Dec. 3, 1935. I. W. KNIGHT 2,022,671

AUTOMATIC SPRINKLER SYSTEM

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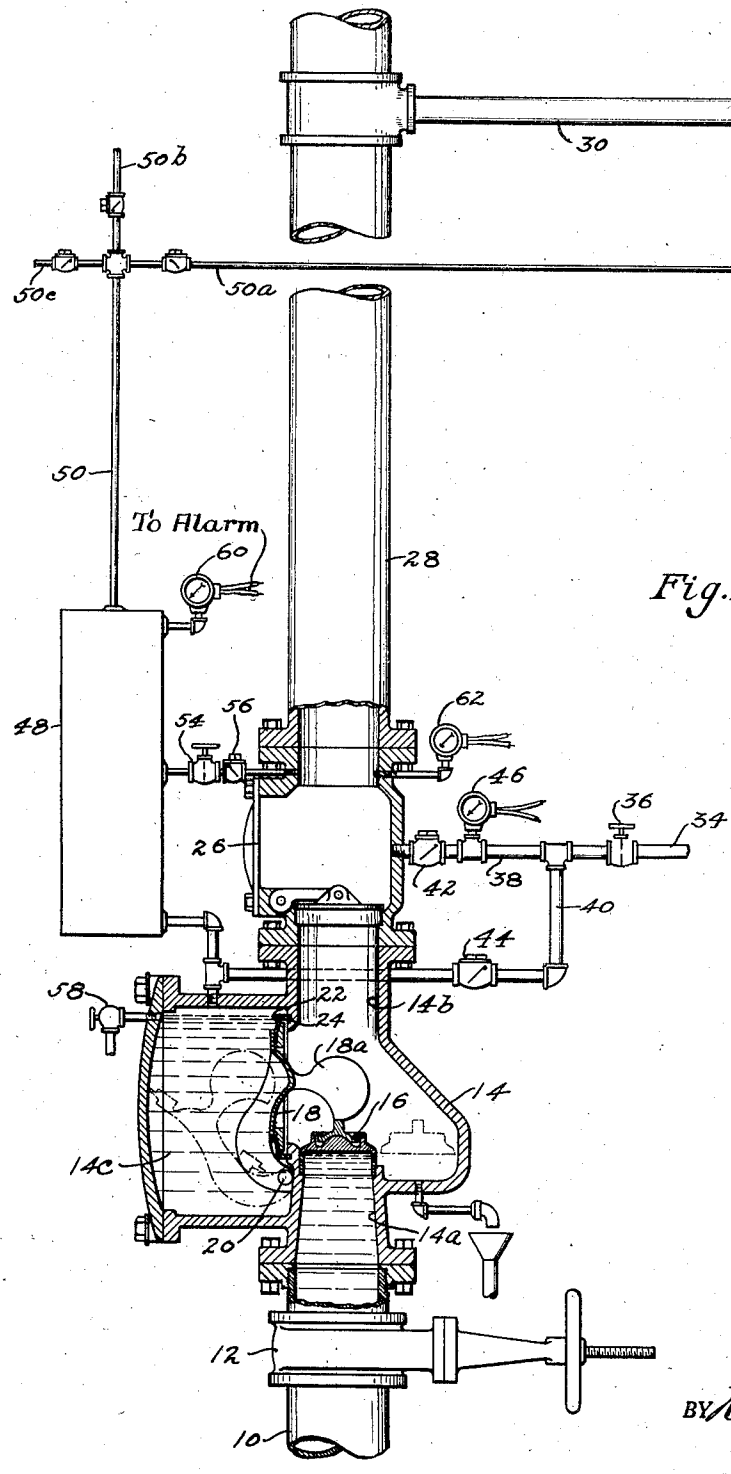


Fig. 1

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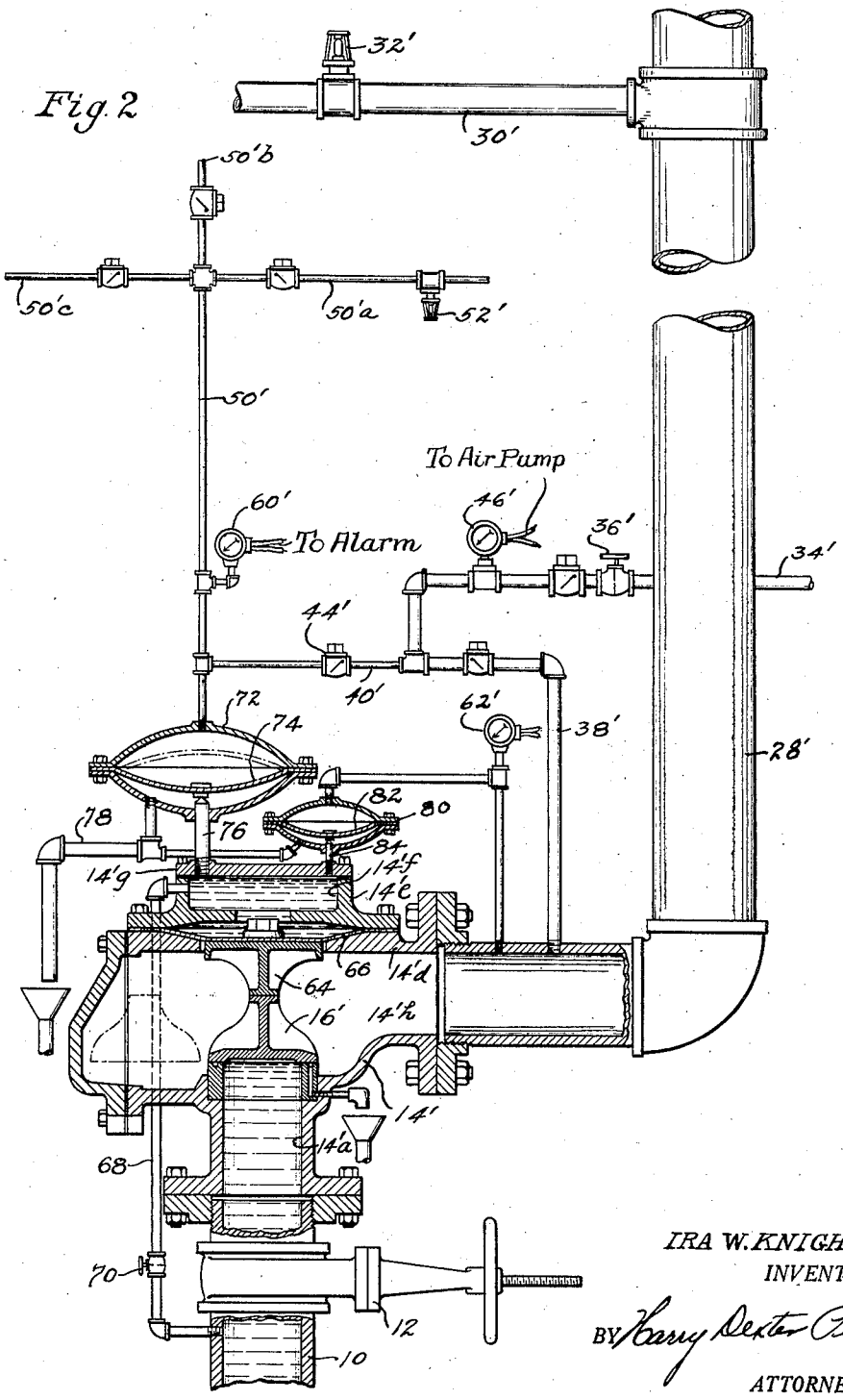
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Fig. 2



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AUTOMATIC SPRINKLER SYSTEM

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6 Claims. (Cl. 169—17)

This invention relates to improvements in automatic sprinkler systems.

For years automatic sprinkler systems have been generally of two types, the wet-pipe system and the dry-pipe system. In the former the distributing pipes stand filled with a fire extinguishing medium ready for immediate discharge upon the opening of a sprinkler. Since water is the most common medium used, it is not feasible to maintain a system wet where the pipes thereof are exposed to freezing temperature and so in such cases the dry-pipe system is employed. In this the distributing pipes stand charged with a gas—usually air under pressure—which, acting through a so-called dry pipe valve, holds back the water supply until a sprinkler opens. When this occurs the air escapes and thus reduces its pressure to a point where the water acting on the dry pipe valve forces the latter open and flows through the pipes to the open sprinkler. Both systems have recognized advantages and disadvantages. The wet pipe system being always filled with the fire extinguishing medium immediately discharges this medium upon the giving way of a sprinkler head. As already stated, it can not be used where there is danger of freezing and even in risks where this danger is absent, it is frequently desirable to have dry pipes to avoid leakage of water on the stock or equipment under protection. In fact both the wet and dry pipe systems are liable to cause water damage in many cases far in excess of the fire damage which occasions their operation.

To minimize this danger of water damage, especially such as might follow the unintentional venting of the distributing pipes, it has been the practice in some installations to provide a dry-pipe system with a valve which will be locked shut until the lock thereof is released by an auxiliary system whose responsive mechanism is a rate-of-rise device. Upon the action of the said device and consequent unlocking of the main valve, water can flow into the distributing pipes and stand therein ready for discharge when the automatic heads open, but if for any reason the rate-of-rise device fails, due to being inoperative at the moment or because the change of temperature is not fast enough to effect its intended action, no water will flow even though the fire progresses to the extent of causing the sprinkler heads themselves to open. It is alleged, as an attribute of this last mentioned system that if a sprinkler opens prematurely or the distributing piping becomes broken no water can flow because the valve which holds it back is locked against opening and can only be unlocked by the rate-of-rise control means. While this characteristic of the system is commendable from the viewpoint of preventing water damage, it is contrary to the fundamental principle of all automatic sprinkler systems, to wit, that the flow of water will be automatically effected by the opening of a sprinkler head.

In keeping with this well-established rule, the present invention is directed to the provision of a dry-pipe system which will unfailingly operate if a sprinkler opens. In the intended course of events an auxiliary system is expected to respond initially to a predetermined temperature condition and charge the normally dry pipes with water ready to be discharged upon the subsequent opening of a sprinkler. If, however, for any reason the auxiliary system should not respond, flow of water will nevertheless occur when a sprinkler has opened. To avoid needless water discharge should a sprinkler open prematurely or a distributing pipe become broken, the present invention provides for a sufficient delay between such unintentional venting of the pipes and the opening of the dry valve to give an attendant ample opportunity to shut off manually the water supply and thus prevent flow past the valve.

Indeed, it is within the scope of the invention to make it possible to prevent sprinkler discharge even after the distributing pipes have been charged with that liquid. In other words, it is an object to provide a sufficient delay between the unintentional venting of the distributing pipes and the entrance of water thereto, or between the normal filling of these pipes with water and the opening of a sprinkler, to permit the water supply to be shut off manually before damaging discharge can occur. Other features and advantages of the improved system will become apparent as the detailed description develops.

There is disclosed herein two embodiments of the best mode in which I have contemplated applying my invention, but these are merely illustrative and it is intended that the patent shall cover by suitable expression in the appended claims whatever features of patentable novelty exist in the improvements disclosed.

In the accompanying drawings:

Figure 1 is an elevation, partly in section showing an embodiment of the invention, wherein the water supply is held back solely by the air pressure of the system; and

Figure 2 is a similar view but showing how the

water supply pressure itself may be utilized to resist its tendency to flow.

In the system shown in Figure 1 a fire extinguishing medium such as water under suitable pressure stands in supply pipe 10, an open gate valve 12 and in the inlet 14a of a dry pipe valve 14. The latter has a water clapper 16 adapted when seated to close the waterway and hold back the water supply, and being so mounted that when free to move this clapper will travel transversely off its seat to the position shown in dot and dash outline. When the system is quiescent or standing-by the water clapper is held seated by an air clapper 18 pivoted at 20 and having a rubber gasket 22 around its edge making contact with an annular seat 24. A weighted arm 18a on this air clapper engages the water clapper and holds the latter firmly closed when the air pressure on clapper 18 is above a predetermined degree.

The outlet 14b of the dry pipe valve is connected to a check valve 26 to which in turn is connected the distributing pipes of the system such as the riser 28 and horizontal feed pipes 30. These pipes carry at suitable intervals automatic sprinkler heads 32 which are normally held closed but adapted to open automatically when a thermally responsive element is heated to a predetermined degree. Air under pressure is supplied from any suitable source through pipe 34 to the system. In this supply line is a restriction valve 36 beyond which are branches 38, 40 leading respectively to the distributing pipes above the check valve 26 and to the air chamber 14c of the dry pipe valve. In both branches are check valves 42, 44 to prevent back flow of air from both the pipes and the said air chamber. Attached to the air supply is a pressure responsive device 46 which acts automatically upon a drop of the air pressure to a certain degree to actuate means for forcing air into the system until the normal stand-by pressure is restored, and then shuts off said air supply means.

Connected to the air chamber 14c is an auxiliary air system comprising a tank 48 and tubing 50 which may ramify as desired about the risk to be protected, there being shown in the drawings three branches 50a, 50b, 50c indicative of its ramifications. Wherever a fire hazard exists or wherever desired, thermally responsive devices 52 are attached to the tubing. These, like the sprinkler heads previously mentioned, are capable of automatically opening when a predetermined temperature condition exists. Indeed these thermally responsive devices may themselves be sprinkler heads, operative at the same or at a lower temperature than the heads 32. If operative at the same predetermined temperature, the heads 52 should be closer to the fire hazard or their thermal element better exposed so that they will be heated to said predetermined degree prior to the heating of the heads 32 to the same temperature.

This auxiliary system is also connected to the distributing pipes through another restriction valve 54. This latter connection also comprises a check valve 56 preventing flow of air from the distributing pipes to the auxiliary system. Both the restriction valve 36 in the air supply line and the restriction valve 54 are adjustable, but as will more particularly appear later, the air supply restriction valve 36 should always be set to a less flow capacity than the restriction valve 54 between the distributing pipes and auxiliary system.

In setting the system for operation, the gate valve 12 is closed and the system beyond drained of water. The water clapper 16 is then seated and the air clapper 18 swung to its seat with its counterbalancing arm 18a resting on the water clapper. The air chamber is next primed with water to cover the rubber ring, the proper level of this water being indicated by discharge from the quick-opening hand valve 58. When this discharge appears, the flow of priming water is cut off, the hand valve is closed and the system charged with air. The degree of pressure of this air is determined in part by the pressure of the water supply to be held back and in part by the differential of the dry pipe valve. In the particular valve illustrated the differential is approximately 6 to 1 and so if the water supply pressure is, say 90 pounds, the air pressure necessary in the system to keep the water clapper closed must be at least 15 pounds. In practice a pressure of from 20 to 25 pounds will ordinarily be maintained under stand-by conditions through the automatic action of the pressure responsive device 46.

In the intended operation of the system, as when a fire occurs, one or more of the thermally actuated devices 52 will respond and vent the auxiliary system, thereby promptly dropping the pressure in the air chamber of the dry pipe valve. This sudden drop of pressure actuates a pressure responsive device 60 to cause a distinctive alarm to be given indicating that the pressure holding the dry pipe valve closed has fallen and that the valve is about to open for flow of water into the distributing pipes. If the fire is of such a nature that it is promptly discovered and can be manually extinguished before one or more of the heads 32 give way, no water will be discharged and hence no water damage will occur. If, however, the fire increases in intensity so that one or more of the heads open, water is thereupon discharged from the water charged pipes with fire extinguishing effect. As soon as the fire is out, the main gate valve 12 is closed, the system drained, the opened heads 32 and devices 52 replaced, and the system again prepared as already described.

Assume, however, that for some unexpected reason the auxiliary system does not respond in the event of a fire and that the first effect on the system is a giving way of one of the sprinkler heads 32. This promptly vents the distributing pipes (but, as will presently appear, does not immediately open the dry pipe valve) and the consequent drop of air pressure therein actuates another pressure responsive device 62 to cause a different alarm to be sounded indicating that in some way air is rapidly escaping from the distributing pipes. If this alarm brings an attendant promptly to the fire, and he finds that he can extinguish it by hand, he can go or send another to close the main gate valve 12 to prevent water flow into the system. If, however, he sees that the fire requires the prompt action of the sprinkler system he can go to the dry pipe valve and open the quick-opening hand valve 58. This will effect the immediate opening of the dry valve with consequent rush of water through the distributing pipes to the open sprinklers 32.

But if no attendant is at hand, water will nevertheless be discharged from the system. This is due to the provision of the connection between the auxiliary system and the distributing pipes. When the latter are vented, air will at once begin to flow slowly through the restriction valve 54 from the auxiliary system to the distributing pipes and, depending upon the rate of

flow and the air capacity of the auxiliary system, will in due time so reduce the pressure in the air chamber 14c as to bring about the automatic opening of the dry pipe valve. Thus the fundamental rule of an automatic sprinkler system is obeyed because in the event of a sprinkler opening water will unfailingly be discharged unless, as previously stated, the attendant intentionally closes the main gate valve or, if he prefers, closes the restriction valve 54.

The drop in air pressure which follows the opening of either a thermal device 52 or a sprinkler 32 affects the pressure device 46 to admit air to the system through pipe 34. But this can not flow into the system as fast as the rate of flow through restriction valve 54 because the restriction valve 36 in the air supply line will always be set for less flow capacity than is valve 54. Consequently, even when a sprinkler head prematurely opens or the distributing pipes become broken and the air supply is turned on, the rate of flow of the air from the air chamber of the dry pipe valve is determined by the setting of restriction valve 54. The flow capacity of the latter, together with the quantity of air in the auxiliary system, controls the period of delay between the unintentional venting of the distributing pipes and the opening of the dry pipe valve. With device 60 set to give an alarm almost immediately following a drop of pressure in the auxiliary system, it is quite feasible for an attendant to investigate conditions and determine whether or not sprinkler discharge is needed. Thus although the system is bound to discharge water if the distributing pipes are vented, and no other action is taken, the invention provides a margin of delay sufficient to permit the water supply to be shut off manually and thus avoid unnecessary water damage.

Figure 2 shows another embodiment of the same invention, the means disclosed illustrating a different application of the principles involved. Here the water stands in supply pipe 10, gate valve 12 and inlet 14'a of a dry pipe valve 14'. The water clapper 16' of this valve is held seated by a strut member 64 secured to a diaphragm 66 held at its edge between the body 14'd and an intermediate portion 14'e of the valve. These form a chamber for the diaphragm which is in open communication with another chamber 14'f formed by the intermediate portion and the cover 14'g. Water is transmitted from the supply pipe 10 to these chambers through the pipe 68 which includes a restriction valve 70. This water, acting on the diaphragm 66 and strut 64 keeps the water clapper seated. The intermediate chamber 14'h of the dry pipe valve opens into the distributing pipes 28' and 30' which serve the automatic sprinkler heads 32'.

An auxiliary system comprising the tubing 50', having branches 50'a, 50'b, and 50'c extends as before throughout the risk and has devices 52' adapted to open automatically when a predetermined temperature condition exists. This tubing is connected to a casing 72 having a diaphragm 74 therein controlling a vent 76 of relatively large capacity from the water chamber 14'f. Under normal stand-by conditions the air pressure in the tubing, acting on the diaphragm 74 keeps the vent 76 closed, but if a device 52' opens with consequent drop of this air pressure, the water pressure flexes the diaphragm 74 to a position such as is indicated in dot and dash outline. With the vent 76 thus opened water flows into the casing 72 and thence through pipe 78 to waste. This rate of flow is greatly in excess of the possible flow of water past the restriction valve 70 and so very promptly the water pressure acting on the clapper 16' forces it, together with the strut 64 and diaphragm 66 upward, thus admitting the water to the distributing pipes. The clapper 16' is so mounted and organized that the water causes it to travel to one side of its seat to a position indicated by the dot and dash outline. Thus upon the action of a device 52', the distributing pipes are charged with water ready for immediate discharge whenever a sprinkler opens.

If, however, a sprinkler should open prematurely or the distributing pipes become broken, the consequent loss of air is not transmitted to the diaphragm 74 because of the check valve 44' in the branch 40' from the air supply line 34'. This drop of pressure is communicated to a second casing 80 having another diaphragm 82 therein controlling a relatively small vent 84 from water chamber 14'f. The flow capacity of this vent is only slightly greater than the flow capacity of restriction valve 70, and accordingly there is a delay between the opening of vent 84 and the ultimate opening of the dry pipe valve. This is comparable with the delay between the venting of the distributing pipes and the opening of valve 14 as already described in connection with the system of Figure 1 and allows an attendant to shut the main gate valve 12 if flow of water into the distributing pipes is not needed.

Since the water clapper 16' in this arrangement of Figure 2 is primarily held closed by the water pressure itself, the air pressure carried in the distributing pipes and in the tubing can be very small. Pressure responsive devices 60' and 62' provide for suitable alarms and another such device 46' automatically maintains the normal stand-by pressure of air. A restriction valve 36' in the air supply line prevents the air supply from affecting the diaphragms when either have been flexed to vent the water chamber 14'f.

I claim:

1. An automatic sprinkler system comprising distributing pipes normally charged with air under pressure and provided with automatic sprinkler heads capable when opened of venting said pipes; a supply of fire extinguishing medium therefor; a dry pipe valve interposed between the said pipes and said supply and acted upon by the air pressure to hold back said supply from the distributing pipes; an auxiliary system charged with air under pressure having an operative connection with said valve on the air side thereof and having thermally responsive devices adapted to vent said system to atmosphere and thereby effect the opening of said valve for admission of said medium; and a restricted connection between the distributing pipes and the auxiliary system adapted upon the venting of said distributing pipes, prior to the venting of said auxiliary system, to effect a delay in the opening of said valve.

2. An automatic sprinkler system comprising distributing pipes normally charged with air under pressure and provided with automatic sprinklers; a supply of fire extinguishing medium therefor; a valve held closed by the maintenance of said air pressure holding back said supply from the distributing pipes; an auxiliary system charged with air under pressure having means operative at a predetermined temperature to vent said system and an operative connection with said valve adapted upon the venting of said

auxiliary system to effect opening of said valve for admission of water; a restricted connection between said auxiliary system and the distributing pipes capable of delaying the venting of said system following the venting of said distributing pipes.

3. An automatic sprinkler system comprising closed distributing pipes normally charged with air under pressure; a supply of fire extinguishing medium; a valve acted upon by said air pressure to hold back said supply; means in said distributing pipes adapted to respond at a predetermined temperature to vent said pipes; a restricted connection between said pipes and said valve capable of delaying the opening of the valve for a predetermined period following the venting of said pipes.

4. An automatic sprinkler system comprising closed distributing pipes normally charged with air under pressure and provided with automatic sprinklers; a supply of fire extinguishing medium; an auxiliary system also charged with air under pressure and provided with means responsive at a predetermined temperature to vent said system; a valve holding back said supply and having connections with both the auxiliary system and the distributing pipes and adapted to be held closed by the air pressure thereof; and a restricted connection between said auxiliary system and the distributing pipes capable of retarding the escape of air holding said valve closed, whereby upon the venting of the distributing pipes the opening of said valve is delayed.

5. An automatic sprinkler system comprising closed distributing pipes normally charged with air under pressure and having an automatic sprinkler adapted to open at a predetermined temperature for sprinkler discharge; a supply of fire extinguishing medium connected to said pipes; a valve in the said connection capable when closed of holding back said supply; and an auxiliary system also charged with air under pressure, having associated therewith a device capable of responding, prior to the opening of said sprinkler, upon the occurrence of a predetermined temperature condition to vent said auxiliary system; said auxiliary system being connected to said valve in such manner that the latter is held closed by the pressure in said auxiliary system; the said valve being opened by the supply pressure upon the venting of said auxiliary system consequent upon the opening of said device, thereby to admit said medium to the distributing pipes prior to the opening of the sprinkler; and there being a restricted connection between said auxiliary system and said distributing pipes capable, when a sprinkler responds ahead of said device, of delaying the opening of said valve.

6. An automatic sprinkler system comprising distributing pipes normally charged with air under pressure and provided with automatic sprinklers; a supply of fire extinguishing medium therefor; a valve interposed between said supply and the distributing pipes and acted upon by fluid pressure in opposition to the pressure of said supply for holding the valve closed; and means associated with said valve and said distributing pipes capable of effecting the opening of said valve upon the venting of said pipes and comprising a passage for relief of the fluid pressure normally holding said valve closed; said passage being restricted as to flow to delay the opening of said valve for a predetermined period after the venting of said pipes.

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