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VALVE FOR AUTOMATIC SPRINKLER SYSTEMS

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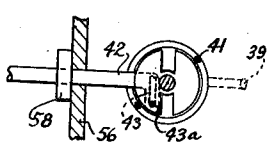


Fig. 3

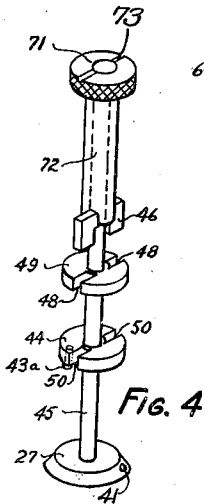


Fig. 4

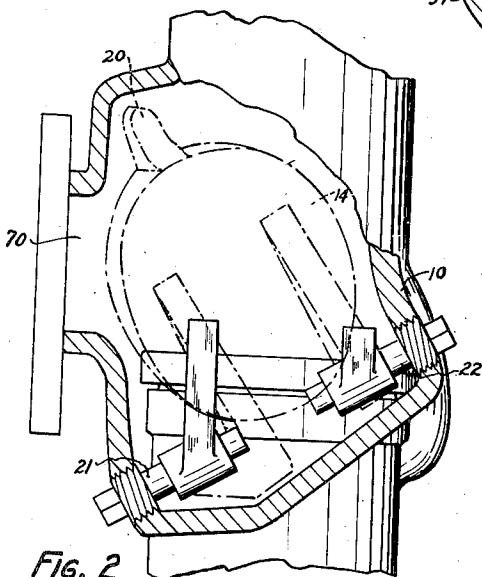


Fig. 2

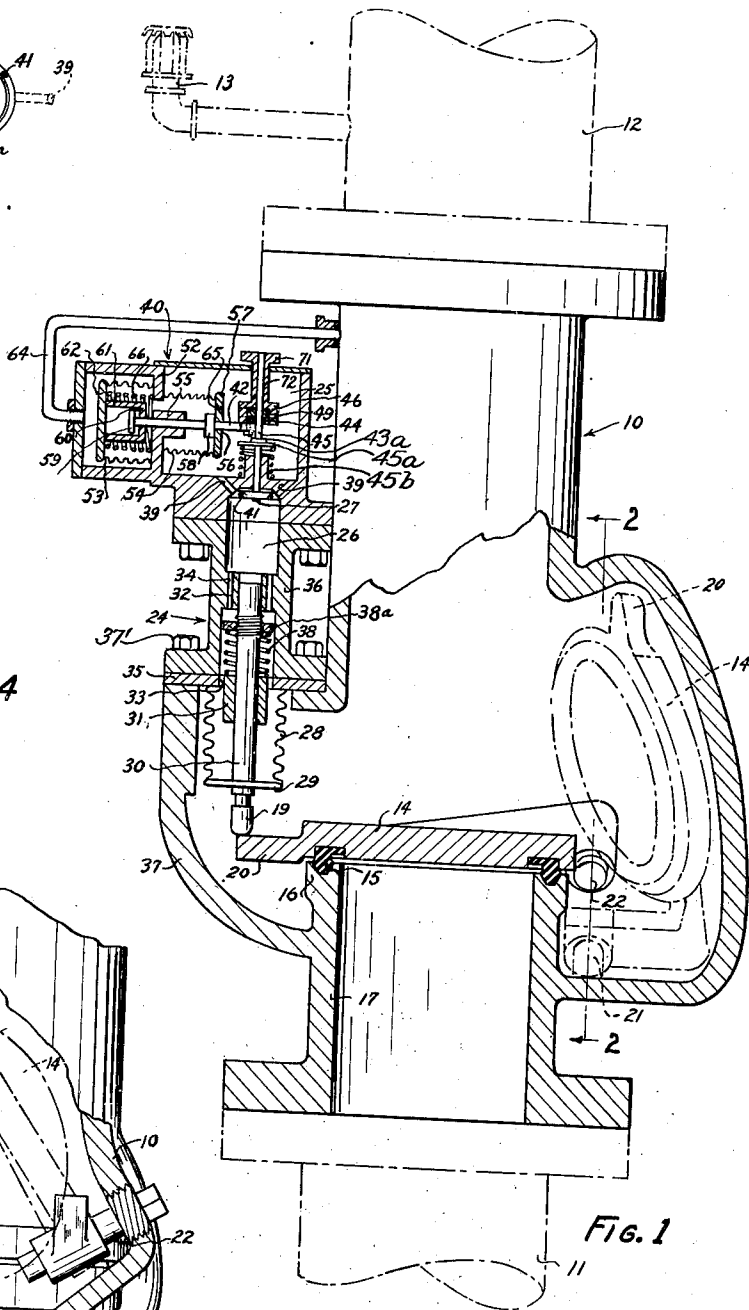


Fig. 1

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## VALVE FOR AUTOMATIC SPRINKLER SYSTEMS

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3 Claims. (Cl. 169—20)

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This invention relates to control valves for automatic sprinkler systems and more particularly to valves for use with dry pipe systems and arranged to admit water into the systems upon opening a sprinkler head, or upon actuation of other heat sensitive means associated with the system.

Dry pipe sprinkler systems are generally considered to be advantageous for providing automatic sprinkler protection in areas subject to freezing temperatures such as cold storage warehouses or in buildings subject to temperatures below freezing, but heretofore the control valves required in such systems have embodied certain undesirable features. For example, the mechanisms employed are rather complicated and expensive and sometimes get out of order. The systems ordinarily require the maintenance of air under fairly high pressure, say about 60 pounds per square inch, in the pipes of the sprinkler systems. The use of air pressure in the systems has resulted in further complications, for it has been necessary to provide so-called quick operating devices, such as exhausters or accelerators, to speed the discharge of water from the open sprinkler heads. Without such devices considerable time would elapse before water could be discharged from the sprinkler heads, because all of the air in the system would first have to be exhausted from the system through the sprinkler heads that have opened.

Accordingly, it is a general object of the present invention to provide an improved type of valve for dry pipe sprinkler systems by use of which the objections noted above are eliminated. Another object is the provision of a dry pipe valve which requires only a relatively low pressure of air about 10 pounds per square inch, in the pipes. A further object is the provision of such a valve in which the need for an accelerator valve is eliminated because of the comparatively small amount of air to be bled from the system. Another object is the provision of such a valve which will permit water to flow into the system immediately upon a sudden drop in air pressure in the system such as would be occasioned by the opening of a sprinkler head, but which will not open the valve to admit water in the event of a slow reduction in pressure such as might occur because of a slow leak in the system or changes in temperature. Further objects of the invention are the provision of such a valve in which corrosion of the working parts is substantially prevented; the provision of a simple and comparatively inexpensive valve of the character de-

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scribed; the provision of a valve which has fail-safe characteristics in that water will be admitted to the system in the event of failure; and the provision of a simple and sturdy valve which can be manufactured at relatively low cost.

Further objects and advantages of my invention will become apparent from the following description of a preferred form thereof, reference being made to the accompanying drawings wherein Figure 1 is an elevational view partly in section, somewhat diagrammatically illustrating a valve made according to my invention as it may be incorporated into a sprinkler system; Figure 2 is a fragmentary elevational view as indicated by line 2—2 of Figure 1, illustrating the main water valve itself; Figure 3 is a fragmentary sectional view on an enlarged scale illustrating a portion of the control mechanism; and Figure 4 is an exploded view showing the control valve setting and indicating mechanism removed from the valve assembly and rotated about 45° from the position shown in Figure 1.

The device is illustrated in the drawings as being associated with a special pipe section or valve housing indicated generally at 10 and interposed between the water supply pipe 11 and the pipe 12 leading to the sprinkler system itself, one of the sprinkler heads being indicated diagrammatically at 13. Obviously such a system would ordinarily include a considerable number of sprinkler heads 13 connected to pipes branching from the pipe 12. In service, the pipe 11 contains water under the pressure of the supply mains, while the pipe 12 is normally dry, containing air under pressure of about 10 pounds per square inch, except when a sprinkler head opens in which case water from pipe 11 is permitted to pass through the housing 10 into the pipe 12.

The flow of water through housing 10 from pipe 11 to pipe 12 is controlled by the clapper valve 14 which is provided with a rubber sealing ring 15 adapted to seal against the valve seat 16 formed at the end of the inlet conduit section 17 of the valve housing 10. The valve 14 is retained in closed position against the pressure of water within the section 17 by the plunger 19, the end of which engages the projecting tongue 20 of the valve clapper 14. As long as the plunger 19 is held downwardly against the tongue 20, the valve clapper is maintained in closed position; if the plunger is permitted to move upwardly, the valve clapper is immediately opened by the pressure of water behind it and takes a position out of the path of the water, as shown in broken lines in Figures 1 and 2. It will be noted that the valve

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clapper is pivotally mounted on pins 21 and 22 which are secured in the housing member 10 on a line extending at an acute angle to the plane of the valve seat 16. With this mounting, when the valve opens, the tongue 20 swings in an arc about the center line of the pins 21 and 22 as an axis, and thus moves obliquely away from the plunger 19 with the result that only a small amount of movement of the plunger is necessary to enable the tongue 20 to clear the plunger and to permit the valve to open freely.

The movement of the plunger 19 is controlled according to a preferred form of my invention so that the plunger will be retracted promptly upon any sudden drop in pressure in the pipe 12 and in the portion of the housing 10 above the valve 14, but will not be moved in response to gradual decreases in pressure, until the pressure is reduced to some predetermined low value, for example, one or two pounds per square inch. This is accomplished by the mechanism to the left of the housing 10, indicated in general at 24 and comprising an auxiliary housing separated into two principal chambers comprising an upper chamber 25 and a lower chamber 26, the communication between these chambers being controlled by a rotary valve 27. Both of these chambers are substantially filled with oil or other suitable incompressible fluid. However chamber 25, though substantially filled with incompressible liquid, is under atmospheric pressure, communication with the atmosphere being had at the upper portion of the housing 40 where sleeve 12 extends therethrough. The liquid cannot leak out for gravity holds it within the chamber. The lower chamber terminates in an expansible fluid chamber which preferably comprises a flexible metallic bellows 28 of the siphon type, to the closed head 29 of which the plunger 19 is secured, so that fluid pressure within the bellows holds the plunger against the tongue 20. On the inner side of the head 29, a guide stem 30 in alignment with the plunger 19 projects upwardly through the guide 31 and has its upper end disposed within the guide 32. Passages 33 and 34 adjacent guides 31 and 32 respectively, provide communication between the interior of the bellows 28 and the upper portion of the chamber 26. These passages are disposed within plate 35 and sleeve 36 respectively, and the entire mechanism 24 is secured as by suitable bolts 37' to the enlargement 37 of the housing 10, within which enlargement the bellows 28 is disposed.

A spring 38, surrounding the stem 30 and acting between the upper surface of the guide 31 and the washer or stop 38a threaded onto stem 30, urges the stem 30, and thus the head 29 of the bellows and the plunger 19 in an upward direction. The arrangement, however, is such that under all normal conditions, i. e., so long as the proper air pressure is maintained in pipe 12 the entire space within the chamber 26, including the spaces around the stem 30 and the space within the bellows 28 are completely filled with the incompressible liquid. Thus as long as the valve 27 remains closed, and the liquid is retained within these spaces, the plunger 19 is held securely against upward movement and acts to retain the valve clapper 14 in closed position. However, opening of the valve 27 will permit fluid to flow from the chamber 26 through the passageways 39 into the upper chamber 25 where the pressure is substantially atmospheric, thus relieving the pressure within the chamber 26 and within the bellows 28, which then may contract permit-

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ting the spring 38 and the pressure exerted by the valve clapper 14 to move the plunger 19 and stem 30 upwardly, and thereby permitting the valve 14 to open to admit water under pressure to the sprinkler system.

The mechanism for controlling the valve 27 is disposed within the housing 40 surrounding the chamber 25 and is illustrated particularly in Figure 1. As there shown, the rotary valve 27 is arranged to be rotated about its vertical axis to place the grooves 41 in alignment with the passages 39 by means of a horizontal rod 42 provided at its end with a slotted laterally extending portion 43 which engages a pin 43a mounted on the collar 44 (see Figures 3 and 4). The collar 44 is loosely mounted on the shaft 45 of the valve 27, but ordinarily is keyed thereto by means of the key 46 which projects through slots 48 of the collar 49 and into the slots 50 of the collar 44. As the collar 49 is fixed to the shaft 45, the collar 44 will be keyed to the shaft 45 when the key 46 is in the position shown in Figure 1, with the result that movement of the rod 42 will rotate the shaft 45 and valve 27. Preferably the arrangement is such that rotation through only about 30° will open the valve.

The valve 27 is maintained in contact with its seat by a spring 45b which surrounds the lower part of shaft 45 and bears upwardly against the disk 45a which is secured to the shaft. The sole purpose of the spring and disk is to counteract the influence of gravity. Any other appropriate means may be utilized to the same purpose. In the drawing the valve 27 is shown in closed position, and movement of the rod 42 to the left will rotate the valve to open position with the grooves 41 coinciding with the passageways 39.

In order to move the rod 42 in response to changes in pressure in the sprinkler system the housing 40 is provided with a partition 52, the open ends of bellows 53 and 54 being secured to the partition, and the bellows projecting in opposite directions therefrom. The bellows 53 is surrounded by air under pressure and the bellows 54 by oil under atmospheric pressure. These bellows are concentric with the rod 42 which is slideably mounted in guide 55 carried by the partition 52 and which projects through the opening 56 in the head 57 of the smaller bellows 54. The rod is provided with a shoulder 58 which is disposed adjacent the head 57 and it also has at its outer end a shoulder or flange 59 which is engageable by the inwardly turned flange 60 of the sleeve member 61 secured to the head 62 of the larger bellows 53, there being clearance between the flanges 59 and 60 so long as the proper air pressure is maintained in the system. Thus movement of the head of bellows 53 to the left in the arrangement shown in the drawings, if sufficiently great in extent, will result in movement of the rod 42 to the left and opening of the valve 27, and movement of the head 57 of bellows 54 to the left will immediately result in corresponding movement of rod 42 and opening of the valve if the movement is continued sufficiently to bring the grooves 41 into alignment with passages 39.

In order to make the bellows 53 and 54 responsive to changes in pressure on the dry side of the system, a conduit 64 extends from the space within the housing 40 surrounding the larger bellows 53 to the upper portion of the housing member 10. The interior of both bellows 53 and 54 is filled with oil at substantially atmospheric pressure, communication between the interior of the

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bellows and the chamber 25 being afforded by the very slight clearance space between the rod 42 and the head 57 of the bellows 54 and by the small orifice 65 in the head 57. A spring 66 acting between the partition 52, and the head 62 of the large bellows tends to urge the head of the large bellows to the left in the drawings.

With this arrangement, so long as the pressure within the pipe 12 and chamber 10 above the valve 14 remains at the desired level, this pressure acting on the exterior of the larger bellows 53 holds the parts in substantially the position shown in the drawings. Any sudden reduction in pressure, however, will result in an expansion of the larger bellows 53 and the movement of the head 62 thereof to the left in response to the action of the spring 66. The increase in volume within the large bellows will reduce the pressure within both the larger and smaller bellows, and accordingly oil under atmospheric pressure on the exterior of the smaller bellows 54 within the chamber 25 will act to contract the smaller bellows, the orifice 65 and the clearance between the shaft 42 and the head of the smaller bellows being sufficiently restricted that oil cannot flow into the smaller bellows rapidly enough to prevent contraction of the bellows in response to a sudden drop in pressure. Because of the smaller size of bellows 54, the head 57 thereof will tend to move a greater distance in response to changes in pressure than the head 62 of the larger bellows 53. The engagement between the head of the smaller bellows and the shoulder 58 will result in the movement of the rod 42 to the left and rotation of the valve 27 to open position, permitting flow of liquid from the chamber 26 to the chamber 25 and permitting the plunger 19 to move upwardly to release the clapper valve 14 and admit water into the system. This is the sort of action that will take place upon the opening of a sprinkler head, or in response to other heat sensitive means associated with the system, or if for any reason the air pressure within the dry side of the system drops with sufficient rapidity the sensitivity of the system can be varied by varying the size of the orifice 65, the larger the orifice, the more rapid the pressure drop required to open the valve.

In the event of a slow leak by which the pressure might be reduced gradually over a period of several hours, or if the pressure should change gradually because of changes in temperature, then the larger bellows will expand so slowly that fluid from the chamber 25 can flow to the interior of the bellows through the orifice 65 and the slight clearance around the rod 42 fast enough to prevent any substantial contraction of the smaller bellows from taking place. The clearance between the flanges 59 and 60 will prevent the initial movement of the head 62 from actuating the rod 42 to open the valve. However, if the pressure should continue to drop to a predetermined low value, say one or two pounds per square inch, then the larger bellows would be expanded to such an extent by the spring 66 that the inwardly turned flange 60 will engage the end flange 59 of the rod 42 and move it to the left, opening the valve 27 and permitting the clapper valve 14 to open as before. Thus the system normally responds only to rapid pressure drops such as would occur in the event of the opening of a sprinkler head, but ultimately if the pressure reaches a predetermined low value, water will be admitted to the system. It is contemplated that

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an alarm may be provided which will be set off if the pressure in the system is reduced to a predetermined amount, above the pressure at which the large bellows is set to open the valve, thus giving an indication of slow leak before the system is filled with water.

After the clapper valve has been opened to admit fluid to the system, it may be reset by shutting off the water in the supply pipe 11 and draining the system, moving the valve 14 back onto its seat and positioning the plunger 19 in engagement with the tongue 20 thus drawing down spring 38 and permitting oil to flow downwardly through valve 27. This may be accomplished through the hand hole 70 (see Figure 2), which is closed by a suitable removable cover plate.

The valve 27 may be opened to admit oil to the chamber 26 by means of the knob 71 which projects to the exterior of the housing 40 and is connected to the key 46 by a sleeve portion 72. The opening in the housing 40 through which sleeve 72 extends is large enough so that the pressure in chamber 25 can always be maintained at atmospheric pressure. By lifting up the knob 71 so that key 46 engages only the collar 49 and not the collar 44, the valve 27 may be turned to admit oil which flows freely from chamber 25 to the chamber 26 and then, after the plunger 19 is properly positioned against tongue 20, it may be turned manually to closed position, locking plunger 19 against the tongue 20 to retain the valve 14 in closed position. The water in supply pipe 11 may then be turned on to make certain there is no leakage past rubber sealing ring 15 and valve seat 16. The removable cover plate is then secured to hand hole 70 and air under pressure is admitted to the system above clapper 14. By noting whether knob 71 is in a raised position engaging only collar 49 or in a lowered position engaging both collars 44 and 49 it may be determined whether or not the valve is properly set since the position of the mark 73 on the top of the knob 71 when in a lowered position indicates the position of the grooves 41 in valve 27.

From the foregoing it will be evident that my invention provides a system in which the water valve 14 will be operated promptly in the event of any sudden drop in pressure in the dry side of the system, but will not be operated by a slow drop in pressure until a predetermined low pressure is reached. However, regardless of the position of the large bellows 53 when the sudden pressure drop occurs, any sudden drop will result in immediate movement of the head 57 of the smaller bellows to the left which immediately engages the shoulder 58 and moves the rod 42 to open the valve 27. Thus the pressure within the dry side of the system need not be maintained accurately so long as it is above a predetermined minimum. High pressures need not be maintained within the dry side of the system, for the water pressure tending to open the valve 14 cannot react against the mechanism within the upper chamber 25. Inasmuch as low pressures may be employed the relatively small amount of air will be exhausted rapidly from the system in the event of opening of a sprinkler head, and therefore, the need for auxiliary accelerating devices is eliminated.

It will be noted that failures of various parts of the apparatus will result in opening the valve 14 and filling the dry side of the system with

water; hence the device has fail-safe characteristics. A leakage in the chamber 26 or bellows 28 would permit the plunger 19 to move upwardly, and the valve 14 to open. Failure in the conduit 64 extending from the housing 40 to the housing 10 would result in a reduction in pressure on the exterior of the bellows 53, which would open the valve 27 and therefore open the valve 14. A leak in the bellows 53 would admit air under pressure to the interior of the bellows, equalizing the pressures on the outside and inside of the bellows, and thus permitting the spring 66 to move the head of the bellows to the left, operating the rod 42 to open the valve 27. Failure of the bellows 54 might result in slowing down of the operation of the system, but could not otherwise effect it.

While failure of these parts would not be dangerous, nevertheless, the structure is simple and sturdy so that failures are very unlikely to occur. Furthermore, all of the working parts of the apparatus, with the exception of the clapper valve 14 and plunger 19, are immersed in or filled with oil, and thus protected from corrosion.

Those skilled in the art will appreciate that various changes and modifications may be made in the apparatus without departing from the spirit and scope of my invention. Therefore, it is to be understood that my patent is not to be limited to the preferred form described in detail in this specification or in any manner other than by the scope of the appended claims.

I claim:

1. A valve for a dry pipe sprinkler system comprising a main clapper valve adapted to control the flow of water into said dry pipe system, a plunger engaging said main valve for retaining it in closed position, hydraulic means for holding said plunger in engagement with said main valve, a control valve for controlling said hydraulic means, and operating means for said control valve comprising a chamber divided into two portions by a partition, the portion on one side of said partition being subject to the pressure within said dry pipe system, the portion on the other side of said partition being subject to atmospheric pressure, a flexible diaphragm mounted on said partition and extending into the said portion subject to pressure within said dry pipe system whereby the exterior of said diaphragm is subject to the pressure within said dry pipe system, another flexible diaphragm mounted on said partition and extending into the said portion subject to atmospheric pressure whereby the exterior of said other diaphragm is subject to atmospheric pressure, the interiors of said diaphragms being in substantially unrestricted communication with each other and the interior of said diaphragms being in restricted communication with the portion of said chamber subject to atmospheric pressure, whereby relatively rapid changes in pressure within said dry pipe system will cause movement of both said diaphragms and relatively slow changes in pressure will cause movement only of the diaphragm subject to pressure within said dry pipe system, and means engageable by said diaphragms for operating said control valve to release said plunger and permit said main valve to open in response to a rapid decrease in pressure in said dry pipe system and

in response to any reduction in pressure in said dry pipe system below a predetermined minimum.

2. A valve for a dry pipe sprinkler system comprising a main valve adapted to control the flow of water into said dry pipe system, means for controlling said main valve, comprising two flexible diaphragms, one side of the first diaphragm being subject to the pressure of fluid within said dry pipe system and the other side thereof being subject to the pressure of fluid between said diaphragms, one side of the second diaphragm being subject to the pressure of fluid between said diaphragms and the other side thereof being subject to atmospheric pressure, the space between said diaphragms being in restricted communication with atmospheric pressure, whereby relatively rapid changes in pressure within said dry pipe system will cause movement of both said diaphragms and relatively slow changes in pressure will cause movement only of the first diaphragm, and means operated by said second diaphragm for opening said main valve in response to a rapid decrease in pressure in said dry pipe system and operated by said first diaphragm for opening said main valve in response to a reduction in pressure in said dry pipe system below a predetermined minimum.

3. A valve for a dry pipe sprinkler system comprising a main clapper valve adapted to control the flow of water into said dry pipe system, a plunger engaging said main valve for retaining it in closed position, hydraulic means for holding said plunger in engagement with said main valve, a control valve for controlling said hydraulic means, and means for opening said control valve to permit said main valve to open, comprising two flexible diaphragms, one side of the first diaphragm being subject to the pressure of fluid within said dry pipe system and the other side thereof being subject to the pressure of fluid between said diaphragms, one side of the second diaphragm being subject to the pressure of fluid between said diaphragms and the other side thereof being subject to atmospheric pressure, the space between said diaphragms being in restricted communication with atmospheric pressure, whereby relatively rapid changes in pressure within said dry pipe system will cause movement of both said diaphragms and relatively slow changes in pressure will cause movement only of the first diaphragm, and means operated by said second diaphragm for opening said control valve in response to a rapid decrease in pressure in said dry pipe system and operated by said first diaphragm for opening said control valve only in response to a reduction in pressure in said dry pipe system below a predetermined minimum.

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