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OIL BURNER BY-PASS VALVE

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2 Sheets-Sheet 2

FIG 3.

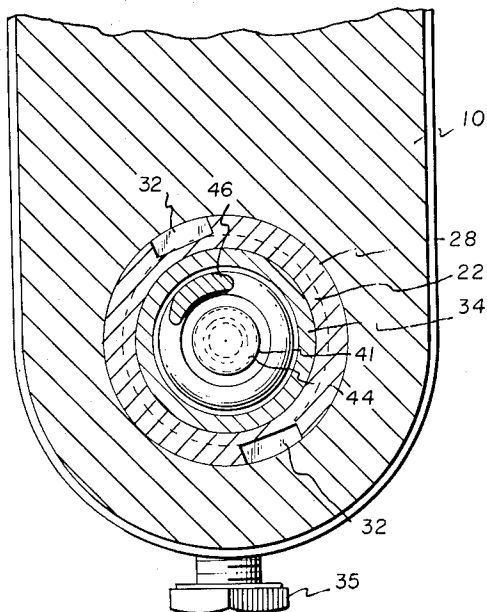
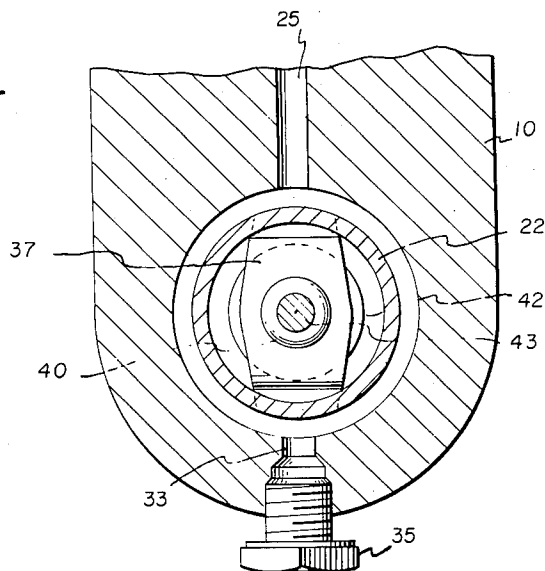


FIG 4.



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1

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OIL BURNER BY-PASS VALVE

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14 Claims. (Cl. 137—116)

My invention relates to valves and more particularly to a by-pass valve. My valve has particular utility in connection with oil burner installations, but is not necessarily restricted to such use.

It is frequently the practice, in connection with oil burner installations, to provide a by-pass valve means between the oil burner pumping unit and the oil burner. This permits by-passing of the oil either back to the source of supply or back to the pump in the event that the discharge pressure from the pump exceeds a predetermined value due to an obstruction in the discharge pipe or nozzle, or for any other reason.

One of the operating problems which is frequently encountered with by-pass valves presently available is the fact that oil leakage occurs through the by-pass valves under normal operating pressure conditions, when by-passing of the oil is not necessary, causing a loss of pressure at the oil burner nozzle. The resulting loss of pressure adversely affects the operation of the oil burner, frequently resulting in a smoky fire due to improper atomization of the oil. This leakage, which is characteristic of many presently available by-pass arrangements, is largely due to the principle of operation of such by-pass valves in which ports in a movable piston are brought into registry with stationary by-pass ports upon the occurrence of a predetermined pressure. Frequently, only a very short axial distance, as little as $\frac{1}{16}$ inch, separates the ports of the piston from the stationary by-pass ports. Consequently, if either the outer surface of the movable piston or the stationary wall surface which it engages become worn in the relatively short distance between the movable and stationary ports, leakage occurs through the by-pass valve. As a result, it is frequently necessary to replace the movable piston members or sleeves of such by-pass valves after a relatively short period of time. It has also been my experience that it is difficult to make field repairs on leaky valves of this type, thereby necessitating undesirable shut-down of the oil burner while repairs are made in the shop.

It is also frequently the practice to incorporate in the same valve structure a cut-off valve means for controlling the normal flow of liquid to the oil burner nozzle, as well as a by-pass valve means for controlling the by-pass of high pressure oil. A difficulty which is frequently encountered in such valve structures is that, upon drop in pressure, the cut-off action is not sufficiently rapid, with the result that "after fire" of the burner occurs, causing a smoky fire.

Accordingly, it is an object of this invention to provide a by-pass valve which is relatively leak-proof under normal operating conditions.

It is another object of this invention to provide a by-pass valve arrangement which has a substantially greater life expectancy than by-pass valves presently available.

Still another object of this invention is to provide a valve structure having both a by-pass valve action and a cut-off valve action and in which the cut-off action is rapid upon oil pressure drop, so as to minimize "after fire" at the oil burner.

In accordance with these objectives, I provide a hollow cup-like piston member slidably movable along the interior of a fixed cylindrical sleeve member, the piston member having an operating end which is acted upon by the oil under pressure. The operating end of the piston

2

member is provided with an aperture in which a spring biased valve member is normally seated, the valve being normally movable with the piston. The outer end of the valve member carries a detent means which is movable into engagement with a stationary abutment, which may be the end of the sleeve, after a predetermined axial movement of the piston has occurred under the influence of the oil pressure. Engagement of the detent means with the abutment prevents further movement of the valve with the piston, with the result that the valve becomes unseated and permits passage of by-pass oil through the aperture in the operating face of the piston. The by-pass oil passes into the hollow interior of the piston, which is in communication with a by-pass conduit means.

The features of this invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and use, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a view in longitudinal section through a by-pass valve in accordance with my invention, showing the valve in a position corresponding to a shut-down condition of the oil burner;

Fig. 2 is a view partially in longitudinal section similar to Fig. 1, showing the position of the valve upon the occurrence of an excessive pressure condition;

Fig. 3 is a view in section along line 3—3 of Fig. 1; and

Fig. 4 is a view in section along line 4—4 of Fig. 2.

Referring now to the drawings, the by-pass valve is housed in a casing 10 having a bore 12 extending there-through. A bushing or cap 14 is screw threaded into one end of the bore 12, the bushing 14 being provided with an axial passage 16 which communicates with the nozzle of the oil burner. A valve seat member 18, having an axial orifice 20, is positioned in the inner end of passage 16.

A stationary sleeve member 22 is pressed into the intermediate portion of the bore 12. Sleeve 22 is spaced axially from the inner end of cap or bushing member 14 so as to form, between the adjacent ends of the sleeve 22 and the bushing 14, a valve chamber 24. An inlet duct 25 provides communication between the pumping means and the valve chamber 24. The sleeve member 22 is spaced radially from the surface of the bore for a substantial portion of its length to provide an annular chamber 26 between the outer surface of sleeve 22 and the inner surface of the bore 12. A by-pass outlet duct 27 is connected to the annular chamber 26 and serves to carry the by-passed oil either back to the oil supply or to the inlet end of the pump, depending on where it is desired to conduct the by-passed oil.

Sleeve 22 is provided with an annular shoulder 28 at its end adjacent the valve chamber 24, shoulder 28 having an outer diameter substantially equal to the diameter of the bore 12 to prevent the flow of liquid from the valve chamber 24 to the annular chamber 26 along the exterior surface of the sleeve member. Sleeve member 22 is also provided with another annular shoulder 30 at its left-hand end, with respect to the view shown in the drawings, annular shoulder 30 having a diameter substantially equal to the inner diameter of the bore but being provided with a pair of diametrically-opposed axially extending slots 32 to permit passage of oil from the left-hand end of sleeve 22 to the annular chamber 26, as will be described hereinafter. A duct 33 extends between the exterior of the casing 10 and the valve chamber 24 and may serve to communicate the pressure of the valve chamber to a suitable pressure gauge. The duct may be plugged by a screw threaded member 35.

A hollow piston member 34 is axially movable along

3

the hollow interior of sleeve 22. The piston member 34 is provided at its end adjacent the valve chamber 24 with an operating end 36. In accordance with my invention, the operating end 36 is provided with a beveled opening 38 to provide a by-pass port which communicates between the exterior surface of operating end 36 and the hollow interior of the piston member. A valve 40 is adapted to seat in the beveled aperture 38, which serves as a valve seat, the stem 43 of the valve extending into the hollow interior of the piston. The innermost end of the valve stem carries a flange-like head member 41.

As an important feature of my invention, I provide a detent member 37 which is carried on the outer end of the by-pass valve member 40 adjacent the outer surface of the operating end 36 of the piston 34. As will best be seen in Fig. 4, detent member 37 may be in the form of a collar member having a pair of diametrically opposed ears which project radially beyond the outer periphery of the piston member. Detent member 37 acts to unseat by-pass valve 40 upon a predetermined axial movement of piston 34 under the influence of high oil pressure.

Movement of piston 34 serves to control flow of oil to the burner nozzle through orifice 20, as well as to control by-passing of oil under excessive pressure. To provide this cut-off function at orifice 20, the outer end of the valve member 40 carries axially outwardly of the detent member 37 a disk member 42 which is adapted to seat on the valve seat 18 to serve as a cut-off valve for the oil supply to the burner nozzle. Disk member 42 may be made of a synthetic rubber, such as neoprene, for example.

A spring member 44 surrounds the valve stem 43, being seated at one end on the inner face of base member 41, and at the other end on the inner face of the operating end 36 of piston 34. Spring 44 serves to normally bias the valve 40 so that it is seated in the valve seat 38.

A cap or bushing member 45 is in threaded engagement with the opposite end of bore 12, this being the left-hand end with respect to the view shown in the drawings. A spiral spring 46 engages the inner surface of operating end 36 of the piston 34, the opposite end of spring 46 being seated on a cup-shaped bearing member 48 carried by an adjusting screw 50 which passes through the bushing member 45. Spring 46 biases piston member 34, together with valve 40 and disk 42, to the right so that in the absence of oil pressure against the operating end 36, the piston will assume the position shown in Fig. 1 in which orifice 20 is closed by disk 42. A removable closure member 52 is in threaded engagement with the outer end of bushing 45 and may be removed to permit adjustment of the screw member 50 to calibrate the spring 46 to a desired value.

The relative lengths of the piston 34, sleeve 22, bushing 45, and bore 12 are so adjusted that oil by-passed into the interior of piston 34 through by-pass port 38 will always find a free flow path around the end of the piston to the axial slots 32 in sleeve 22.

When the oil burner is not in operation, and there is no pump pressure through duct 25 to valve chamber 24, the spring 46 pushes the piston member 34, including the by-pass valve 40 and the disk member 42, axially to the right, with respect to the view shown in the drawings, so that disk member 42 is seated on the valve seat 18 and closes the orifice 20. In this position, the oil supply to the oil burner nozzle is cut off.

When the oil burner is energized and the oil supply through duct 25 to valve chamber 24 reaches a predetermined desired operating value, the oil pressure on the face of the operating end 36 of the piston causes the piston to move axially to the left, with respect to the view shown in the drawings, thereby unseating the disk 42 from the valve seat 18 and permitting a normal flow of oil through orifice 20 and duct 16 to the oil burner nozzle. Under the normal operating conditions at the desired oil pressure, the by-pass valve 40 remains seated in the by-pass

4

aperture 38 due to the biasing action of spring 44. However, if the oil pressure in valve chamber 24 exceeds a predetermined desired value, the piston 34 is moved axially to the left, as shown in Fig. 2, a distance sufficient to cause the detent member 37 to abut against the end edge of stationary sleeve member 22. When this occurs, further motion of by-pass valve 40 to the left is prevented and any further motion of piston member 34 in that direction occurs without a corresponding motion of valve member 40. Valve 40 therefore becomes unseated with respect to the by-pass aperture or valve seat 38, permitting a flow of the high-pressure liquid through the by-pass aperture 38 to the interior of the hollow piston 34. The liquid which flows into the hollow interior of piston 34 then flows longitudinally of the piston interior to the end thereof, around the end of the sleeve 22, and through the slots 32 of annular shoulder 30 into the annular chamber 26 from whence it passes to the by-pass duct 27.

The construction described hereinbefore has the advantage that a long path is provided from the valve chamber 24 to the by-pass outlet chamber 26 along the wear surfaces between the movable piston 34 and the stationary sleeve 22. Hence, before any leakage can occur, there must be wear along substantially the entire length of the piston member. In contrast to this, the leakage path offered in most presently available by-pass valve arrangements, as previously explained, is much shorter, being sometimes of the order of magnitude of one-sixteenth inch. The practical experience which I have had with the by-pass valve arrangement hereinbefore described shows that my valve arrangement has a life expectancy at least three times that of by-pass valves having a short leakage path.

A further advantage of the by-pass valve hereinbefore described is the fact that the axially-extending by-pass aperture 38 in the operating end 36 of the piston member can be made much larger than by-pass orifices of the type generally used in by-pass valves, with the result that there is less danger of clogging of the by-pass outlet by foreign matter and grit than in the case of the by-pass orifices generally used.

The valve arrangement hereinbefore described also has the advantage that when the oil pressure in the inlet duct 25 and valve chamber 24 decreases, as happens at the time of shut-down of the oil burner, the piston 34 is moved rapidly to the right, with respect to the view shown in the drawings, to cut off further flow of oil to the oil burner nozzle. Disk 42, which serves as a cut-off valve, is rapidly seated on the valve seat 18 and shuts off further flow of oil through the orifice 20 and duct 16 to the nozzle of the oil burner. This fast shut-off prevents "after fire" and reduces smoking and carbon in the furnace.

The by-pass valve arrangement hereinbefore described also may be very easily serviced and frequently the movable piston member and by-pass valve of my invention may be substituted into existing pressure deficient pumps. Unlike many available by-pass valve arrangements, servicing of the by-pass valve of my invention may be completed at the location of the oil burner, without the necessity for making shop repairs which sometimes necessitate prolonged shut-down of the burner.

While there has been shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications can be made therein without departing from the invention and, therefore, it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A valve means comprising an elongated sleeve, an elongated cup-shaped hollow piston located within and movable axially with respect to said sleeve, said piston having an operating end located adjacent one end of said sleeve, said operating end having an opening extending therethrough a valve normally seated in and blocking said

5

opening, a valve stem extending from said valve into the interior of said piston, a spring surrounding said stem, said spring being under compression and engaging said stem and said piston to bias said valve into seated position in said opening, and means effective after a predetermined movement of said piston relative to said sleeve to unseat said valve and unblock the opening in said operating end.

2. A valve means comprising an elongated sleeve, an elongated cup-shaped hollow piston located within and movable axially with respect to said sleeve, said piston having an operating end located adjacent one end of said sleeve, said operating end having an opening extending therethrough, a valve normally seated in and blocking said opening, a valve stem carried by said valve and extending through said opening, spring means disposed within the interior of said piston and engaging said valve stem and said piston to bias said valve toward seated position, a collar carried by said valve externally of said operating end, said collar extending radially beyond said piston, said collar engaging said sleeve upon a predetermined axial movement of said piston to thereby unseat said valve from said opening.

3. A valve means comprising an axially movable piston member, said piston member having an operating end face and a surface opposite said operating end face, a fluid port extending axially through said operating end face and into communication with said opposite surface, a valve means normally closing said port, a valve stem carried by said valve and extending through said port, spring means disposed on the same side of said piston as said opposite surface and engaging said valve stem and said opposite surface to bias said valve to closed position in said port, a detent means carried by said valve means adjacent the operating end of said piston, and means engageable with said detent means upon a predetermined axial movement of said piston to unseat said valve means from said port.

4. A valve means comprising an axially movable piston member, said piston member having an operating end face and a surface disposed opposite said operating end face, a fluid port extending axially through said operating end face and into communication with said opposite surface, a valve means carried by said piston and normally closing said port, a valve stem carried by said valve and extending through said port, and spring means disposed on the same side of said piston member as said opposite surface, said spring means being engageable with said valve stem and said opposite surface to bias said valve toward closed position in said port, a collar surrounding said valve externally of said operating end, said collar extending radially beyond said piston, and stationary abutment means engageable with said collar upon a predetermined axial movement of said piston to unseat said valve from said port.

5. A valve means comprising an axially movable piston member, said piston member having an operating end, fluid inlet means in communication with said operating end, a by-pass port extending axially through said operating end, said by-pass port communicating with the interior of said piston, a by-pass valve means normally closing said by-pass port, spring means engaging said by-pass valve means and said piston member to bias said by-pass valve means toward closed position in said port and means operable upon a predetermined movement of said piston whereby said by-pass valve means is unseated from said by-pass port to permit passage of fluid to the interior of said piston, and means communicating with the interior of said piston for conducting fluid away from said valve.

6. A valve means comprising an axially movable piston member, said piston member having an operating end face and a hollow interior, fluid inlet means in communication with said operating end, by-pass outlet means in communication with said hollow interior, a by-pass port extending axially through said operating end com-

6

municating with said hollow interior, a by-pass valve means normally closing said by-pass port, a valve stem carried by said by-pass valve and extending through said port, spring means facing a surface of said piston opposite said operating end face, said spring means engaging said valve stem and said surface opposite said end face to bias said by-pass valve toward closed position in said port, and means operable upon a predetermined movement of said piston whereby said by-pass valve means is unseated from said by-pass port to permit passage of fluid to the hollow interior of said piston and thence to said by-pass outlet means.

7. A valve means comprising an axially movable piston member, said piston member having an operating end and a hollow interior, fluid inlet means in communication with said operating end, by-pass fluid outlet means in communication with said hollow interior, a by-pass port extending axially through the operating end of said piston and into communication with the interior of said piston, a valve means carried by said piston and normally seated in said by-pass port, a valve stem carried by said valve and extending through said port, spring means disposed within the interior of said piston and engaging said valve stem and said piston to bias said valve toward closed position in said port, a detent means carried by said valve means adjacent the outer face of said operating end of said piston, and an abutment means engageable with said detent means upon a predetermined movement of said piston means whereby said valve means is unseated from said by-pass port to permit passage of fluid to the hollow interior of said piston means and thence to said by-pass fluid outlet means.

8. A valve means comprising a casing, a bore in said casing, a fluid inlet passage communicating with one end of said bore, a piston member axially slidable in said bore, said piston member having an operating end face disposed toward said fluid inlet passage, a by-pass port extending axially through said operating end face of said piston, a by-pass valve member normally seated in said by-pass port, said by-pass valve member being normally movable with said piston, spring means facing a surface of said piston opposite said operating end face, said spring means engaging said by-pass valve and said opposite surface to bias said by-pass valve toward closed position in said port, and means acting upon said by-pass valve member upon a predetermined movement of said piston to unseat said by-pass valve member from said by-pass port, whereby fluid passes through said port to the interior of said piston and means in communication with the interior of said piston for conducting fluid passing to the interior of said piston away from said valve.

9. A valve means comprising a casing, a bore in said casing, a fluid inlet passage communicating with one end of said bore, a by-pass fluid outlet passage communicating with the opposite end of said bore, a piston member axially slidable in said bore, said piston member having an operating end face disposed toward said fluid inlet passage and a hollow interior communicating with said by-pass outlet passage, a by-pass port extending axially through said working end of said piston, a by-pass valve member normally seated in said by-pass port, said by-pass valve member being normally movable with said piston, a valve stem carried by said valve and extending through said port into the interior of said piston, spring means facing a surface of said piston opposite said operating end face, said spring means engaging said valve stem to bias said by-pass valve toward closed position in said port and means acting upon said by-pass valve member upon a predetermined movement of said piston to unseat said by-pass valve member from said by-pass port, whereby fluid passes through said port to the hollow interior of said piston and thence to said by-pass fluid outlet passage.

10. A valve means comprising a casing, a bore in said

casing, a fluid inlet passage communicating with said bore, a sleeve member positioned in said bore, said sleeve member being spaced radially from the surface of said bore for at least a portion of its length to define an annular chamber between said portion of said sleeve and said bore, a shoulder means on the exterior surface of said sleeve adjacent said portion, said shoulder means having an outer diameter substantially equal to the diameter of said bore, a piston member movable in said sleeve member, said piston member having an operating end face disposed at the axial end of said piston nearest said fluid inlet passage, spring means for resisting movement of said piston due to fluid pressure at said fluid inlet passage, a by-pass port extending axially through said working end, a by-pass valve means normally seated in said port, a valve stem carried by said by-pass valve means and extending through said port and beyond a surface of said piston member opposite said operating end face, a spring means engaging said valve stem and said piston, a detent means carried by said by-pass valve means, and means engageable with said detent means to arrest movement of said by-pass valve upon a predetermined axial movement of said piston whereby said by-pass valve is unseated from said port, and by-pass outlet means in communication with the interior of said piston whereby fluid passing through said by-pass port is conducted away from said valve means.

11. A valve mechanism comprising a casing, a bore in said casing, a fixed sleeve member in said bore, said sleeve member being radially displaced for a portion of its length from the surface of said bore, means positioned between said bore and said sleeve preventing fluid communication between the ends of said bore along the outer surface of said sleeve, a fluid inlet communicating with said bore on one side of said means, a by-pass outlet communicating with said bore on the other side of said means, a piston member movable in said sleeve, said piston member having an operating end face disposed toward the fluid inlet end of said bore and a hollow interior communicating with said by-pass outlet, a by-pass port in said operating end face of said piston, a valve means carried by said piston and normally seated in said by-pass port, spring means engaging said valve means and said piston member to bias said valve means to seated position in said port a detent means carried by said valve means adjacent the outer face of said working end, said detent means being engageable with the end of said sleeve upon a predetermined movement of said piston whereby said by-pass valve is unseated from said by-pass port to permit passage of fluid to the hollow interior of said piston and thence to said by-pass outlet.

12. A valve means comprising a casing, a bore in said casing, a fixed sleeve member in said bore, said sleeve member being spaced radially from the interior surface of said bore for a portion of its length, means interposed between the interior surface of said bore and said sleeve to prevent fluid communication between the ends of said bore along the exterior surface of said sleeve, a fluid inlet communicating with an end of said bore on one side of said means, a fluid by-pass outlet communicating with an end of said bore on the other side of said means, a piston member axially movable in said sleeve, said piston member having an operating end face disposed adjacent the fluid inlet end of said bore and a hollow interior communicating with said by-pass outlet, a fluid by-pass port in the operating end face of said piston, a by-pass valve means seatable in said by-pass port, spring means engaging said by-pass valve means and said piston member to bias said by-pass valve means to seated position in said port a detent means carried by the outer end of said by-pass valve means adjacent the operating end of said piston, a spring means for normally maintaining said by-pass valve means seated on said by-pass port, spring means engaging said piston

to normally bias said piston toward the fluid inlet end of said bore, said detent means being engageable with an end of said sleeve upon a predetermined movement of said piston whereby said by-pass valve is unseated from said by-pass port to permit fluid flow into the interior of said piston means and thence to said by-pass outlet means.

13. A valve means comprising a casing, a bore in said casing, a fluid inlet passage communicating with one end of said bore, a fluid outlet passage communicating with said one end of said bore, a piston member axially slidable in said bore, said piston member having an operating end face disposed toward said one end of said bore and a hollow interior disposed toward the opposite end of said bore, a port extending axially through said operating end face, a valve stem extending through said port into the hollow interior of said piston, a first valve carried by the outer end of said valve stem and engageable with said fluid outlet passage to control passage of fluid through said passage, first spring means to bias said piston toward said one end of said bore, a second valve carried by said valve stem and engageable with said port, second spring means to normally retain said second valve seated on said port, said second spring means being disposed between said valve stem and said piston member to bias said second valve to closed position in said port, means operable upon a predetermined movement of said piston whereby said second valve is unseated from said port to permit passage of fluid into the hollow interior of said piston, and a by-pass outlet means communicating with said hollow interior whereby fluid entering said hollow interior is conducted away from said valve means.

14. A valve means comprising a casing, a bore in said casing, closure means at each end of said bore, an outlet orifice through one of said closure means, a fluid inlet means communicating with the end of said bore adjacent said outlet orifice, a by-pass outlet communicating with the opposite end of said bore, a fixed sleeve member in said bore, said sleeve member being spaced at each of its ends from said respective closure means, said sleeve being spaced radially from the interior surface of said bore, means interposed between said sleeve and said bore to prevent fluid communication between the ends of said bore along the outer surface of said sleeve, a piston slidably movable axially inside said sleeve, said piston having an operating end face disposed toward the fluid inlet end of said bore, said piston having a hollow interior in communication with the by-pass outlet end of said bore, the operating end of said piston having a by-pass port extending axially therethrough, a valve stem axially movable through said by-pass port, said valve stem carrying a by-pass valve member normally seatable on said by-pass port, the outer end of said valve stem adjacent the outer face of said operating end of said piston carrying a second valve member engageable with said outlet orifice, first spring means disposed between said by-pass valve and said piston and normally biasing said by-pass valve into seated engagement with said by-pass port, second spring means normally biasing said piston member in a direction to engage said second valve member with said outlet orifice, a detent means carried by the outer end of said valve stem, said detent means being engageable with an abutment means upon a predetermined movement of said piston whereby said by-pass valve is unseated from said by-pass port to permit fluid flow into the hollow interior of said piston and thence to said by-pass outlet.

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