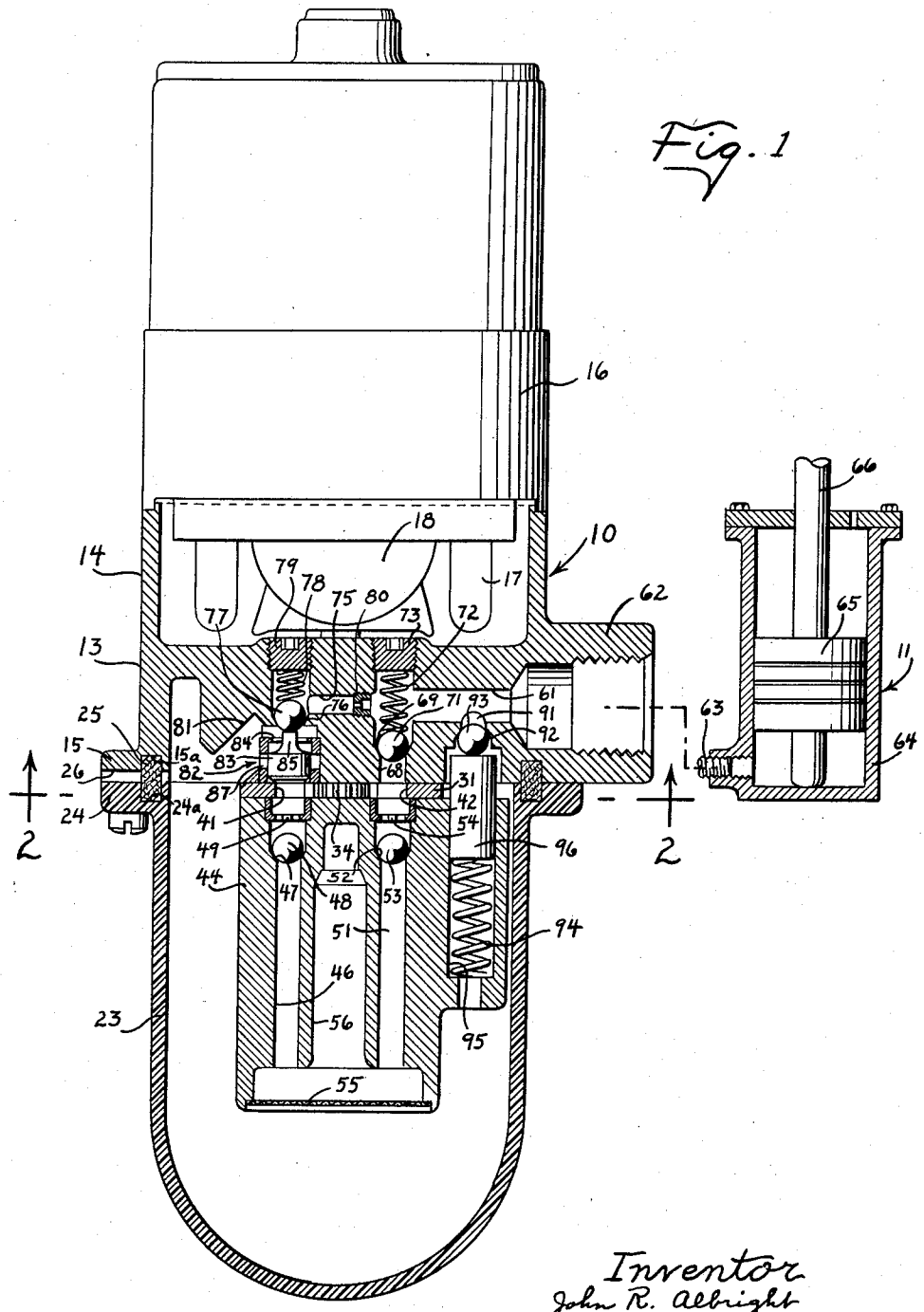
March 15, 1960 J. R. ALBRIGHT 2,928.243

PUMP CONTROL SYSTEM

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Fig. 1




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Fig. 2

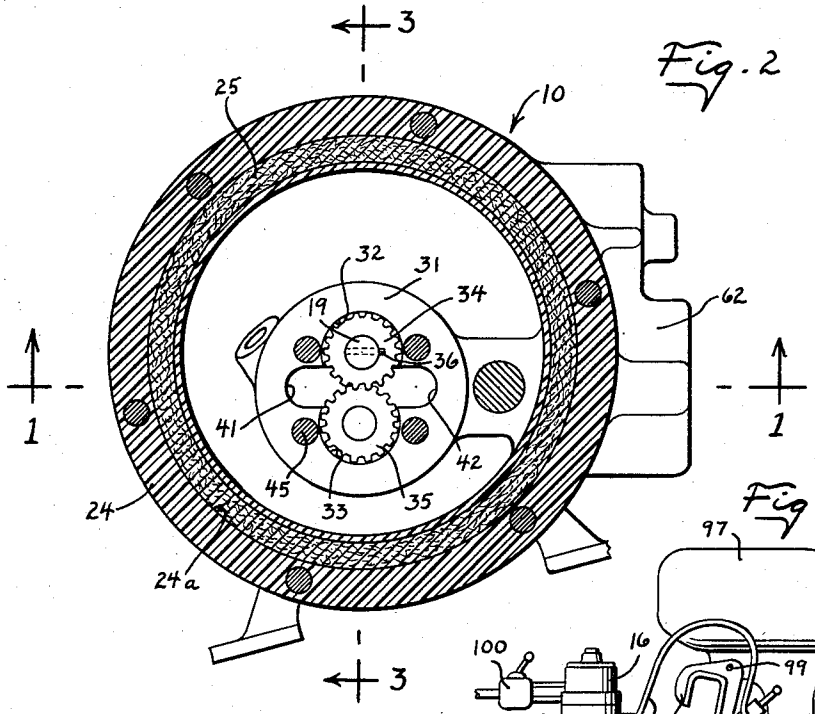



Fig. 4

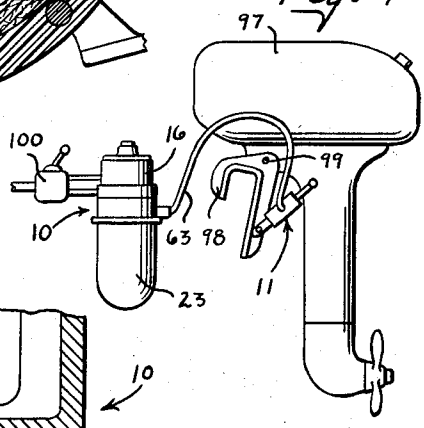
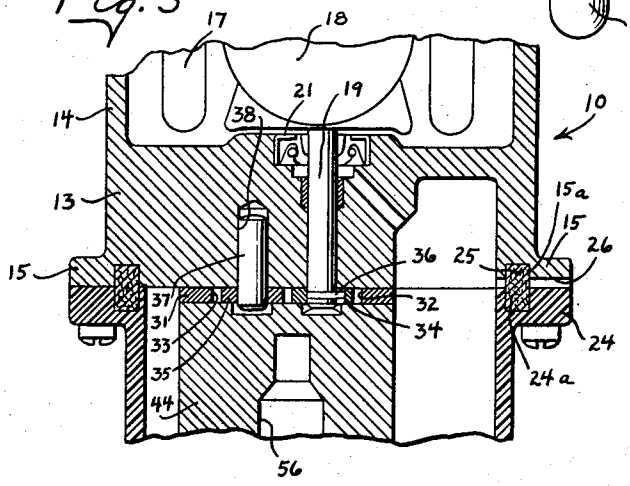



Fig. 3




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# PUMP CONTROL SYSTEM

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7 Claims. (Cl. 60—52)

This invention relates to a pumping apparatus and particularly to a pump and control system therefor for operating a single acting fluid operator.

In the pump control systems heretofore provided for actuating single acting fluid operators, the pump discharge has been connected to the fluid operator through a check valve to effect movement of the operator in one direction when the pump is operated and to hold the operator in its moved position when the pump is stopped. A by-pass under the control of a by-pass valve is provided for returning the fluid from the operator around the check valve and pump to enable return movement of the operator. In some installations it is desired to enable remote operation of the by-pass valve and for this purpose an electrically-controlled actuator is generally provided for the by-pass valve.

An important object of this invention is to provide a control system for a single acting fluid operator, which control system is electrically operable from a point remote from the pump to selectively extend the fluid operator; to hold the operator in the extended position, and to thereafter permit return of the operator to its retracted position, and which control system is of simple and economical construction.

A more particular object of this invention is to provide a control system for a single acting fluid operator including a reversible pump, which control system is operable to extend the fluid operator when the pump is operated in one direction; to hold the fluid operator in its extended position when the pump is stopped, and which has an hydraulically-controlled actuator for opening the valve in the fluid return line in response to reversal of rotation of the pump.

Another object of this invention is to provide a control system in accordance with the foregoing object, in which the hydraulically-controlled actuator for opening the valve in the fluid return line also controls by-passing of the pump discharge, when the pump is rotated in the reverse direction, so as to prevent by-passing of the pump discharge during reverse operation thereof until the valve of the return line is opened.

These, together with various ancillary objects and advantages of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description when taken in connection with the accompanying drawings wherein:

Figure 1 is a side view of the pump and pump control unit with parts broken away along the plane 1—1 of Fig. 2 and shown in section to illustrate details of construction;

Fig. 2 is a transverse sectional view through the pump, taken on the plane 2—2 of Figure 1;

Fig. 3 is a fragmentary longitudinal sectional view taken on the plane 3—3 of Fig. 2, and

Fig. 4 is a diagrammatic view illustrating one application of the pump control unit of the present invention.

The pump control unit 10 of the present invention is generally adapted for controlling the flow of fluid to and



from a single acting hydraulic operator 11 to selectively effect extension of the fluid operator, hold the operator in its extended position, and to relieve the fluid pressure on the operator to enable retraction of the same. In Fig. 4, the pump control unit is shown applied to an outboard motor to effect raising and lowering of the same and, for convenience, the pump control unit will be described in connection with this specific application.

More particularly, the control unit includes a cast pump body 13 having a peripheral wall 14 on the upper edge thereof and an outwardly extending flange 15 on its lower edge. A reversible electric motor 16 including a stator 17 and an armature 18 is mounted on the wall 14 and extends upwardly from the cast body. As best shown in Fig. 3, the motor output shaft 19 extends through a shaft seal 21 and is rotatably supported in the cast body 13. A fluid reservoir 23, conveniently formed of plastic, has a flange 24 on the upper edge thereof, which flange is secured to the flange 15 on the cast body. Opposed recesses 15*a* and 24*a* are formed in the flanges 15 and 24 respectively to receive a filter ring 25, and a plurality of radially extending grooves 26 are formed at the interface between the flanges 15 and 24 to vent the reservoir 23 to atmosphere through the filter ring.

A plate 31 is disposed at the underside of the body 13 and has parallel intersecting bores 32 and 33 therein defining a pump cavity for receiving the meshing gears 34 and 35. The gear 34 is non-rotatably keyed to the motor output shaft 19, as by a pin 36, and the gear 35 is rotatably supported on a stub shaft 37 disposed in a bore 38 in the body 13. Flow chambers 41 and 42 are formed in the plate 31, at opposite sides of the mesh point of the gears 34 and 35, and, as is conventional, the gears are arranged to pump liquid from one of the flow chambers such as 41 to the other of the flow chambers 42, when the motor 16 is operated in one direction, and to pump liquid from the last-mentioned chamber 42 to the first-mentioned chamber 41, when the direction of rotation of the gears is reversed.

A valve body extension 44 is disposed at the underside of the plate 31 and a plurality of bolts 45 (see Fig. 2) extend through the valve body extension 44, and through the plate 31 into the valve body to hold the same in assembled relation. The valve body extension 44 has a first inlet passage 46 formed therein, which inlet passage communicates at its lower end with the reservoir 23 and at its upper end with the flow chamber 41 in the plate 31. The inlet passage 46 is counterbored at its upper end to provide a valve seat 47 and a check valve 48 is provided in the passage and cooperates with the seat 47 to open and permit flow from the reservoir to the chamber 41 and to close to prevent return flow. A cage 49 is provided for retaining the ball 48 in the inlet passage 46.

A second inlet passage 51 is also provided in the valve body extension and is counterbored at its upper end to define a valve seat 52. A check valve 53 is disposed in the passage and cooperates with the seat to open to permit flow from the reservoir to the chamber 42 and to close to prevent return flow. A cage 54 is provided for retaining the check valve 53 in the passage 51. A screen 55 is provided at the lower end of the valve body extension and overlies both inlet passages 46 and 51 to filter the fluid flowing thereto. Advantageously, the valve body extension may be formed with an upwardly extending cored passage 56, to reduce the overall weight of the unit.

The valve body 13 has a fluid delivery passage 61 formed therein having a fitting 62 adapted for connection through a conduit 63 to the fluid operator 11. As is conventional, the operator 11 includes a cylinder 64 and a piston 65 movable in the cylinder and having an operating rod 66 attached thereto. The conduit 63 com-

munications with the cylinder 64 at one side of the piston to extend the same when fluid under pressure is delivered through the conduit 63, and to retract the same when the fluid pressure at the underside of the piston is relieved.

An outlet passage 68 is formed in the valve body 13 and communicates the chamber 42 with the delivery passage 61 whereby the pump is operative to draw fluid through the inlet passage 46 past check valve 48 into the chamber 41 and to deliver the fluid under pressure from chamber 42, outlet passage 68 to the delivery passage 61 to extend the piston 65. The outlet passage 68 is counterbored to define a valve seat 69 and a check valve 71 is disposed in the outlet passage and cooperates with the seat 69 to prevent return flow through the outlet passage. In this manner, the piston 65 will be maintained in its extended position when the operation of the pump is stopped. A spring 72 is interposed between a plug 73 and the check valve 71 to assure closing of the latter.

A fluid return passage 75 is formed in the valve body 13 and communicates at one end with the delivery passage 61. A valve seat 76 is provided in the return passage and a check valve 77 cooperates with the seat to close to prevent return flow through the passage 75. A spring 78 is interposed between a plug 79 and the check valve 77 to normally urge the same to its closed position. Fluid which flows through the return passage 75, when the valve 77 is open, is passed through a passage 81 to the reservoir 23. A flow restrictor 80 is provided in the return passage to regulate the rate at which the piston 65 can move to its retracted position.

In accordance with the present invention, an hydraulic actuator is provided for opening the valve 77 in the return line when the direction of rotation of the pump is reversed, to thereby enable extension or retraction of the fluid operator 11 selectively in accordance with the direction of rotation of the pump drive motor 16. In particular, a guide cylinder 82 is mounted in the valve body 13 and communicates with the flow chamber 41. A piston 83 is slidably disposed in the cylinder 82 and a flange 84 is formed on the upper end of the cylinder to limit outward movement of the piston. A valve actuating finger 85 extends upwardly from the piston 83 and engages the check valve 77 to open the same when the piston is extended. Preferably, the cross-sectional area of the piston 83 is made appreciably greater than the effective cross-sectional area of the check valve 77 which is exposed to the fluid pressure in the return line 75 so that the piston will be operative to open the check valve even when the fluid pressure in the return line exceeds the pump discharge pressure.

A by-pass is provided for discharging fluid from the pump when the latter is operated in the reverse direction, to thereby prevent overloading of the pump. Advantageously, flow through the by-pass is controlled in accordance with the position of the piston 83 so as to prevent by-passing of the pump discharge during reverse operation of the pump, until the piston 83 has been extended to open the return check valve 77. As shown in Figure 1, the by-pass comprises a port 87 formed in the cylinder 82 and arranged so as to be normally closed by the piston 83, when the latter is in the retracted position shown in Figure 1, and to be at least partially opened when the piston is extended so as to permit the fluid from the pump to be returned to the reservoir. With this arrangement, the pump discharge pressure, during reverse operation of the pump, will build up until the pressure at the underside of the piston 83 is sufficient to overcome the pressure of the spring 78 and the fluid pressure at the upper side of the check valve 77. At that time, the piston will move upwardly to open the check valve, the piston operating to simultaneously uncover the by-pass port 87 and permit the by-passing of the pump discharge to the reservoir. As is apparent, the piston will automatically move in the cylinder 82 across the port 87 to throttle the flow therethrough sufficient to maintain the requisite pressure on the underside thereof.

A pressure relief valve is provided for preventing overloading of the pump motor during forward operation of the pump. In the embodiment illustrated, a relief passage 91 is formed in the valve body 13 to communicate at one end with the delivery passage 61. The other end of the relief passage 91 is enlarged and opens to the reservoir 23. A valve seat 92 is formed in the relief passage and has a check valve 93 cooperable therewith to normally prevent flow through the relief passage. A spring 94 is mounted in a bore 95 in the valve body extension and engages a rod 96 for normally urging the relief valve 93 to its closed position. As is conventional, the spring is selected so as to permit opening of the relief valve 93 when the pressure at the delivery passage 61 reaches a preselected maximum value. As will be noted, the relief valve 93 communicates with the delivery passage 61 and is operative to open and permit relief of the fluid pressure thereat, even when the pump is stopped. In this manner, overloads in the fluid operator 11 or in the connecting line 63 are avoided.

In Fig. 4, the pump control system 10 is shown applied to an outboard motor 97 which, as is conventional, is arranged to be mounted by a bracket 98 on a boat for vertical swinging movement about a pin 99. The fluid operator 11 is interposed between the bracket 98 and the motor 97. It is frequently desired to elevate the motors, as when entering shallow water or passing over an obstruction; to hold the same in an elevated position for a period of time, and to thereafter lower the same. The pump control system of the present invention enables elevating and lowering of the motor to be controlled electrically from a remote point such as the forward portion of the boat, by merely controlling the operation of the reversible motor 16. The switch 100 for controlling energization of the motor and also for reversing the direction of rotation thereof can be located at any convenient position. When the switch is operated to drive the motor in the forward direction, fluid is drawn from the reservoir 23 through the inlet passage 46, past the check valve 48 to the chamber 41. The pump delivers fluid under pressure through the chamber 42, outlet passage 68 past the check valve 71 to the delivery line 61 to thereby extend the fluid operator and raise the motor 97. When the switch 100 is operated to deenergize the motor 16, the pump is stopped and the check valve 71 prevents return flow through the delivery line 61 to thereby maintain the motor in its raised position. Lowering of the outboard motor 97 can be effected by merely operating switch 100 to reverse the pump drive motor 16. Fluid is then drawn through the inlet passage 51 past check valve 53 to the chamber 42. The pump delivers fluid under pressure to the chamber 41 and to the underside of the piston 83 to thereby raise the same and open the return check valve 77. As previously described, the piston 83 raises sufficient to open the port 87 and permit the fluid from the pump to be by-passed during reverse operation thereof. When the return check valve 77 is open, the fluid can flow through the delivery line 61 and through the return line 75 back to the reservoir 23.

It is also to be noted that the control system is such as to not impede extension of the fluid operator 11, in the event that the outboard motor 97 strikes an obstruction while the pump motor 16 is inoperative. In this regard, it is to be noted that fluid can flow freely from the reservoir through the inlet passage 51, past the check valve 53 and through the outlet passage 68 and past the check valve 71 to the delivery passage 61, whenever a force is applied to the fluid operator 11 in a direction to extend the same.

I claim:

1. A pump control system for a single acting fluid operator comprising, a reversible rotary pump having first

and second flow chambers operable when the pump is rotated in one direction to pump fluid from the first chamber to the second chamber and operable when the pump is operated in the other direction to pump fluid from the second chamber to the first chamber, a fluid reservoir, first and second inlet passages each communicating with said reservoir and respectively communicating with said first and second chambers, a check valve in each of said inlet passages operable to open to permit flow from the reservoir to the respective chamber and to close to prevent return flow, a delivery passage for passing fluid to and from the fluid operator, an outlet passage communicating at one end with said second chamber and at the other end with said delivery passage, a check valve in said outlet passage operative to open to permit flow from said second chamber and to close to prevent return flow, a return passage communicating at one end with said delivery passage and at the other end with said reservoir, a normally closed valve in said return passage operative when closed to prevent return flow of fluid from said delivery passage to said reservoir, fluid pressure responsive means communicating with said first chamber and operative when said pump is rotated in said other direction to pump fluid from said second chamber to said first chamber for opening said normally closed valve and permit fluid to flow from said delivery passage to said reservoir, and means operable to selectively rotate said pump in either direction.

2. A pump control system for a single acting fluid operator comprising, a reversible rotary pump having first and second flow chambers operable when the pump is rotated in one direction to pump fluid from the first chamber to the second chamber and operable when the pump is operated in the other direction to pump fluid from the second chamber to the first chamber, a fluid reservoir, first and second inlet passages each communicating with said reservoir and respectively communicating with said first and second chambers, a check valve in each of said inlet passages operable to open to permit flow from the reservoir to the respective chamber and to close to prevent return flow, a delivery passage for passing fluid to and from the fluid operator, an outlet passage communicating at one end with said second chamber and at the other end with said delivery passage, a check valve in said outlet passage operative to open to permit flow from said second chamber and to close to prevent return flow, a return passage communicating at one end with said delivery passage and at the other end with said reservoir, a return passage check valve in said return passage operative to close and prevent return flow of fluid from said delivery passage to said reservoir, a piston engageable with said last-mentioned check valve for opening the same, and passage means for supplying fluid under pressure from said first chamber to said piston to thereby move the same from a first position to a second position to open said return passage check valve when said pump is rotated in said other direction.

3. A pump control system for a single acting fluid operator comprising, a reversible rotary pump having first and second flow chambers operable when the pump is rotated in one direction to pump fluid from the first chamber to the second chamber and operable when the pump is operated in the other direction to pump fluid from the second chamber to the first chamber, a fluid reservoir, first and second inlet passages each communicating with said reservoir and respectively communicating with said first and second chambers, a check valve in each of said inlet passages operable to open to permit flow from the reservoir to the respective chamber and to close to prevent return flow, a delivery passage for passing fluid to and from the fluid operator, an outlet passage communicating at one end with said second chamber and at the other end with said delivery passage, a check valve in said outlet passage operative to open to permit flow from said second chamber and to close to prevent return flow, a return passage communicating at one end with said delivery passage and at the other end with said reservoir, a return passage check valve in said return passage operative to close and prevent return flow of fluid from said delivery passage to said reservoir, a piston engageable with said last mentioned check valve for opening the same, passage means for supplying fluid under pressure from said first chamber to said piston to thereby move the same from a first position to a second position to open said return passage check valve when said pump is rotated in said other direction, a port communicating said last mentioned passage means with said reservoir, and means on said piston for closing said port when said piston is in said first position and for uncovering said port when said piston is in said second position.

4. The combination of claim 3 wherein said piston has a cross-sectional area exposed to the fluid pressure at said second chamber greater than the area of said return passage check valve exposed to the fluid pressure in said delivery passage.

5. The combination of claim 3 including means in said return passage defining a flow restriction for limiting the rate of return flow from said delivery passage to said reservoir.

6. The combination of claim 3 including a pressure relief means communicating with said reservoir and said delivery passage operable to open and permit flow from the delivery passage to the reservoir when the pressure in the delivery passage reaches a preselected upper limit.

7. A pump control system for a single acting fluid operator comprising a pump body having intersecting pump bores therein, a pair of meshing gears disposed in said bores in said body, a reversible motor mounted on one side of said body and drivingly connected to said gears, a reservoir attached to the side of said body opposite to said motor, a pump body extension attached to said pump body and extending into said reservoir, said extension having first and second inlet passages therein each communicating at one end with said reservoir and at the other end thereof with said pump bores at opposite sides of the mesh point of said gears, a check valve in each of said inlet passages operable to open to permit flow from the reservoir to the pump and to close to prevent return flow, said pump body having a delivery passage therein for passing fluid to and from a fluid operator, an outlet passage in said pump body communicating at one end thereof with said delivery passage and at the other end thereof with said pump bores at one side of the mesh point of said gears, a check valve in said outlet passage operable to open to permit flow to said delivery passage and to close to prevent return flow, a return passage in said pump body communicating at one end with said delivery passage and at the other end with said reservoir, a normally closed valve in said return passage operative when closed to prevent flow therethrough from the delivery passage to said reservoir, and means responsive to the fluid pressure in said pump bores at the other side of the mesh point of said gears for opening said normally closed valve when said motor is operated to rotate said gears in a direction to discharge fluid at said other side of the mesh point of said gears.

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