

[72] Inventor **Roger C. Johnson**
10881 Hermosa Court, Northglenn, Colo.
80232
[21] Appl. No. **835,328**
[22] Filed **June 23, 1969**
[45] Patented **June 29, 1971**

1,674,614	6/1928	Berkman	103/50
2,898,865	8/1959	Gates	103/152
3,434,490	3/1969	Lyall	103/48

FOREIGN PATENTS

29,922	6/1933	Netherlands	103/48
816,035	7/1959	Great Britain	103/48

Primary Examiner—Carlton R. Croyle
Assistant Examiner—John J. Vrablik
Attorney—Richard D. Law

[54] **FLUID FEEDER FOR PRESSURIZED FLUID SYSTEM**
12 Claims, 8 Drawing Figs.

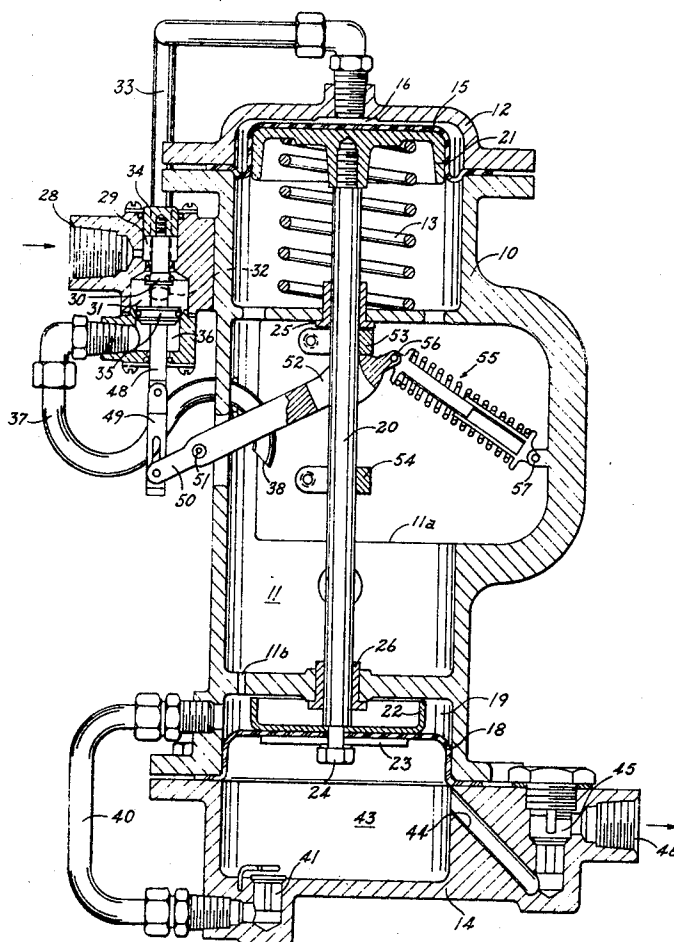
[52] U.S. Cl. **417/391,**
417/401, 91/347
[51] Int. Cl. **F04b 17/00,**
F011 31/02, F04b 35/00
[50] Field of Search 103/44, 45,
48, 50, 152; 417/390, 391, 401; 91/347

References Cited

UNITED STATES PATENTS

862,867 8/1907 Eggleston 103/44 D

ABSTRACT: Fluid feeder apparatus for injecting fluid into a pressurized fluid system includes a pump activated by a pressurized system acting on a fluid motor for periodically driving said pump to inject fluid from a separate fluid reservoir at about ambient pressure into said pressurized fluid system. A valve system actuated by said pump cycles the fluid under pressure into and out of the pump.



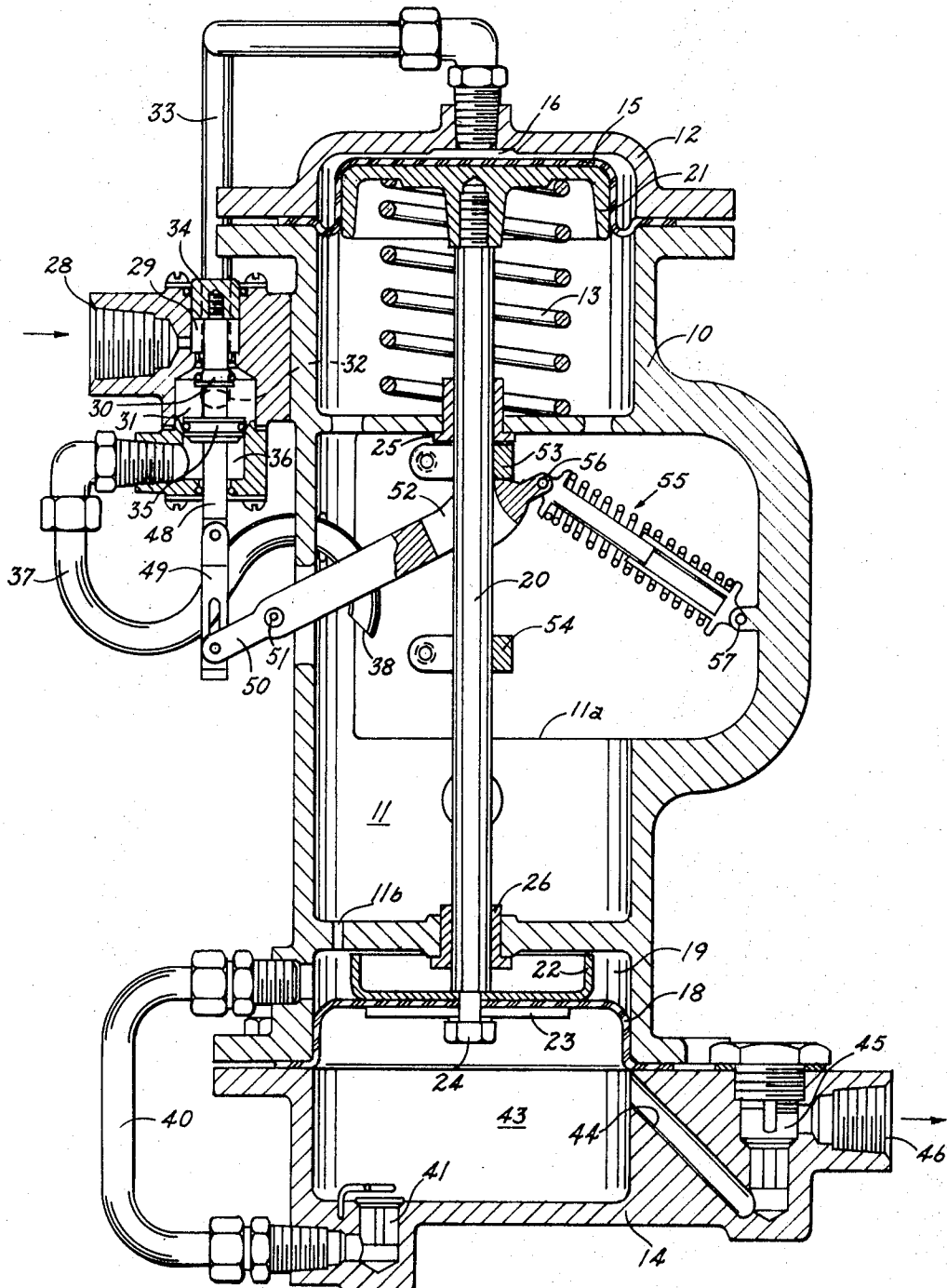


FIG. 1

INVENTOR

ROGER C. JOHNSON

BY

Richard H. Law
ATTORNEY

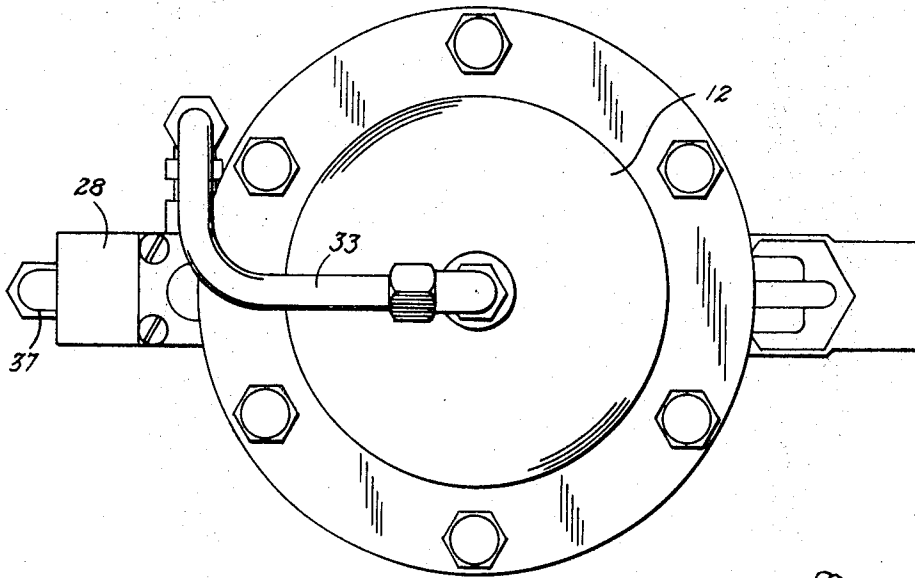


FIG. 2

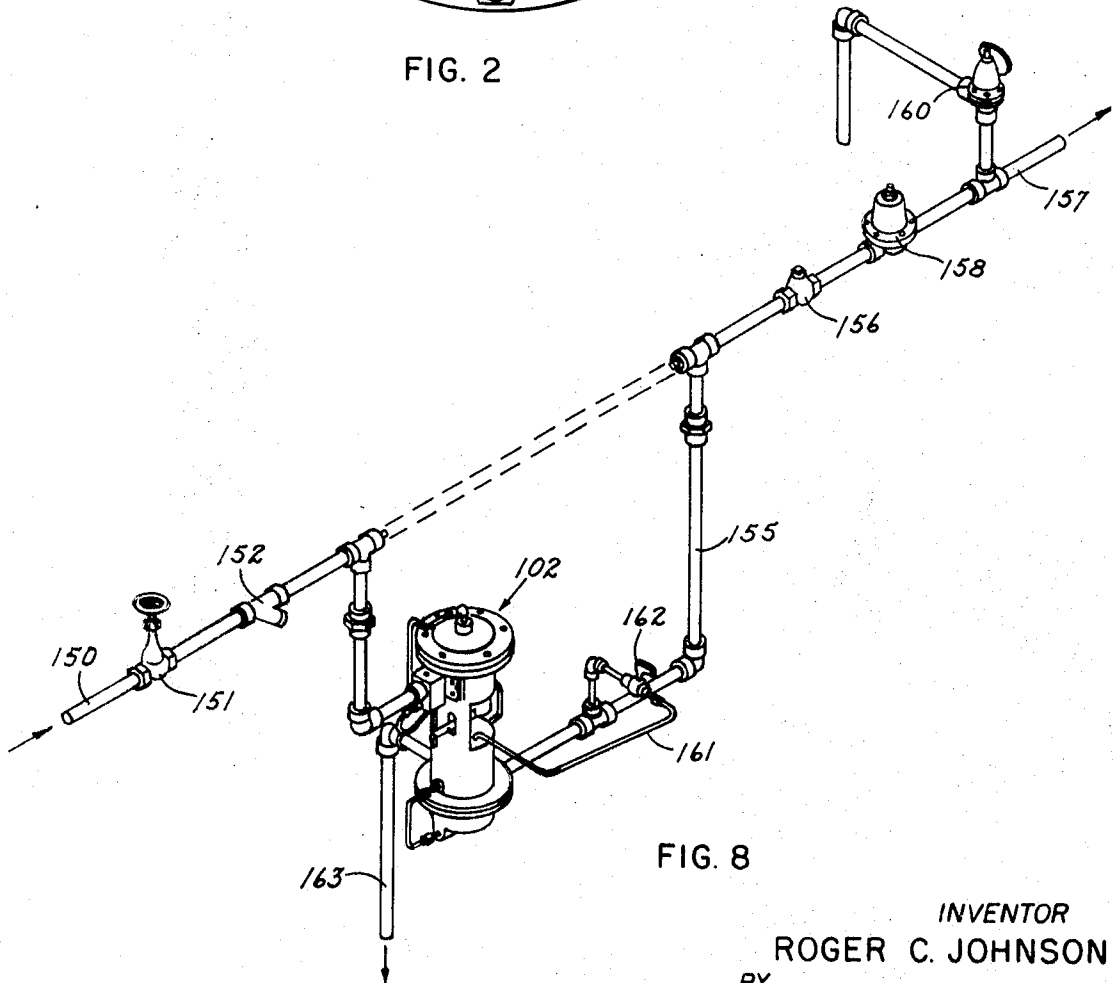


FIG. 8

INVENTOR
 ROGER C. JOHNSON
 BY
Richard H. Law
 ATTORNEY

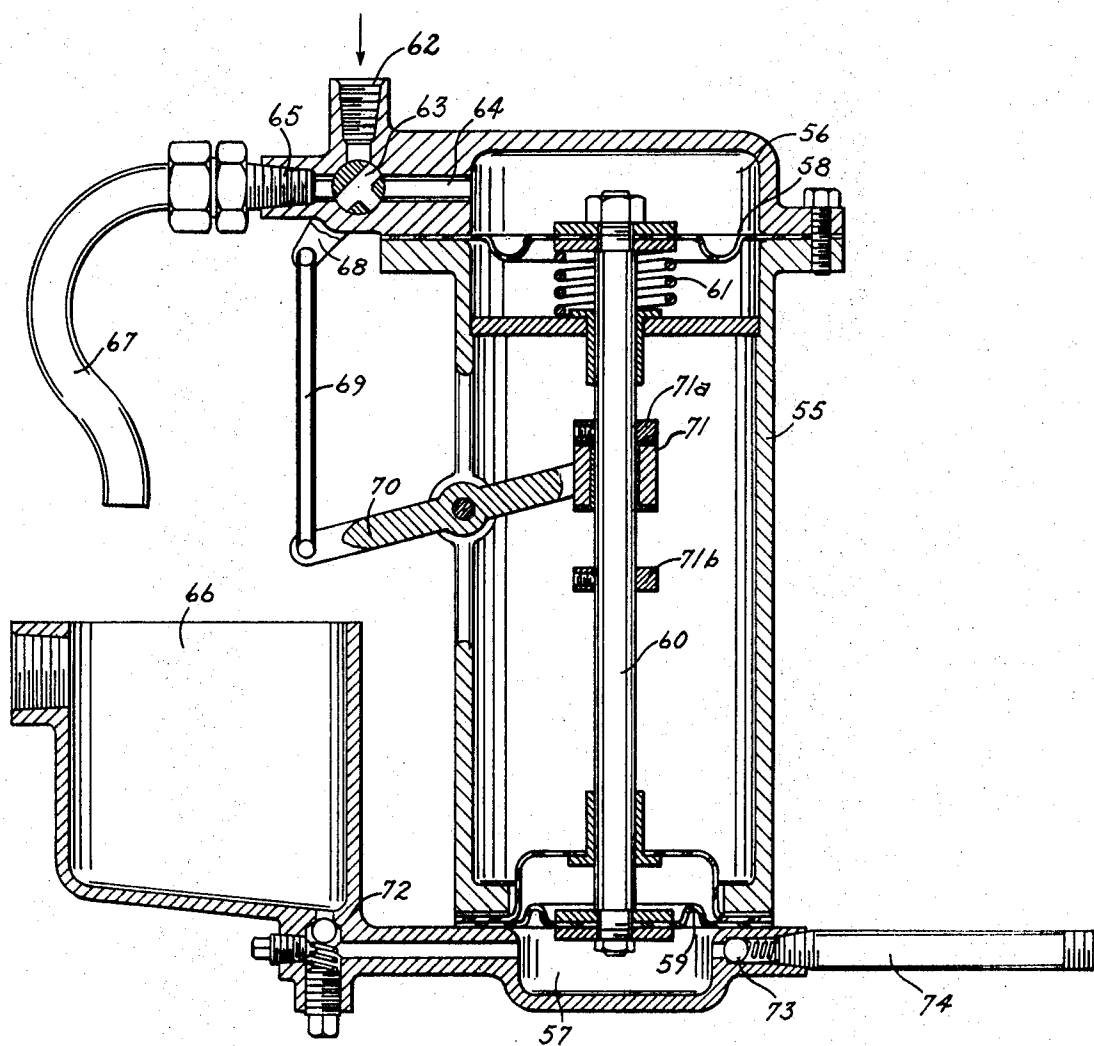


FIG. 3

INVENTOR,

ROGER C. JOHNSON

BY

Richard H. Law
ATTORNEY

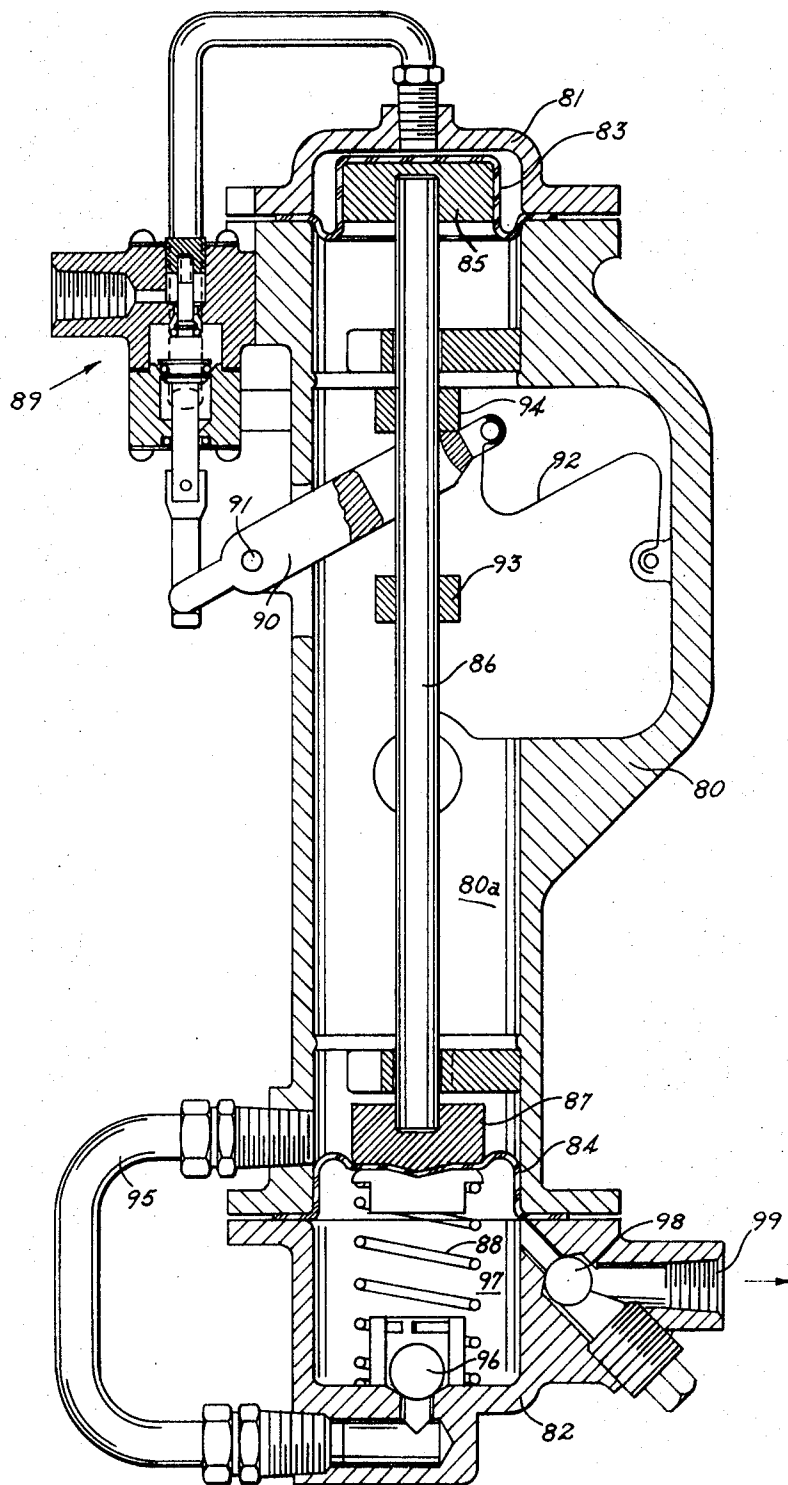


FIG. 4

INVENTOR
 ROGER C. JOHNSON
 BY
Richard H. Law
 ATTORNEY

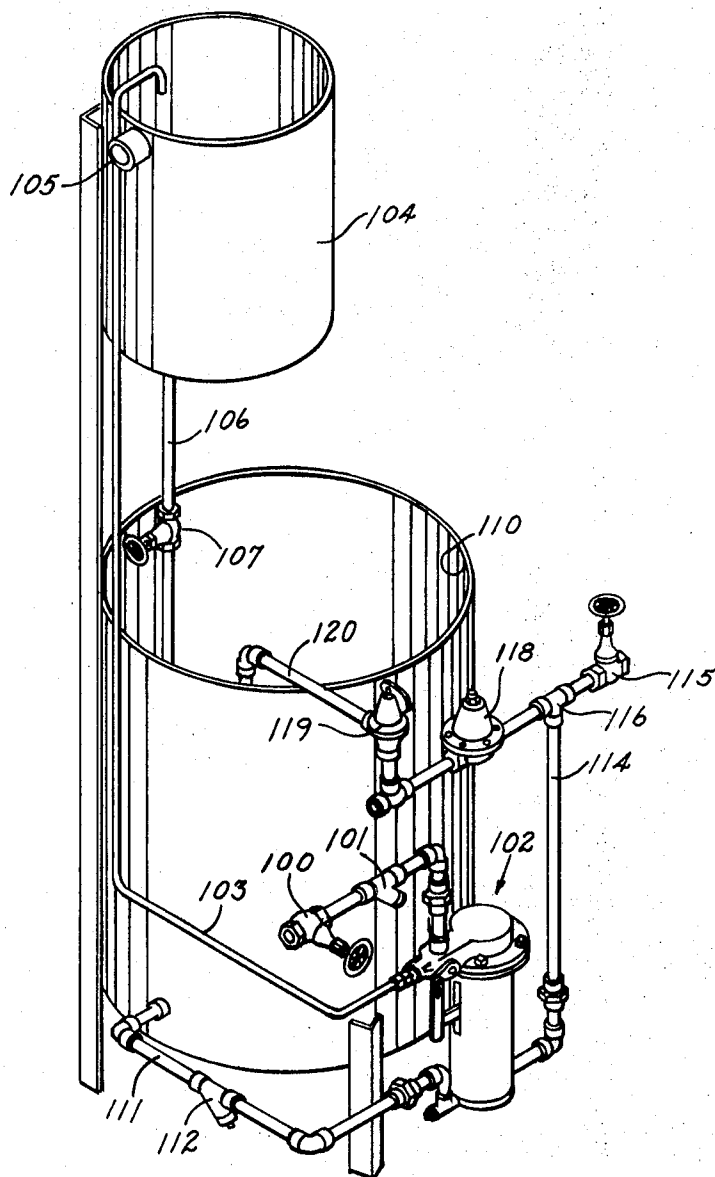
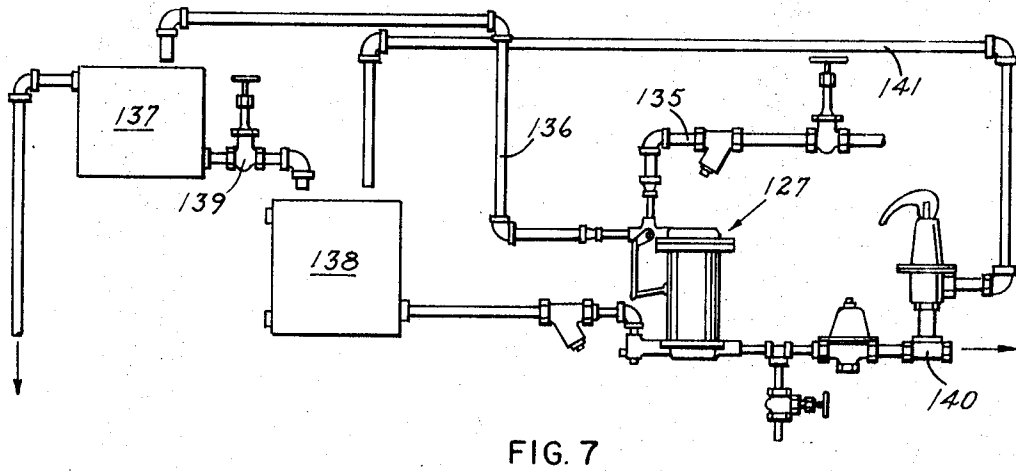
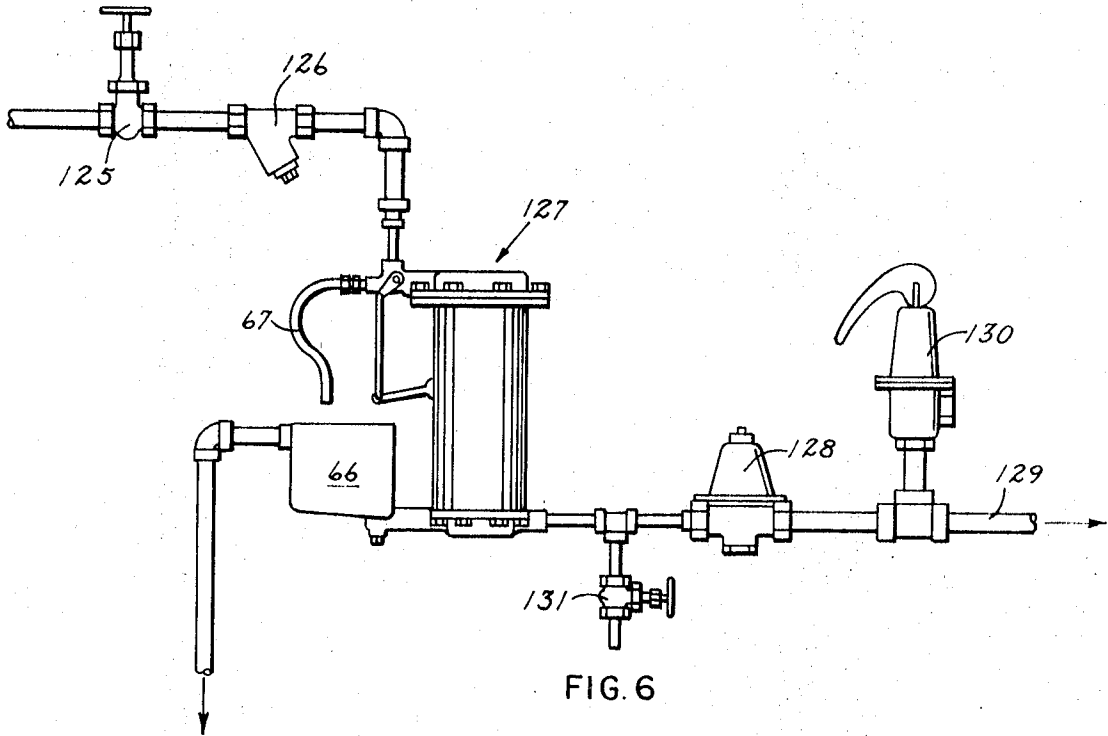


FIG. 5

INVENTOR
 ROGER C. JOHNSON
 BY
Richard H. Law
 ATTORNEY



INVENTOR.
 ROGER C. JOHNSON
 BY
Richard H. Law
 ATTORNEY

FLUID FEEDER FOR PRESSURIZED FLUID SYSTEM

Closed, pressurized piping system in which water or other aqueous solution is circulated, normally requires some provision for injection of makeup water or aqueous solution to compensate for leakage, venting or any other cause of pressure or volume reduction in the system. Many such circulating systems are nonportable due to many causes, including lack of sterilization of the construction, the nature of the fluid circulated, or the necessity of adding treating chemicals to the circulating solution. In many such systems, potable water from a commercial water supply is used as a source of makeup for the nonpotable pressurized solutions. When so used, some means must be incorporated to prevent a backflow of the nonpotable water into the potable water system.

In many circulating water systems, the operating pressure of the circulating system is lower than the pressure of the available potable water supply. This pressure differential can be utilized to inject makeup water to require into the lower pressure circulating water system. In the event, that the portable water system pressure is reduced below the pressure of the circulating nonpotable water system, however, a flow reversal could occur permitting nonpotable water to enter the potable water system. A number of devices are available to prevent such a flow reversal, ranging from simple check valves to complex backflow preventors. A common characteristic of such devices is that a continuous piping connection is maintained between the systems, and protection from flow reversal depends on the action of one or more valves. Valves are mechanical devices, and, as such, are subject to malfunction.

Most, if not all, plumbing codes recognize that the only completely safe method for preventing backflow is to discharge fluid through an airgap. Vacuum breakers and backflow preventors are permitted for the protection of other discharged points, but only where an airgap is considered impractical. Where a potable water system is used to induce water into a pressurized circulating system, to provide an airgap at atmospheric pressure requires that the water from atmospheric pressure be pressurized in some manner, usually by a pump. Automatically controlled pumping systems require outside power and are expensive, complex and have been considered impractical in most small systems. A mechanical valve or combination of valves has usually been permitted in lieu of an airgap, therefore, disregarding the degree of health hazard.

The present invention incorporates an airgap, through which backflow cannot occur, and the system uses the pressure of the potable water supply to inject potable water or a solution thereof from an atmospheric reservoir into the pressurized system. No additional source of power is required for the operation of the system. The unit consists of a hydraulic engine connected to a pump in combination with necessary valves, springs and the like, all arranged so that the engine is driven by the potable water system pressure. Water from the supply discharges through an airgap into an open reservoir, the pump draws water from the reservoir and discharges it into the pressurized system.

It is, therefore, an object and an advantage of the invention to inject fluid through an airgap into a pressure system whereby backflow from pressure system into the fluid system cannot occur.

Another object to the invention is to provide a hydraulic motor operating under the pressure of a potable water supply for injecting water from the supply into a circulating nonpotable water system.

A further object to the invention is to eliminate a direct connection between a potable water makeup system and a nonpotable pressurized fluid receiving system.

A still further object to the invention is to provide an atmospheric reservoir for a solution to be injected into a pressurized circulating system including hydraulic motor means driven by a potable pressurized water system for injecting the fluids from the reservoir into the pressurized system.

These and other objects and advantages of the invention may be readily ascertained by referring to the following description and appended illustrations in which:

FIG. 1 is a cross-sectional view of one form of a combined hydraulic motor and pump according to the invention;

FIG. 2 is a top plan view of the device of FIG. 1;

FIG. 3 is a cross-sectional view of a modified form of combined hydraulic motor and pump according to the invention;

FIG. 4 is a still further modified form of a hydraulic motor and pump according to the invention;

FIG. 5 is a perspective view of a system for injecting a solution into a pressurized system from an atmospheric reservoir;

FIG. 6 is a side elevational side view of a modified form of system using the combined hydraulic motor and pump of the invention;

FIG. 7 is a further modified system for injecting a solution from an atmospheric tank into a pressurized circulating system; and

FIG. 8 is another modified system according to the invention.

The device illustrated in FIGS. 1 and 2 includes a hollow body 10 having an upper bonnet 12 and a lower cover 14; the upper bonnet 12 and the lower cover 14 being conventionally secured to the body 10 by means of bolts or the like. A diaphragm 15 secured across the upper opening to the body by means of the bonnet 12 separates a cylinder or chamber 16. A diaphragm 18 secured across the lower opening of the body between the body 10 and the bottom 12, separates a cylinder or chamber 19. A connecting shaft 20 is provided with a piston 21 at the upper end biased against the diaphragm 15. A piston 22 secured to the lower end of the shaft 20 is secured by a disc 23 thereto by means of a bolt 24 with the diaphragm 18 mounted therebetween so that the diaphragm is secured to the end of the shaft 20. The shaft reciprocates through sleeve bearings 25 at the upper end and 26 at the lower end, providing guides for smooth action of the shaft. A water inlet 28 introduces water into a cavity 29 which is provided with an outlet controlled by a valve 30. The chamber 29 exhausts into chamber 31 through the valve 30. An outlet 32 from the chamber 31 permits water to pass into a conduit 33 which exhausts into chamber 16 above the diaphragm 15. The lower part of the chamber 31 is closed by a valve 35 which is connected to the valve 30 and these two are spaced-apart so that when one is seated on its valve seat the other is open. Chamber 31 exhausts into chamber 36 past the valve 35, and from there through a conduit 37 to an outlet 38 exhausting into an open reservoir 11 in the body 10. Water from the reservoir 11 passes through an orifice 11b into a conduit 40, through a check valve 41 and into pump chamber 43 below the diaphragm 18. Water from the chamber 43 passes through passage 44 through a check valve 45 and to an outlet 46 which is connected to the pressure system.

The two valves 30 and 35 are mounted on a shaft 48 connected to an articulated lever arm 49, which is in turn connected to a pivot arm 50, pivoted on a pivot 51, and including a yoke 52 which passes around the shaft 20. A stop 53 is secured to the shaft above the yoke 52 and a stop 54 secured to the shaft below the yoke. A spring detent 55 is pivotally secured at 56 to the yoke 52 and at 57 to the housing provides snap action of the yoke as explained below.

The mechanism of FIG. 1 is shown at the start of a pumping power stroke. Water from a potable water supply (usually a commercial water supply) enters the inlet 28 passing through the open valve 30, into the opening 32, into the conduit 33 and discharges into the chamber 16 above the diaphragm 16. The water pressure on the top of valve 35 holds that valve shut and the valve 30 open due to the larger size of valve 35. When the pressure in the chamber 43 is reduced, water under pressure is forced into the cylinder or chamber 16 forcing the diaphragm and the shaft 20 downwardly, pressurizing chamber 43 by means of the diaphragm 23. As the diaphragm 15 is forced downwardly the pressure on the chamber 43 forces the fluid out through conduit 44, through the check

valve 45, and into the pressurized receiving system connected to outlet 46.

Downward motion of the shaft 20 causes the stop 53 to press the yoke and lever arm downwardly about the pivot 51, also, compressing the spring of the spring detent 55. When the yoke lever is rotated beyond the horizontal position the detent spring forces the yoke lever downwardly with a snap action against the stop 54, simultaneously pressing up on the lever arm 49 and shaft 48 opening valve 35 and closing the valve 30. The valve 30 is maintained in its closed position by the pressure of the water acting against piston 34 which has a larger effective area exposed to the water under pressure and the valve 30. When the valve 35 opens, a spring 13 pressing against the piston 21 forces water out of the chamber 16 back into chamber 31, then through the conduit 37 and into the outlet 38. Water passes from the reservoir 11 through an aperture 11b through the conduit 40 and into the chamber 43.

Upward motion of the shaft 20 and the lower stop ring 54 against the yoke pushes the yoke upwardly, and when it moves beyond the horizontal position, the spring detent snaps the yoke upwardly against the stop 53. The arm 50 then pulls down on the link 49 closing the valve 35 and opening the valve 30. The valve are held in this positions due to the fact that the effective area of the valve 35 is greater than the area of the piston 34. The unit stays in this position until the pressure in the system connected to outlet 46 is reduced below the pressure of chamber 43 permitting water to flow past valve 45 thereby reducing the pressure in chamber 43, and again starting the operation of the unit. Open reservoir 11 in body 10 is spaced away from outlet 38 by a backflow-preventing "air-gap." Thus, any backflow which occurs will overflow wall 11a of open reservoir 11 rather than flowing back through outlet 38 contaminating the potable water supply.

In the modified form shown in FIG. 3, a body 55 is provided with an upper chamber 56 and a smaller lower chamber 57. The upper chamber is provided with a diaphragm 58 and the lower chamber with a diaphragm 59. The diaphragms are connected to a rod 60 and thereby both equally move. A spring 61 biases the diaphragm unit toward the chamber 56. A water inlet 62 extends to a three-way valve 63, which is arranged to feed a passage 64 to the chamber 56 or an outlet 65 which feeds an atmospheric reservoir 66 through a pipe 67. The valve 63 is controlled by a lever arm 68 which is attached by a connecting rod 69 to a pivot rod 70. The opposite end of the rod 70 is mounted in a yoke mounting 71 on the shaft 60. A ball check valve 72 permits water to pass from the reservoir 66 into the chamber 57, and a check valve 73 permits water to pass from the chamber 57 to a pressure system connected to conduit 74.

When the piston rod 60 is in the full up position the three-way valve opens providing a passage from the water inlet 62 to the chamber 56 pressurizing the chamber and applying downward pressure on the diaphragm. When the pressure in line 74 is reduced so that the pressurized fluid in chamber 57 forces liquid into the pipe 74, the diaphragm 58 is extended forcing addition water from the chamber 57 into the line 74 and moving the shaft 60 downwardly. At full movement of the shaft downwardly the three-way valve is turned to shut off the fresh water inlet 62 and to open the chamber 56 to the outlet 65. The spring 61 forces the diaphragm upwardly forcing the water from chamber 56 into the reservoir 66 through the outlet pipe 67. Upward movement of the shaft 60 reduces the pressure in chamber 57 drawing water through the check valve 72 from the reservoir 66 into the chamber 56 ready for the next pump stroke of the diaphragm. By adjusting the size of the diaphragm 58 in relation to the diaphragm 59, water from the chamber 57 can be injected into the system 74 at a higher pressure than the water supply system entering the inlets 62.

Where desired, chemicals may be added to the reservoir 66 for injecting a solution into the system 74. Due to the airgap between the pipe 67 and the reservoir 66 there can be no reverse flow from the system 74 into the supply system into inlet 62.

A slightly modified version of the hydraulic motor and pump system is shown in FIG. 4, wherein a housing 80 is provided with a bonnet 81 and bottom cover 82. A diaphragm 83 is retained between bonnet and the housing upper end, and a diaphragm 84 is retained between the housing and the bottom cover 82. The diaphragm 83 rests on a piston 85 connected to the top of a rod 86 and the diaphragm 84 is held on a piston 87 connected to the rod 86. The whole piston and rod assembly is biased upwardly by a spring 88. A valve assembly, shown in general by numeral 89, is similar to the valve assembly of FIG. 1, and it operates in a similar manner. A yoke arm 90 pivoted on pivot 91 is arranged to activate the valves of the assembly 89 in a manner similar to that of FIG. 1, and the yoke thereof passes around the rod 86. The yoke is biased by means of an S-shaped flat spring 92. Stops 93 and 94 on the shaft 86 permit the snap action of the yoke for operating a valve assembly 89. A reservoir 80a in the body 80 feeds a conduit 95 which passes through a check valve 96 into a chamber 97. Fluid in chamber, under influence of the diaphragm 84 passes through a check valve 98 to the pressure system through outlet 99. The unit of FIG. 4 operates in the same manner as that of FIG. 1.

In the system shown in FIG. 5, a batching reservoir is used from which a solution is injected into a pressure system. In this case, a water inlet from a potable system enters valve 100 through a strainer 101 and into the hydraulic engine and pump, shown in general by numeral 102, which may be the same as that shown in FIGS. 1 or 4. Water is discharged from the engine cylinder through a pipe 103 into a remote, elevated water reservoir 104 having an overflow 105, and chemical may be added into the reservoir 104 for admixing with the water coming from the pipe 103. Chemical solution is released from the remote reservoir 104 through a conduit 106 controlled by a valve 107 into a batching reservoir 110. The solution from the reservoir 110 flows through a pipe 111, through a strainer 112 and into the bottom pressure chamber of the feed mechanism 102. The solution is pressure fed from the feed system through a conduit 114 and through a valve 115 which is connected to the circulating pressure system. A tee 116 permits some solution to pass a pressure regulator through 118, past a pressure relief valve 119 and exhausting back into the batching reservoir 111 by a conduit 120. Where it is desired or necessary to retain good control on the composition of the chemical from the remote tank 104, the waste water passing through the conduit 103 may be passed to waste rather than going into the reservoir 104.

A modified system is shown in FIG. 6, where inlet water passes valve 125, a strainer 126 and into the hydraulic engine pump combination, shown in general by numeral 127, which is same as the unit of FIG. 3. The overflow water through conduit 67 passes into the reservoir 66 and from the reservoir to the pressure chamber of the unit, through a pressure regulating valve 128 and until the pressure system circuit 129. A pressure relief valve 130 is added for safety. A drain valve 131 may be added to the system and for use in maintenance.

A solution makeup system is shown in FIG. 7, where the hydraulic engine and pump 127 is fed from a water system 135, controlled as the inlet arrangement shown in FIG. 6, and the activating water from the hydraulic motor passes through conduit 136 into a remote chemical makeup tank 137 which feeds a mixing tank 138 through a valve outlet 139. The makeup tank 138 feeds through the pressure chamber of the unit 127 into the pressure system through a tee 140. The solution may be recycled through a conduit 141, passing from the tee back into the makeup tank 138.

The system of FIG. 8 shows a water makeup system which is a positive backflow preventing system. A water supply enters through a conduit 150 controlled by a valve 151 and passing through a strainer 152. Water enters the hydraulic motor and pump system, shown generally by numeral 102 (similar to the unit of FIG. 1) which passes water from the internal, open reservoir through conduit 155, through a check valve 156 into a pressurized system through conduit 157. A pressure regulating valve 158 may be used in the line for a regulating system, and a relief valve 160 provides a safety for the unit. A bypass

61 from the conduit 155 back into the reservoir of the unit 102 provides means for testing and starting up the system, and this bypass is controlled by a valve 162. A drain valve 163 from the reservoir provides a drain for the unit. This system provides an excellent reverse flow regulator, providing makeup water for circulating water system from a potable water source, such as a commercial supply. It provides a positive airgap which prevents the backflow of water from the pressurized system into the potable water system, but does provide an inexpensive and continuous means for providing makeup water for the system. The unit takes the place of a through line, indicated by dashed lines, from the supply 150 to the circulating system attached to the conduit 157.

While the invention has been described by reference to particular embodiments there is no intent to limit the spirit or scope of the invention to the precise details so set forth, except as defined in the following claims.

I claim:

1. Liquid feed apparatus for pressurized liquid systems comprising, diaphragm operated fluid motor means actuated by a supply of liquid under pressure; diaphragm pump means for injecting liquid into a pressurized liquid system; connecting means between said fluid motor means and said pump means; valve means for introducing liquid from said supply of liquid under pressure into said fluid motor means and for withdrawing liquid therefrom; means interconnecting said valve means with said connecting means for actuating said valve means on movement of said connecting means; an open reservoir separate from the supply of liquid under pressure; means for introducing liquid from said reservoir into said pump means; means separated from liquid in said reservoir for introducing liquid into said reservoir from the discharge outlet of said fluid motor means; and spring biasing means biasing said fluid motor means towards undistorted position.

2. Liquid feed apparatus according to claim 1, wherein said means interconnecting said valve means with said connecting means is spring loaded to provide a snap action of said valve.

3. Liquid feed apparatus according to claim 2 wherein said means interconnecting is a pivoted lever with one end of said lever including a yoke around said connecting means, and including stops on said connecting means to permit limited free movement of said yoke thereon.

4. Liquid feed apparatus according to claim 1 wherein said valve means includes a three-way rotary valve.

5. Liquid feed apparatus according to claim 1 wherein valve means includes a pair of spaced-apart valve seats, a pair of spaced-apart valve closure members, and a valve shaft connecting said pair of valve closure members so that one said valve closure member is not seated when the other is seated.

6. Liquid feed apparatus according to claim 5 wherein one said valve closure member has more effective surface area exposed to liquid than the other said valve closure member for maintaining said smaller valve open when said larger valve closure member is closed.

7. Liquid feed apparatus according to claim 6 further

characterized by an extension on said valve shaft from said smaller valve closure member on the side opposite said larger valve closure member, piston means mounted on said shaft extension, a cylinder reciprocally receiving said piston, said cylinder being open at one end, and said piston having an exposed area larger than said larger valve closure member for maintaining said larger valve closure member biased open with the smaller valve closure member shut.

8. Liquid feed apparatus according to claim 1 wherein said fluid motor and said pump are mounted spacedly in a common housing, and said housing from said reservoir.

9. Liquid feeds apparatus according to claim 1 being further characterized by means for introducing a predetermined amount of chemicals into the liquid in said reservoir.

10. Liquid feed apparatus according to claim 1 wherein said supply of liquid is a potable water supply, said open reservoir is maintained at about atmospheric pressure; and said means for introducing liquid into said reservoir is a conduit exhausting into and spaced above said open reservoir providing an airgap between said water supply and said pressurized liquid system, preventing backflow from said pressurized fluid system into said potable water supply.

11. Liquid feed apparatus for pressurized liquid systems comprising, a diaphragm operated fluid motor actuated by a supply of liquid under pressure; a diaphragm pump for injecting liquid into a pressurized liquid system; connecting means between said fluid motor and said pump; a pair of spaced-apart valve seats arranged with one seat of said pair of valve seats arranged at the intake of said fluid motor and the other seat of said pair of valve seats arranged at the exhaust of said motor; a pair of spaced-apart valve closure members and a valve shaft mounting said valve closure members such that one said valve closure member is seated when the other is not seated for selectively allowing the introduction of liquid from said supply of liquid under pressure into said fluid motor and the withdrawal of liquid from said fluid motor, one said valve closure member having more effective surface area exposed to liquid than the other for maintaining said smaller valve unseated when said larger valve closure member is seated; means interconnecting said valve shaft with said connecting means for actuating said pair of valve closure members on movement of said connecting means a reservoir separate from said supply of liquid under pressure; means for introducing liquid from said reservoir to said pump; and means for introducing liquid into said reservoir.

12. Liquid feed apparatus according to claim 11 further characterized by an extension on said valve shaft from said smaller valve closure member on the side opposite said larger valve closure member, piston means mounted on said shaft extension, a cylinder reciprocally receiving said piston, said cylinder being open at one end, and said piston having an exposed area larger than said larger valve closure member for maintaining said valve biased not seated with the smaller valve closure member seated.

60

65

70

75