United States Patent [19]

Hodgman, Jr.

[11] **3,710,813**

[45] **Jan. 16, 1973**

[54] **PNEUMATIC FIRE DETECTION SYSTEM FOR DELUGE VALVE**

[75] Inventor: **Willis K. Hodgman, Jr.**, Taunton, Mass.

[73] Assignee: **Hodgman Manufacturing Company, Inc.**, Taunton, Mass.

[22] Filed: **Feb. 16, 1971**

[21] Appl. No.: **115,275**

[52] **U.S. Cl.** **137/79,** 137/468, 251/73

[51] **Int. Cl.** **F16k 31/143,** F16k 31/363

[58] **Field of Search**.....137/78, 79, 80, 81, 468; 251/66, 73; 169/19, 20, 21, 22

[56] **References Cited**

UNITED STATES PATENTS

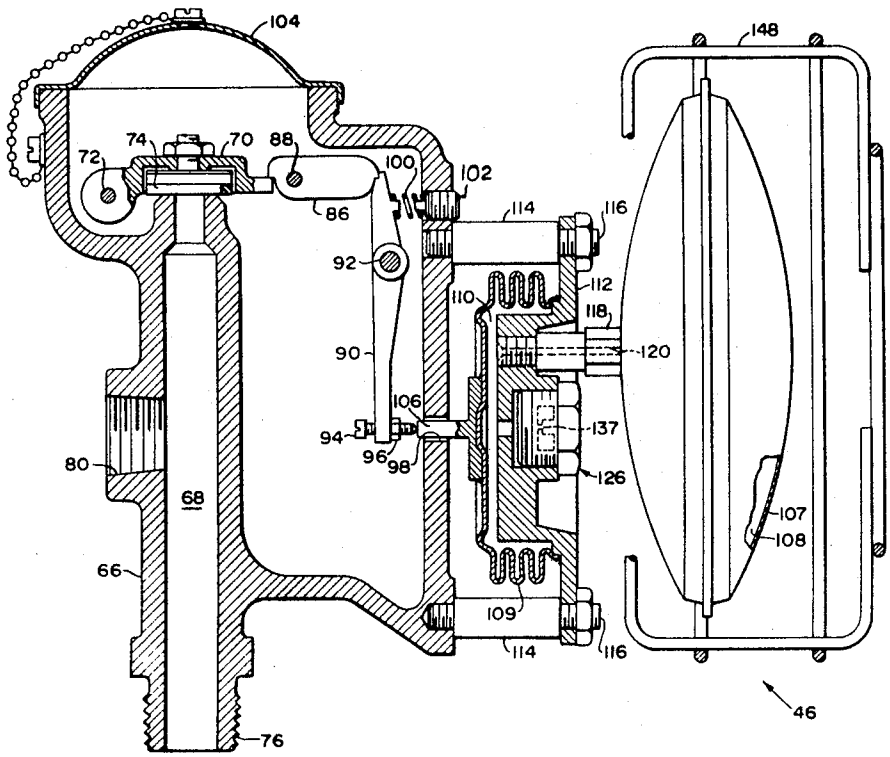
1,143,762	6/1915	Hooks	137/79 X
1,869,204	7/1932	Lowe et al.	169/19
2,187,906	1/1940	Lowe	137/79 X
2,469,831	5/1949	Lews	169/19
2,485,091	10/1949	Freeman	169/21
2,586,720	2/1952	Rowley	169/19
3,262,322	7/1966	Fallis et al.	169/21
3,292,709	12/1966	Hodgman, Jr.	169/21

Primary Examiner—Henry T. Klinksiek
Assistant Examiner—David R. Matthews
Attorney—Kenway, Jenney & Hildreth

[57] **ABSTRACT**

A system for initiating the release of a deluge valve. A pneumatic detection impulse, operating through a mechanical link, releases the pressure in a fluid-filled pilot line, thereby releasing the holding mechanism on the deluge valve. The pneumatic impulse is produced when the ambient air temperature rises rapidly in an expansible chamber communicating with ambient air through a vent having a restriction.

10 Claims, 6 Drawing Figures



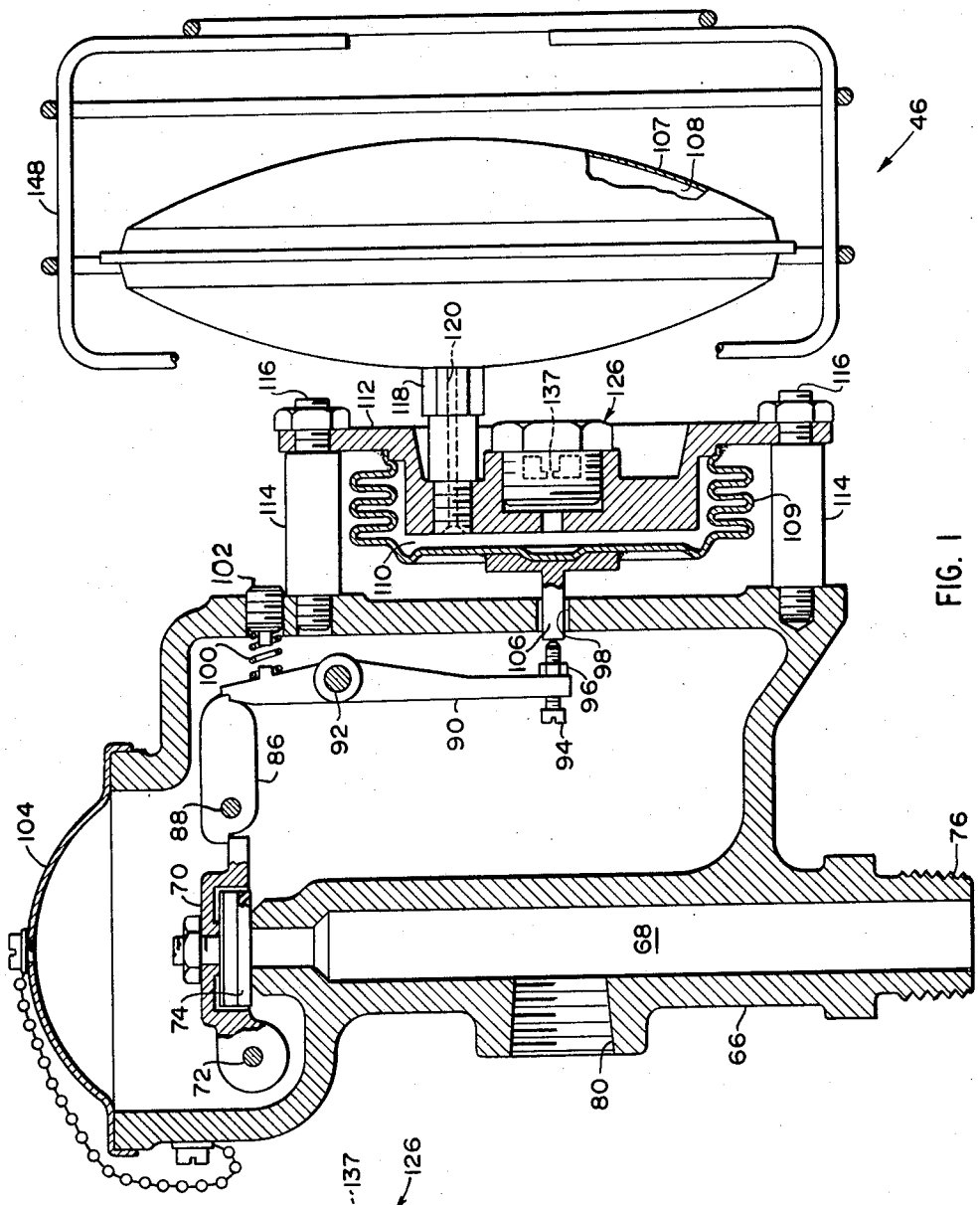


FIG. 1

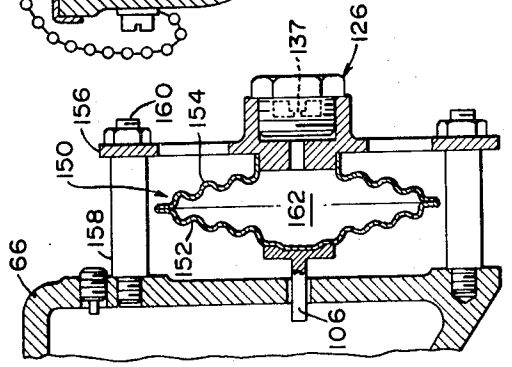


FIG. 1a

INVENTOR
WILLIS K. HODGMAN, JR.
BY Kenway, Jenney & Hildreth
ATTORNEYS

FIG. 2

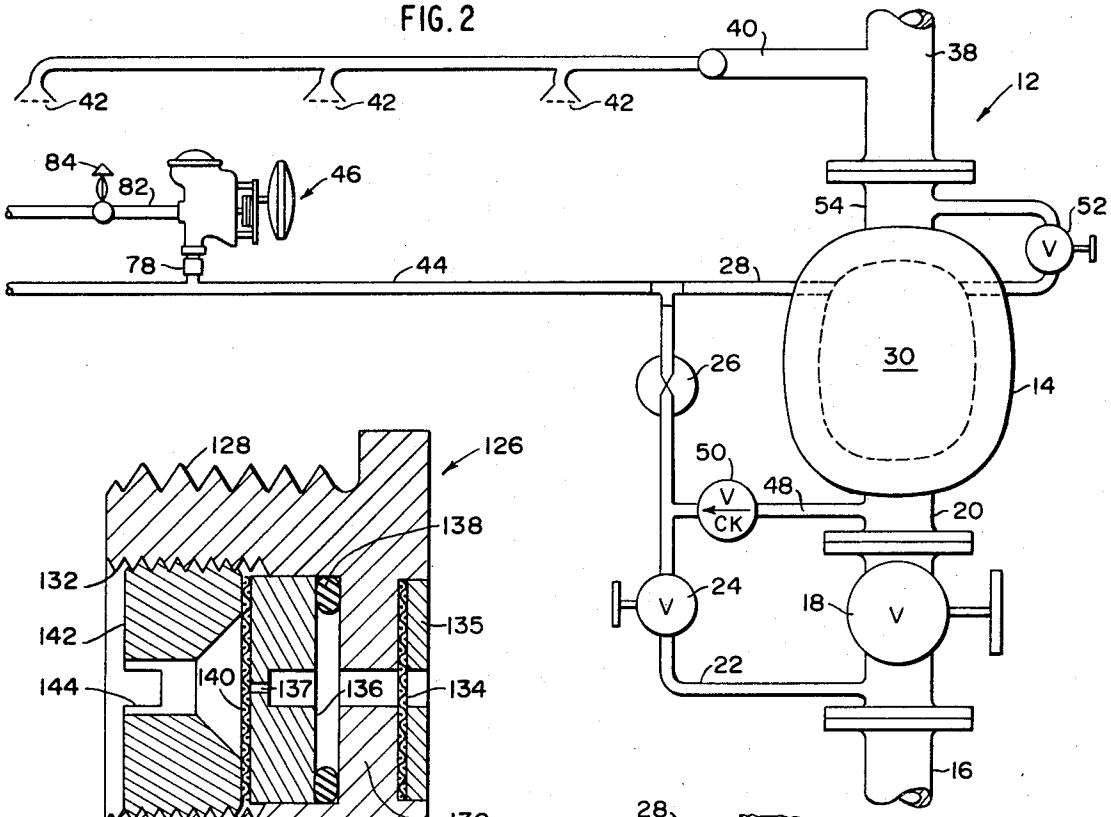


FIG. 4

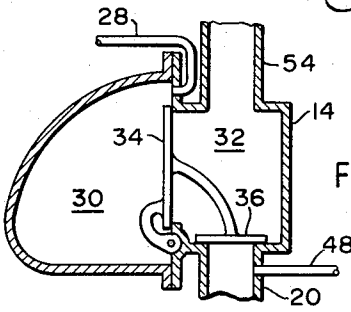


FIG. 5

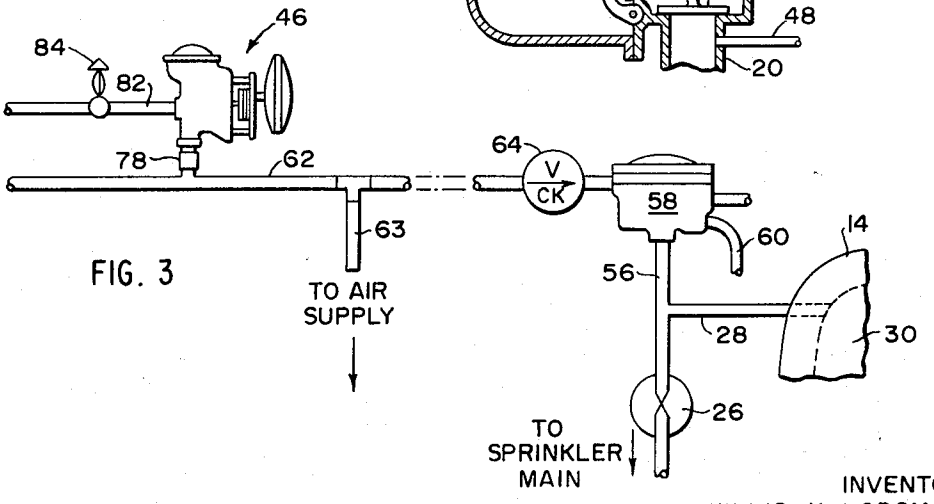


FIG. 3

INVENTOR
WILLIS K. HODGMAN, JR.

BY Kenway, Jenney & Hildreth
ATTORNEYS

PNEUMATIC FIRE DETECTION SYSTEM FOR DELUGE VALVE

BACKGROUND OF THE INVENTION

This invention relates generally to deluge sprinkler systems for fire control. More specifically, it concerns a system for detection of a fire and transmission of a control impulse to release a deluge valve, allowing it to open.

A typical deluge system includes a network of empty pipes having open sprinkler heads connected to a sprinkler main through a normally closed deluge valve. This is called an "empty pipe" system because the sprinkler pipes do not contain a fluid under pressure until the deluge valve is opened. By contrast, a "dry pipe" system is one in which the sprinkler pipes normally contain air under pressure, with the sprinkler heads normally sealed, and in a "wet pipe" system the sprinkler pipes are normally filled with water pressure, also with the sprinkler heads normally sealed. The normal absence of fluid pressure in a deluge system makes it necessary to provide a pilot or auxiliary line extending from the fire detection means adjacent the sprinkles to the release means for the deluge valve. The pilot line may consist of electrical wiring or it may consist of tubing or piping of much smaller diameter than that connected with the sprinklers, the pilot line containing a fluid through which a control pulse may be transmitted from the detection means to the deluge valve release means. The fluid may be water, air or an inert gas such as nitrogen.

Electrical pilot systems are expensive because it is ordinarily necessary to provide them with emergency electrical power sources including storage batteries and trickle chargers to anticipate a possible public power system failure at the time a fire is occurring. This equipment and the electrical apparatus for receiving and transmitting signals from fire detection thermostats make it necessary to provide a suitable electrical control panel with the attendant complexity of wiring and installation costs.

Fluid pilot lines for deluge systems have previously taken the form of "wet pilot lines," "dry pilot lines," and "empty pilot lines." In the applicant's prior U.S. Pat. No. 3,292,709, dated Dec. 20, 1966, FIG. 3 illustrates a wet pilot line system and FIG. 4 illustrates a dry pilot line system. In each case the pilot line is under fluid pressure. The wet pilot line is connected to the sprinkler main upstream of the deluge value through a restricting orifice. Downstream of the orifice the pilot line is connected with a pressure chamber. Means are provided whereby the maintenance of water pressure in this chamber equal or nearly equal to that in the main holds the deluge valve closed. Therefore, a sudden release of water pressure in the pilot line by operation of a fixed temperature automatic sprinkler head connected thereto releases the pressure in the control chamber and allows the deluge valve to open.

In the dry pilot line system of said patent, the pilot line is filled with air under pressure and is connected to a secondary valve, normally holding it in closed position, thus maintaining the pressure in a water-filled control line like that in the wet pilot line system and which is connected to the sprinkler main upstream of the deluge valve through a restricting orifice. The deluge valve has the same type of control chamber previously described, with a connection to the control line at a point located between the restricting orifice and the secondary valve. Thus a release of air pressure in the pilot line by the opening of a fixed temperature automatic sprinkler head connected thereto opens the secondary valve, releasing the pressure in the control line and the control chamber connected to it, allowing the deluge valve to open.

These prior pressurized, fluid-filled pilot line systems have the advantages of a supervised system of detection, in that any cutting, leaking or breakage of the pilot line functions in the same manner as a detected fire, rather than resulting in a dormant defect that disables the detection system completely without necessarily providing any warning of this serious condition.

The patent to E. A. Lowe et al., U.S. Pat. No. 1,869,204, dated July 26, 1932, illustrates what may be called an "empty pilot line" system for control of a deluge valve, the pilot line extending from an air chamber in the space where fire detection is required to a flexible diaphragm having a portion for releasing a latch to permit a deluge valve to open. The pilot line has a vent by which its interior communicates with the ambient air. This vent permits the pilot line to operate on the "rate of rise" principle, but has the disadvantage that accidental cutting, leaking or breaking of the pilot line disables it so that it cannot transmit a pulse corresponding to a rapid rise in the temperature at the air chamber, and the system itself is not so devised as to be supervised to insure against this defect. A further disadvantage is noted in installations having branched pilot lines which may be several hundreds of feet in length, with multiple detectors. In order to prevent these branches from absorbing energy from the signal impulse it is usually necessary to install check valves in each branch, which adds to the cost.

Other forms of rate-of-rise detection devices have been proposed for release of deluge valves, including a device having a pair of aluminum rods of different diameters that elongate at different rates during a rapid increase in the ambient temperature. This differential rate is utilized for releasing the pressure on a wet pilot line. The advantage of this system lies in providing the combination of supervision with a rate-of-rise detection device, but the system suffers from the disadvantage that the detection means itself is usually of substantial size, with rods typically about two feet long. The difficulty of physically providing for the bulk of the detection devices is further compounded by the possibility of corrosion of the metal rods by fumes in the air.

It is an object of this invention to provide rate-of-rise detection in a supervised system, utilizing detection means of small and inconspicuous size, without the necessity of providing electrical apparatus, power supplies or controls.

Other objects of this invention will become more evident from the following description.

SUMMARY OF THE INVENTION

This invention achieves the foregoing objects by providing a system in which the fire detection signal is produced by pneumatic means operating on the rate-of-rise principle, the system operating through a mechanical transition to transmit a control pulse through a pressurized, fluid-filled pilot line to the

deluge valve where the pulse is operative to release the valve and fill the sprinkler system with water. The pilot line may be filled with either air or water under pressure, and the detection device includes a control valve latched in closed position. The latch may be released by the movement of an expansible chamber filled with air and communicating with the ambient space through a restricted vent. The pneumatic detection portion of this system is closely confined within the detection device itself and there is no extended air-filled pilot line normally at ambient pressure as in the previously mentioned Lowe patent. The extended portion of the pilot line is under fluid pressure and therefore any accidental sudden loss of pressure therein produces the same result as a detected fire. Thus the important advantages of the supervised prior systems have been combined in a single system with rate-of-rise detectors readily and inconspicuously installed even in small and relatively inaccessible spaces.

Other features of the invention will become evident from the following description of two preferred embodiments, one a wet pilot line system and the other a dry pilot line system.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a side elevation partially in section illustrating a rate-of-rise detector for use in the system of this invention.

FIG. **1***a* is a fragmentary side elevation in section of an alternative to the embodiment of FIG. **1** showing a different means for releasing the control valve.

FIG. **2** is a fragmentary and partially schematic illustration of a wet pilot line system embodying the invention.

FIG. **3** is a fragmentary and partially schematic illustration of a modification of the system of FIG. **2** illustrating a dry pilot line embodiment of the invention.

FIG. **4** is a side elevation in section showing the detailed structure of the restricted vent fitting forming a part of the rate-of-rise detector.

FIG. **5** is an elevation in section of a deluge valve of the type employed with this invention, being somewhat fragmentary and diagrammatic in form for clarity of description.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning first to the preferred wet pilot line embodiment of this invention illustrated in FIG. **2**, the system as a whole is designated at **12** and is similar in structure to that shown in FIG. **3** of said U.S. Pat. No. 3,292,709 except for the rate-of-rise detector and its associated structures. Reference is made to said patent for a more detailed description of the structure and operation of the system as a whole, except in so far as the same relates directly to the operation of the fire detection device itself. In brief summary, the operation is as follows.

A deluge valve **14** (FIGS. **2** and **5**) is connected with a sprinkler main **16** through a hand-operated gate valve **18** and an inlet passage **20**. A control line **22** leads from the upstream side of the gate valve through a hand-operated priming valve **24** and a restricted orifice unit **26** to a connection **28** communicating with a control chamber **30**. The control chamber has a connection to a space **32**, this connection being closed by a clapper **34**. The clapper **34** is mechanically connected with a clapper **36** for isolating the sprinkler main from the space **32**. Although the clappers **34** and **36** are illustrated as being fully integral, it will be understood that the actual structures are somewhat more complex and include flexible seals and a universal joint as illustrated in said patent. The effective area of the seat for the clapper **34** exceeds that of the seat for the clapper **36**, whereby under normal standby conditions the presence of the same or nearly the same water pressure at the inlet **20** and within the chamber **30** maintains the clappers in the illustrated closed positions.

A sufficient drop in the pressure within the control chamber **30**, as by a sufficiently sustained relief of pressure in the control line **28**, permits the inlet pressure to swing the clappers open, allowing water to flow through the space **32** into the main sprinkler pipe **38**. In the usual system, secondary lines **40** are connected to the pipe **38**, these lines having one or more open sprinkler heads **42**.

As disclosed in the last-mentioned patent in greater detail, priming of the system is accomplished by closure of the gate valve **18** and opening of the valve **24** to allow water from the main **16** to pass through the restricted orifice unit **26** and the connection **28** into the control chamber, holding the clappers in the closed position illustrated in FIG. **5**. At the same time water fills a wet pilot line **44** extending throughout the space occupied by the sprinklers where one or more detectors **46** are located in suitable positions for detecting a rapid rate of rise of the ambient temperature caused by a possible fire. Once the pilot line has been completely filled with water the valve **24** is closed and the valve **18** is opened to apply the supply pressure to the clapper **36**. This does not open the deluge valve, however, because supply pressure then exists within the control chamber **30**.

Through operation of the detector **46** as hereinafter more fully described and caused by a rapid increase in the temperature adjacent this device, a sudden reduction occurs in the pressure within the line **44**, which is communicated to the control chamber **30**. There is a tendency for this pressure to be restored by a flow of water from the inlet **20** through a connection **48**, a check valve **50** and the orifice unit **26**, but this flow is impeded by the orifice unit **26** to such an extent that the drop in the control chamber pressure is very rapid and this permits the supply pressure to open the clappers practically immediately and to fill the sprinkler supply pipe **38** and the associated branches and sprinklers.

A test valve **52** provides a simple means for releasing the pressure within the control chamber **30** by connection thereof to an outlet **54** on the valve connected with the pipe **38**.

The preferred dry pilot line embodiment of the invention illustrated in FIG. **3** contains many of the same elements as those illustrated in FIG. **2**, and is also fully described in said U.S. Pat. No. 3,292,709 except for the detector **46**. The deluge valve **14** has the same water connections and associated structures including the control chamber **30**, the restricted orifice unit **26** leading to the sprinkler main and the connection **28**. However, in place of the wet pilot line **44** of FIG. **2**, a short

line 56 leads to a secondary valve 58 operative upon opening to relieve the pressure on the line 56 through a discharge line 60. The secondary valve 58 is held closed by air pressure in a dry pilot line 62 connected to the valve through a check valve 64. The line 62 has a branch 63 leading to an air supply provided with the usual fittings for a dry pilot line release system, omitted from the drawing for simplicity. These fittings normally include a pressure regulator, a pressure relief valve, a check valve and a low-air alarm switch. The air pressure in the line 62 is normally held at about one-third the value of the water pressure in the sprinkler main.

In case of a rapid rate of rise in the temperature adjacent the detector 46 as hereinafter more fully described, there is a drop in the air pressure within the pilot line 62 which is communicated to the secondary valve 58, causing it to open, thereby relieving the water pressure in the lines 56 and 28 and the control chamber 30. This causes the deluge valve to open in the manner previously described.

It will be observed that in both of the embodiments of FIGS. 2 and 3 there is a fluid-filled, pressurized pilot line extending from the deluge valve to the fire-protected area. It will be understood that in many applications the latter area is somewhat remote from the deluge valve as a result of the necessity of locating the valve within a space maintained above the freezing temperature of water. One example is the cooling tower for an air conditioning system, mounted in an unheated position on the roof of a building. In this case the deluge valve is installed within a heated space in the building and the pressurized pilot line extends from this heated space to the cooling tower. An extended pilot line of this kind is subject to possible damage as it passes through walls, framework and partitions, but the accidental opening of the pilot line for any reason cannot result in a latent defect that will remain unnoticed until the advent of an actual fire condition. It will be understood that any sudden drop in the pressure within the pilot line is almost instantaneously transmitted to the control chamber to operate the deluge valve, whether the pilot line is filled with air or with water.

We turn next to a description of the preferred form of rate-of-rise detector 46, described in connection with FIGS. 1 and 4. This detector has a cast body 66 having an inlet passage 68 closed by a clapper valve 70 pivoted on a stud 72 suitably fastened in the body 66. The valve has a rubber seal 74 for tightly closing the passage 68. The passage 68 has a threaded nipple 76 for receiving a coupling 78 (FIGS. 2 and 3), the coupling communicating with the pilot line 44 or 62 depending upon whether the system has a wet pilot line or a dry pilot line.

A tapped hole 80 in the body 66 receives a threaded pipe 82 (FIGS. 2 and 3), this pipe being connected to a closed head sprinkler 84 which may be of a conventional form, for example a fixed temperature fusible link sprinkler. Such sprinklers operate on absolute temperature rather than the rate of rise and their purpose is to provide a supplementary means for releasing the pressure on the pilot line in cases where a fire causes a slow rate of rise of the temperature. The tapped hole 80 may be plugged in case this feature is not desired.

The valve 70 is held closed by a notched latch 86 pivoted on a stud 88 fastened in the body 66. The latch 86 is normally restrained by a lever 90 pivoted on a stud 92 similarly secured in the body 66. Near one end the lever 90 has a threaded adjustment screw 94 fitted with a lock nut 96, the screw 94 being located opposite an aperture 98 in an extension of the body 66 external to the passage 68. Suitable access to the head and lock nut on the adjustment screw is provided by a lateral access hole in the body. The lever 90 is normally urged in a counterclockwise direction by a compression spring 100 bearing at one end on a threaded adjustable screw 102.

The body 66 has a round opening above the valve 70 to which a dust cover 104 is fitted. This cover may be readily removed for inspection and resetting of the valve 70.

The parts of the valve are illustrated in FIG. 1 in the positions corresponding to the normal standby, pressurized condition of the pilot line. The control valve is released by the movement of a push rod 106 against the adjustment screw 94, pivoting the lever 90 clockwise a sufficient amount to release the latch 86 against the restraining pressure of the spring 100. Fluid pressure within the passage 68 normally applies a clockwise torque to the latch 86 as viewed in the drawing, through the application of a counterclockwise torque to the valve 70. The latch 86, once released by the lever 90, therefore pivots in a clockwise direction, allowing the valve 70 to swing to an open position, quickly relieving the fluid pressure within the passage 68 and the pilot line. As previously described, this immediately releases the deluge valve 14 and floods the deluge sprinkler system.

The movement of the push rod 106 toward the left as viewed in FIG. 1 is the result of a sufficiently rapid rate of rise in the ambient temperature at the detector 46. This is accomplished by means of pneumatic bulb means including a hollow soft copper bulb 107 defining a fixed volume air chamber 108, a metal bellows 109 defining an extensible air chamber 110 and a mutual supporting bracket 112 mounted on the body 66 by means of standoff posts 114 and screws 116. The bulb 107 is mounted on the bracket 112 by means of a suitable brass coupling 118 having a central passage 120 passing through it from end to end. The chamber 108 is filled with air, and the bulb 107 has a relatively thin wall whereby the ambient air temperature is quickly communicated to the air within the chamber and the temperature within the chamber is normally substantially identical to that of the surrounding air.

The expansible metal bellows 109 has a closed end and an open end brazed or otherwise secured to the bracket 112. The closed end is movable and suitably fastened by brazing or otherwise to the push rod 106 which has a flange for this purpose. It will be seen that the fixed and expansible air chambers 108 and 110 are in continuous communication through the passage 120 in the coupling 118.

The bracket 112 has a central counterbored aperture in which is threaded a vent unit 126, shown in detail in FIG. 4. This unit has a threaded body 128. The body has a central portion 130 between a tapped hole 132 on one side and a concentric bore on the opposite side for receiving a stainless steel screen 134. The screen 134 is held in place by a disk 135 with a central hole, brazed or otherwise secured to the body. A stainless steel disk

136 having an accurately bored aperture 137 is placed in the hole 132 against a gasket which may be an 0-ring seal 138. A stainless steel screen 140 is held against the disk 136 by a threaded cap 142 having a slot 44 for receiving a screwdriver or similar assembly tool.

The characteristic rate-of-rise response of the detector 46 results from the dimension of the orifice 137 in the disk 136. A relatively slow increase in the ambient air temperature does not operate the detector because the temperature within the chambers 108 and 110 rises slowly and the resulting expansion of the air within the chambers is accommodated by its movement through the orifice 137. However, if there is a sudden rise in temperature such as occurs in the case of a fire, the expanding air cannot pass rapidly through the orifice 137 and the pressure within the chambers 108 and 110 rises rapidly above the ambient pressure. This expands the chamber 110, forcing the push rod 106 against the screw 94, releasing the valve 70.

The response of the detector as described above is enhanced by the fact that the volume capacity of the chamber 108 is large compared to that of the chamber 110, partly because of its greater diameter and partly because a portion of the bracket 112 preferably extends into the interior of the bellows. Also, since the effective cross sectional area of the bellows 109 is preferably relatively small, a relatively small increase of pressure within the two chambers can be made to result in a substantial elongation of the bellows. Thus the function of the bulb 107 is to provide a heat collector chamber for the bellows.

In this embodiment the vent unit 126 is so located as to be protected by a cage 148, which also protects the parts 107, 109 and 118. Preferably, the metal screen or cage 148 is mounted over the bulb 107 in such a way as to protect it from inadvertent damage while allowing the ambient air to circulate freely over its walls and to cause a rapid transfer of heat therethrough.

If desired, the entire detector 46 may be installed pendant, that is, upside down as compared to the upright position shown in FIG. 1.

It will be seen that the above-described detector is relatively small in size and is therefore easily installed.

The alternative embodiment of FIG. 1a is simpler in structure, in that a single expansible unit 150 serves as the air-filled bulb means in place of the combination of the bulb 107 with the bellows 109. The unit 150 consists of two thin-walled corrugated circular metal diaphragms 152 and 154 sealed together at their outer peripheries. The diaphragm 154 has an inner end with an opening sealed to a boss on a bracket 156, the latter being mounted on the body 66 by means of standoff posts 158 and screws 160. The vent unit 126 described above with reference to FIG. 4 is threaded into the the bracket 156 which has a central hole to permit the space 162 within the unit 150 to communicate with the ambient air through the aperture 137. The diaphragm 152 has a closed end brazed or otherwise secured to the push rod 106. The operation of this embodiment will be apparent from the above description. With a sudden increase in ambient air temperature, while the inner end of the diaphragm 154 remains fixed in position, the space 162 expands with the movement of the other parts of the diaphragms toward the left as viewed in the drawing to move the rod 106.

It will be evident that certain structural and dimensional modifications may be incorporated in the above-described systems, in accordance with commonly-accepted practice, and without departing from the spirit or scope of this invention.

I claim:

1. In a detection and release system for a deluge valve of the type having a fluid pressurized space, means responsive to pressure in said space to hold said valve closed, a fluid pressurized control line connected to said space and release means including a fluid pressurized pilot line extending to a second space remote from the deluge valve, said release means being adapted to release the fluid pressure in the control line upon release of pressure in the pilot line, the combination of

control valve means connected to said pilot line,

latch means to hold the control valve means in closed position, and

air-filled bulb means expandable to release said latch means, said bulb means being connected with ambient air in said second space through a restricting orifice.

2. The combination according to claim 1, in which the control valve means and bulb means are closely adjacent and located within said second space where the rate of rise of air temperature is to be detected.

3. The combination according to claim 2, in which the pilot line is water-filled.

4. The combination according to claim 2, in which the pilot line is air-filled.

5. The combination according to claim 2, in which the control valve means has a body defining a passage for connection to the pilot line and a control valve mounted in the body in position to close the passage, the latch means being located in the body and having means to set the latch to hold the valve closed, the bulb means being mounted externally on said body.

6. The combination according to claim 5, in which the bulb means include a fixed air chamber in close heat exchange relation to ambient air and an extensible air chamber communicating with the fixed air chamber and having a movable portion engaged with the latch.

7. The combination according to claim 6, in which the fixed air chamber has a substantially higher air volume than the extensible air chamber.

8. The combination according to claim 6 in which the bulb means include a bracket secured to said body and having a fitting containing said restricting orifice, said fixed and extensible air chambers having portions thereof secured to said bracket.

9. The combination according to claim 5, in which the bulb means comprise an expansible diaphragm member defining an enclosure and having a portion with a restricted orifice by which said enclosure communicates with said second space and a movable end portion to release said latch.

10. The combination according to claim 9, in which the diaphragm member comprises two thin-walled corrugated metal diaphragms sealed together at their outer peripheries.

* * * * *