March 27, 1962 J. W. BLAIR 3,026,908

THREE-POSITION VALVE

Filed July 9, 1958 2 Sheets-Sheet 1

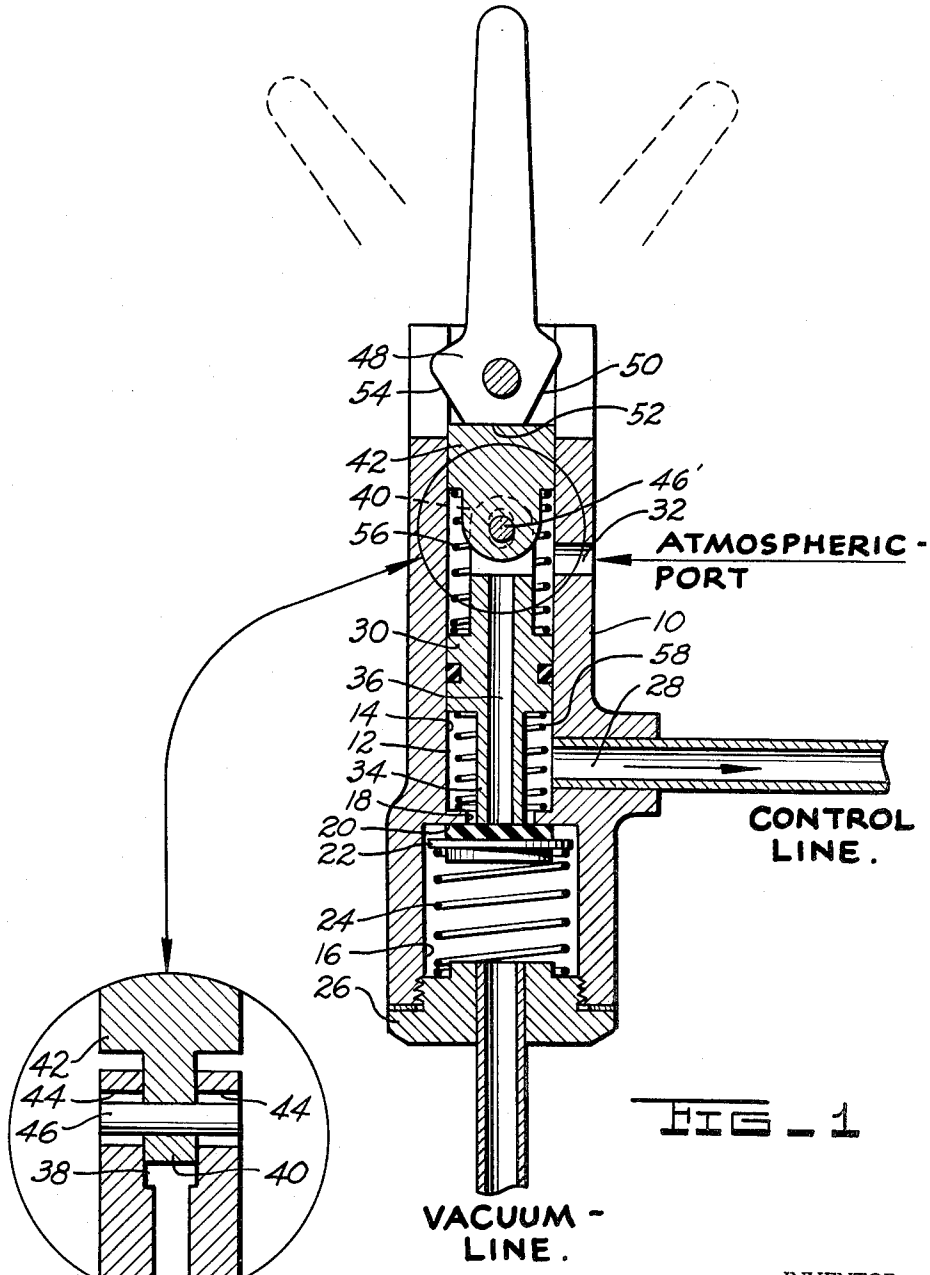

FIG_1

FIG_2

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THREE-POSITION VALVE

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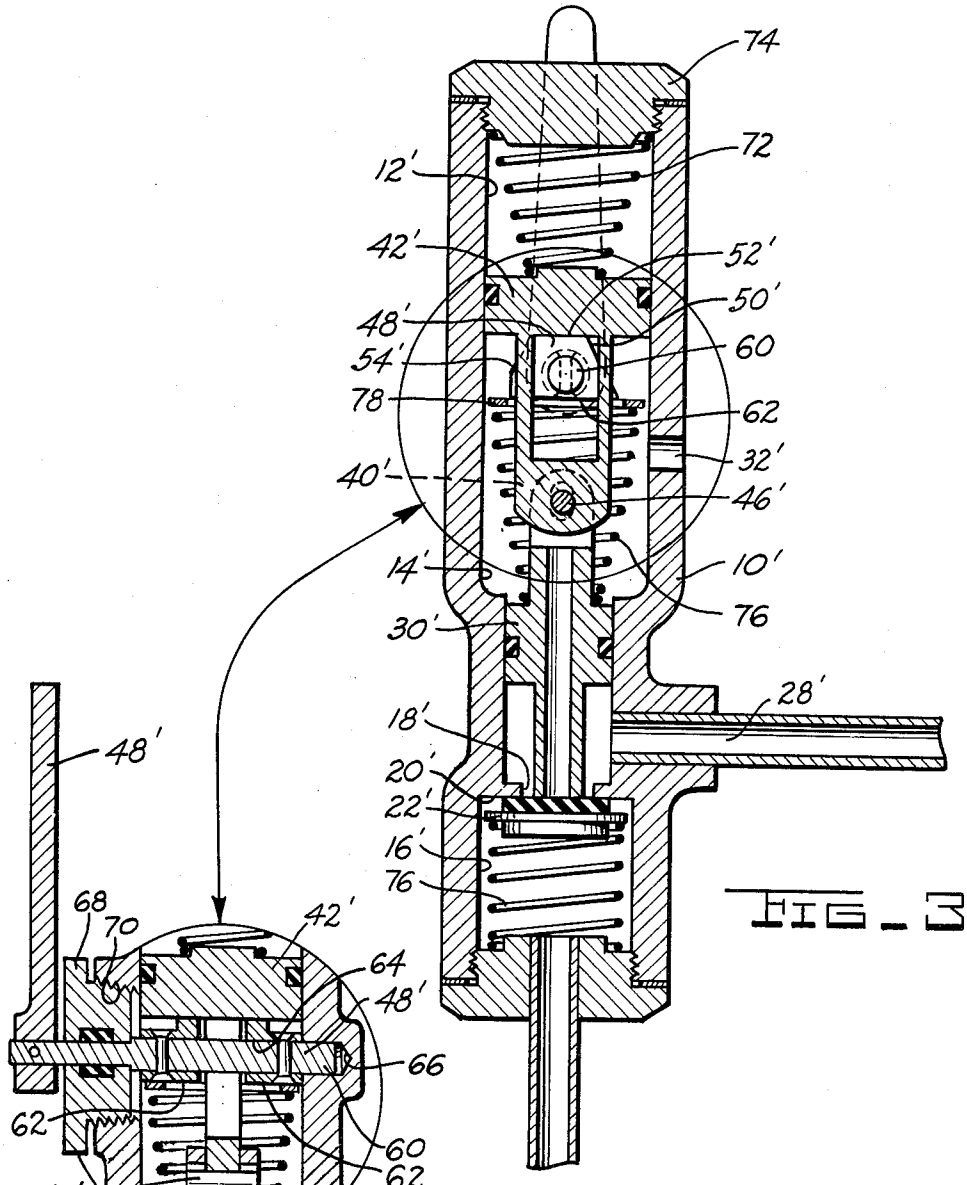

FIG. 3

FIG. 4

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THREE-POSITION VALVE

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5 Claims. (Cl. 137—627.5)

The present invention relates, as indicated, to three-position valves; and more particularly to a simplified form of valve construction wherein a first pressure port is communicated to its control port in one position of its operating handle, a second pressure port is communicated to the control port in a second position of its operating handle, and wherein both first and second ports are isolated from the control port in a third position of its operating handle.

An object of the present invention is the provision of a new and improved valve construction of the above described type which is simple in design, rugged in construction, and inexpensive to manufacture.

Another object of the invention is the provision of a new and improved valve construction of the type having a single poppet member for controlling communication between one of its pressure ports and its control port, and a tubular member having a tubular flow conducting projection for projecting through the control chamber into engagement with the poppet member for conducting the second source of pressure to the control chamber and which is valved off when the tubular projection abuts the poppet member, a cam follower connected to the tubular member through a connection having predetermined lost motion, and a cam member having three surfaces each of which corresponds with a position of the valve and the intermediate surface of which centers the lost motion connection while the tubular member is in abutment with the poppet member, and a spring which biases the tubular member into engagement with the poppet member with a generally predetermined force when the cam member holds the lost motion connection in its centered position.

The invention resides in certain constructions and combinations and arrangements of parts, and further objects and advantages of the invention will become apparent to those skilled in the art to which the invention relates from the following description of the preferred embodiments described with reference to the accompanying drawings forming a part of this specification, and in which:

FIGURE 1 is a longitudinal cross sectional view of one embodiment of the invention;

FIGURE 2 is an enlarged fragmentary cross sectional view of a portion of the valve structure shown in FIGURE 1;

FIGURE 3 is a longitudinal cross sectional view of a second embodiment of the invention; and

FIGURE 4 is an enlarged fragmentary cross sectional view of a portion of the valve structure shown in FIGURE 3.

The valve construction of the present invention will have utility in any non-modulating valve service wherein either one of two pressure sources are to be communicated individually to an outlet or control port, and wherein there must also be provided a shut-off position wherein both of the pressure sources must be valved off from the outlet or control port. As an indication of one application in which the valve will have definite advantages, reference may be had to my copending application Serial No. 706,456, filed December 31, 1957, now abandoned. Referring now to the drawings, the valve shown in FIGURE 1 generally comprises a body member 10 having an axially extending chamber 14 therein of a predetermined

diameter 12 in its upper end, and a larger diameter portion 16 adjacent its lower end, which chambers are connected by a small diameter passage or port 18 to form a shoulder or valve seat 20 in the chamber 16. A valve closure or poppet member 22 is provided in the lower chamber 16 and is biased into engagement with the seat 20 by a relatively stiff coil spring 24 that is positioned between the poppet member 22 and a pipe adapter 26 screwed into the bottom end of the lower chamber 16. A control port 28 communicates with the longitudinally extending chamber 14 immediately above the valve seat 20, and a generally tubularly-shaped valve member 30 is positioned in the chamber 14 in a manner to provide a suitable seal with the portions of the chamber 14 upwardly of the control port 28. An atmospheric port 32 is provided in the body member adjacent the upper end of the generally tubularly-shaped valve member 30, and the generally tubularly-shaped valve member 30 is provided with a reduced diameter tubular portion 34 adapted to extend through the valve port 18 into engagement with the poppet member 22. The central opening 36 of the tubular member 30 extends throughout its length, and the upper end of the tubular member is milled out to provide a bifurcated portion having a slot 38 adapted to receive the tongue 40 of a cylindrically shaped cam follower member 42 that is positioned in the upper end of the valve chamber 14. A slotted hole 44 is provided in each of the legs of the bifurcated portion of the tubular valve member 30, and each hole receives a respective end of a pin 46 that is carried by the tongue 40 of the cam follower member 42. The pin 46 is adapted to normally be held centrally in the elongated hole or slot 44 by a cam member 48 when the cam member 48 is the intermediate or valve closed position shown in the drawing.

In the embodiment shown in FIGURE 1, the cam member 48 is formed by means of a pivoted lever that is pinned to the body member adjacent the upper end of the cam follower member 42, and which lever is provided with three surfaces 50, 52 and 54 respectively arranged at progressively greater distances from the pivotal axis of the lever or cam member 48. The intermediate surface 52 of the cam member 48 and the cam follower member 42 are so arranged relative to the lost motion connection, as provided by the slotted holes 44 and pin 46, so as to centrally locate the pin 46 in the slotted holes 44 when the lower end of the tubular valve member 30 is in abutment or engagement with the poppet member 22. A suitable coil spring 56 is positioned between the tubular valve member 30 and the cam follower member 42 to urge the members in opposite directions and thereby hold the cam follower member 42 in engagement with the cam member 48 and at the same time hold the tubular valve member 30 in engagement with the poppet member 22.

The first coil spring 24 will normally be made stronger than is the coil spring 56 so that the coil spring 56 will not bias the poppet member 22 away from its shoulder or valve seat 20 when the pin 46 is centered in the slotted holes 44. There is thereby provided a generally predetermined positive force tending to hold the tubular member 30 into engagement with the poppet member 22, which force is less than that force holding the poppet member 22 into engagement with its valve seat 20 to thereby provide the closed position of the valve.

When the handle 48 is rotated to its position wherein the first surface 50 is brought into position for engagement with the cam follower 42, sufficient clearance will exist between the cam member 48 and the cam follower member 42 to permit the pin 46 to move into engagement with the upper end of the slotted holes 44, under the

action of coil spring 56, to cause the cam follower member 42 and the tubular member 30 to assume their expanded condition. A third coil spring 58 is provided between the body member 10 and the tubular valve member 30 to move the tubular valve member and the cam follower member 42 upwardly as a unit after the pin 46 "goes solid" with the upper end of the slotted holes 44 to thereby draw the lower end 34 of the tubular valve member 30 out of engagement with the poppet member 22. In this position, therefore, atmospheric pressure from the port 32 will be communicated through the central opening 36 of the tubular valve member to the control port 28 to thereby provide the first operating position of the valve structure.

When the handle 48 is moved out of its right hand or first operating position above described to its vertical position, the tubular valve member 30 will be moved downwardly into engagement with the poppet member 22 to provide the valve closed position also previously described; and when the handle 48 is moved into its left hand position to bring the flat cam surface 54 into engagement with the cam follower 42, the cam follower member will be moved downwardly sufficiently to cause the pin 46 to "go solid" with the lower end of the slotted holes 44 and thereby positively move the tubular valve member 30 still further downwardly to lift the poppet member 22 out of engagement with its valve seat 20. In this position, therefore, communication between the atmospheric port 32 and the control port 36 will be closed off, while communication between the lower chamber 16 and the control port 28 will be opened. In this position of the valve, therefore, the pressure which is supplied to the chamber 16 (which in this case is vacuum) is supplied to the control port 28 of the valve.

It will be apparent that pressures other than atmospheric pressure can be supplied to the port 32 provided suitable sealing means is used between the cam follower member 42 and the axially extending chamber 12; and that pressure levels other than vacuum can be supplied to the lower chamber portion 16, so that the valve may be used to alternately communicate substantially any pressure levels which differ from each other to a control port. In this regard, the pressure forces exerted on the cam follower member, the tubular valve member and the poppet member must be taken into consideration when sizing the various springs so that there will be a positive sealing force insufficient to lift the poppet member 22 from its seat 20 when the valve is in its centered or closed position, and the tubular valve member 30 is in engagement with the poppet member.

The embodiment shown in FIGURE 3 of the drawings is similar in many respects to the embodiment shown in FIGURE 1, and differs principally in the spring and camming arrangement used to actuate the valve. Those valve portions of FIGURE 3 which have corresponding parts in FIGURE 1 will be designated by a like reference numeral, and will be characterized further in that a prime mark is affixed thereto. In the embodiment shown in FIGURE 3 the body member 10' is slightly elongated over that shown in FIGURE 1 so as to provide a longer valve chamber 14' than that shown in FIGURE 1. The camming member 48' of the present embodiment is shaped somewhat differently than the cam member of the embodiment shown in FIGURE 1, and differs further in that it is positioned beneath the cam follower member 42' so as to at all times positively bias the cam follower member 42' away from the tubular valve member 30'. The cam member 48' of the present embodiment is formed by means of a transverse shaft 60 which extends through an opening 64 in the tongue 40' and which has a pair of laterally spaced camming surfaces 62 formed integrally thereon which straddle the tongue 40'. One end of the shaft 60 is suitably journalled in an opening 66 in the sidewalls of the body member and the other end of the shaft is journalled in a threaded plug 68 that is threaded into an opening 70 in the opposite side of the body member 10'.

In the center or valve closing position of the lever 48', the pin 46' will be centrally located in the slotted holes 44', as was the structure of the previous embodiment; and in the present embodiment the tubular valve member 30' is held into sealing engagement with the poppet 22' by a coil spring 76 positioned between the tubular valve 30' and a washer 78 which bears against the bottom surface of the shaft 60. When the lever 48' is rotated to its first position to bring the cam surfaces 54' into engagement with the bottom surface of the cam follower member 42', the pin 46' will be moved into engagement with the upper end of the slotted openings 44' to lift the bottom end of the tubular valve member 30' clear of the poppet member 22'. Fluid flow is thereby established between the pressure port 32' and the control port 28'. When the handle 48' is moved into its center position, camming surface 52' will be in engagement with the bottom surfaces of the cam follower member 42' to cause the tubular valve member 30' to be in engagement with the poppet member 22' as previously indicated. When the control handle 48' is moved into its third position, wherein the camming surfaces 50' are brought into engagement with the cam follower 42', the pin 46' will be in engagement with the bottom end of the slotted holes 44' and sufficient force will be provided by the springs 72 and 76 to cause the tubular valve member 30' to lift the poppet member 22' out of engagement with its valve seat 20'. In this third position of the valve, full communication will be provided between the bottom valve chamber 16' and the control port 28' as was done in the previously described embodiment.

While several embodiments of the invention have been shown and described in considerable detail, I do not wish to be limited to the particular constructions shown and described; and it is my intention to cover hereby all novel adaptations, modifications and arrangements thereof which come within the practice of those skilled in the art to which the invention relates.

I claim:

1. In a three position valve: a body member having an axially extending valve chamber therein that forms an axially extending valve port one end of which is surrounded by a first annular valve seat; a poppet member for abutment with said valve seat; a tubular flow conducting member having a first portion of a large cross section that is in sliding sealing engagement with the sidewalls of said valve chamber and a generally tubular second portion which ends in a second annular valve seat having a considerably smaller cross sectional area than that of said first portion, said second portion being adapted to project through said valve port into engagement with said poppet member; said body member having first passage means for communicating with the inside of said tubular member, second passage means for conducting flow from the portion of said chamber positioned between said first valve seat and said sliding sealing first portion of said tubular member, and third passage means which communicates with the portion of said valve chamber on the opposite side of said valve port; a cam follower operatively connected to said tubular member by means of a lost motion connection providing a generally predetermined amount of lost motion between said cam follower and said tubular member, said cam follower having a first position relative to said body member wherein said lost motion connection is in its expanded abutting condition to transmit abutment force from said cam follower to said tubular member causing it to be lifted clear of said poppet member, a third position wherein said lost motion connection is in its contracted abutting condition to transmit abutment force from said cam follower to said tubular member causing it to abut and lift said poppet member from said first valve seat, and an intermediate position wherein said tubular mem-

ber engages said poppet member while it is in engagement with said first seat and said lost motion connection is in an intermediate nonabutting position where it does not transmit abutment force in either direction; first means biasing said poppet member against said first seat; second means for biasing said tubular member against said poppet member with a generally predetermined force when said cam follower is in its intermediate position, said first means providing a greater force than said second means to prevent said second means from lifting said poppet member from its valve seat; and a three position cam for moving said cam follower into its three positions.

2. In a three position valve: a body member having an axially extending valve chamber therein that forms an axially extending valve port one end of which is surrounded by a first annular valve seat; a poppet member for abutment with said valve seat; a tubular flow conducting member having a first portion of a large cross section that is in sliding sealing engagement with the sidewalls of said valve chamber and a generally tubular second portion which ends in a second annular valve seat having a considerably smaller cross sectional area than that of said first portion, said second portion being adapted to project through said valve port into engagement with said poppet member; said body member having first passage means communicating with the inside of said tubular member, second passage means for conducting flow from the portion of said chamber positioned between said first valve seat and said sliding sealing first portion of said tubular member, and third passage means which communicates with the portion of said valve chamber on the opposite side of said valve port; a cam follower operatively connected to said tubular member by means of a lost motion connection providing a generally predetermined amount of lost motion between said cam follower and said tubular member, said cam follower having a first position relative to said body member wherein said lost motion connection is in its expanded abutting condition to transmit abutment force from said cam follower to said tubular member causing it to be lifted clear of said poppet member, a third position wherein said lost motion connection is in its contracted abutting condition to transmit abutment force from said cam follower to said tubular member causing it to abut and lift said poppet member from said first valve seat, and an intermediate position wherein said tubular member engages said poppet member while it is in engagement with said first seat and said lost motion connection is in an intermediate position where it does not transmit direct abutment force in either direction; a cam member for forcing said cam follower toward said tubular member and capable of moving said cam follower from its first through its third positions; first means biasing said poppet member against said first seat, second means biasing said tubular member away from said poppet member; and third means biasing said cam follower and tubular member apart to provide said expanded condition of said lost motion connection and to also hold said cam follower into engagement with said cam member, said third means being stronger than said second means.

3. In a three position valve: a body member having an axially extending valve chamber therein that forms an axially extending valve port one end of which is surrounded by a first annular valve seat; a poppet member for abutment with said valve seat; a tubular flow conducting member having a first portion of a large cross section that is in sliding sealing engagement with the sidewalls of said valve chamber and a generally tubular second portion which ends in a second annular valve seat having a considerably smaller cross sectional area than that of said first portion, said second portion being adapted to project through said valve port into engagement with said poppet member; said body member having first passage means communicating with the inside of said tubular member, second passage means for conducting flow from the portion of said chamber positioned between said first valve seat and said sliding sealing first portion of said tubular member, and a third passage means which communicates with the portion of said valve chamber on the opposite side of said poppet member from said valve port; a cam follower operatively connected to said tubular member by means of a lost motion connection providing a generally predetermined amount of lost motion between said cam follower and said tubular member, said cam follower having a first position relative to said body member wherein said lost motion connection is in its expanded abutting condition to transmit abutment force from said cam follower to said tubular member causing it to be lifted clear of said poppet member, a third position wherein said lost motion connection is in its contracted abutting condition to transmit abutment force from said cam follower to said tubular member causing it to abut and lift said poppet member from said first valve seat, and an intermediate position wherein said tubular member engages said poppet member while it is in engagement with said first seat and said lost motion connection is in an intermediate position where it does not transmit abutment force in either direction; a cam member for forcing said cam follower away from said tubular member and capable of moving said cam from its third to its first position; first means biasing said poppet member against said first seat; second means biasing said tubular member toward said poppet member; and third means biasing said cam follower toward said poppet member to provide said contracted condition of said lost motion connection and to hold said cam follower into engagement with said cam member, said first means being stronger than said second means, and said second and third means together being stronger than said first means.

4. In a three position valve: a body member having an axially extending valve chamber therein the sidewalls of which are provided with a shoulder which faces in one axial direction of said chamber, a poppet member spaced in said one axial direction from said shoulder for abutment therewith, a first spring biasing said poppet member toward said shoulder, a generally tubular member positioned in the opposite axial direction from said shoulder, said generally tubular member having a first portion of large cross section in sliding sealing engagement with the sidewalls of said chamber and having a second generally tubular portion which ends in an annular valve seat for abutment with said poppet member, said annular valve seat having a considerably smaller cross sectional area than that of said first portion, said body member having first passage means communicating with the central opening of said tubular member, second passage means for conducting flow from the portion of said chamber positioned between said shoulder and said sliding sealing first portion of said tubular member, and third passage means which communicates with the portion of said valve chamber positioned in said one axial direction from said shoulder, a cam follower member positioned in said opposite axial direction from said tubular member and having first, intermediate and third positions, said cam follower and said tubular member having a lost motion connection formed by an axial slot in one of the members and a pin carried by the other of the members and extending through said slot, said pin being generally centered in said slot when said tubular member abuts said poppet member and said poppet member is in engagement with said shoulder and abutting the ends of said slot in the first and third positions of said cam follower, a second spring biasing said tubular member and cam follower member apart, a third spring biasing said tubular member away from said poppet member, said second spring being stronger than said third spring, and a cam member arranged to contact and move said cam follower toward said poppet member through said three positions.

5. In a three position valve: a body member having an axially extending valve chamber therein the sidewalls of which are provided with a shoulder which faces in one axial direction of said chamber, a poppet member spaced in said one axial direction from said shoulder for abutment therewith, a first spring biasing said poppet member toward said shoulder, a generally tubular member positioned in the opposite axial direction from said shoulder, said generally tubular member having a first position of large cross section in sliding sealing engagement with the sidewalls of said chamber and having a second generally tubular portion which ends in an annular valve seat for abutment with said poppet member, said annular valve seat having a considerably smaller cross sectional area than that of said first portion, said body member having first passage means communicating with the central opening of said tubular member, second passage means for conducting flow from the portion of said chamber positioned between said shoulder and said sliding sealing first portion of said tubular member, and third passage means which communicates with the portion of said valve chamber positioned in said one axial direction from said shoulder, a cam follower member positioned in said opposite axial direction from said tubular member and having first, intermediate and third positions, said cam follower and said tubular member having a lost motion connection formed by an axial slot in one of the members and a pin carried by the other of the members and extending through said slot, said pin being generally centered in said slot when said cam follower is in its intermediate position in which said tubular member abuts said poppet member and said poppet member is in engagement with said shoulder and abutting the ends of said slot in the first and third positions of said cam follower, a second spring biasing said cam follower to its third position spaced toward said tubular member, a third spring biasing said tubular member toward said poppet member, said first spring being stronger than said third spring and the combined force of said second and third springs being greater than that of said first spring, and a cam member arranged to contact and move said cam follower away from said tubular member from said third position through said first position.

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