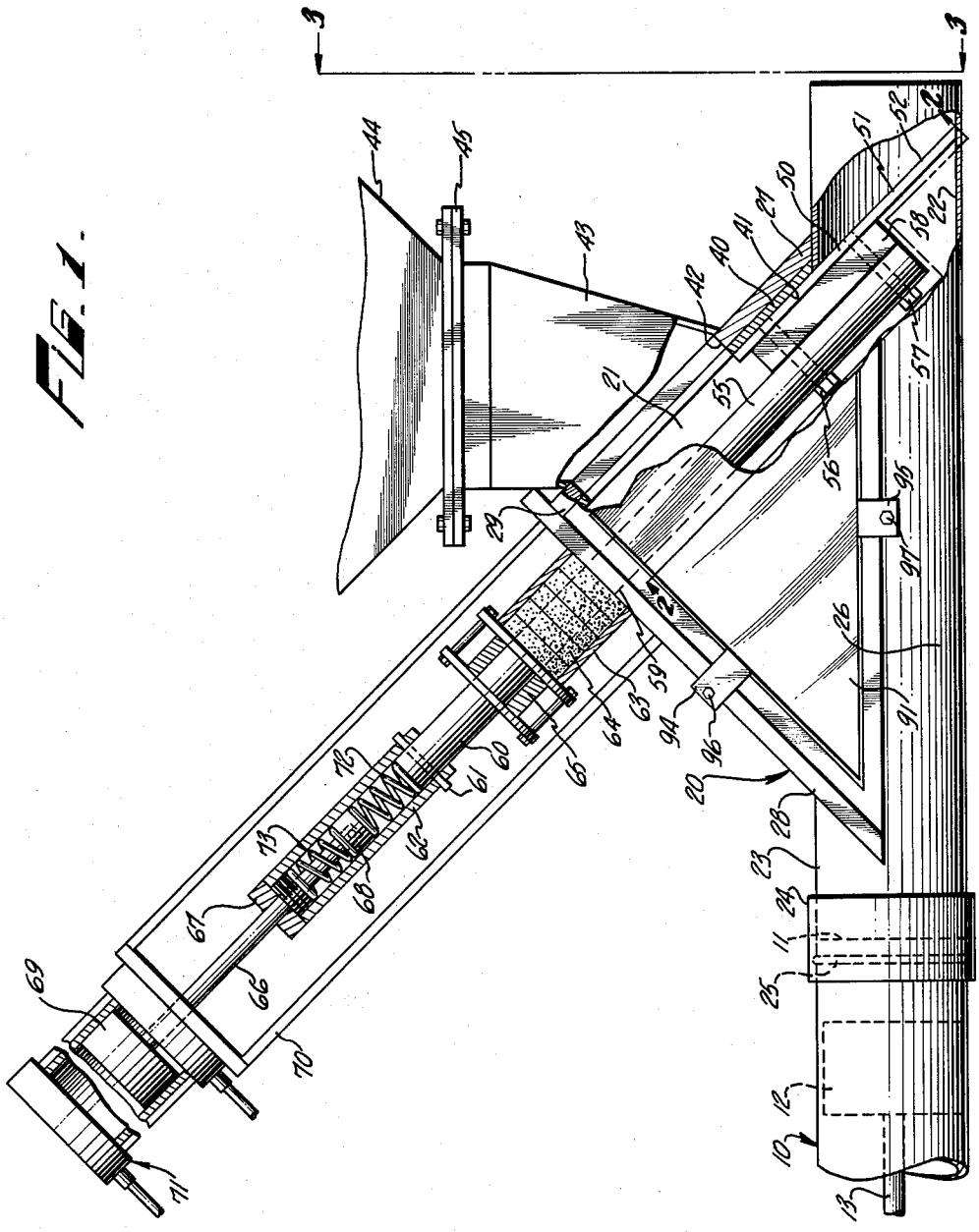
Dec. 17, 1963 K. B. TRIEBEL 3,114,325

CONCRETE PUMP

Filed May 15, 1961 2 Sheets-Sheet 1

FIG. 1.



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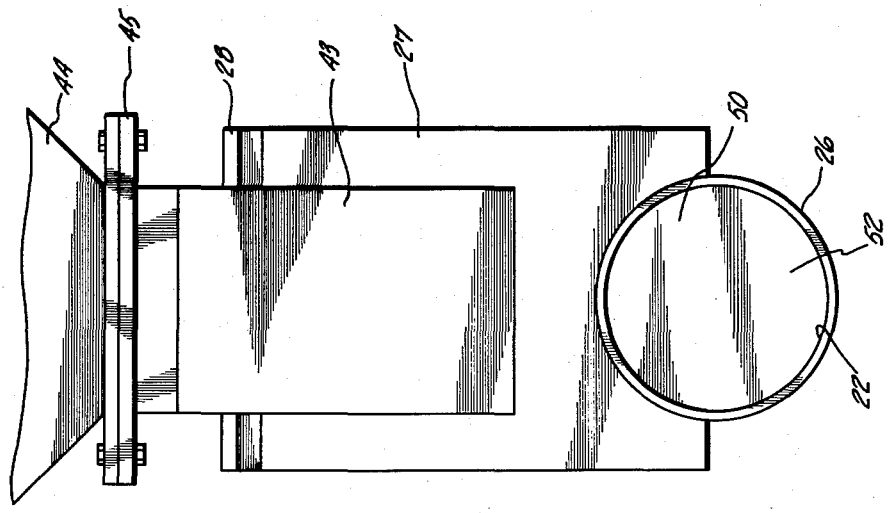

FIG. 1.

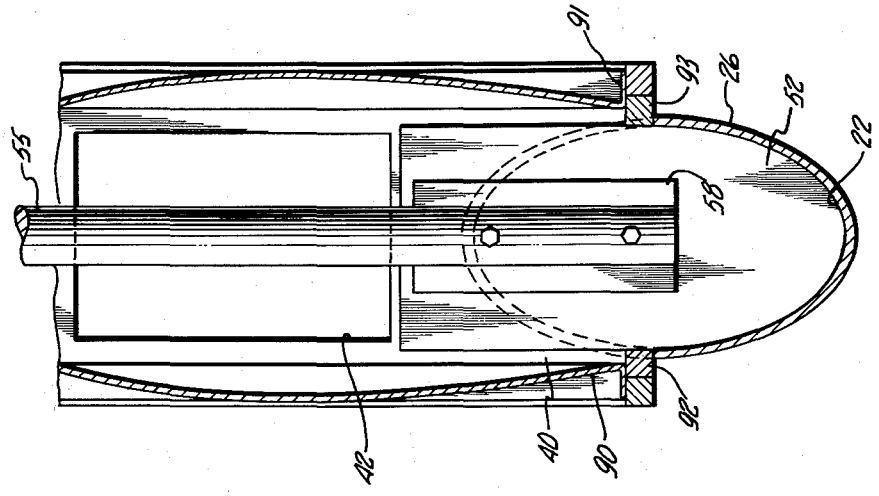

FIG. 2.

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United States Patent Office 3,114,325 Patented Dec. 17, 1963

3,114,325

CONCRETE PUMP

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Filed May 15, 1961, Ser. No. 110,003
1 Claim. (Cl. 103—153)

The invention relates to a pump for plastic concrete and particularly to inlet and outlet valve structure for such a pump.

The inlet and outlet valving of pumps designed to pump plastic concrete is of critical importance. Difficulties are often experienced in this valving because of the viscous nature of plastic concrete, the relatively large size of aggregate contained in the plastic concrete, and the tendency of the plastic concrete to set and harden. Conventional valves for pumps for plastic concrete are often susceptible to jamming and may involve relatively complex and expensive apparatus which is unreliable due to its complexity.

The invention comprises apparatus which provides a simple and highly effective inlet and outlet valve for a pump for plastic concrete which is not susceptible to jamming and which includes provision for absorption of impact shocks without damage to the apparatus which may arise from interference of aggregate in the plastic concrete being pumped with the moving parts of the valve.

In a concrete pump, the inventive apparatus includes, broadly, an elongated pump cylinder having an open end with a piston disposed slidably in the pump cylinder for reciprocative motion within the cylinder toward and away from the open end of the cylinder. A valve housing is connected to the cylinder. The valve housing defines an interior valve chamber which communicates with the open end of the cylinder and also defines a discharge passageway which is spaced from the open end of the cylinder in the direction of the longitudinal axis of the cylinder and communicates between the valve chamber and the exterior of the valve housing. The valve housing also defines an inlet port. The inlet port is spaced from the discharge passageway in a direction transverse to the axis of the discharge passageway and communicates between the valve chamber and the exterior of the valve housing. A valve plate is disposed in the valve chamber. The valve plate is superimposed over the discharge passageway and the inlet port. The valve plate has an end which mates with the bottom of the discharge passageway. Means is provided for slidably mounting the valve plate on the valve housing with the valve plate inclined relative to the discharge passageway away from the direction of flow through the discharge passageway from the valve chamber to the exterior of the valve housing to reciprocate within the valve chamber between a closed position in which its end engages and mates with the bottom of the discharge passageway and closes the discharge passageway and an open position in which the end of the valve plate is spaced from the bottom of the discharge passageway to open the discharge passageway and permit free flow through the discharge passageway. The valve plate is of such extent that it will extend over and close either the discharge passageway or the inlet port, so that

when the discharge passageway is open the valve plate is disposed over the inlet port and closes the inlet port and when the discharge passageway is closed the inlet port is open. Means is provided for reciprocating the valve plate between its open and closed positions.

An important feature of the apparatus is the fact that the reciprocating valve plate has an end which mates with the bottom of the discharge passageway and is inclined relative to the axis of the discharge passageway away from the direction of discharge flow therethrough. During the intake stroke of the pump cylinder in which the piston therein is moving away from the open end of the pump cylinder, the valve plate is disposed with its end in engagement and mating with the bottom of the discharge passageway to close the discharge passageway while leaving the inlet port open and tends to move inwardly into the valve chamber and thus open the discharge passageway. This movement is prevented by the engagement of the valve plate with the bottom of the discharge passageway and its orientation with reference thereto, thus providing a self-actuating support for the end of the valve plate and effectively and securely maintaining the discharge passageway closed. Moreover, the use of a reciprocating valve plate within the valve chamber presents large open areas for free linear flow of the plastic concrete, which is a distinct advantage because it tends to prevent jamming and clogging as would be present in rotary valves which have narrow passageways with bends for flow of the plastic concrete or ball valves which present obstructing structure in the flow passageway to catch concrete and build up a clogged condition of the passageway.

The inventive apparatus will be fully understood from a reading of the following description in conjunction with the accompanying drawings, in which:

FIG. 1 is a partially fragmentary and partially broken away side view of the inventive apparatus;

FIG. 2 is a sectional view looking along the line 2—2 in FIG. 1; and

FIG. 3 is an end view of the inventive apparatus looking along the line 3—3 in FIG. 1.

Referring to FIG. 1, 10 denotes an elongated pump cylinder which has an open end 11. A piston 12 is disposed slidably within pump cylinder 10 for reciprocative motion toward and away from open end 11 of the pump cylinder. The reciprocative motion of piston 12 is produced through a connecting rod 13 connected to the piston at one end and to actuating mechanism at the other end, such as a rotatively driven eccentric or a reciprocating hydraulic piston and cylinder. The motive means for reciprocating piston 12 is purely conventional and for that reason is not illustrated. Sliding seals are effected between piston 12 and the walls of pump cylinder 10 in conventional manner so that there is little or no leakage past the piston.

A valve housing 20 is connected to the open end 11 of pump cylinder 10. Valve housing 20 defines an interior valve chamber 21 which communicates with the open end 11 of the pump cylinder and which defines a discharge passageway 22 spaced from open end 11 of the pump cylinder in the direction of the longitudinal axis of the pump cylinder and communicating between the valve chamber 21 and the exterior of the valve housing. Valve housing 20 is connected to the pump cylinder by

means of a cylindrical portion 23 of the valve housing which has the same inside and outside diameters as the pump cylinder and is coaxially connected to open end 11 of the pump cylinder by means of a sleeve 24 which overlies the pump cylinder and the portion 23 at the connection and is fixed to the valve housing as by welding to portion 23. The outside surface of the pump cylinder is slidably received within connecting sleeve 24 and a seal is effected therebetween in conventional manner by means of an O-ring 25. The discharge passageway 22 is a cylindrical member having the same inside diameter as pump cylinder 10 and, as illustrated, is coaxial with portion 23 of the valve housing and with pump cylinder 10. As a consequence of the coaxial alignment of discharge passageway 22 with pump cylinder 10, the discharge stroke of the pump cylinder, wherein piston 12 moves toward open end 11, discharges plastic concrete through discharge passageway 22 in an axial, linear direction without change in direction of flow of the plastic concrete so that each discharge stroke of piston 12 effects linear movement of the bulk of plastic concrete discharged by that stroke through discharge passageway 22. This is an important feature of the invention because the viscous and highly granular nature of plastic concrete resists changes in its direction of movement and tends to collect and produce clogging at changes of its direction of movement. As illustrated, portion 23 and discharge passageway 22 are defined by a cylindrical body portion 26 of the valve housing which is coaxial with pump cylinder 10 to effect the above described linear discharge of plastic concrete within the valve chamber 21. Body portion 26 may conveniently be a piece of heavy pipe. The valve housing includes a superstructure consisting of a heavy planar front plate 27 and a heavy planar rear plate 28, each of which are cut out to saddle the circular exterior surface of body portion 26 and are rigidly attached thereto as by welding. The front plate 27 and the rear plate 28 extend upwardly from the longitudinal central axis of body portion 26 and are inclined in opposite directions at 45° thereto in order to intersect at a right angle at 29, at which point they are rigidly connected together as by welding.

A planar valve seat 40 is disposed entirely within valve chamber 21 of the valve housing and is connected to the inside surface of front plate 27 by means of screws or the like so that it may be easily removed and replaced when it has become worn. Valve seat 40 saddles the exterior surface of body portion 26 in the same manner as described above for front plate 27 and extends the full length of front plate 27. Surface 41 of valve seat 40 is planar. Valve seat 40 extends upwardly from discharge passageway 22 with its planar surface 41 transverse to the central coaxial longitudinal axes of body portion 26 and pump cylinder 10 and inclined relative thereto and to the axis of discharge passageway 22 at, as illustrated, a 45° angle toward open end 11 of the pump cylinder and away from the direction of flow of plastic concrete discharged from valve chamber 21 through discharge passageway 22 to the exterior of the valve housing. A rectangular inlet port 42 is defined in valve seat 40 and front plate 27 which communicates between valve chamber 21 and the exterior of valve housing 20.

An inlet throat 43 is rigidly connected to the exterior of front plate 27 and extends vertically upwardly to a concrete hopper 44 to which it is connected with a flanged connection 45. The end of throat 43 connected to front plate 27 is coextensive with inlet port 42 so that plastic concrete from hopper 44 communicates linearly downwardly through throat 43 and through inlet port 42 to valve chamber 21 of valve housing 20. There is thus gravity feed of plastic concrete to the valve chamber 21 of the valve housing, which may be encouraged by means of a conventional agitator disposed within concrete hopper 44. It is to be noted that the direction of flow of plastic concrete from hopper 44 into valve chamber 21 is substantially linear without pronounced change in direction of movement for the advantageous reasons described above in connection with discharge passageway 22 and body portion 26. There is thus substantially linear flow of plastic concrete into valve chamber 21 and substantially linear flow of plastic concrete out of valve chamber 21 through discharge passageway 22.

A valve plate 50 is disposed entirely within valve chamber 21 of the valve housing. The disposition of the valve plate entirely within the valve chamber is important because there is then no need for seals between the valve plate and valve seat to prevent leakage of plastic concrete between the valve plate and valve seat to the exterior of the valve housing. Valve plate 50 is a planar member having a planar surface 51 which slidably engages planar surface 41 of valve seat 40. End 52 of the valve plate is shaped to mate with the bottom and sides of discharge passageway 22, as best illustrated in FIG. 2, so that when end 52 engages the sides and bottom of the discharge passageway it mates therewith and closes the discharge passageway. Valve plate 50 is of sufficient areal extent so that it closes discharge passageway 22 when its end 52 engages the bottom and sides of the discharge passageway and closes inlet port 42 when it is disposed over the inlet port, but is of insufficient extent to close both the discharge passageway 22 and inlet port 42 at the same time. Thus, when valve plate 50 has its end 52 in mating engagement with the bottom and sides of discharge passageway 22, it closes the discharge passageway and opens inlet port 42. When valve plate 50 is moved upwardly and to the left in FIG. 1 so as to open discharge passageway 22, it is disposed over inlet port 42 and closes the inlet port. It is thus apparent that reciprocation of valve plate 50 on valve seat 40 alternately opens and closes discharge passageway 22 and inlet port 42 with one open when the other is closed. Since valve plate 50 is planar and slidably engages the planar surface 41 of valve seat 40, the valve plate has the same orientation as described above for valve seat 40 and thus is inclined relative to the bottom of discharge passageway 22 toward open end 11 of the pump cylinder and away from the direction of flow of plastic concrete out of valve chamber 21 through discharge passageway 22 to the exterior of the valve housing.

An elongated shaft 55 has one end fixed to valve plate 50 by means of bolts 56, 57 extending through shaft 55, through filler plate 58 and threadedly received in valve plate 50. Shaft 55 is slidably mounted on the valve housing in a conventional bearing at 59 and extends exteriorly of the valve housing with its exterior end 60 fixed by means of a through pin 61 to a cylindrical sleeve 62. A packing sleeve 63, packing 64, and a packing gland 65 surround shaft 55 exteriorly of the valve housing to seal against leakage in conventional manner while permitting free reciprocation of shaft 55. A plunger 66 extends slidably through a bearing 67 to the interior of sleeve 62 and terminates in a head or piston 68 slidably received within sleeve 62. Plunger 66 is connected to the piston 69 of an actuating hydraulic cylinder 71 mounted on valve housing 20 in fixed position by means of a bracket support 70 secured to the valve housing at one end and to the actuating hydraulic cylinder 71 at the other end. A first compression spring 72 is disposed within sleeve 62 and extends between piston 68 and the end of shaft 55. A second compression spring 73 surrounds plunger 66 and extends between piston 68 and bearing 67, which is threadedly received in sleeve 62, so that piston 68 is free to reciprocate within sleeve 62 under the yielding restraint of compression springs 72, 73. Actuating hydraulic cylinder 71 is operated and phased in conventional manner to reciprocate valve plate 50 in proper synchronism with the reciprocation of piston 12 within pump cylinder 10 so that when piston 12 is moving away from open end 11 on the intake stroke, valve plate 50 is positioned as illustrated with its end 52

in mating engagement with discharge passageway **22** to close the discharge passageway and open inlet port **42**, and when piston **12** is moving toward open end **11** on the discharge stroke, valve plate **50** is moved upwardly and to the right in FIG. 1 to close inlet port **42** and open discharge passageway **22**. This synchronism between operation of hydraulic actuating cylinder **71** and pump cylinder **10** is effected in conventional manner to function as described above and produce the results described above. Compression springs **72, 73** are stiff enough so that reciprocative motion of piston **69** within actuating hydraulic cylinder **71** is transmitted through them to shaft **55** and hence to valve plate **50** for reciprocation thereof. However, if a piece of aggregate or the like is caught between valve plate **50** and the bottom of discharge passageway **22** or the edges of inlet port **42**, springs **72, 73** act as a shock absorber to absorb the impact resulting therefrom and thus prevent damage to the apparatus. This shock absorbing feature is important because the aggregate used in plastic concretes may, by chance, be caught between reciprocating valve plate **50** and a stationary member and result in damage to the apparatus without provision for such contingency and absorption of impact loads resulting therefrom.

The sides of valve housing **20** are closed by means of side plates **90, 91** (FIG. 2) which, as illustrated in FIG. 2, are bowed outwardly about shaft **55** in order to provide a net flow area past shaft **55** which is equivalent to what the flow area would be were shaft **55** not interposed under inlet port **42**. The axis of bend in side plates **90, 91** is parallel to the longitudinal axis of shaft **55** in order to provide this full flow area throughout valve chamber **21** of valve housing **20**. Side plate **90** is rigidly attached by means of welding or the like to front and rear plates **27, 28** and to a flange member **92** welded to body portion **26** of the valve housing. Side plate **91** interfits between front and rear plates **27, 28** and overlies flange member **93** welded to body portion **26** of the valve housing and is secured in position by means of lugs, such as lugs **94, 95**, which are secured to the front and rear plates and to body portion **26** and by means of bolts in conventional manner, such as bolts **96, 97** in lugs **94, 95** respectively. Thus, side plate **91** is removable from the valve housing in order that access may be had to valve chamber **21** for repairs, inspection, and the like. When side plate **91** is disposed in closing position, as illustrated, it tightly closes the valve housing to define the valve chamber **21** therein as a closed chamber.

It is apparent that when discharge passageway **22** is closed by valve plate **50** and piston **12** of the pump cylinder is on its intake stroke, the suction resulting therefrom tends to draw valve plate **50** toward open end **11** of the pump cylinder, but since end **52** of the valve plate engages and mates with the bottom and sides of discharge passageway **22** and is inclined toward open end **11**, as described above, this tendency urges end **52** into firmer engagement with the bottom and sides of discharge passageway **22** and thus supports the valve plate against deflection and more securely closes discharge passageway **22**. Conversely, when piston **12** of the pump cylinder is on its discharge stroke and valve plate **50** is disposed over inlet port **42**, the tendency is to urge valve plate **50** against valve seat **40** and thereby more securely and effectively seal inlet port **42**. It is thus apparent that from the unique design and orientation of the valve plate and valve seat, the forces acting thereon during intake and discharge of plastic concrete not only do not tend to disrupt proper operation of the valve plate and cause leakage but enhance its function and effect a tighter seal, and this is an important feature of the invention.

I claim:

In a concrete pump, an elongated pump cylinder having an open end, a piston disposed slidably in the pump cylinder for reciprocative motion within the pump cylinder toward and away from the open end of the pump

cylinder, a valve housing defining a closed interior valve chamber, means for connecting the valve housing to the pump cylinder with the valve chamber communicating with the open end of the pump cylinder, said valve housing defining a discharge passageway spaced from the open end of the pump cylinder in the direction of the longitudinal axis of the pump cylinder and communicating between the valve chamber and the exterior of the valve housing, said discharge passageway having its axis substantially coaxial with the longitudinal axis of the pump cylinder for linear flow of plastic concrete from the pump cylinder through the valve chamber and the discharge passageway to the exterior of the valve housing, a planar valve seat defining a boundary of the valve chamber disposed in the valve chamber and extending upwardly from the discharge passageway with its planar extent transverse to the axes of the pump cylinder and discharge passageway and inclined relative to such axes and to the botom of the discharge passageway toward the open end of the pump cylinder and away from the direction of flow of plastic concrete from the valve chamber through the discharge passageway to the exterior of the valve housing, means for fixing the valve seat to the valve housing, said valve seat having a surface disposed toward the valve chamber, said valve seat defining an inlet port communicating between the valve chamber and the exterior of the valve housing and spaced along the valve seat upwardly from the discharge passageway for linear gravity flow of plastic concrete through the inlet port into the valve chamber, said inlet port and discharge passageway being aligned along a common straight axis, a hopper for plastic concrete disposed exteriorly on the valve housing and communicating with the inlet port from the exterior of the valve housing, a valve plate defining a planar surface and an opposite surface disposed within the valve chamber, the planar surface slidably engaging only the said surface of the valve seat for reciprocative sliding motion in the direction of the common axis of the inlet port and discharge passageway, the opposite surface of the valve plate being fully exposed to the valve chamber, said valve plate defining a first end which mates with the bottom and sides of the discharge passageway and extending from the first end to an opposite end, which valve plate extends over the discharge passageway when its first end engages and mates with the bottom and sides of the discharge passageway to close the discharge passageway and which extends over the inlet port to close the inlet port when the valve plate is disposed over the inlet port with its first end spaced from the bottom of the discharge passageway so that when the first end of the valve plate engages and mates with the bottom and sides of the discharge passageway it closes the discharge passageway and leaves open the inlet port and when the valve plate is disposed over the inlet port it closes the inlet port and leaves open the discharge passageway, an elongated shaft fixed to the opposite surface of the valve plate and extending exteriorly of the valve housing coaxially with the axis of alignment of the inlet port and discharge passageway, means for slidably mounting the shaft on the valve housing for reciprocative movement of the shaft in the direction of its longitudinal axis, a cylindrical sleeve on the end of the shaft exterior of the valve housing coaxial with the shaft, means for fixing the sleeve to the end of the shaft, a plunger disposed within the sleeve and extending exteriorly of the sleeve coaxially with the shaft, means for slidably mounting the plunger on the sleeve for reciprocative sliding motion of the plunger relative to the sleeve, an enlarged head on the end of the plunger within the sleeve, first and second compression springs disposed coaxially within the sleeve on opposite sides of the head with one end of each in engagement with the head, means for fixing the other end of each of the first and second compression springs to the sleeve, a hydraulic actuating cylinder and piston mounted on the valve housing, a

piston rod connected to the piston in the actuating cylinder and extending exteriorly of the actuating cylinder coaxially with the shaft, and means for connecting the piston rod exterior of the actuating cylinder to the end of the plunger exterior of the sleeve for reciprocating the valve plate through the plunger, first and second springs, and shaft between a position in which it closes the discharge passageway and leaves open the inlet port and a position in which it closes the inlet port and leaves open the discharge passageway.

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