator, as will be described.

As the piston pumps 11 and 12 are identical except for the left and right location thereof, respectively, as viewed in Fig. 1, the following detailed description of the pump assembly 11 applies equally to the pump assembly 12.

Piston pump assembly 11 is disposed in an elongated, cylindrical chamber 18 formed in the left lower portion of housing 13 and extending transversely of Fig. 1. A sleeve-shaped cylinder 19 is fitted within the right portion of chamber 18, being retained therein by an inwardly extending shoulder 20 of the chamber 18 against the left end of which the right side of a flange 21 integrally formed with the left end portion of cylinder 19 bears. The flange 21 is provided with a peripheral, annular groove 22 to receive an O-ring seal, whereby leakage of pressure between the wall of chamber 18 and periphery of cylinder 19 is avoided. Pump piston 23 is slidably journaled within cylinder 19 and is provided with a passage 24 which extends axially through the piston from the left end thereof to a point slightly spaced from the right end thereof. Aperture 24 at its right end communicates with a radially extending aperture or port 25 whereby hydraulic fluid may be drawn into the piston chamber during the suction stroke. The location of the right end of the passage 24 must be such that at the end of the compression stroke of piston 23 the outer end of radial passage 25 is still in communication with the sump 10.

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A check valve 26 comprising a ball poppet is arranged to seat on a valve seat 27 provided by sharply enlarging the aperture 24 immediately adjacent its left end, the ball poppet being urged into seating relation by a small, very light spring 28, carried within the radially segmented or slotted left portion 30 of piston 23 and bearing at its left end against a dished expansion plug or plate 31 fitted tightly within an annular, coaxially disposed recess 32 formed in the left, inner end of the segmented portion 30. Spring 28 exerts only sufficient pressure to move the ball valve 26 to closed position at the end of the suction stroke. During the suction stroke of piston 23, the ball poppet valve 26 readily opens permitting hydraulic fluid to be drawn into the piston chamber; then, upon the piston reversing direction, the ball poppet 26 immediately seats and the fluid in the chamber is delivered under pressure.

Immediately adjacent the left end of sleeve cylinder 19 there is mounted an annular plate or disc 33 defining at its left, inner edge a valve seat 34 for a second ball poppet valve 35 mounted on the left side of the plate 33 in axial alignment with the central aperture formed therethrough. The plate 33 bears at its right side against the left end of the sleeve cylinder 19. Like the flanged portion 21 of the sleeve cylinder, the plate 33 is provided with an annular peripheral groove 37 in which is positioned an O-ring seal 40. The ball poppet valve 35 is urged into seating relation by a relatively heavy coiled compression spring 41, the left portion of which is received in a cylindrical recess 42 formed in a plug or closure block 43 mounted in the left side of housing 13, as viewed in Fig. 1. The closure plug 43 is threaded into an enlarged left portion 44 of the piston chamber, and its right end bears against the left side of valve seat disc 33, thus holding the disc rigidly against the cylinder 19 and the cylinder 19 rigidly against the shoulder 20. It will be noted that the right end portion of retainer plug 43 is segmented or radially slotted, similarly to the left end of piston 23, the inner edges of the segmental portions 45 serving as guides for the poppet valve 35 to maintain the valve in correct axial alignment with valve seat 34, the poppet valve being loosely fitted between the segments.

During the suction stroke of the piston 23, the ball poppet 35 is seated, preventing the pump piston from withdrawing fluid from the outlet port 14. The ball poppet 35 also remains seated due to spring 41 when the pistons are not reciprocated. The ball poppet valve 35 is unseated only in response to the compression of the spring 41 being overcome by the pressure of the hydraulic fluid acting thereagainst in response to the pumping stroke of piston 23. Upon unseating of ball poppet 35, pressure fluid is delivered to a side-wardly extending passage 46 which communicates with a vertically extending passage 47 terminating at its lower end in outlet port 14. The passage 46 extends at an acute angle to the axis of reciprocation of piston 23, when viewed in plan view, so that one end thereof may communicate with the vertical passage 47 while the opposite end is in communication with pump chamber 18. A similar, angularly extending passage is, of course, provided for the right pump assembly 12, both passages connecting to the common outlet passage 47.

Reciprocation of the piston 23, and the corresponding, alternate reciprocation of the right pump assembly 12 is effected by pivoting a pump

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lever arm 50 which is secured, at its lower end, to the right end of a hollow shaft 51, as viewed in Fig. 2. Shaft 51 is journaled in housing 13 and has fixed thereto a cam block 52, the cam block 52 being provided with an aperture 53 through which the shaft 51 extends and a set screw 54 to lock the cam to the shaft. A downwardly depending portion 55 of the cam provides a double faced cam surface, the curved, left side of downwardly depending portion 55 engaging the right end of piston 23, and the curved, right side of downwardly depending portion 55 engaging the left end of the corresponding piston of pump assembly 12.

More particularly, it will be noted that the opposed ends of the two pistons are provided with terminal portions of flattened and substantially reduced width. Termination 56 at the right end of piston 23 is connected to the correspondingly reduced termination of the right pump piston by a pair of links 57, the links 57 being mounted on either side of each termination, in spaced relation, and the downwardly depending portion 55 of the cam 52 being disposed between the intermediate spaced portions. The links 57 are made only sufficiently long so that the cam portion 55 may be fitted between the opposed ends of the pistons without substantial tolerance. At the same time the curved, piston end engaging, side surfaces of cam portion 55 are made to have a radius of curvature substantially equivalent to one-half the distance between the opposed piston ends. Thus, pivoting of the cam involves no change in the spacing between the pistons and a tight action is maintained.

From the foregoing, it will be evident that by pivoting or rocking the pump handle 50 back and forth in the plane of Fig. 1, the pump pistons will be alternately reciprocated to cause delivery of hydraulic pressure to the outlet port 14.

When it is desired to release pressure, that is, to permit return of pressure from the pressure actuated device through the outlet port 14, the return valve 17 is opened to provide a passage to the sump 10. This is accomplished by pivoting the lever 50 to the left, as viewed in Fig. 2, that is to say, at right angles to its normal plane of movement, to cause a push rod 60 to move the ball valve 61 of the return valve assembly away from its seat. Ball valve 61 is arranged to seat on a valve seat insert 62 of sleeve-shape which is mounted in a recessed portion 63 at the left end of a short passage 64, formed in housing 13 and communicating at its right end with the sump chamber 10. The left end or tip portion of the push rod 60 is substantially smaller in diameter than the inner diameter of insert 62 and extends into insert 62 so that the left terminal end of the push rod may be engaged with the right side of ball valve 61. By moving the push rod 60 to the left, the ball valve 61 may be unseated to permit return flow of hydraulic fluid; when the ball valve 61 is unseated, a return passage is thus afforded from the common discharge passage 47 to the control or return valve chamber 55, formed in housing 13, and from there to the sump through a short annular passage defined by the periphery of the reduced tip portion of push rod 60 and the adjacent inner wall of insert 62 and passage 64.

The ball valve 61 is normally urged to closed position by a coiled compression spring 66, the left portion of which is received in a relatively deep recess 67 formed in a retainer cap 68, which is in turn threaded into the left end of chamber

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65, as viewed in Fig. 2. It will be noted that the right end portion 70 of the retainer cap 68 is reduced so that there is a substantial space between the periphery of the reduced portion 70 and the adjacent wall of chamber 65. The right end of cap 68 is spaced from the left end of insert 62 so that when the ball valve 61 is unseated, the fluid may pass to the sump. This terminal portion 70 also serves as a guide for the ball valve 61 which is loosely fitted therein. In some cases it may be desirable to axially slot the terminal portion 70 of the cap 68 to apply system pressure to the left side of ball valve 61 to aid in holding the valve seated.

The right portion of the push rod 60 is journalled in an axially extending aperture 71 formed in the hollow shaft 51 and the right end of the push rod bears against the left end of an adjusting screw 72 threaded into and extending transversely of the pump lever 50. A coiled compression spring 73 surrounds the right end portion of push rod 60, being received in an enlarged or recessed portion 74 of the aperture 71 and the right end of the spring 73 bearing against the left side of the lower end portion of lever arm 50. The lower end of lever arm 50 is pivotally supported at a point substantially lower than the location of adjusting screw 72 on a transversely extending pivot or stub shaft 75, mounted at right angles to the axis of shaft 51, the two ends of stub shaft 75 being fixed in the opposed sides of a tubular member 76 in which member the lower portion of lever arm 50 is received. Member 76 is rigidly secured adjacent its lower mid portion to the right end of sleeve shaft 51, as by welding; the left side of the portion of the arm 50 extending from the stub shaft 75 up to slightly beyond the upper end of tubular member 76 is cut away to provide a long recess or notch 77 on the left side thereof, as viewed in Fig. 2. This permits lever arm 50 to be pivoted about the axis of shaft 75 to the left, as viewed in Fig. 2, a sufficient distance to cause the push rod 60 to unseat the ball valve 61. This pivoting of arm 50 to unseat valve 61 may be done anywhere in the path of and during the reciprocation of lever arm 50 in the plane of Fig. 1.

In some cases it is desirable to incorporate a relief valve in the power unit. In accordance with the present invention, this may be done by employing a floating valve seat for the control valve, the valve seat being arranged to move in response to the system pressure exceeding a predetermined maximum desired value while the ball poppet is held or prevented from following the valve seat by the tip of push rod 60.

Referring now to Fig. 3, showing a modification of the control valve 17 to provide a relief valve arrangement, it will be seen that a floating valve seat insert 62-a is substituted for the valve seat insert 62 shown in Fig. 2 and the insert 62-a is slidably journalled in the right end of a slightly modified short passage 63-a and is axially displaceable therein. The passage 63-a may comprise substantially only a slightly enlarged extension of valve chamber 65. The left end of insert 62-a abuts the right side of a shoulder 80 formed on the chamber wall at the point the passage ends and the chamber proper begins, the shoulder 80 preventing the sleeve insert from moving too far into the chamber. The right end of the sleeve insert 62-a is reduced to define an annular ledge 81 against which the left end of a coiled compression spring 82, surrounding the tip of push rod 60, bears, the right end of spring

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82 bearing against the left end of sleeve shaft 51. Preferably spring 82 is made sufficiently large in diameter to be located in coaxially spaced relation to the push rod and the right end of spring 82 may be received in an annular recess 83 coaxially disposed with respect to the axially extending aperture 71 formed in shaft 51.

When the system pressure exceeds a predetermined value, this pressure, exerted against the left side of poppet ball 61 and the left terminal end of valve seat 62-a, will cause the floating valve seat 62-a to move to the right against the compression force exerted by spring 82. Poppet ball 61 is prevented from moving more than a very short distance to the right by engaging the left end or tip of push rod 60, but the valve seat 62-a is free to move a sufficient distance away from the valve 61, in accordance with the pressure exerted, to open the return passage defined by the periphery of the reduced left portion of push rod 60 and the relatively larger passage extending through insert 62-a. During movement of floating valve seat 62-a, axial alignment thereof with passage 63-a and valve 61 is maintained because of the journal fit of the valve seat in the tip passage 63-a. Operation of the poppet valve 61 as a return control valve is not affected by the provision of the floating valve seat since the valve seat remains substantially stationary until the relief pressure level has been exceeded. Ordinarily, this would be considerably higher than the normal operating pressure level. By properly selecting the compression value of spring 82, it will be evident that the opening or relief level may be established at any desired level.

Where herein the various parts of this invention have been referred to as being located in a right or a left position, it will be understood that this is done solely for the purpose of facilitating description and that such references relate only to the relative positions of the parts as shown in the accompanying drawings.

While but two embodiments of this invention have been shown and described, it will be understood that many changes and modifications may be made therein without departing from the spirit or scope of the invention. Also, while this invention has been described in conjunction with a double acting pump assembly, it will be evident that a single acting pump assembly may also be constructed within the scope of this invention.

What is claimed is:

1. In a hydraulic power unit including a low pressure fluid reservoir, a pressure generator having at least two opposed oppositely acting piston type pumps in fluid communication with said reservoir, manual means movable in one plane and pivotal about one axis effective to cause operation of said generator to deliver pressure fluid from said reservoir to a pressure actuated device and including camming means common to and serving to actuate said oppositely acting piston type pumps when said manual means is pivoted about the axis, said manual means being movable in a second plane lying substantially at right angles to said first plane, and means in fluid communication with said pressure actuated device and said low pressure reservoir effective in response to movement of said manual means in said second plane to effect return flow of fluid from said device to said reservoir, said last-mentioned means being disposed coaxially with said axis.

2. In a hydraulic power unit including a low pressure liquid reservoir, at least two opposed op-

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positely acting reciprocable piston type liquid pressure generators in liquid communication with said reservoir adapted to deliver liquid from said reservoir to a pressure responsive motor, a pressure return flow control valve assembly in liquid communication with said pressure responsive motor and with said reservoir, and a single, manually operable means having a first pivotal movement about a first axis effective to operate said pressure generators to cause the generation and delivery of pressure liquid from said reservoir to said pressure responsive motor and having a second planar movement effective to operate said return flow control valve assembly for causing the return flow of liquid from said motor through said assembly to said reservoir, said return flow control valve assembly being disposed coaxially with said first-mentioned axis.

3. In a hydraulic power unit including a low pressure fluid reservoir, a pressure generator having a pair of opposed oppositely acting piston type pumps in communication with said reservoir, manual means movable through a first range of movement and pivotally connected to rotate about a first axis effective to cause operation of said generator to deliver pressure fluid from said reservoir to a fluid pressure actuated device and including a cam common to both piston type pumps, a combined release and relief valve associated with said pressure generator, said valve being in fluid communication with said motor and said reservoir, said valve including a plunger effective to cause said valve to operate alternately as a release or a relief valve and disposed for movement coaxially with the axis of rotation of said manual means, said manual means being movable through a second range effective to cause said plunger to move axially along the axis of rotation of said manual means to open said valve to permit return flow of fluid from said motor through said valve to said reservoir, said valve being arranged to open in response to return pressure exceeding a predetermined value to cause said fluid to return to said reservoir through said valve, the latter being effected by control of said plunger.

4. In a hydraulic power unit including a low pressure liquid reservoir, a pair of opposed oppositely acting reciprocable piston type liquid generators in liquid communication with said reservoir and adapted to deliver liquid to a pressure responsive device, a pressure return flow control valve assembly in liquid communication with said pressure responsive device and with said reservoir, said valve assembly comprising a movable valve, seat, valve means cooperable with said seat, resilient means associated with said valve means for normally urging said valve means toward said seat, resilient means associated with said seat for normally urging said seat towards said valve means, and manually operable means including camming means disposed between said oppositely acting pistons and common to both, said manually operable means being mounted for pivotal movement about a first axis and having a first movement effective to operate said pressure generators to cause delivery of pressure liquid from said reservoir to said pressure responsive device and having a second planar movement at substantially right angles to said first movement effective to unseat said valve means to cause pressure from said pressure responsive device to return to said reservoir through said valve assembly, said manually operable means further including a plunger mounted coaxially with said first-mentioned axis and in response to said sec-

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ond planar movement of said manual means, said valve seat being movable away from said valve means independently thereof in response to pressure from said pressure responsive device acting against said seat and exceeding a predetermined value to cause said pressure to return to said reservoir through said valve assembly, the latter being accomplished by said axially disposed plunger.

5. In a hydraulic power unit, a low pressure liquid reservoir, a reciprocable piston type pressure generator in liquid communication with said reservoir and adapted to deliver liquid to a pressure responsive device, means for actuating said generator, said means including a manually operable means mounted for rotation about a first axis, a valve assembly in liquid communication with said reservoir and located on the discharge side of said generator, said valve assembly being disposed coaxially with the axis of said manually operable means and including means defining a valve chamber, an annular floating valve seat journaled in said chamber, stop means for limiting movement of said valve seat in one direction, resilient means for urging said valve seat towards said stop means, and a valve arranged to seat on said valve seat when said valve seat is positioned against said stop means, and means associated with said pressure generator actuating means and mounted coaxially with said first-mentioned axis for moving said valve off said valve seat to cause pressure from the discharge side of said generator to return to said reservoir through said valve assembly.

6. A hydraulic power unit in accordance with claim 5 wherein said pressure generator actuating means comprises manual means movable in one plane effective to cause operation of said generators to deliver pressure liquid to said pressure responsive device, said manually actuated means being movable in a second plane lying substantially at right angles to said first plane to effect return flow of liquid from said device by unseating said valve from said movable valve seat.

7. In a pressure generator comprising a low pressure reservoir, a pair of pump cylinders, pistons in said cylinders, said cylinders and pistons being arranged to define oppositely acting pumps in communication with said reservoir, a camming means, a shaft, said camming means being disposed on said shaft intermediate said oppositely acting pistons; a hand lever connected to said shaft for actuating the same thus effective to operate said pistons, said hand lever being pivotally movable in one direction to accomplish generation of pressure by said piston pumps, a return flow control valve assembly in communication with the discharge side of said pumps on one side and with the low pressure reservoir on the other side, said valve assembly being mounted coaxially with said shaft and comprising a movable valve seat, valve means cooperable with said seat, resilient means associated with said valve means for normally urging said valve means towards said seat, resilient means associated with said seat for normally urging said seat towards said valve means, a plunger mounted coaxially with said shaft and reciprocable therethrough, said plunger effective to cause said valve means to move away from said seat to cause pressure generated by said pumps to return to said reservoir through said valve assembly, said movement being accomplished either by movement of said plunger through movement of said hand lever in a second pivotal direction or by movement of said movable

valve seat to a position where said plunger effects unseating of said valve, said movement of said valve seat being accomplished by return flow pressure.

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