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PILOT CONTROLLED VALVE FOR FIRE EXTINGUISHING SYSTEMS

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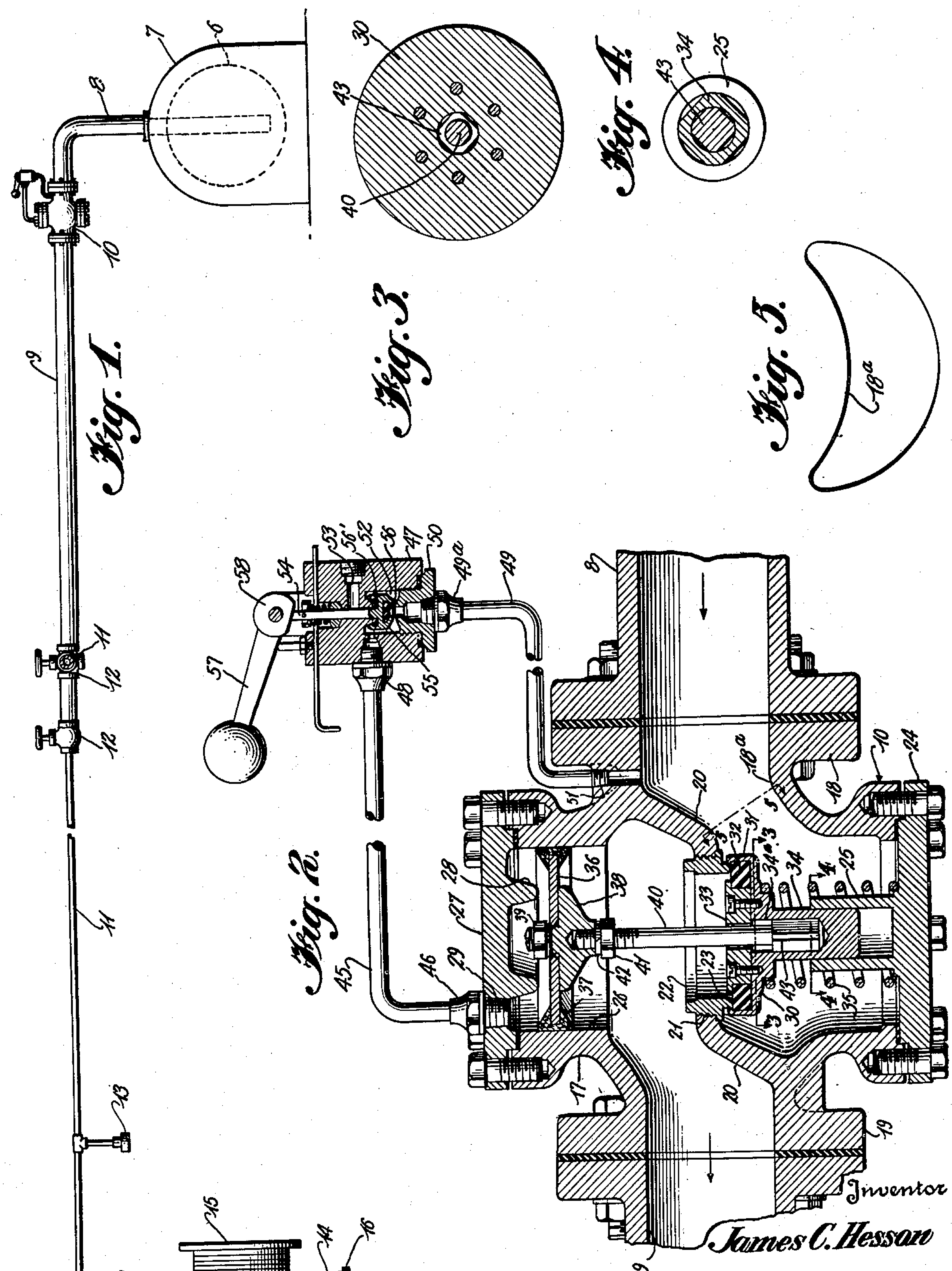

Inventor
James C. Hesson

By L. Donald Myers Attorney

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PILOT CONTROLLED VALVE FOR FIRE EXTINGUISHING SYSTEMS

James C. Hesson, Chicago, Ill., assignor to Cardox Corporation, Chicago, Ill., a corporation of Illinois

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This invention relates to new and useful improvements in fluid pressure operated valves and deals more particularly with valves which are adapted for controlling the flow of liquid carbon dioxide from a storage receptacle into a fire extinguishing system.

Fixed and semi-fixed fire extinguishing systems employing carbon dioxide as the extinguishing medium are normally supplied with liquid carbon dioxide from a strategically located storage receptacle. A master valve, located near the storage receptacle, controls the flow of liquid carbon dioxide from the receptacle to a main or header pipe, and the proper selector valve is used to direct the flow into the branch line which leads from the header pipe to the point where the carbon dioxide is to be discharged. When sufficient carbon dioxide has been discharged to accomplish its desired purpose, the operated selector valve and the master valve are closed, whereby liquid carbon dioxide is trapped between these valves. In order to prevent excess pressure from building up in the piping, due to the vaporization of the liquid, it is necessary that some provision be made for returning the entrapped liquid to the storage receptacle.

The primary object of this invention is to provide a valve which is particularly adapted for use in controlling the flow of liquid carbon dioxide from a storage receptacle into a fire extinguishing piping system.

A further important object of the invention is to provide a valve of the type discussed above which may be opened and closed and held in either of such positions by the pressure of the controlled liquid carbon dioxide, and which will automatically open sufficiently to permit the carbon dioxide that is trapped in the piping between the valves, at a higher pressure than that existing in the receptacle, to flow back through the valve to the storage receptacle.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawing forming a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a schematic view of a fire extinguishing system having a valve, of the type embodying this invention, properly assembled therein,

Figure 2 is a vertical sectional view taken through the valve structure of Fig. 1,

Figure 3 is a sectional view taken on line 3—3 of Fig. 2,

Figure 4 is a sectional view taken on line 4—4 of Fig. 2, and

Figure 5 shows a diagram or pattern illustrating the shape of the flow path through the valve casing at line 5—5 of Fig. 2.

In the drawing, wherein for the purpose of illustration is shown a preferred embodiment of the invention, and first particularly referring to Fig. 1, reference character 6 designates a storage tank in which liquid carbon dioxide is to be confined at a controlled, subambient temperature, and its corresponding vapor pressure, by means of an automatically controlled refrigerating system, not shown. This type of bulk storage for liquid carbon dioxide is more fully illustrated in the Eric Geertz patents, No. 2,143,311, issued January 10, 1939 and No. 2,202,343, issued May 28, 1940. The storage tank 6 is suitably confined in a housing 7 and the space between the housing and the tank 6 is filled with a suitable heat insulating material to retard absorption of heat by the liquid carbon dioxide confined in the tank.

A dip tube 8 extends out of the storage tank for connection with the large capacity piping header 9 through a master control valve 10. The dip tube 8, upstream of the valve 10, may be provided with a manual shut-off valve, not illustrated, which will normally remain open and will be closed when repairs or additions are to be made to the system. When such a shut-off valve is open the master control valve 10 acts at all times to confine the liquid carbon dioxide in the storage tank 6 and to effect its release into the header 9 when a fire occurs.

The header 9 normally is connected to a plurality of branch lines 11 which may separately or independently protect the various hazards encompassed by the system. The admission of the liquid carbon dioxide from the header 9 into each one of the branch pipe lines 11 is controlled by a selector valve 12. In other words, one selector valve 12 is provided for each one of the separate branch lines 11, and the selector valves may be either manually or automatically controlled.

Each branch line 11 may have connected therein any desired number of carbon dioxide discharge nozzles, or other devices. Fig. 1 discloses one of the branch lines 11 as having connected therein a discharge nozzle 13 which will directly apply the discharge of carbon dioxide onto the particular hazard that is to be protected thereby. Additionally, this branch line 11 is illustrated as having connected thereto the hose line 14, normally wound on the reel 15, and having the discharge nozzle 16 connected to its outer end, for supplementing the action of nozzle 13, if desired.

It will be noted that when carbon dioxide is being discharged from one of the branch lines 11, that branch line and the header 9 will be filled with liquid carbon dioxide. When sufficient carbon dioxide has been discharged to accomplish its desired purpose, the selector valve 12 of that line is closed before or simultaneously with the closing of the master control valve 10. This prevents loss of liquid carbon dioxide from the header 9, and thereby results in a more economical use of the carbon dioxide. The liquid carbon dioxide thus trapped in the header 9 will be caused to expand, by the subsequent absorption of heat, and to prevent the development of excess pressure in the header it is desirable that the trapped carbon dioxide be permitted to flow back to the storage tank 6 through the master control valve 10.

Referring now to Fig. 2 for a detailed description of the master control valve 10, the casing 17 is provided with a flanged inlet 18 for connection to the flanged end portion of the dip tube 8. The flanged outlet 19 of the casing is similarly connected to the flanged end of the header 9. Fig. 5 illustrates in profile the shape of the flow path 18*a* through the inlet portion of the valve casing.

A partition 20 is formed in the casing 17 to separate the inlet 18 and the outlet 19. The central portion of the partition 20 is provided with a threaded opening 21 for receiving the bushing 22 which provides a seating surface 23 for the opening 21 on the inlet side of the partition 20.

The casing 17 is provided with top and bottom openings in axial alinement with the opening 21 and on opposite sides of the casing. The bottom opening, which lies on the inlet side of the partition 20, is closed by a cover plate 24. The inner surface of the cover plate 24 is provided with a hollow cylindrical guide 25 which projects toward and in axial alinement with the partition opening 21.

The upper portion of the casing 17, on the outlet side of the partition 20, is bored to form a cylinder 26 which is also in axial alinement with the partition opening 21. The top opening of the cylinder 26 is closed by a cylinder head 27. The inner surface of the cylinder head 27 is provided with a concentrically positioned annular projection 28. A tapped hole 29 passes through the cylinder head outwardly of the projection 28.

A valve disc 30 is positioned in the casing 17 for movement to close the opening 21. The periphery of the disc 30 is provided with a flange 31 for receiving the seating ring 32 which is held in place by the flanged retaining ring 33. A pilot extension 34 projects from the back surface of the valve disc 30, and is provided with a recess 34*a* which opens on the face of the disc through the retaining ring 33. As illustrated in Fig. 4, the pilot extension 34 is substantially rectangular in cross section and is received by the guide 25 which limits movement of the disc 30 in an axial direction with respect to the opening 21. The spaces between the flat surfaces of the pilot extension 34 and the cylindrical surface of the guide 25 permit the escape of fluid when the pilot extension moves into the guide.

A spring 35 is positioned between the cover plate 24 and the back of the disc 30 and around the guide 25 and pilot 34 so that the pressure exerted by the spring acts to force the disc 30 and its seating ring 32 into sealing engagement with the seating surface 23 of the bushing 22.

A disc type piston 36, having a resilient sealing gasket 37 bonded around the outer edge portion thereof, is located within the cylinder 26. A central aperture through the piston 36 acts to receive a threaded boss on the adapter member 38 and is fastened thereto by the nut 39. The adapter member 38 projects from the face of the piston 36 toward the partition opening 21, and is provided with a tapped axial recess in alinement with the opening 21.

A valve stem 40 is threadedly connected in the aforesaid tapped recess of the adapter member 38 and is locked in the desired position by the nut 41 and lock washer 42. The opposite end of the stem 40 is provided with an enlarged head 43 positioned in the cylindrical recess 34*a* formed in the pilot 34. As illustrated in Fig. 3, the head 43 is provided with flattened surfaces to permit the escape of fluid from the recess 34*a* between the stem and the cylindrical surface of the recess. The retaining ring 33 acts to prevent removal of the stem 40 from the recess 34*a* by encircling the narrower portion of the stem above the head 43.

A tube 45 is connected at one of its end portions to the tapped hole 29 in the cylinder head by the coupling 46, and at its other end portion is connected to a pilot valve body 47 by the coupling 48. A tube 49 is similarly connected by the coupling 49*a* to the plug 50 in the valve body 47, and is suitably connected to the casing 17 through the tapped hole 51 so that pressure fluid from the inlet 18 of the casing may enter the tube 49. The central chamber 52 of the pilot valve is in communication with the tube 49 and the tube 45 and a venting aperture 53. The operating stem 54 of the pilot valve carries a sealing disc 55 which is located within the central chamber 52 and which is provided with sealing members 56 and 56′ on opposite faces thereof. Movement of the valve stem 54 in one direction results in placing the tubes 49 and 45 in communication through the valve while sealing the venting aperture 53; and in the other direction results in placing the venting aperture 53 in communication with the tube 45 while sealing the tube 49. Movement of the valve stem 54 is accomplished by pivoting the valve operating handle 57 to rotate the cam 58 upon which the stem 54 rides.

The operation of the master control valve 10 illustrated in Fig. 2 will now be explained. Whenever a fire occurs in one of the hazards protected by the system, the master control valve 10 and the appropriate selector valve 12 will be opened. The procedure for opening the master valve 10 to permit flow from the inlet 18 to the outlet 19 and into the header 9 is as follows:

The pilot valve operating handle 57 is moved to the position illustrated in Fig. 2 so that the cam 58 permits the stem 54 to rise whereby the venting aperture 53 is sealed and the tubes 49 and 45 are placed in communication with each other. The pressure fluid in the inlet 18 of the master control valve 10 is thereby transmitted through the tubes 49 and 45 to the cylinder 26 where it acts upon the piston 36. The area of the piston is sufficient to produce a total force in excess of the force exerted by the fluid on the inlet side of the disc 30 plus the force exerted by the spring 35. The piston 36 will therefore move downwardly causing the stem 40 to bear against the end surface of the recess 34*a* to move the disc 30 and its seating ring 32 out of engagement with the seating surface 23 of the bushing 22. In the illustration of Fig. 2, it should be considered that the pilot valve operating handle 57 has just been placed in the position for opening the master control valve 10, and the downward movement of the piston 36 will cause the valve to open. The master valve 10 will then be in its open position and flow through the valve from the inlet to the outlet side thereof will be continuous for as long as the communication between the tubes 49 and 45 through the central chamber 52 of the pilot valve remains unchanged.

When sufficient carbon dioxide has been discharged to accomplish its desired purpose and it is desired that the flow of carbon dioxide be stopped, the selector valve is closed and the pilot valve operating handle 57 is moved to the right of the position illustrated in Fig. 2. The cam 58 thereby depresses the valve stem 54 so that the fluid pressure applied through the tube 49 into the pilot valve is cut off and the pressure in the cylinder 26 is drained off through the tube 45 and the venting aperture 53 which is now open. When the pressure in the cylinder 26 is removed, the pressure on the under side of the piston 36 forces the piston into its uppermost position. The annular projection 28 contacts the piston 36 to prevent damage to the sealing member 37 and to provide a limited clearance between the head of the stem 40 and the inner surface of the retaining ring 33. The combined fluid and spring pressure on the inlet side of the disc 30 act to hold the seating ring 32 in sealing engagement with the seating surface 23 to prevent flow through the valve.

As the pressure on the outlet side of the master control valve 10 increases due to the absorption of heat by the entrapped liquid carbon dioxide, the pressure on the outlet side of the disc 30 exceeds the pressure exerted by the spring 35 and the carbon dioxide on the inlet side of the disc 30. The disc 30, therefore, will move downwardly with respect to the position illustrated in Fig. 2 to a point where the retaining ring 33 contacts the head of the stem 40 at which point the seating ring 32 and the seating surface 23 are out of contact and carbon dioxide may flow from the outlet to the inlet side of the valve 10 until the total force exerted on the inlet side of the disc again becomes greater than that exerted on the outlet side.

The carbon dioxide entrapped between the selector valve 12 and the master control valve 10 wil therefore be returned through the master control valve as expansion occurs until an insignificant amount of carbon dioxide gas remains in the header 9.

It is to be understood that the form of this invention herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described the invention, I claim:

1. A pressure fluid operated valve, comprising a casing having an inlet and an outlet separated by a partition, said partition having an opening therethrough surrounded by a seating surface on the inlet side of the opening, a disc mounted in the inlet portion of said casing for movement to engage said seating surface and having a cylindrical recess centrally entering the engaging side thereof, resilient means urging said disc into engagement with said seating surface, a stem for said disc having an enlarged head of angular cross-section positioned in and of less axial length than the cylindrical recess, the dissimilar cross-section of the recess and the stem head providing for venting of the recess, a retaining ring detachably connected to the valve disc for engagement by the valve stem head to prevent withdrawal of the head from the recess while permitting the disc to move axially relative to the stem and away from said seating surface in response to an excess pressure on the outlet side of said disc, pressure fluid operated means connected to said stem and positioned in the outlet portion of said casing for movement to disengage said disc from said seating surface, means for limiting the extent of movement of the pressure fluid operated means away from said seating surface, and means for axially adjusting the effective length of the stem to vary the distance the disc may move away from said seating surface in response to said excess outlet pressure.

2. A pressure fluid operated valve, comprising a casing having an inlet and an outlet separated by a partition, said partition having an opening therethrough surrounded by a seating surface on the inlet side thereof, a disc mounted in the inlet portion of said casing, a seating ring carried by the disc valve to engage said seating surface, said valve disc having a cylindrical recess centrally entering the engaging side thereof, resilient means urging said valve disc seating ring into engagement with said seating surface of the partition, a stem for said valve disc having an enlarged head of angular cross-section positioned in and of less axial length than the cylindrical recess, the dissimilar cross-sections of the recess and stem head providing for venting of the recess, a flanged retaining ring detachably connected to the valve disc for fastening the seating ring to said disc and for engagement by the valve stem head to prevent withdrawal of the head from the recess while permitting the disc to move axially relative to the stem and away from said seating surface in response to an excess pressure on the outlet side of said disc, a cylinder positioned in the outlet portion of the casing in axial alinement with said seating surface, a piston movable in said cylinder, means operatively associated with the cylinder and the piston for limiting the extent of movement of the piston axially away from said seating surface, means for axially adjustably connecting the stem to the piston to vary the distance the disc may move axially relative to the stem and away from said seating surface in response to said excess outlet pressure, and means for admitting pressure fluid to said cylinder above the piston to move the piston and its attached stem to disengage the disc from its seating surface.

JAMES C. HESSON.

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