April 23, 1957 R. E. MEYNIG 2,789,510

LIQUID INJECTOR

Filed March 11, 1954 2 Sheets-Sheet 1

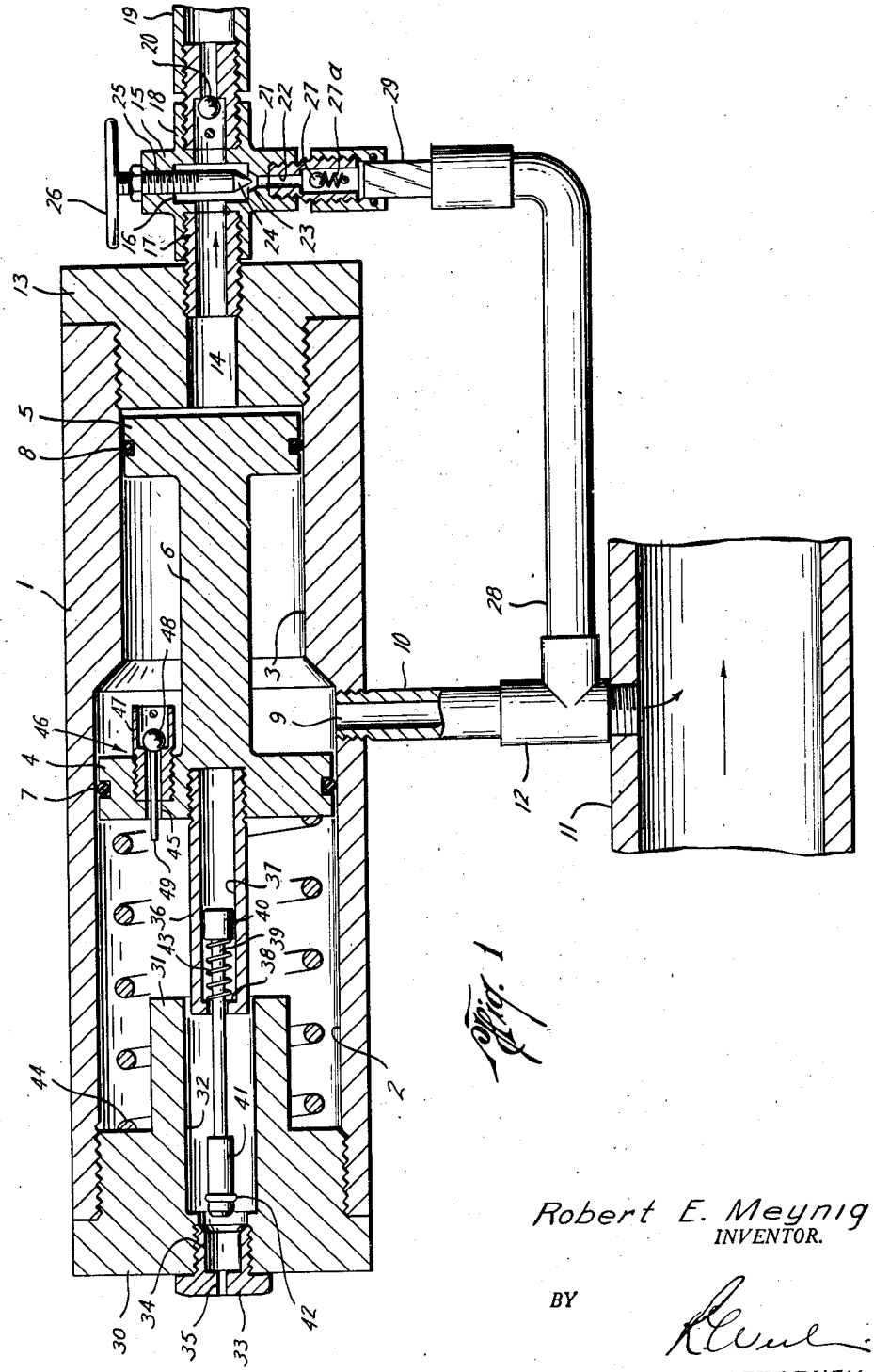


Fig. 1

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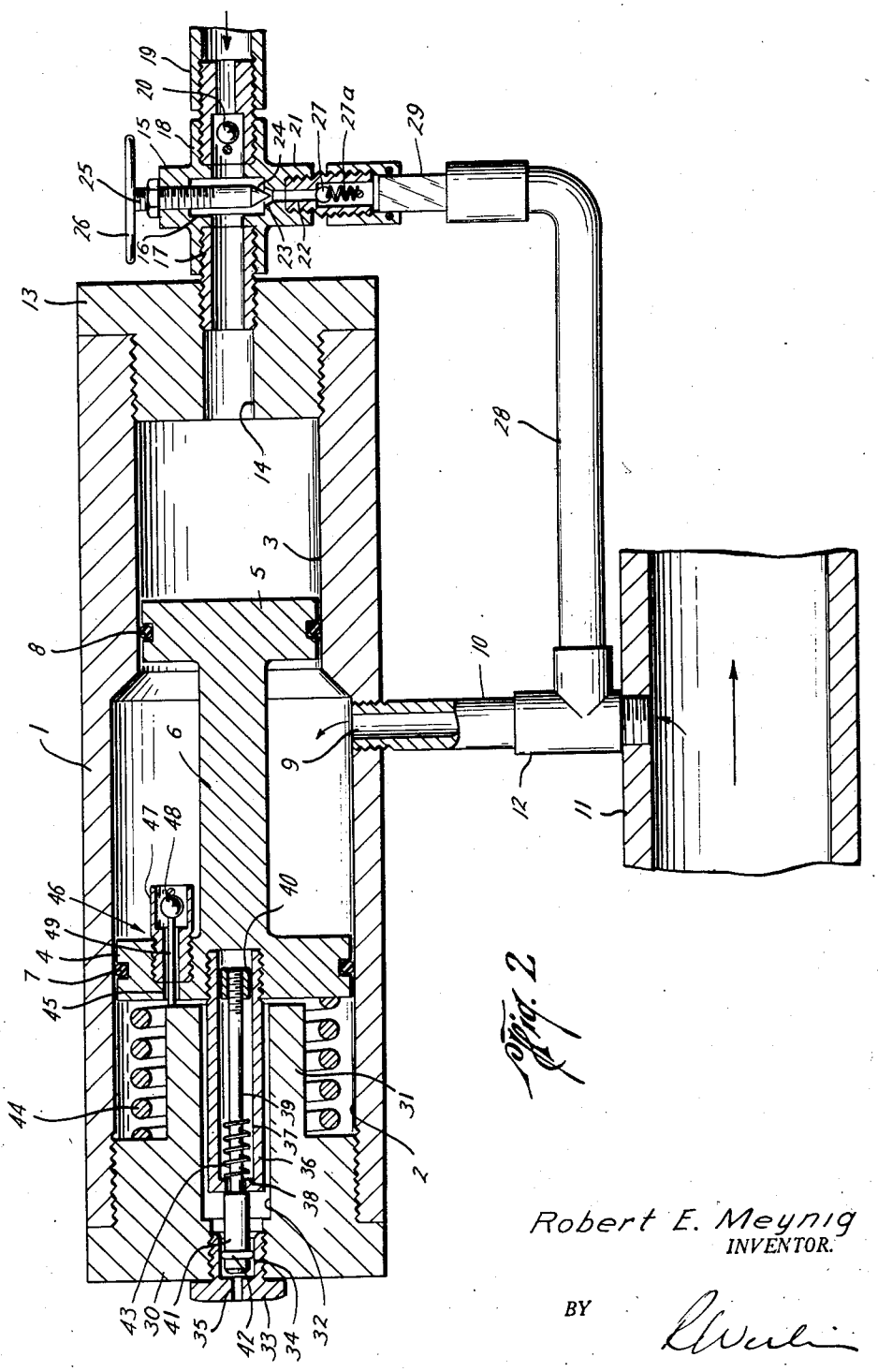


Fig. 2

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2,789,510

LIQUID INJECTOR

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Application March 11, 1954, Serial No. 415,581

9 Claims. (Cl. 103—50)

This invention relates to pumps, particularly to injector pumps for injecting relatively small controlled quantities of chemical liquid into a main body of a fluid.

A primary object of the present invention is to provide a chemical injector for feeding chemical liquid into an oil and gas stream, such as the stream leaving a well and entering an oil and gas separator.

A further object is to provide a chemical injector or pump which employs the pressure of the gas separated from a mixed gas and oil stream to actuate the injector.

A further object is to provide a chemical injector which is simple in design and operates with a minimum of expense.

An additional object is to provide a chemical injector operated by a pressure fluid into which chemical is to be injected.

Still another object is to provide a differential pump having a needle valve controlling the discharge thereof in order to regulate the amount of chemical being discharged by the pump.

Other and more specific objects and advantages of this invention will become more readily apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with this invention.

In the drawing:

Fig. 1 is a longitudinal sectional elevation of the pump in accordance with an embodiment of this invention, showing the piston element at termination of a discharge stroke; and

Fig. 2 is a view similar to Fig. 1, showing the piston at the termination of an intake stroke.

The pump comprises a horizontally disposed body 1 which encloses a pair of co-axial differential cylinders 2 and 3 respectively containing a pair of differential pistons 4 and 5 which are connected for simultaneous movement by a member 6. Cylinder 2 is the lower pressure cylinder and cylinder 3 the higher pressure cylinder. Packing members 7 and 8, such as conventional O-rings, are mounted in the peripheries of the respective pistons to form slidable fluid-tight seals between the pistons and the walls of the respective cylinders. An inlet passage 9 provides communication between the larger area cylinder 2 and a conduit 10 which communicates with a source of actuating gas, such as the pipe 11, through a T-fitting 12. The outer end of the smaller area cylinder 3 is closed by a head 13 having a passage 14 therethrough. A T-shaped valve casing 15 encloses a chamber 16. One horizontal branch 17 of the valve casing connects chamber 16 to passage 14 and another horizontal branch 18 connects chamber 16 to a conduit 19 which leads to a chemical reservoir of any conventional form. (Not shown.) An inwardly opening check valve 20 is mounted in branch 18 to control communication between chamber 16 and conduit 19. The third branch 21 of the valve casing extends vertically downwardly and contains the outlet passage 22, the inner end of which communicates with chamber 16 and is formed with a tapered seat 23

to receive the tapered end 24 of a needle valve 25. The latter extends through the wall of valve casing 15 opposite seat 23 and is threadedly mounted in the casing wall for movement relative to seat 23 to control fluid flow through outlet passage 22. The outer end of needle valve 25 is fitted with a handle 26 by which the valve may be rotated to adjust it relative to seat 23. Outlet passage 22 is controlled by an outwardly opening ball check valve 27 which is normally biased to the closed position by a spring 27*a*. Outlet passage 22 communicates below check valve 27 with a discharge conduit 28 which connects into a side branch of T-fitting 12. A vertically disposed sight glass 29 is interposed between outlet passage 22 and conduit 28.

The outer end of the larger area cylinder 2 is closed by head 30 having inwardly extending tubular boss 31 having an external diameter smaller than the internal diameter of cylinder 2, and extending inwardly of the cylinder from the head. Head 30 and boss 31 are provided with a central bore 32 which is reduced in diameter near its outer end and internally threaded to receive a plug 33 having a cylindrical chamber 34 therein co-axial with bore 32 and opening through the outer end of the plug through a relatively restricted passage 35 which provides means for venting to the atmosphere pressure fluid trapped between head 30 and piston 4.

Vent valve means for controlling vent passage 35 is mounted in piston 4. The vent valve means includes a sleeve 36 having a bore 37 and having one end screwed into the outer end of piston 4 is receivable longitudinally in bore 32. The outer end of sleeve bore 37 is reduced in diameter to form the inwardly facing shoulder 38. An elongated valve stem 39 is slidably disposed in bore 37 and extends through the outer end thereof. Stem 39 is provided on its inner end with enlarged head 40 and on its outer end with a valve head 41 in which is mounted a sealing ring 42. Valve head 41 and sealing ring 42 form a valve adapted to enter chamber 34 and form a fluid-tight seal therein to close off communication through bore 32 between the portion of cylinder 2 outside piston 4 and vent passage 35. A coil spring 43 is loosely mounted about valve stem 39 inside bore 37 and is made substantially shorter than the distance between shoulder 38 and enlargement 40 when stem 39 is fully retracted within sleeve 36, so that sleeve 36 may travel for an appreciable distance relative to stem 39 before spring 43 is engaged by head 40. A relatively strong coil spring 44 is mounted about boss 31 in compression between the inner end of head 30 and the opposing outer face of piston 4.

Piston 4 is provided with a pressure equalizing passage 45 which extends from face to face thereof and is controlled by means of a pressure equalizing valve, designated generally by the numeral 46, the latter includes a valve cage 47 in which is mounted a ball check valve 48 which is adapted to open and close the inner end of passage 45. A thrust rod 49 is mounted in passage 45 and extends through the outer end of passage 45 for engagement with the inner end of boss 31, in order to thrust ball check valve 48 away from the inner end of passage 45 when piston 4 moves to the left a sufficient distance, as will be subsequently described.

The operation of the injector is substantially as follows: Starting with the parts in the position shown in Fig. 1, which illustrates the position just after completion of a discharge stroke at which point the injector is ready to begin an intake stroke, it will be seen that intake valve 20 is still closed and discharge valve 27 open, needle valve 25 being in its adjusted position for controlling the rate of discharge through passageway 22 and valve 27. Pressure equalizing valve 46 is closed and vent valve 41 open, thereby unbalancing the pressures on the opposite sides of

piston 4. At this instant, that is, when vent valve 41 has been pulled out of chamber 34, pressure fluid from source 11 will flow through conduit 10 and passage 9 into the space between pistons 4 and 5. This same pressure will, at the same time, be exerted against valve 27 which will close off discharge passage 22. The pressure admitted between the pistons will act on the larger area of piston 4 to urge both pistons and their connected valve elements to the left against the resistance of spring 44, which will be compressed by this leftward movement of the pistons. As the pistons move to the left, suction will be created in passageway 14 and cylinder 3 to the right of piston 5, which will cause ball check valve 20 to open and draw chemical fluid through conduit 19, valve casing 15 and passageway 14 into cylinder 3. This movement will continue until the leftward movement of piston 4 closes vent 35 by moving valve 41 into chamber 34. Immediately after vent 35 is thus closed, rod 49 will strike the inner end of boss 31 which will thrust ball 48 away from its seat in the end of equalizing passageway 45, allowing the pressure to be equalized on both sides of piston 4. When that occurs, it will be obvious that the pressures in all parts of the injector will be substantially equal, whereupon the compression which has been stored in spring 44 will force the pair of pistons to the right and will force the chemical back from cylinder 3 through passageway 14 and thence through discharge passageway 22, sight glass 29 and conduit 28 back into pipe 11 through T 12. Of course, intake valve 20 will be closed and the rate at which the chemical will be discharged through passageway 22 will be determined by the setting of needle valve 25.

The movement of the pistons to the right under the force of spring 44 will continue until sleeve 36 has moved along stem 39 a distance such that spring 43 will be compressed between shoulder 38 and enlargement 40, this engagement serving to pull valve 41 out of casing 34, again venting the portion of cylinder 2 outside piston 4 to the atmosphere, and again unbalancing the pressures across piston 4 which will restart the cycle of operations.

From the foregoing, it will be seen that the injector is fully automatic in operation; is actuated by pressure of the fluid from the stream into which the chemical is to be discharged; and that the rate of discharge can be effectively controlled by regulation of needle valve 25. Sight glass 29 provides a visual means for observing the rate at which the chemical is discharged and can serve as a guide to the regulation by needle valve 25.

Pipe 11 may be the conventional discharge pipe or header leading from an oil well to an oil and gas separator; or it may be the gas compartment of a separator; or may be the well head itself. In any event, the injector will be connected to be operated by gas trapped from the stream or body of fluid contained in any of these vessels to which the injected chemical is to be returned. It will be seen, therefore, that no special source of actuating fluid is required for operation of the injector; that the device is fully automatic in operation; and that any desired degree of regulation may be obtained in controlling amounts of chemical to be injected.

Spring 44 will obviously need to be only strong enough to overcome mechanical and fluid friction losses in the injector, since on the discharge stroke, the pressures on opposite sides of the pistons will be substantially balanced.

It will be understood that various alterations and modifications may be made in the details of the illustrative embodiment within the scope of the appended claims but without departing from the spirit of this invention.

What I claim and desire to secure by Letters Patent is:

1. A liquid injector, comprising a high pressure cylinder, a low pressure cylinder, differential pistons having a space therebetween and connected for simultaneous movement within the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of the higher pressure cylinder, an inlet for the introduction of acuating pressure fluid communicating with the space between the pistons, spring means normally urging the pistons in the discharge direction, a valve controlled passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon completion of an intake stroke, and a valve controlled vent passage in the portion of the lower pressure cylinder outside said lower pressure piston for venting said portion upon completion of a discharge stroke.

2. A liquid injector, comprising a high pressure cylinder, a low pressure cylinder, differential pistons having a space therebetween and connected for simultaneous movement within the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of the higher pressure cylinder, adjustable valve means in said passage operable to regulate the rate of discharge of the liquid from the higher pressure cylinder, an inlet for the introduction of actuating pressure fluid into the space between said pistons, spring means normally urging the pistons in the discharge direction, a valve controlled passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon the completion of an intake stroke, and a valve controlled vent passage in the portion of the lower pressure cylinder outside said lower pressure piston for venting said portion upon completion of a discharge stroke.

3. A liquid injector, comprising, a high pressure cylinder, a low pressure cylinder, differential pistons having a space therebetween and connected for simultaneous movement within the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of the higher pressure cylinder, inlet conduit means providing communication between a source of actuating pressure fluid and the space between said pistons, outlet conduit means providing communication between said passage and said inlet conduit, spring means normally urging the pistons in the discharge direction, a valve controlled passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon completion of an intake stroke, and a valve controlled vent passage in the portion of the lower pressure cylinder outside said lower pressure piston for venting said portion upon completion of a discharge stroke.

4. A liquid injector, comprising, a high pressure cylinder, a low pressure cylinder, differential pistons having a space therebetween and connected for simultaneous movement within the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of the higher pressure cylinder, inlet conduit means providing communication between a source of actuating pressure fluid and the space between said pistons, outlet conduit means providing communication between said passage and said inlet conduit, adjustable valve means in said passage operable to regulate the rate of discharge of the liquid through said outlet conduit, spring means normally urging the pistons in the discharge direction, a valve controlled passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon completion of an intake stroke, and a valve controlled vent passage in the portion of the lower pressure cylinder outside said lower pressure piston for venting said portion upon completion of a discharge stroke.

5. A liquid injector, comprising, a high pressure cylinder, a low pressure cylinder, a pair of differential pistons connected for simultaneous movement within the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of said higher pressure cylinder, said means including a valve casing having an inlet passage providing communication between a source of said liquid and said higher pressure cylinder, and an outlet passage for discharge of said fluid, an inwardly opening check

valve in said inlet passageway, an outwardly opening check valve in said outlet passage, and an adjustable needle valve in the outlet passage to control the rate of discharge of said liquid therethrough, an inlet for the introduction of actuating pressure fluid communicating with the space between the pistons, spring means normally urging the pistons in the discharge direction, a valve controlled passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon completion of an intake stroke, and a valve controlled vent passage in the portion of the lower pressure cylinder outside said lower pressure piston for venting said portion upon completion of a discharge stroke.

6. A liquid injector, comprising, a high pressure cylinder, a low pressure cylinder, a pair of differential pistons connected for simultaneous movement in the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of the higher pressure cylinder, adjustable valve means in said passage operable to regulate the rate of discharge of the liquid from the higher pressure cylinder, a head closing the outer end of the lower pressure cylinder, spring means disposed in compression between the head and the lower pressure piston to normally urge the piston in the discharge direction, an inlet for the introduction of actuating pressure fluid into the lower pressure cylinder between said pistons, a valve controlled passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon completion of an intake stroke, a vent passage through said head, and valve means movable in response to reciprocation of the lower pressure piston to open and close said vent passage, said valve means being constructed and arranged to open said vent passage upon completion of discharge stroke and to close said vent passage upon completion of an intake stroke.

7. In combination with a fluid flow line, a high pressure cylinder, a low pressure cylinder, differential pistons having a space therebetween and connected for simultaneous movement within the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of the higher pressure cylinder, an inlet for the introduction of actuating pressure fluid communicating with the space between the pistons, a single duct connecting said inlet and said passage outlet to the fluid flow line whereby the pressure actuating fluid flows through said duct to said inlet and the liquid to be pumped flows through said duct to said fluid flow line, a valve controlled passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon completion of a stroke in one direction, a valve controlled vent passage in the portion of the lower pressure cylinder outside the lower pressure piston for venting said portion upon completion of a stroke in the other direction, and means normally urging the pistons in the said other direction.

8. In combination with a fluid flow line, a high pressure cylinder, a low pressure cylinder, differential pistons having a space therebetween for simultaneous movement within the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of the higher pressure cylinder, an inlet for the introduction of actuating pressure fluid communicating with the space between the pistons, a single duct connecting said inlet and said passage outlet to the fluid flow line whereby the pressure actuating fluid flows through said duct to said inlet and the liquid to be pumped flows through said duct to said fluid flow line, a valve controlled passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon completion of an intake stroke, a valve controlled vent passage in the portion of the lower pressure cylinder outside said lower pressure piston for venting said portion upon completion of a discharge stroke, and means normally urging the pistons in the discharge direction.

9. A liquid injector comprising, a high pressure cylinder, a low pressure cylinder, differential pistons having a space therebetween and connected for simultaneous movement within the respective cylinders, means forming a passage in the higher pressure cylinder through which liquid to be pumped is passed into and out of the higher pressure cylinder, an inlet for the introduction of actuating pressure fluid communicating with the space between the pistons, spring means normally urging the pistons in the discharge direction, a passage through the lower pressure piston for equalizing the pressure of the actuating fluid across the lower pressure piston upon completion of an intake stroke, means controlling the flow of fluid through said passage, and a valve controlled vent passage in the portion of the lower pressure cylinder outside said lower pressure piston for venting said portion upon completion of a discharge stroke.

References Cited in the file of this patent

UNITED STATES PATENTS

1,901,148	Creveling	Mar. 14, 1933
1,939,182	McConkey	Dec. 12, 1933
2,350,045	Kathe	May 30, 1944
2,450,781	Carlson	Oct. 5, 1948
2,500,624	Bailey	Mar. 14, 1950
2,698,710	Pedroia	Jan. 4, 1955