Sept. 26, 1950 P. J. HARINCK 2,523,532

HYDRAULIC CONTROL VALVE

Filed April 30, 1947 2 Sheets-Sheet 1

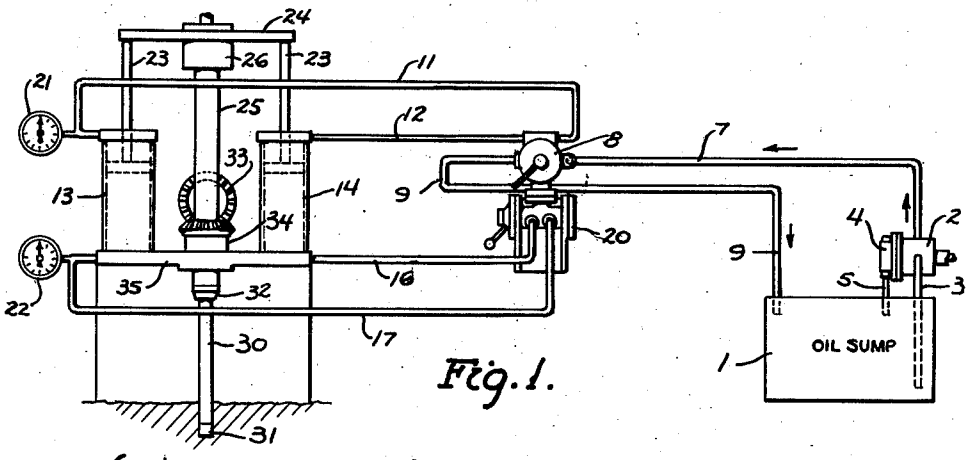

Fig. 1.

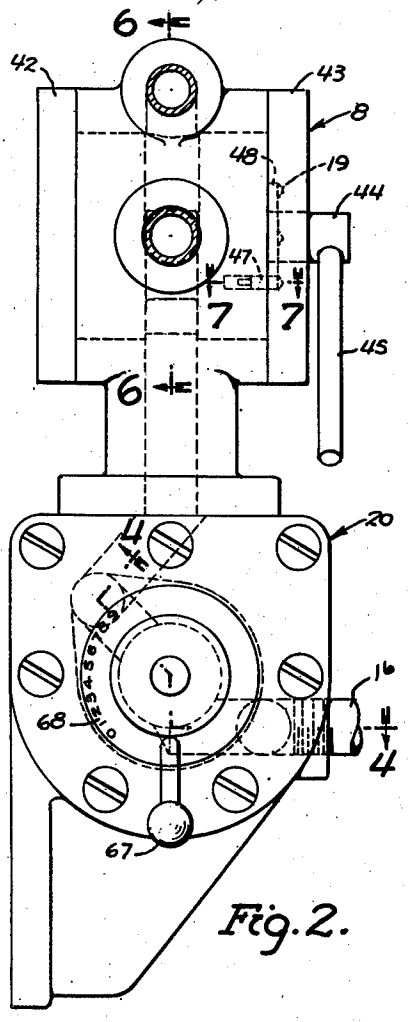

Fig. 2.

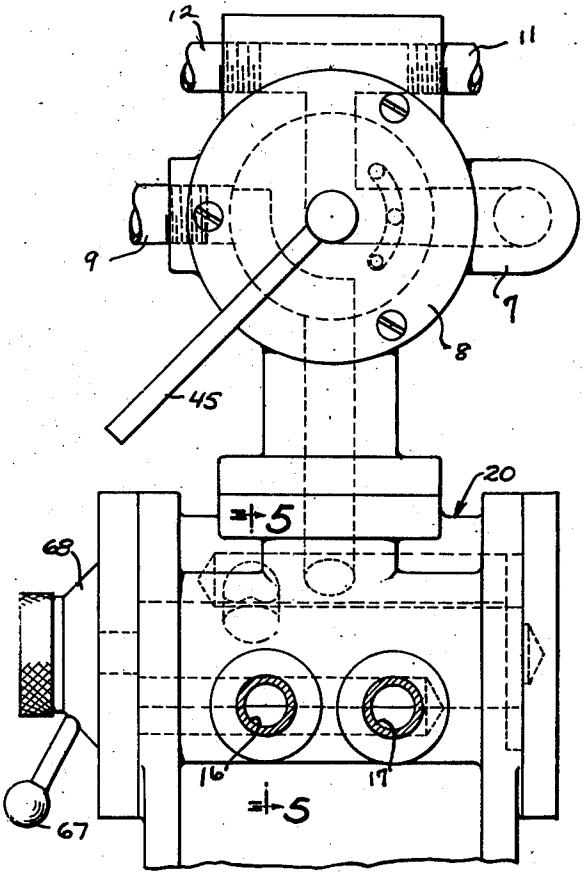

Fig. 3.

INVENTOR.
Peter J. Harinck
BY
Barnes, Kisselle, Raighlin & Risley
ATTORNEYS.

Sept. 26, 1950 P. J. HARINCK 2,523,532

HYDRAULIC CONTROL VALVE

Filed April 30, 1947 2 Sheets-Sheet 2

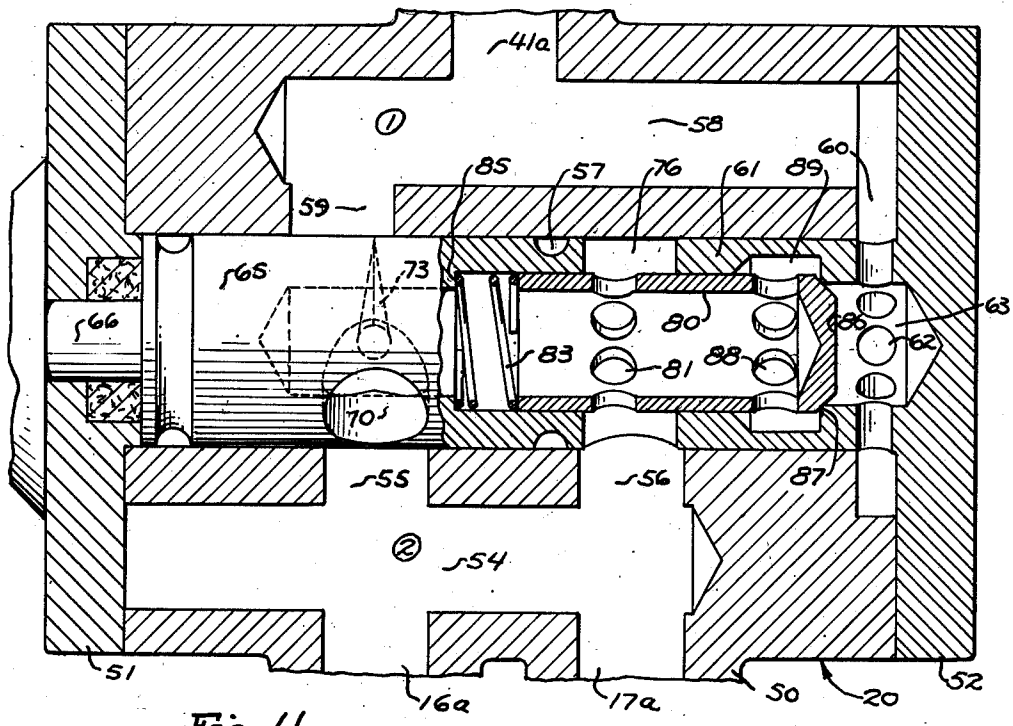

Fig. 4.

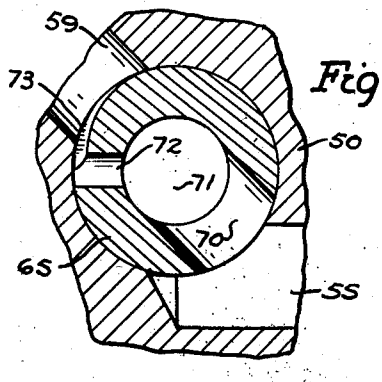

Fig. 5.

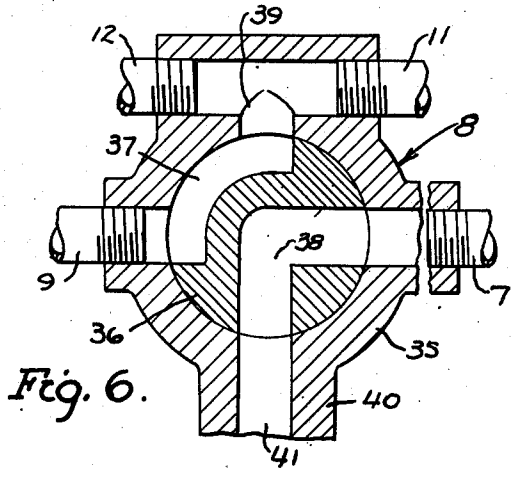

Fig. 6.

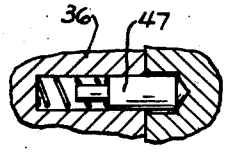

Fig. 7.

INVENTOR.
Peter J. Harinck
BY
Barnes, Kisselle, Laughlin & Raisch
ATTORNEYS.

Patented Sept. 26, 1950 2,523,532

UNITED STATES PATENT OFFICE

2,523,532

HYDRAULIC CONTROL VALVE

Peter J. Harinck, Ferndale, Mich.

Application April 30, 1947, Serial No. 745,057

5 Claims. (Cl. 277—8)

1

This invention relates to a control valve for a hydraulic system, and it has to do particularly with a valve of the metering type useful for governing the rate of flow of a hydraulic medium to, in turn, govern the rate of operation of hydraulically actuated mechanism.

One place where the valve of the present invention is useful, is with hydraulically actuated mechanism for drilling into the earth. When the mechanism is being operated, the drill bit, which is rotary, is advanced into the earth hydraulically and the rate of advancement can be easily controlled and governed with a nicety by means of the control valve of the present invention. It will be appreciated, however, that the drilling operation is carried on in step by step fashion in that, after the drill bit has been advanced a certain distance, a retracting motion of the driving and advancing mechanism is needed to take a new hold on the drill rod to thus operate and advance the drill bit in the next step of the operation. This retracting movement, which is also accomplished hydraulically should be rapid, and the present valve is so arranged and constructed as to provide for a rapid retracting movement.

The invention aims to provide an improved hydraulic control valve for governing the rate of flow of the hydraulic medium and for providing one rate of flow under one condition and another variable rate of flow under other conditions. A further object is to provide an improved hydraulic control valve for governing the flow of the hydraulic medium where a plurality of hydraulic flow lines or conduits are incorporated in the hydraulic mechanism.

A valve constructed in accordance with the present invention is disclosed in the accompanying drawings:

Fig. 1 is a diagrammatic illustration of a hydraulic system associated with earth drilling mechanism and illustrating the valve incorporated in the hydraulic system.

Fig. 2 is an enlarged side elevational view of the metering valve and also indicating a direction control valve.

Fig. 3 is a view similar to Fig. 2 looking from the right of Fig. 2.

Fig. 4 is an enlarged cross sectional view of a developed nature taken substantially on line 4—4 of Fig. 2 showing the construction of the metering valve.

Fig. 5 is an enlarged cross sectional view taken substantially on line 5—5 of Fig. 3 showing metering ports.

Fig. 6 is a sectional view taken substantially

2

on line 6—6 of Fig. 2 showing the direction controlling valve.

Fig. 7 is a detailed sectional view taken substantially on line 7—7 of Fig. 2 illustrating a detent arrangement for the direction controlling valve.

While the valve of the present invention may be used with earth drilling mechanism as above mentioned, it is to be appreciated that the valve is not limited to such use, but in order to provide a clear understanding of the valve and its performance, a hydraulic system and drilling equipment operated thereby is diagrammatically illustrated in Fig. 2. There is a reservoir or sump 1, for a hydraulic medium such as oil, which is moved by a pump 2 having an inlet pipe 3 extending into the sump. A pressure relief valve is at 4 which has a line 5 for discharging oil back into the sump if the pressure gets too high. The pressure line leading from the pump is shown at 7, and it extends to the direction control valve generally indicated at 8. Extending from the direction control valve is a return line 9 which goes back to the sump.

Leading from the direction control valve are two pressure lines 11 and 12 which connect respectively into the upper portions of two cylinders 13 and 14. Also two lines or conduits 16 and 17 extend from the lower ends of the cylinders 13 and 14 to the metering valve generally indicated at 20.

Suitable gauges 21 and 22 may be located in the system and the cylinders have pistons therein with piston rods 23 connected to a yoke 24 for reciprocating a rotary member 25 mounted in the yoke by means of a suitable bearing 26. Rotary member 25 is hollow and a drill rod 30 extends therethrough, the same having a drill bit at its lower end, as shown at 31, and member 25 has a chuck 32 for engaging the drill rod to rotate the same. A driving gear 33 has its teeth meshing with a gear 34 which is mounted upon a support 35 and which has a slidable connection as by means of a spline or the like to the rotary member 25. It will be seen, from this construction, that the gears 33 and 34 may rotate the member 25 and, therefore, rotate the drill rod 30 through the means of the chuck 32, and at the same time, the hydraulic system through the means of the cylinders and the pistons may shift the rotary member 25 and thus urge the drill bit 31 into the earth. It will also be appreciated that, if the chuck is relieved from the drill rod, that the rotary member 25 and the chuck may be elevated so as to take a new hold

on the drill rod 30. The above description of the drilling mechanism is, of course, brief but will suffice to show how the valve may be used. Such drilling mechanism is fully disclosed in my co-pending application Serial No. 717,128 filed December 19, 1946, titled Drilling Apparatus.

The direction valve 8 is a type of four-way valve having a casing 35 with a rotary valve member 36 with ports 37 and 38 therein. The valve body has ports as shown in Fig. 6 for connection to the lines 7 and 9 and a common outlet port 39 for the lines 11 and 12. The body has an extension 40 which is provided with a passage 41. The body may be closed at opposite sides by plates 42 and 43 and the valve member 36 may have a projecting shaft 44 provided with an operating handle 45. Functioning between the valve member and the plate 43 is a spring pressed detent 47 (Fig. 7), the detent shifting with the valve member and operating in a slot 48 and the plate 43, which slot is provided with three depressions 19.

The metering valve 20 (Fig. 4) has a body 50 which may be closed at opposite ends by plates 51 and 52. The body has parts 16*a* and 17*a* for connection to the conduit lines 16 and 17 and a port 41*a* which connects into the passage 41 of the direction valve, and the two valves are placed together as shown in Figs. 2 and 3.

The ports 16*a* and 17*a* connect into a sort of manifold passage 54 with ports 55 and 56 leading into a cylinder or bore 57. A passage 58 is connected with the cylinder by a port 59, this passage also connecting with port 41*a*, and the body 50 is cored out to provide a circumferential space 60 which extends around a hollow projection 61 on the plate 52 and which projection extends into the cylinder 57. The projection 61 is provided with a number of ports 62 which lead into a chamber 63 in the hollow projection.

Positioned in the cylinder is a control member 65 having a shaft 66 which extends through plate 51 and which is provided with an outside operating handle 67. The handle is associated with a visible dial 68, with indicia, as shown, which may be used in adjusting the valve. As shown in Fig. 5, the control member 65 has a port 70 which may be registered with the port 55 and it has an interior hollow or passage 71 connecting into which is a small metering port 72. Joining the mouth of the port 72 on the exterior thereof is a peripheral groove type of port 73, which extends circumferentially and is of gradually increasing depth as shown in Fig. 5, and of gradually decreasing width as shown by the dotted lines in Fig. 4.

A chamber of circumferential extent 76 is formed between the end of the extension 61 and the member 65 and a piston type valve member 80 is slidably positioned in the member 65 and in the extension 61, and it has a series of ports 81 in a position to communicate with the chamber 76. The port 56 registers with the chamber 76, as shown. A coil spring 83 acts upon the member 80 and reacts against a shoulder 85 in the member 65 and serves to push the end of the member 80 which is closed by a head, as illustrated at 86, against the seat 87 in the extension 61. The member 80 also has a number of ports 88 which register with a circumferential enlargement forming a chamber 89 in the extension 61.

The normal position of the parts is shown in Fig. 4 with the spring 83 holding the member 80 against the seat 87. The rotary adjustable member 65 may be adjusted in any desired position to meter the flow from passage 72 through the groove 73.

In order to operate the mechanism so that the hydraulic medium is entered into the upper portions of the cylinders 13 and 14, the direction valve is adjusted to the position shown in dotted lines in Fig. 3. The hydraulic medium then flows from the line 7 through the passage 38 and into the common outlet 39 and thence to the upper portions of the cylinders through the lines 11 and 12. This forces the pistons downwardly with the resultant displacement of the hydraulic medium which lies below the pistons. The medium or oil is displaced through the conduits 16 and 17 and into ports 16*a* and 17*a* and thence into the manifold 54 (Fig. 4). Some of this oil attempts to flow, or at least applies pressure to, oil trapped in the passage 76, ports 81, and thus increases the pressure with which the member 80 seats on the valve seat 87 so that there is no escape of oil. The oil, of course, fills the ports 88 and the circumferential passage 89 but cannot escape. There is also a free communication from the manifold passage 54 through ports 55 and 70 into the interior of the member 65 and into the piston valve 80.

Such oil as does escape must flow through port 55, port 70 and into the interior passage 71. The escaping oil passes through the port 72 and through the metering groove 73 into port 59. The passage 58 is, of course, filled with oil but the seating of the valve member 80 closes the passage 58 at one end. Now, the rate of speed with which the drill bit is advanced into the earth by movement of the pistons is thus determined by the rate of discharge of the displaced hydraulic medium. And this rate can be variably adjusted by rotary adjustment of the member 65, by the handle 67 and the operator may employ the indicia visible on the dial 68. The maximum rate of speed may be determined by the size of the port 72, and from this maximum position, the rate may be cut down slower and slower utilizing the tapered construction of the metering groove 73.

After the pistons have made their full stroke, and it is necessary to elevate them, to take a new hold on the drill rod 30 by the chuck 32, the direction valve 8 is swung clockwise as Fig. 3 is viewed to position the ports 37 and 38, as shown in Fig. 6. The hydraulic medium now flows through port 38 and into the passage 58 in the metering valve. A small amount of this oil may flow through the metering port and back into the manifold 54 in a direction just reverse to that above described, but most of the oil will flow from the passage 58 into the chamber 60 and the pressure on the head 86 of the member 80 and unseat the same. The oil now flows into the chamber 89 through ports 88 into the member 80 through ports 81 into the chamber 76 thence into the manifold 54. From this point, the pumped liquid flows through lines 16 and 17 to the lower ends of the cylinders to elevate the pistons with the displaced liquid flowing back through lines 11 and 12 and into the common outlet 39 (Fig. 6) thence through port 37 and then into the return line 9. Under these conditions, it will be observed that there is substantially no metering of the flow because the member 80 is unseated from its seat 87 and the liquid flows freely through the metering valve. This gives a rapid movement to the pistons for elevating the same at which time the chuck 32 is manipulated to take a new hold on

the drill rod **30**. Following this, the direction valve **8** is swung back to the Fig. 3 position and the mechanism is in position to again force the drill bit into the earth with a slow metered action. The three detent recesses may indicate three positions of the direction valve. One extreme position is for the drilling operation, the other extreme position is for the retracting action, while the intermediate position is one where the ports **37** and **38** are out of register with all other ports in the valve body to cut off oil flow.

Of course, all kinds of subterranean conditions are encountered, and when soft substance is encountered the projection of the drill bit may be relatively fast while, when hard substance or rock is encountered, the valve **65** is adjusted to slowly meter the pumped liquid for a slow advancement of the drill bit. Any time the drill bit meets resistance which prevents it from advancing with a rate of speed corresponding to that of the adjustment of the member **65**, the relief valve **4** which is of any conventional relief valve construction, relieves for the discharge of the liquid back to the sump through the line **5**.

Thus, it will be seen that the metering valve provides a simple construction embodied in a single unit for metering the flow of liquid therethrough in one direction and yet allowing a substantially free and unobstructed flow of liquid therethrough in the opposite direction.

I claim:

1. A control valve for a hydraulic system comprising, a body having passageways therein for connection into a hydraulic system for the flow of liquid hydraulic medium through the body, sometimes in one direction and sometimes in the opposite direction, a single cylinder formation in the body, a rotatably adjustable member in the cylinder formation adjacent one end thereof, the cylinder formation and the adjustable member having ports for the passage of liquid from one passageway in the body to the other, at least one of said ports being a metering port which is variable with rotatable adjustment of the adjustable member, means forming a seat adjacent the other end of the cylinder formation, port means for connecting one of the passageways directly to one side of the seat, a slidably mounted piston-type valve having a head arranged to engage said seat, said piston-type valve having ports therein communicating with the other of said passageways directly whereby the pressure of the liquid entering said last named passageway serves to seat the head of the piston-type valve on said seat to close the same against flow of liquid through the body independently of the position of the said rotatably adjustable member, the head of the piston being acted upon by pressure of the liquid entering the other of said passageways to shift the piston-head off said seat for the flow of liquid therethrough.

2. A control valve for a hydraulic system comprising, a body having first and second passageways for connection into a hydraulic system, a cylinder formation in the body, ports in the cylinder formation forming a connection between the passageways, a rotatably mounted metering valve member cooperating with said ports for metering the flow of liquid from one passageway to the other through said ports, a hollow projection extending into the cylinder formation from the end thereof opposite the control valve member, a hollow piston-type valve having a head slidably mounted in the control member and projection, the control member and projection being spaced apart to provide a chamber connecting into the second passageway, said hollow piston-type valve having a series of ports registering with the said chamber, said projection having an internally enlarged portion forming a second chamber outside the piston valve, said piston valve having another series of ports registering with the said second chamber, a seat for the piston head, a third chamber on the side of the seat opposite the piston head, said third chamber being in communication with the first passageway, whereby the pressure of liquid entering the second passageway enters the piston-type valve and urges its head upon the seat so that the liquid passes only through the metering valve and whereby the pressure of liquid entering the first passageway and said third chamber shifts the head of the piston valve off its seat for substantially unobstructed flow of liquid from the first passageway through said chambers and the ports in the piston-type valve to the second passage.

3. A control valve for a hydraulic system comprising, a body having first and second passageways for connection into a hydraulic system, a cylinder formation in the body, ports in the cylinder formation forming a connection between the passageways, a rotatably mounted metering valve member cooperating with said ports for metering the flow of liquid from one passageway to the other through said ports, a hollow projection extending into the cylinder formation from the end thereof opposite the control valve member, a hollow piston-type valve having a head slidably mounted in the control member and projection, the control member and projection being spaced apart to provide a chamber connecting into the second passageway, said hollow piston-type valve having a series of ports registering with the said chamber, said projection having an internally enlarged portion forming a second chamber outside the piston valve, said piston valve having another series of ports registering with the said second chamber, a seat for the piston head, a third chamber on the side of the seat opposite the piston head, said third chamber being in communication with the first passageway, whereby the pressure of liquid entering the second passageway enters the piston-type valve and urges its head upon the seat so that the liquid passes only through the metering valve and whereby the pressure of liquid entering the first passageway and said third chamber shifts the head of the piston valve off its seat for substantially unobstructed flow of liquid from the first passageway through said chambers and the ports in the piston-type valve to the second passage, and spring means for normally seating the piston head on its seat.

4. A control valve for a hydraulic system comprising, a body having first and second passageways for connection into a hydraulic system for the flow of liquid hydraulic medium through the valve, a cylinder formation in the body, a rotatably mounted control valve positioned in the cylinder formation adjacent one end thereof, a hollow piston-type valve having a head, said piston-type valve being disposed on the axis of the rotatable control valve, means forming a seat for the head of the piston-type valve adjacent the opposite end of the cylinder formation, metering port means variable by adjustment of the rotary member for varying the connection between the two passageways, port means for establishing a direct communication between the first pas-

sageway and one side of the head of the piston-type valve and for directly connecting the second passageway to the interior of the piston-type valve, whereby hydraulic medium entering the second passageway seats the piston head on its seat and hydraulic medium entering the first passageway shifts the piston head from its seat independently of the position of the rotatably mounted control valve, and other ports in the piston-type valve for establishing a flow connection between the first and second passageways when the head of the piston-type valve is off said seat.

5. A control valve for a hydraulic system comprising, a body having first and second passageways for connection into a hydraulic system for the flow of liquid hydraulic medium through the valve, a cylinder formation in the body, a rotatably mounted control valve positioned in the cylinder formation, a hollow piston-type valve having a head, said piston-type valve being disposed on the axis of the rotatable control valve, means forming a seat for the head of the piston-type valve, metering port means variable by adjustment of the rotary member for varying the connection between the two passageways, port means for establishing a communication between

the first passageway and one side of the head of the piston-type valve and for connecting the second passageway to the interior of the piston-type valve, whereby hydraulic medium entering the second passageway seats the piston head on its seat and hydraulic medium entering the first passageway shifts the piston head from its seat, other ports in the piston-type valve for establishing a flow connection between the first and second passageways when the head of the piston-type valve is off said seat, and spring means for normally seating the head of the piston-type valve on said seat.

PETER J. HARINCK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
552,793	Stoner	Jan. 7, 1896
843,525	Frey	Feb. 5, 1907
920,616	McKnight	May 4, 1909
1,810,331	Wilhjelm	June 16, 1931
1,947,637	Bolster	Feb. 20, 1934