Dec. 15, 1953

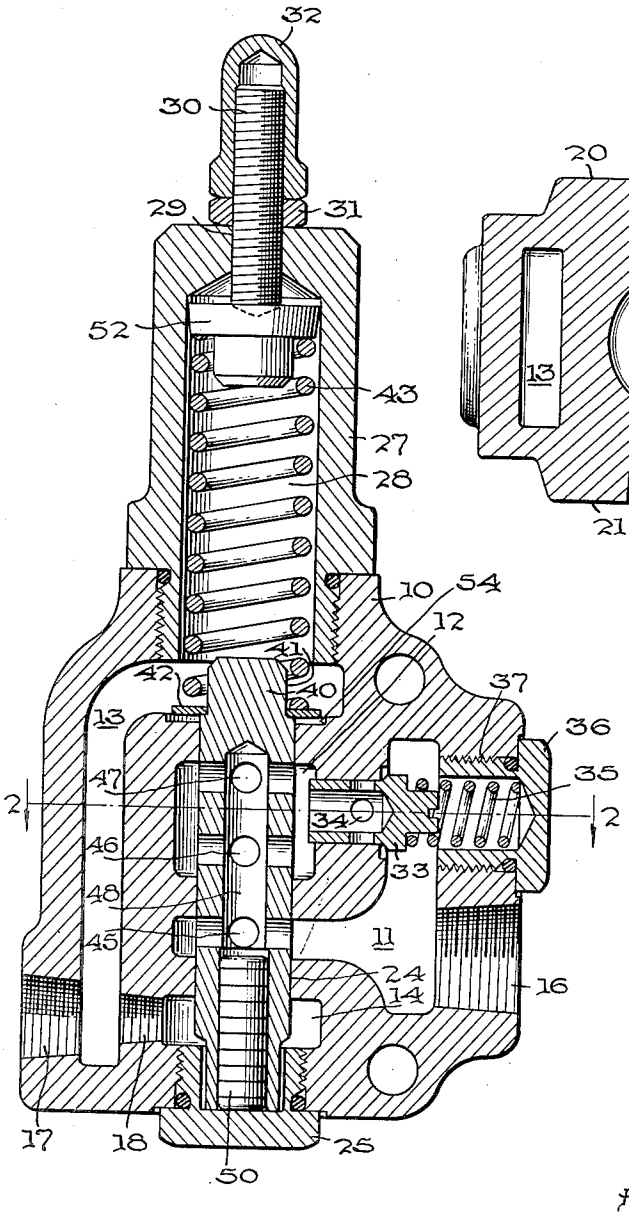
H. J. STACEY

2,662,543

PRESSURE REDUCING VALVE

Filed March 27, 1950

Fig. 1.



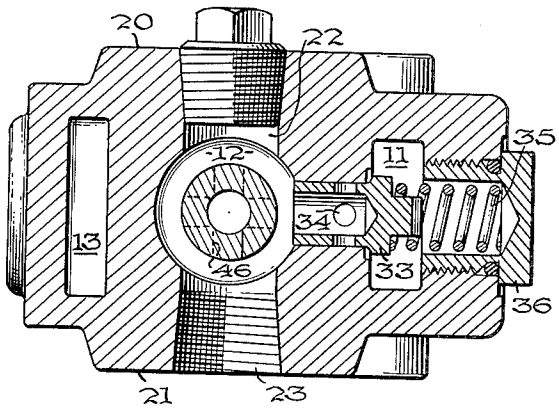


Fig. 2.

INVENTOR.
HUGH J. STACEY

BY

Leech & Radue

ATTORNEYS

Patented Dec. 15, 1953

2,662,543

UNITED STATES PATENT OFFICE

2,662,543

PRESSURE REDUCING VALVE

Hugh J. Stacey, Willoughby, Ohio, assignor, by mesne assignments, to The New York Air Brake Company, New York, N. Y., a corporation of New Jersey

Application March 27, 1950, Serial No. 152,209

2 Claims. (Cl. 137—115)

1

This invention relates to pressure reducing valves, and more particularly to such valves for operation in connection with hydraulic liquids at relatively high pressures.

It is a general object of the present invention to provide a novel and improved type of pressure reducing valve for use with high pressure liquids.

More particularly it is an object of the present invention to provide a valve of the type described wherein the actual valve mechanism is directly associated with and forms part of the operating piston or plunger which has an area subject to the reduced pressure for controlling the valve.

An important object of the invention comprises the arranging of a one piece housing with a plurality of liquid chambers adapted for different pressurization and in which a single plunger valve extends through all the chambers and has ports or passages to cooperate at times with each of them.

Another important object of the invention consists in the construction and arrangement of the pressure sensitive piston whereby two working pressure ranges are available from the same pressure balancing spring.

A further important object of the invention comprises the use of a hollow piston-plunger incorporating radial passages cooperating with high pressure, working pressure and exhaust pressure chambers arranged in the order enumerated.

Among the novel features of the construction of the present invention may be mentioned the use of a hollow pressure responsive valve-plunger in which the pressure chamber is also the conduit which connects the several liquid chambers in the valve housing; an arrangement whereby initial movement of the valve plunger is by high pressure liquid and subsequent movement by working pressure liquid; the use of unavoidable leakage along the surface of the piston-plunger for maintaining relative plunger stability under all working conditions; the reduction of excess pressure in the working chamber by discharge to exhaust without loss of high pressure liquid for maintaining desired working pressure.

Other and further features and objects of the invention will be more apparent to those skilled in the art upon a consideration of the accompanying drawing and following specification, wherein is disclosed a single exemplary embodiment of the pressure reducing valve, it being understood that such changes and modifications may be made therein as fall within the scope of the appended claims without departing from the spirit of the invention.

2

In said drawings:

Fig. 1 is a vertical central section through a pressure reducing valve constructed according to the present invention and illustrating the high pressure inlet port and the exhaust passage; and

Fig. 2 is a horizontal section on line 2—2 of Fig. 1, illustrating the duplicate working ports.

In the operation of many hydraulic devices there is a requirement for means to reduce the operating liquid pressure, either for the purpose of maintaining a constant and uniform pressure on apparatus requiring such a condition or to permit the operation of several devices at different working pressures from a single pressure liquid source, such as a high pressure accumulator or a constant or variable volume high pressure pump. Devices of this character may have pressure ranges from the order of 100 p. s. i. to several thousand p. s. i., and obviously the usual expedient of adapting a diaphragm for controlling the actual valve is out of the question. Such diaphragm operated devices are restricted to the use of low pressures of the order of pounds and ounces, as for illuminating gas and similar operations. The present device makes use of a piston of relatively small diameter having an area subject to the reduced or working pressure attempting to move it and being opposed in movement by a spring whose pressure can be regulated by adjusting means. The expression high pressure used hereafter is intended to refer to pressures of the order of 100 p. s. i. or greater but not to any definite range of pressures.

The valve shown in the drawing is assembled in a relatively heavy cast housing 10 of generally rectangular configuration having a plurality of cored passages and chambers, including the generally L-shaped high pressure chamber 11, the central low pressure chamber 12, and the inverted L-shaped exhaust chamber 13. There is also a circular auxiliary exhaust chamber 14 near the bottom.

The high pressure chamber 11 is provided with a threaded bore or port 16 extending through the right wall of the housing. A corresponding port 17 extends through the left wall of the housing and connects to the lower end of the inverted L-shaped exhaust chamber. Threaded passage 18, in alignment with 17, connects chambers 13 and 14 and may be closed by a plug under certain conditions. The central or reduced pressure chamber 12 is conveniently connected to opposite faces 20 and 21 of the housing by duplicate

threaded ports 22 and 23. This permits the connection of two working devices if desired, or, by the plugging of one, a convenient lead for a pipe from the desired side of the housing to the device using the reduced pressure.

The chambers 11, 12, 13 and 14 all have portions in vertical central alignment and are intersected by the vertical bore 24 extending entirely through the housing. This bore is counterbored at the bottom to receive the hollow closure plug 25 suitably headed for wrench engagement and sealed against leakage with a packing ring, as shown. The opposite end of the bore is enlarged to a threaded counterbore for receiving the elongated spring hood 27 having an enlarged bore 28 coaxial with the bore 24 as well as a reduced coaxial and threaded bore 29 to receive the spring pressure adjusting screw 30, which is provided on the exterior of the hood with a lock nut 31 and acorn cap 32.

A horizontal bore parallel to and above high pressure bore 16 connects the upward extension of chamber 11 with chamber 12 and receives the check valve member 33 having a conical seat cooperating with the outer end of the bore. The inner portion of the valve member is tubular, as shown, and has radial ports 34 which provide connections from 12 to 11 when the valve 33 is lifted by excess pressure beneath it against the action of its relatively light helical spring 35 housed in the hollow of closure plug 36 threaded in the counterbore 37 and appropriately sealed as shown.

The bore 24 receives the combined plunger-valve member 40 composed of a length of cylindrical rod having reduced upper end 41 to receive the support washer 42 and to center the lower end of helical spring 43 resisting movement of the piston-plunger. The lower end of the piston is likewise reduced in diameter to provide a clearance in the bore of lower cap 25. The lower end of the plunger bottoms in this bore, as shown, under the action of spring 43.

The plunger-piston is centrally bored from the lower end through most of its length. Three groups of radial ports 45, 46 and 47 connect the bore 48 of the plunger with its surface. In the position shown ports 45 communicate with chamber 11 and ports 46 and 47 with chamber 12.

For relatively high pressure operation, i. e. pressures in the range of 200 to, say, 1200 p. s. i., a close fitting cylindrical pin 50 closes the lower end of bore 48 and is circumferentially grooved, as shown, to provide as nearly as possible a leak proof working fit so that the pin can slide in respect to the plunger.

If it is now assumed that high pressure port 16 is connected to a suitable source of high pressure liquid, through a control valve which can shut off this liquid and allow a return of used liquid to a tank for reuse, and that one of the ports 22 or 23 is connected with a device requiring a constant pressure within the range of control of the valve and less than that supplied to the port 16, the operation is as follows: On opening the control valve high pressure liquid flows into chamber 11. It is prevented from passing through the check valve to reach chamber 12 because this valve is closed by excess pressure in 11 over that in 12. The liquid flows into the piston-plunger through ports 45 and from ports 46 and 47 flows into chamber 12 for delivery to the apparatus supplied by the pressure reducing valve. When the pressure in chamber 12 reaches that for which the spring has been adjusted, by means of screw 30 and follower 52, pressure within the bore 48 acting between its upper end and the top of the pin 50, begins to move the plunger upwardly, and if there is no continued usage the pressure in chamber 12 finally moves the plunger to a position where ports 45 are cut off from chamber 11. If the apparatus connected to chamber 12 requires a continuous supply of liquid the plunger reaches a balanced position opening ports 45 just sufficiently to supply this liquid at the pressure set by the spring adjustment.

Assuming, however, that the apparatus connected to 12 is a cylinder and piston with the piston having reached the maximum movement permitted by the length of the cylinder or by the load thereon, no further liquid is therefore needed from chamber 12 and the ports 45 remain closed. In a device of this sort it is impossible to eliminate all leakage and there will be a certain amount of liquid flow from chamber 11 into chamber 12 alongside of the piston, and this will increase the pressure in 12 above the spring setting, whereby the plunger will continue to move upwardly until such time as ports 47 are exposed above the enlarged counterbore 54 beneath the support washer 42.

This counterbore serves to insure clearance of the washer so that it never bottoms and also fixes a sharp edge at a predetermined distance above the bottom stop for the plunger.

Excess pressure in chamber 12 above the desired working pressure is exhausted into low pressure chamber 13 and the liquid drains through port 17 back to the tank or reservoir supplying the pump. This loss in pressure permits the spring to move the plunger 40 downwardly to close off ports 47 and brings the pressure in chamber 12 substantially to the desired normal. The over-travel of the plunger as above described would seemingly result in constant plunger movement with corresponding pressure fluctuations in chamber 12, which might under certain circumstances cause a fluttering of the valve to be accompanied by noise and vibration. Actually, however, there is additional leakage from the plunger between chambers 12 and 13 which partially compensates for that between chambers 11 and 12, although taking place at a lesser pressure differential. Therefore the above described operating cycle occurs only at infrequent intervals. Under true working conditions the two amounts of leakage are very close to the same so there is little additional movement of plunger 40 after its original movement closing ports 45 from high pressure chamber 11.

Under the above described operating conditions the effective pressure area on which the reduced pressure works to move the plunger against its spring is that of the bore 48 and this determines the high pressure operating range of the valve with any selected spring 43. Under these conditions the lower exhaust chamber 14 is in communication with chamber 13 so that any leakage downwardly from the plunger is carried away and does not build up a trapped pressure below the piston. If bore 18 is plugged and pin 50 removed, the working pressure liquid acts in the chamber 14 and on the total cross-sectional area of the plunger to oppose the spring. The spring therefore has a second or lower pressure range of say 100 to 300 p. s. i. The same spring with the pin in place will have a range of, say 200 to 1200 p. s. i.

If the control valve, not shown, is closed to shut off the flow of high pressure liquid to the

chamber 11 and then moved to its venting position to permit liquid from the reducing valve to return to the tank, then any mechanism of the cylinder and piston type connected to chamber 12 will begin to return its liquid to the pressure reducing valve. Initially, however, the ports 45 are closed and returning liquid lifts the check valve 33 since the pressure in 12 is now greater than in 11. As soon as the flow through the check valve reduces the pressure in 12 to less than that for which the spring is set plunger 40 moves downwardly, ports 45 cooperate with chamber 11, and liquid is returned in the manner in which it was delivered. It will be noted that the check valve can never open during operating conditions because the pressure on the outside of it is greater than on the inside.

Various uses for valves of the above type will suggest themselves, and one quite common use will be for the operation of two hydraulic hoists or rams where one requires a low working pressure which remains fairly constant and the other is capable of operating at the pressure of the source. The first of the hoists is connected through a pressure reducing valve of the type of the present invention, whereas the other is connected directly to the high pressure system. One single control valve, however, may serve to deliver and return liquid from both.

I claim:

1. In a combined pressure-reducing and relief valve the combination of a housing enclosing a bore adapted to serve as a valve seat, and also enclosing a vented chamber communicating with both ends of said bore, there being a high pressure supply connection and port leading to said bore near the first end thereof and a reduced pressure connection and port leading to said bore between the high pressure port and the second end of said bore, and there being at said second end a control edge for coaction with a valve to control discharge to said vented chamber; a valve piston reciprocable in said bore between limits and stop means to define said limits, said piston being closed at the end adjacent said second end of the seat and having an axial bore leading thence past said seat ports and open at the end of the piston which extends into said vented chamber beyond the first end of the seat, said piston having ports leading from said bore through the wall of the piston and adapted to coact with said seat ports, said piston having a first limiting position in which the piston bore is in free communication with both the high pressure supply port and the reduced pressure port and the control edge is blanked, a second and opposite limiting position in which the supply port in the seat is blanked and the piston bore is connected with the reduced pressure seat port and with the vented chamber past said control edge and intermediate positions in which the piston bore communicates solely with the reduced pressure ports; yielding means biasing the valve piston toward said first limiting position; and a plunger reciprocable through

the open end of the piston bore out of obstructing relation with the high pressure ports the bore of the piston serving as a cylinder for the plunger and the plunger reacting upon the housing in opposition to said bias with a force dependent on the fluid pressure in said bore.

2. In a combined pressure-reducing and relief valve the combination of a housing enclosing a bore adapted to serve as a valve seat, and also enclosing a vented chamber communicating with both ends of said bore, there being a high pressure supply connection and port leading to said bore near the first end thereof and a reduced pressure connection and port leading to said bore between the high pressure port and the second end of said bore, and there being at said second end a control edge for coaction with a valve to control discharge to said vented chamber; a valve piston reciprocable in said bore between limits and stop means to define said limits, said piston being closed at the end adjacent said second end of the seat and having an axial bore leading thence past said seat ports and open at the end of the piston which extends into said vented chamber beyond the first end of the seat, said piston having ports leading from said bore through the wall of the piston and adapted to coact with said seat ports, said piston having a first limiting position in which the piston bore is in free communication with both the high pressure supply port and the reduced pressure port and the control edge is blanked, a second and opposite limiting position in which the supply port in the seat is blanked and the piston bore is connected with the reduced pressure seat port and with the vented chamber past said control edge and intermediate positions in which the piston bore communicates solely with the reduced pressure ports; yielding means biasing the valve piston toward said first limiting position; a plunger reciprocable through the open end of the piston bore out of obstructing relation with the high pressure ports the bore of the piston serving as a cylinder for the plunger and the plunger reacting upon the housing in opposition to said bias with a force dependent on the fluid pressure in said bore; and means for permitting removal of said plunger and isolation of the first end of the valve seat bore from said vented chamber whereby the device may be conditioned to control at a lower pressure.

HUGH J. STACEY.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
776,839	Hoffman	Dec. 6, 1904
797,648	Waring	Aug. 22, 1905
1,725,539	Riley	Aug. 20, 1929
2,002,717	Robart	May 28, 1936
2,255,231	Slater	Sept. 9, 1941
2,500,627	Chinn	Mar. 14, 1950
2,563,192	Scruggs	Aug. 7, 1951