Feb. 9, 1932. H. E. McKINNEY 1,843,953

REDUCTION VALVE

Filed July 12, 1930

Fig. 1.

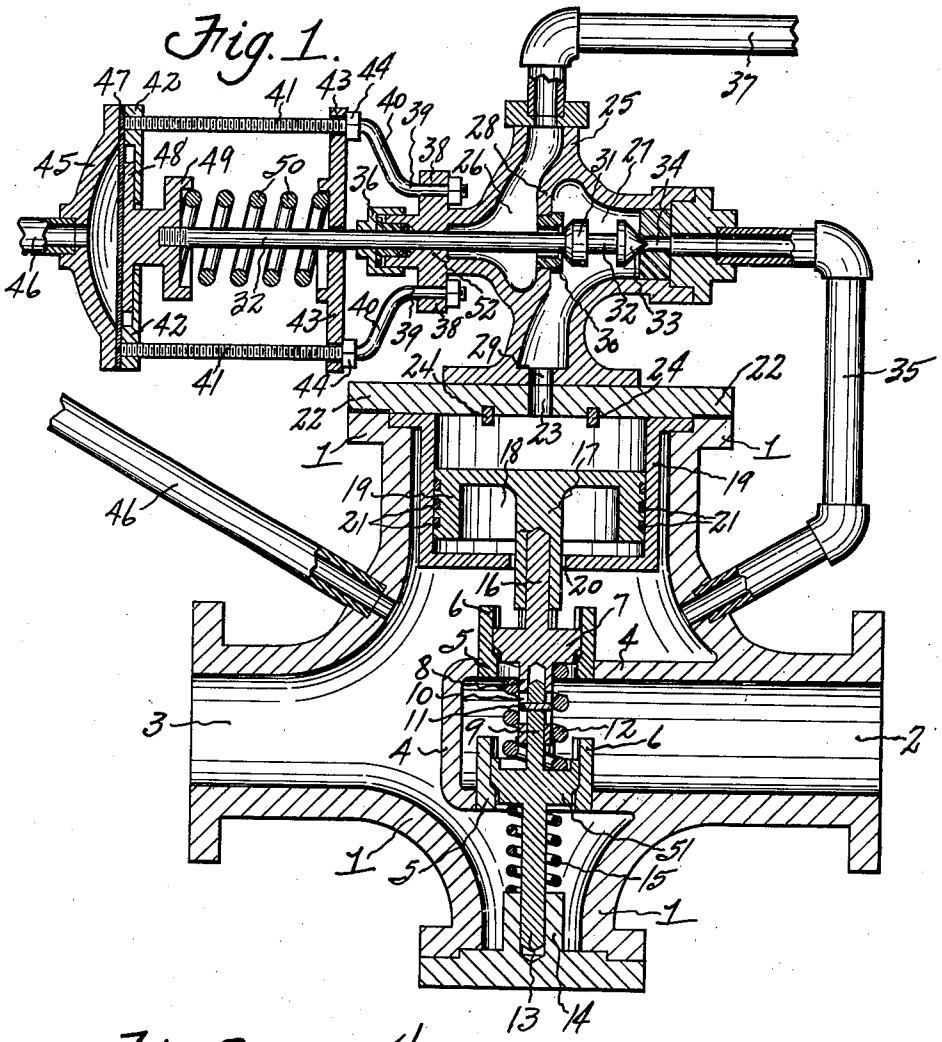
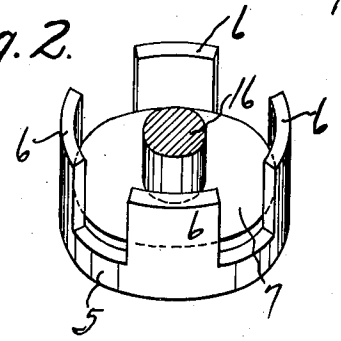


Fig. 2.



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REDUCTION VALVE

Application filed July 12, 1930. Serial No. 467,442.

The invention relates to valves, and particularly to reduction valves, and has for its object to provide a valve of this character constructed to exhaust fluid therefrom at a constant predetermined pressure which will not vary regardless of variations in the pressure supplied to said valve.

A further object is to provide a valve of this character having cooperating valve members adapted to seat on spaced valve seats and interconnected in a manner to permit limited movement of one relative to the other to obtain a control between the intake and outlet of said valve responsive to slight variations in the pressure supplied to the valve and to eliminate special machining and fitting of said valves on said seats.

A further object is to provide a valve of this character in which pressure balancing valve members and a diaphragm actuated member are mounted on the same shaft for positive inter-related movement whereby said valve members are instantly responsive to variations in the exhaust pressure of said valve.

With the above and other objects in view, the invention resides in the combination and arrangement of parts as hereinafter set forth, shown in the drawings, described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings:

Figure 1 is a vertical sectional view of the valve.

Figure 2 is a fragmentary perspective view of one of the valve seats and valve members.

Referring to the drawings, which illustrate the preferred embodiment of the invention, the numeral 1 designates a valve casing having an intake 2 and an outlet 3. The valve intake 2 comprises a cylinder 4 extending into the casing and having its inner end closed. At vertically aligned opposite points of the cylinder 4 and preferably in the center of casing 1 are mounted upper and lower valve seats 5 having spaced vertically projecting guide arms 6 at their upper sides, as shown in Figure 2, the inner sides of arms 6 being slightly off-set from the inner sides of the valve seats by a bevelled portion which forms an inclined seat for valves 7 and 51 mounted on the upper and lower valve seats, respectively. The upper valve 7 has integrally formed therewith and centrally depending therefrom an open ended cylindrical guide member 8 into which a centrally vertically extending stem 9 carried by the lower valve 51 is adapted to telescopically fit. Longitudinal registering slots 10 are formed in opposite sides of the cylindrical guide member 8 and are adapted to receive therein a cross pin 11 carried by stem 9 whereby stem 9 may have limited vertical movement relative to cylindrical guide 8. A spring 12 is coiled about guide 8 and stem 9 with its ends bearing on said upper and lower valve members to normally hold said valve members in extended or spaced relation. A stem 13 depends centrally from the lower valve 51 and is received in an aperture formed in a guide 14 carried by the lower end of the valve casing 1, said stem being movable relative to said guide. A coil spring 15 encircles stem 13 and extends between lower valve 51 and guide 14 and normally projects the lower valve upwardly, said spring 15 preferably being of about one-half the strength of spring 12. From the center of the upper side of the valve 7 projects a vertical stem 16 which is fixedly carried by a cylindrical depending member 17 carried by a piston 18 mounted for reciprocal vertical movement in a cylinder 19 carried by the upper end of casing 1. Cylinder 19 has a central opening 20 in its bottom to provide a passage for depending member 17 of the piston; and piston 18, which is of a substantially greater area than valves 7 and 51, is provided with suitable piston rings 21 to form an air-tight seal between said piston and cylinder. A cover plate 22 is mounted on the upper end of the casing 1 to form an air-tight closure for cylinder 19, said plate having a port 23 therein communicating with said cylinder. Studs 24 depend from cover plate 22 to limit the upward movement of piston 18 in said cylinder.

Centrally mounted on cover plate 22 is a control valve casing 25 having chambers 26 and 27 formed therein which are separated by a vertical wall 28. Chamber 27 has communication with the cylinder 19 through a port 29 in casing 25 which registers with port 23 in cover plate 22. Chambers 26 and 27 communicate with each other through an opening in wall 28 in which is mounted a valve seat 30 on which a valve 31 mounted on a horizontal rod 32 is adapted to seat. A valve 33 is mounted on rod 32 in spaced relation to valve 31 and is adapted to seat against and close an aperture 34 communicating with casing 1 by means of a conduit 35, said conduit connecting chamber 27 and casing 1. Rod 32 carrying the valves 31 and 33 disposed in chamber 27 extends horizontally through valve seat 30, chamber 26, and thence out of casing 25 through bearing 52, and a stuffing box 36 is carried by casing 25 to form an air-tight seal about rod 32 at bearing 52. Chamber 26 has connection through a conduit 37 with the supply line connected to intake 2 of the valve, said conduit being tapped to said supply line (not shown) at a point preferably 10 or 15 feet in advance of said valve.

Lugs 38 are carried by casing 25, and said lugs carry rods 39 having outwardly directed off-set portions 40, said rods terminating in threaded portions 41 extending parallel to rod 32 in equally spaced relation thereto. A plate 42 is fixedly carried by the outer end of rods 39, and loosely mounted on the threaded portion 41 of said rods between plate 42 and casing 25 is a plate 43 whose position relative to plate 42 is regulated by adjusting nuts 44, plate 43 having a central aperture therein through which rod 32 extends. At the outer side of plate 42 is secured a registering dome member 45 which has connection through a conduit 46 with the low pressure or outlet side of casing 1, and between dome member 45 and plate 42 is disposed a diaphragm 47. The outer face of plate 42 is recessed to receive flange 48 of a diaphragm actuated member 49 to which the outer end of rod 32 is secured, and between member 49 and plate 43 is disposed a coil spring 50 which encircles rod 32.

The operation of the valve is as follows: Spring 50 is compressed to the desired strength by shifting plate 43 on threaded rods 41 by means of adjusting nuts 44, the setting of said spring being made the same as the desired outlet pressure of said valve. The fluid is then passed through said valve from intake 2 through one or both valves 7 and 51, into casing 1, and out through outlet 3. The exhaust pressure in casing 1 acts on diaphragm 47 through conduit 46, and if said pressure is the same as that for which the spring 50 is set, said diaphragm and spring will be balanced in substantially the position illustrated, which will position rod 32 carrying valves 31 and 33 whereby said valves are both open, valve 33 being but slightly open and valve 31 being almost completely open. The open position of valve 31 permits passage of fluid from the supply line through conduit 37, chamber 26, valve seat 30, chamber 27, ports 29 and 23, into cylinder 19 where it acts upon piston 18. Piston 18, through its fixed connection with the upper valve 7 and the connection between the upper and lower valves 7 and 51, regulates the relative position of said valves in a manner to be more fully set forth. Thus when the position of valves 7 and 51 is such that the pressure passing through outlet 3 and conduit 46 is greater than that for which spring 50 is set, the pressure in dome 45 acting against diaphragm 47 will shift member 49 and rod 32 to the right against the action of spring 50 whereby valve 33 will be completely closed and valve 31 completely opened; the entire pressure of the supply line passing through conduit 37 will then pass through valve seat 30 into cylinder 19 and will depress piston 18 whereby valves 7 and 51 will be moved toward closed position by said piston to reduce the pressure of the fluid exhausted from the valve until said pressure is equal to the pressure for which spring 50 has been set. Should the pressure passing through outlet 3 and conduit 46 be less than the pressure for which spring 50 is set, the spring 50 will shift member 49 and rod 32 to the left against the pressure in dome 45 to move valve 31 toward closed position and to open valve 33; this permits reduction of pressure in cylinder 19 through chamber 27, aperture 34 and conduit 35 into valve casing 1, whereby the springs 12 and 15 controlling valves 7 and 51 may open said valves against the reduced pressure on piston 18 until the position of said valves permits an exhaust pressure in outlet 3 and conduit 46 sufficient to balance spring 50. The studs 24 prevent cylinder 18 from contacting the cover plate under the influence of springs 12 and 15, so that the full surface of said piston may always be acted upon by the pressure of the fluid entering the cylinder through port 23. Thus the valve adjusts itself to variations in the supplied pressure, the change of position of valve members 7 and 51 as so controlled and actuated being substantially instantaneous upon variation of the pressure of the exhaust therefrom.

The operation of the valve members 7 and 51 is as follows: Release of pressure on piston 18 permits spring 12 to move the upper valve 7 upwardly toward open position against the pressure applied thereto by said piston. The lower valve 51 is held in closed position during the opening of valve 7 by spring 12, which is preferably of about twice the strength of spring 15; and the pin and

slot connection 10, 11 between the telescoping members 8, 9 carried by said valves permits limited movement of the upper valve relative to the lower valve. Upon continued upward movement of the upper valve 7 the cross pin 11 carried by the stem 9 of the lower valve 51 engages the bottom of slot 10 to limit the relative movement of valves 7 and 51 so that the spring 12 can no longer hold the valve 51 closed; and from that point the spring 15 will raise both valves against the pressure applied to piston 18. The above-described mode of operation is reversed when pressure on the piston 18 is increased; that is, the piston depresses both valves against the action of springs 12 and 15, valve 51 being first closed against the action of spring 15 and valve 7 then being closed against the action of spring 12. This valve arrangement permits of a sensitive valve control responsive to slight variations of pressure on piston 18, and it will be obvious that if spring 15 is of but one-half the strength of spring 12, both valve members 7 and 51 will be raised thereby only one-half as fast against the pressure applied to the piston as when valve member 7 alone is actuated by spring 12. The pin and slot connection between the stems of valve members 7 and 51 is such that pin 11 will not normally contact the top of slot 10 when said valves are both closed, whereby said valves may both be operatively seated on their valve seats without close machining and special fitting of each individual valve member to its seat, thereby permitting replacement of this valve assembly with a standard assembly which is not possible where such spaced cooperating valves are fixedly connected.

With a valve of the construction described, many advantages over conventional valves of this type are obtained. Thus the direct connection of the pressure balancing valves 31 and 33 with the diaphragm actuated member 49 makes said valves instantaneously responsive to changes in the pressure exhausted from the valve members 7 and 51 whereby valves 31 and 33 may immediately shift to alter the amount of pressure applied to piston 18 so that valves 7 and 51 may immediately change their position to lessen or increase the pressure passing therethrough. The valves 7 and 51, in combination with the springs 12 and 15, are sensitive and highly responsive to changes in the pressure applied to piston 18, and with the particular construction of valve seats 6 are capable of slight adjustment to accommodate small variations in pressure; the valves 7 and 51 when both fully opened permitting the entire pressure in the supply line to pass therethrough, as where the supplied pressure is only equal to or is less than the desired exhaust pressure. By reversal of the valve seats 6 and valves 7 and 51, together with reversal of conduits 35 and 37 whereby conduit 35 extends between casing 1 and chamber 26 and conduit 37 extends between the supply line and aperture 34, the valve may be made "spring closing" instead of "spring opening" which may be of advantage in connection with some of the uses to which the valve may be put.

The invention having been set forth, what is claimed as new and useful is:

1. In a valve having an intake and outlet, spaced valve seats each interposed between said intake and outlet, valve members cooperating with said valve seats, a cylindrical member carried by one valve member and extending in the direction of the other valve member, a stem carried by the second valve member and adapted to be slidably received in said cylindrical member, a cross pin carrier by said stem, said cylindrical member having a longitudinal slot formed therein to receive said cross pin, a coil spring encircling said cylindrical member and stem and bearing against said valve members, and a spring of less strength than said first named spring bearing upon said second valve member and adapted to open said second valve after said first valve has been opened by said first named spring.

2. In a valve having an intake and outlet, spaced valve seats each interposed between said intake and outlet, valve members cooperating with said valve seats, cooperating members carried by said valve members, a pin and slot connection between said cooperating members, a spring bearing against said valve members to unseat one of said valve members, and a spring of less strength than said first spring bearing against and adapted to unseat the other valve member after the first spring has unseated the first valve member.

3. In a valve having an intake and outlet, spaced valve seats each interposed between said intake and outlet, valve members cooperating with said valve seats, means permitting limited relative movement of said valve members, a spring bearing against said valve members tending to unseat one of said valve members, and a spring adapted to unseat the other valve member upon completion of the relative movement of said valve members.

4. In a valve having an intake and outlet, pressure influenced means, a valve carried by said pressure influenced means, a second valve spaced from said first valve, said valves each being inserted between said intake and outlet means connecting said valves to permit limited relative movement thereof, a spring engaging said valves and adapted to unseat said first valve in opposition to said pressure influenced means, and a second spring of less strength than said first spring adapted to unseat said second valve in opposition to said pressure influenced means upon completion of the movement of the first valve rela-

tive to the second valve, said valves communicating with said intake and outlet.

5. In a valve having an intake and outlet, spaced valve members each interposed between said intake and outlet, pressure influenced means, means governed by the pressure in said outlet and controlling the pressure applied to said pressure influenced means, means connecting said valve members to permit limited relative movement thereof, a spring bearing against said valve members adapted to unseat one of said valve members against the action of the pressure influenced means, and a second spring of less strength than said first spring adapted to unseat the second valve member against the action of the pressure influenced means upon completion of the movement of said first valve member relative to the second valve member.

6. In a valve having an intake and outlet, spaced valve members each interposed between said intake and outlet, pressure influenced means, means governed by the pressure in said outlet and controlling the pressure applied to said pressure influenced means, means connecting said valve members to permit limited relative movement thereof, means for unseating one of said valve members against the action of said pressure influenced means, and means for unseating the second valve member against the action of said pressure influenced means upon completion of the movement of the first valve member relative to the second valve member.

In testimony whereof I affix my signature.

HARRY E. McKINNEY.