United States Patent

Martin et al.

[15] **3,698,483**

[45] **Oct. 17, 1972**

[54] AUTOMATICALLY RESETTABLE FIRE SPRINKLER VALVE

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[22] Filed: **Oct. 27, 1970**

[21] Appl. No.: **84,319**

[52] **U.S. Cl.** **169/37,** 169/22

[51] **Int. Cl.** **A62c 37/08**

[58] **Field of Search** 169/19, 20, 22, 37; 137/79, 137/468; 251/11

[56] **References Cited**

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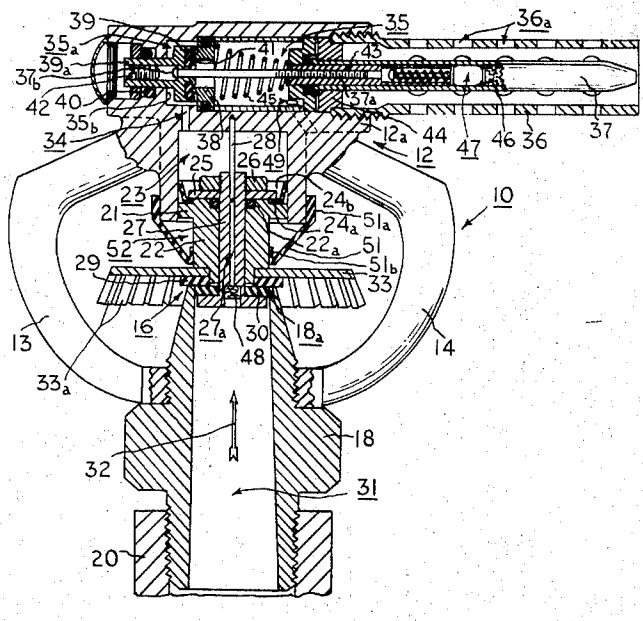
[57] **ABSTRACT**

An automatically-resettable fire sprinkler valve is normally held closed by a piston-cylinder unit in which both ends of the piston are exposed to the high main-supply water pressure, one of the piston ends being of greater effective area than the other, such that the same water pressure acting on the different end areas normally forces a valve member to a flow-blocking position. A normally-closed bleed port associated with the broader-area end of the unit is valved open to a pressure-relieving condition by mechanical response of a thermal actuator to temperatures above a predetermined critical level, whereby the sprinkler valve is forced open by the main-supply pressure; when the temperature decreases to a safe low level, the bleed port is automatically closed by the thermal actuator, and equal pressures on the unequal-area piston ends cause positive reclosing of the sprinkler valve.

12 Claims, 6 Drawing Figures



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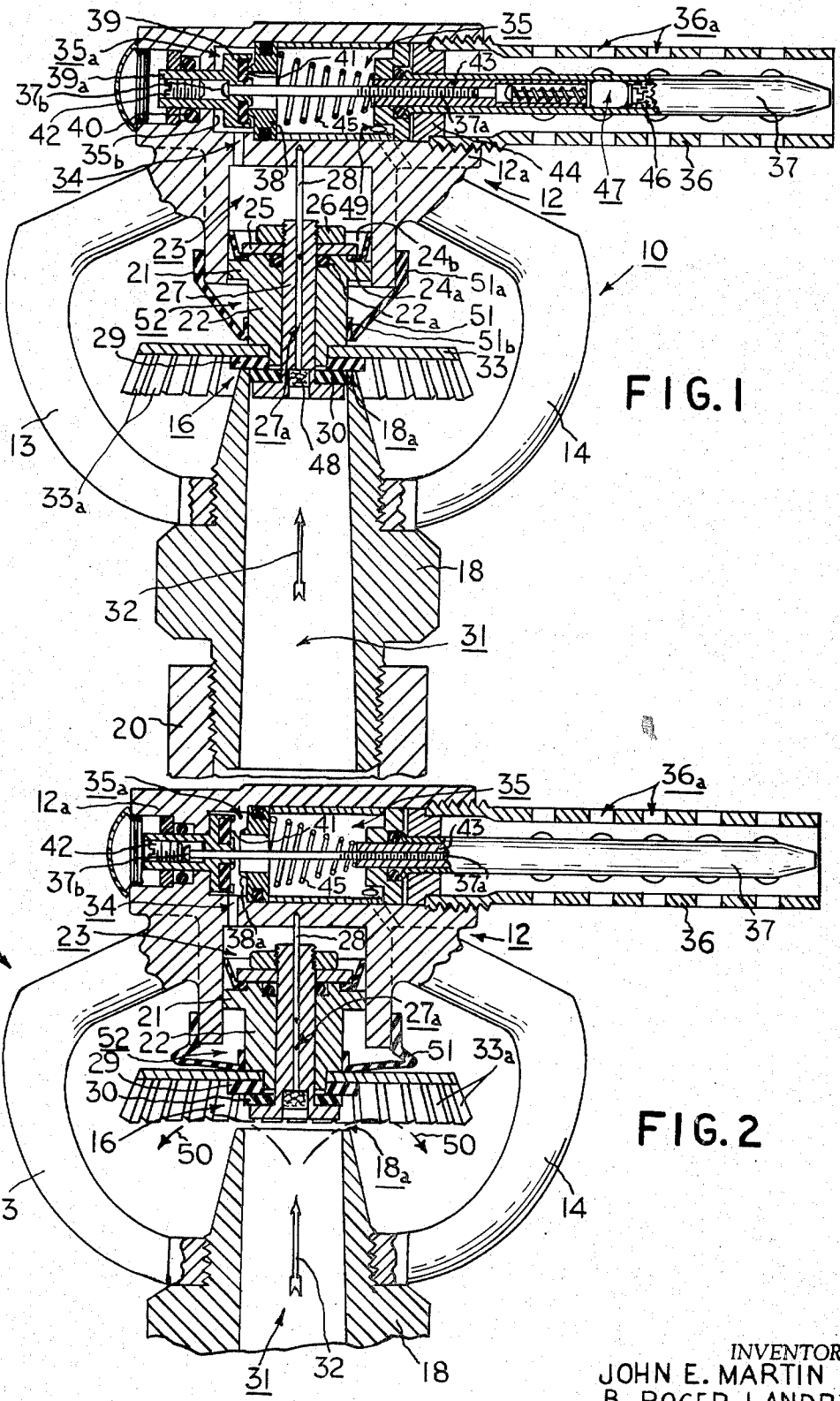

FIG. 1

FIG. 2

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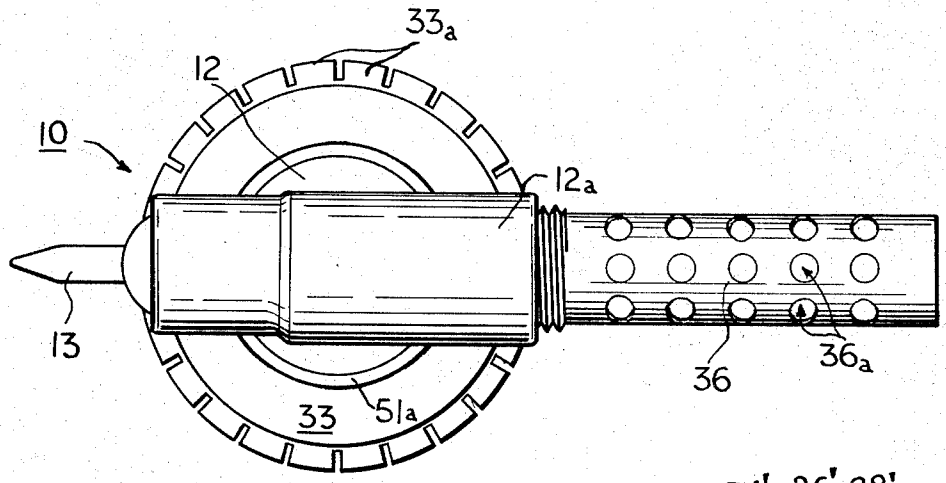

FIG. 3

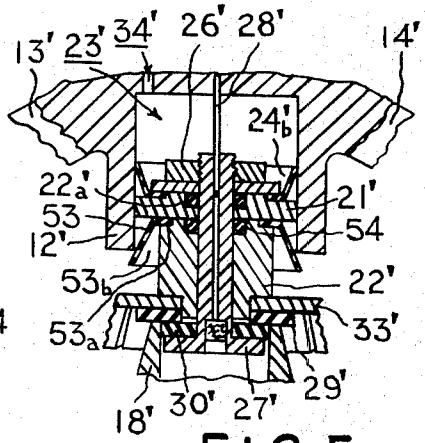

FIG. 5

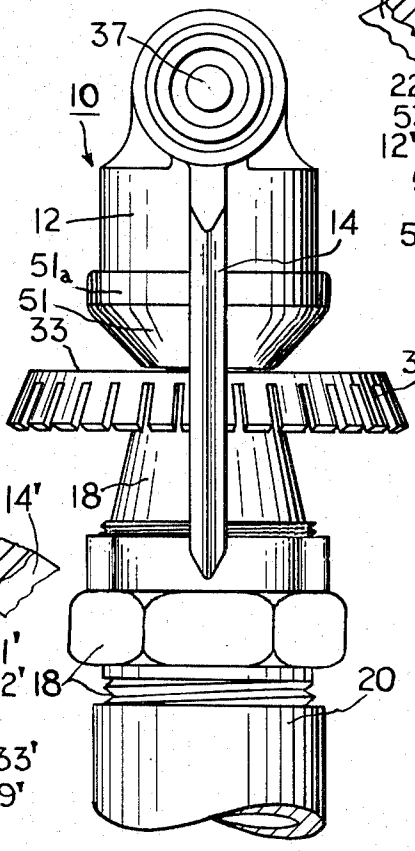

FIG. 4

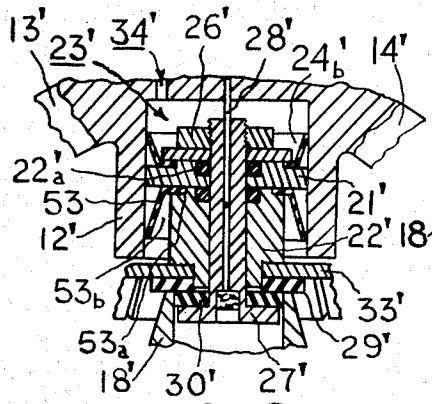

FIG. 6

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AUTOMATICALLY RESETTABLE FIRE SPRINKLER VALVE

BACKGROUND OF THE INVENTION

The present invention relates to improvements in automatic fire-extinguishing sprinkler systems, and, in one particular aspect, to a novel and improved automatic fire-control sprinkler of economical and uncomplicated construction which will not only reliably spray supply-line water when the ambient rises beyond a predetermined level but will also automatically undergo a supply-line powered positive reclosure to prevent unnecessary water damage when its temperature-sensitive thermal actuator control element senses restoration of a predetermined safe temperature level.

As commonly practiced, fire-extinguishing sprinkler systems employ one-way valves, generally associated with fusible elements, which become operable or are automatically opened by these elements at dangerously high temperatures, such as occur whenever there is a fire, which are capable of melting the fusible elements. Once operated, however, these valves remain open and continue to permit water to be released, usually from an overhead position, even after the fire may have been extinguished, until the system is manually shut-off via a main divisional or sectional valve in the water supply line. This can result in greater losses being inflicted by damage from the water itself than because of the fire which initiates its action, especially at times when the incident is not discoverable for a relatively long period after the fire itself has been extinguished, or when the shut off valve cannot be located and operated quickly. If such valves function properly, they are effective to extinguish a fire swiftly but they thereafter release vast quantities of water without attracting prompt attention; resulting losses of equipment and materials could be significantly reduced by fire-control valves which automatically re-close, although the requisites of economy, simplicity and high reliability have not heretofore been satisfied.

Proposals have long been known concerning the concept of automatic cut-off provisions for automatic sprinkler systems, the objective of which is closure of the water valves whenever the fire has been extinguished. For example, a thermostatically-controlled actuating element which is intended to effect reclosure of a water valve when temperature subsides to a normal level is illustrated in U.S. Pat. No. 1,143,762, issued June 22, 1915, to J. J. Hooks. Certain features of this type of device, and others that followed it, have not been entirely satisfactory, however. Among these is the disposition of a valving element inside the water supply line upstream of the water-discharge or sprinkler position, the arrangement being such that the main flow interferes with the valve operating characteristics by tending to keep the valve open or shut, so that shut-off in particular is not easily and reliably accomplished. Because such devices rely upon spring forces to achieve reclosure, the closing actions may be variable with spring stiffness, pressure conditions, and the like. Also, both opening and closing actions depend upon more than one auxiliary valving, which renders operation uncertain and imprecise.

SUMMARY OF THE INVENTION

Accordingly, it is one of the objects of the present invention to provide a unique and improved sprinkler unit, for an automatic fire-extinguishing system, which is of relatively simple and low-cost construction, which is positive and reliable in both opening and closure actions, and which is compact and of trim lines promoting its use in place of conventional non-reclosing sprinklers.

Another object is to provide a high-precision automatically-resetting fire sprinkler unit wherein automatic opening when the temperature of the surrounding atmosphere rises to a predetermined dangerous level and automatic reclosing when the temperature falls to a predetermined safe level are powered by supply-line pressure in response to pilot controls by a thermal actuator.

A further object of this invention is to provide an improved automatic fire-extinguishing sprinkler in which supply-line pressure drives both opening and closing actions of a valving element located downstream of and external in relation to the water supply outlet, the valving element itself serving to communicate line pressures to an external piston-cylinder unit which powers closures of the sprinkler.

Yet another object of the invention is to provide a novel and highly effective automatically-reclosing fire-extinguishing sprinkler which utilizes a thermal actuator for reliably controlling the openings and closings of a supply-line valve without use of a reclosing spring, and in which an auxiliary piston-cylinder unit which powers valve reclosures is uniquely sealed against contamination of critical exposed piston-cylinder surfaces.

The foregoing and other objects may be realized by way of valve assembly including a supply-line valve element fixed with and opposed by the piston of an auxiliary piston-cylinder unit, the piston being exposed to the supply-line water pressure on one broad-area side, and the valve element having a smaller area exposed to the same water pressure and disposed to block the flow of water from the line. Water pressure tends to maintain the valve in a closed position so long as a bleed port associated with the broad-area side of the piston is valved closed by an auxiliary valve operated by a miniature thermal actuator. The supply-line valve element and piston-cylinder unit are both positioned downstream of the ends of the supply line. When ambient temperature sensed by the actuator rises to a dangerous level, as might be caused by a fire, the bleed port is valved open by low-level forces from the thermal actuator, and the supply-line valve element is then forced open by the water pressure, to permit escape of fire-extinguishing water. When the temperature decreases, as might occur when the fire has been put out, the thermal actuator valves the bleed port closed, whereupon water pressure again builds up within the piston-cylinder unit via an opening through the main valve element which, though displaced downstream, is enveloped by the escaping water. The resulting differentials in pressure-area products favors positive driving of the supply-line valve element to closure.

BRIEF DESCRIPTION OF THE DRAWINGS

Although the aspects and features of this invention which are believed to be novel are expressed in the appended claims, additional details as to preferred practices and as to the further advantages, objects and details of preferred embodiments of the invention may be most readily appreciated through reference to the following description taken in connection with the accompanying drawings, wherein:

FIG. 1 is a side elevation, partly in section, of a fire-extinguishing sprinkler valve assembly embodying the invention and illustrating the parts thereof in conditions which maintain the valve closed;

FIG. 2 is a similar side elevation, partly cross-sectioned, of the assembly of FIG. 1 with its parts oriented to promote a fire-sprinkling water discharge;

FIG. 3 is a plan view of the assembly shown in FIGS. 1 and 2;

FIG. 4 is a side view of the same assembly shown in FIG. 1, in the closed condition;

FIG. 5 is a detail, in side elevation, of a piston-cylinder unit for an assembly like that of FIG. 1, wherein sealing against external contaminants is achieved by a lip-seal member; and

FIG. 6 illustrates the same detail of FIG. 5 for an open or water-discharging condition of the assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Having reference to the drawings, and more particularly to FIG. 1 thereof, an improved sprinkler assembly, preferably constructed mainly of bronze or other suitable metallic material highly resistive to corrosion in a water environment, and adapted to be installed in a conventional overhead automatic sprinkler system for fire protection service, is generally indicated at **10**. This sprinkler assembly comprises a body portion **12** carried by arms **13** and **14** and supporting a main valve unit generally indicated at **16**, the arms in turn being threadedly engaged with and supported by a threaded fitting **18** which is used to attach the assembly to the main water supply line **20** of a sprinkler system.

The main valve unit **16** is fixed with a piston **21** by way of a stem connection **22**, and is vertically movable in conjunction with sliding movements of piston **21** within a cylinder **23** formed within body portion **12**. Cooperating with piston **21** is a flexible truncated conical lip-seal member, an annular part **24***a* of which is clamped to the inner end of the piston facing inwardly toward the interior of cylinder **23**, and the truncated part **24***b* of which flares outwardly in direction toward the interior of cylinder **23**. The said clamping is achieved by a washer **25** held in place by a nut **26** engaged with a central stem element **27**. O-ring seal **22***a* between stem **22** and stem element **27** insures a fluid-tight relation between them. Stainless steel pin **28**, staked into body portion **12**, mates with central stem element **27** via an opening **27***a* through the latter, and serves to aid in guiding vertical sliding movements of the stem and piston. This piston-cylinder arrangement is normally effective to force the compressible sealing washer **29** tightly against the cooperating valve seat surfaces **18***a* formed at the downstream end of the fitting **18**, and washer **29** thus functions as a valve disc

to block flow from the seat. A further auxiliary sealing washer **30**, of lesser diameter than washer **29**, is disposed for snug mating as a plug within the downstream end of fitting **18**; both washers are preferably made of silicone rubber or a like material which is somewhat compressible and capable of forming secure long-lasting seals. Enlarged end **27***b* of stem element **27** fastens these washers in place, when nut **26** is tightened.

The aforesaid valving washers, when seated as shown in FIG. 1, prevent escape of water from the interior **31** of fitting **18**, where it exists at the supply-line pressure furnished by supply line **20**. Upon opening of this main valving arrangement, the water of course escapes, flowing in the direction of arrow **32**, which is normally vertically downward in the usual inverted installation position of the entire assembly. Released water is then deflected laterally by spray deflector **33**, which has circumferentially-disposed ribs **33***a* for breaking up and spraying the stream.

Centrally disposed opening **27***a* through the stem element, serves not only as a guide for pin **28** but also as a pressure-equalizing passageway between the high-pressure region **31** of the water supply line and the cylinder chamber **23** inwardly of the piston **21**; clearance is provided for that purpose. Accordingly, because the construction involves an effective area of the upper surface of the piston **21**, including its lip-seal, which is larger than the effective seating area of the valve disc arrangement on the fitting **18**, the sprinkler valve assembly normally remains closed, as shown in FIG. 1.

For the sprinkler valve assembly to be opened, as when a fire breaks out, pressurized water trapped within the cylinder chamber **23** must be permitted to escape and relieve the pressure which normally urges the valve washers **29** and **30** to their closing positions. For this purpose, a bleed port **34** is provided within the frame **12**, leading from the cylinder chamber **23** to a smaller cavity **35***a*. The latter cavity **35***a*, is part of larger opening or bore **35** formed in the upper portion **12***a* of the frame **12**. One end of the bore **35** is partly closed by end wall **35***b* thereof, while the other end is threaded internally for receiving the externally threaded end of a perforated protective tubular shield **36** of an elongated thermal actuator **37**. Perforations **36***a* allow the actuator to be heated and cooled uniformly and rapidly as the ambient temperature changes occur. An auxiliary annular valve seat member **38** is disposed within and in sealed relationship to the bore **35**, and has a raised annular valve seat lip **38***a* (FIG. 2) on the side facing cavity **35***a*. An auxiliary valve member **39** of slightly less cross-sectional area than the cavity **35***a* is positioned therein for lateral sliding movement along the axis of the bore **35**. Stem portion **39***a* of member **39** is guided in an aperture in the end wall **35***b* and is slidably engaged within an O-ring sealing element **40** disposed in an annular channel about the aperture. On its opposite side, confronting the valve seat lip **38***a*, the valve member **39** is provided with an annular valve disk **41** disposed for engagement with valve seat **38***a*. In the normal stand-by condition of the sprinkler system, the valve member **39** is seated against lip **38***a* by influence of the thermal actuator **37**, to the output shaft **37***a* of which it is coupled via a slip fit and via an enlarged head end **37***b* thereof which is

received in a central bore of member **39**. End **39***a* of member **39** is internally threaded to receive a calibration screw **42** against which the head **37***b* of thermal actuator shaft may abut to exert force which will open the auxiliary valve when dangerous temperatures are sensed. Shaft **37***a* terminates at its other end inside a hollowed output member **43** slidably disposed within the thermal actuator **37**. An annular collar **44** holds the tubular actuator in the illustrated position within body portion **12***a*. Coil spring **45** is compressed between the exposed end of output member **43** and annular member **38**, thereby tending to force shaft **37***a* as far into the actuator as its temperature-responsive condition will allow; under normal-temperature conditions, the spring **45** will thus tend to urge shaft head **37***b* to draw auxiliary valve disk **41** against seat **38***a*, thereby maintaining the auxiliary valve closed, so that bleed port **34** is also closed.

Thermal actuator **37** is of a known construction in which the outer tubular element, closed at its outer end, retains a fill of thermally-responsive material **46** between that end and a movable piston-seal unit **47**. The fill **46** may consist essentially of a wax which exhibits a very substantial increase in volume as it makes the transition from a solid to liquid state within a predetermined narrow temperature range. Petroleum-type waxes having widely different melting temperatures are readily obtainable commercially, for example, and may be blended to achieve desired melting characteristics. The movable piston-seal unit **47** may include a compressible cylinder of silicone rubber or the like, held under compression by a spring, and abutting the inner end of output member **43**. A suitable unit is illustrated in U.S. Pat. No. 3,302,391 to Ferd P. Mihm, issued Feb. 7, 1967 (see FIG. **5** thereof, for example).

During installation of the sprinkler **10**, a clip or wedge (not shown) may be fastened over the deflector **33** to prevent occurrence of an immediate surge of water when the sprinkler piping is first pressurized. Once the system is pressurized, such a clip or wedge is not called for and is to be removed.

When supply-line water pressure is witnessed in the fitting **18**, it passes through the passageway **27***a* in the stem element **27** and into the cylinder chamber **23**, the latter being kept free of water-born contaminants by a filtering screen or mesh **48**. Because effective area of the piston **21** and its lip seal is larger than the effective seating area of the valve discs **29** and **30** in relation to the downstream end of fitting **18**, the main valve arrangement for the sprinkler is maintained closed by the related pressure differential. This same line pressure is also felt in the auxiliary-valve cavity **35***a*, by way of the bleed port **34**, and, in conjunction with the effects of spring **45** and shaft **37***a*, tends to maintain the auxiliary valve disk **41** closed against its seat **38***a*. So long as a safe temperature exists, and until the thermal actuator **37** senses a temperature just below the predetermined opening temperature of the sprinkler head, the auxiliary valve will remain closed, and, in turn, the supply-line water pressure in cylinder chamber **23** will constantly hold the main valve closed, even though the full water pressure is being exerted against the main valve disk **29** in the downstream direction. As the temperature more closely approaches a predetermined danger-level sprinkler opening temperature, the thermal actuator fill **46** expands rapidly, pushing the piston-seal unit **47** outwardly, along with shafts **43** and **37***a*, until ultimately the enlarged head **37***b* of shaft **37***a* engages the calibration set screw **42**. At that juncture, the motion and force exerted by the thermal actuator **37** are transmitted to the auxiliary valve member **39**, and upon further rise of ambient temperature, the valve disk **41** carried by member **39** is separated from its seat **38***a*, FIG. **2**. Water pressure within cylinder chamber **23** is then relieved through the annular valve-seat member **38**, the cavity **35**, and a vent **49** leading from cavity **35** to the ambient exterior. When egress of pressurized fluid through the vent **49** exceeds the rate at which it can be made up through the passageway **27***a* in the main valve stem element **27**, the pressure in cylinder chamber **23** diminishes and the related force on the piston **21** becomes less than the counteracting force exerted by the substantially-undiminished line pressure on the main valve disk **29**, whereupon the latter is pushed downstream of fitting **18** and the main sprinkler valve becomes opened, as shown in FIG. **2**. The released water impinges upon the deflector **33** and is dispersed as a spray for fire-extinguishing action, as suggested by arrows **50** in FIG. **2**.

Once a fire is put out, the ambient temperature around the sprinkler diminishes and the thermal actuator fill **46** contracts, thus permitting the actuator output member **43** to be pushed back by the coil spring **45**. Shaft **37***a* is pulled along with member **43**. At a predetermined temperature, the enlarged head **37***b* of shaft **37***a* comes into engagement with a shoulder in valve member **39**, and, with further reduction in temperature, it firmly seats the auxiliary valve disk **41** against lip-seat **38***a*, thereby re-closing the auxiliary valve. When the flow through the auxiliary valve is reduced below the flow coming through the passageway **27***a* in stem element **27**, the pressure in cylinder chamber **23** rises. The pressure felt in chamber **23** ultimately tends to be the same as the pressure in the fitting **18**, because the opening of passageway **27***a* is directly exposed to the supply-line water being emitted forcefully from the downstream end of fitting **18**, and even though the main valve disk **29** is unseated. Once a near-balance is restored between the pressures in cylinder chamber **23** and in the water supply line, the differences in effective areas of the piston and main valve disk again favor the forcing of the disk **29** against seat surfaces **18***a*, and the sprinkler halts its spray and is ready to re-cycle if necessary.

Assemblies of the character described are operative efficiently, precisely and reliably when the cooperating surfaces between piston **21** and the cylinder chamber are maintained scrupulously clean of contaminants which might either cause jamming or cause loss of fluid-tight sealing. In corrosive atmospheres or in environments where dirt, dust or other foreign matter can collect, such freedom from contamination is nevertheless obtained, through use of flexible shields which cover the otherwise-exposed external surfaces of the piston and cylinder chamber. Cover **51** in FIGS. **1 – 4** serves the purposes, and is conveniently in the form of a truncated conical silicone-rubber boot, the larger rim end **51***a* of which is fitted tightly over the open end of the cylinder boss forming cylinder chamber **23**, and the smaller-diameter end **51***b* of which is fitted tightly

about the stem 22 which extends outwardly from piston 21. The interior 52 of the boot is thus well sealed against contaminants and corrosive effects, and is in enclosing relation to the aforementioned surfaces and sealing area. Normally, boot or cover 51 is fully extended, as shown in FIG. 1, but, as the main valve is opened, the stem 22 and deflector 33 move vertically and cause it to be partially collapsed, as shown in FIG. 2. The conical surfaces of that cover are naturally forced to bulge outwardly under the latter conditions, and therefore cannot cause jamming of the piston-cylinder unit.

In another highly advantageous sealing and covering arrangement illustrated in FIGS. 5 and 6, the boot-type cover is eliminated and its main functions are assumed by a simple lip-seal member 53. The latter member, generally like the lip seal formed as an effective part of the piston 21, is disposed on the opposite externally-exposed side of the piston, and its flexible lip 53*b* is sufficiently long to project slightly out of the cylinder chamber and completely enclose all cylinder surfaces in the normal "closed" condition of the assembly, as shown in FIG. 5. The fragmentary views in both FIGS. 5 and 6 are of portions of overall structure generally the same as in FIGS. 1 – 4, and the same reference characters, with distinguishing single-prime accents added, are therefore used to designate the same or functionally-similar parts in the respective embodiments. In FIG. 6, the relationship of elements for the "open" condition of the main valve is depicted, and it will be noted that the flexible lip 53*b* is readily depressed into the cylinder chamber; on withdrawal, that lip tends to wipe the inner cylinder surfaces clean and then expands to the sealing orientation appearing in FIG. 5. Annular part 53*a* of the lip-seal type cover 53 is conveniently secured between piston element 21′ and stem 22′, and a further O-ring seal 54 promotes sealing of the separate piston element 21′ with stem element 27′. Lip-seal cover 53 may be of silicone rubber, polytetrafluoroethylene, or like flexible material capable of withstanding high temperatures.

It may thus be seen that the automatically-resetting sprinkler assembly disclosed herein meets the announced objects of the invention. Various modifications, additions and substitutions may obviously be effected by those skilled in the art without departure from these teachings, and it is therefore to be understood that the invention may be practiced otherwise than as specifically described, within the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. Automatic fire-extinguishing apparatus comprising a fluid inlet member connectable with a pressurized water supply line and having a main valve seating surface formed at its downstream end, a movable main valving member disposed externally of said inlet member and in downstream relation to said downstream end, and means disposed externally of said inlet member for mounting said movable valving member for movements into and out of seating engagement with said seating surface and for urging said valving member into said engagement responsive to pressures in said inlet member, said last-named means including a frame fixed with said inlet member, a piston mated with a cylinder chamber in said frame and having a stem extending out of said chamber and supporting said valving member for movements therewith into and out of said seating engagement, the effective cross-sectional area of said piston exposed to pressure in said chamber being greater than the effective cross-sectional area of said valving member exposed to pressure in said inlet member, first fluid pressure communication means between said inlet member and said cylinder chamber, said first fluid-pressure communication means being in the form of an opening extending from the area of said main valving member exposed to pressure in said inlet member and through said stem and piston into said cylinder chamber, said opening being disposed for communication with water discharged from the downstream end of said inlet member when said main valving member is out of said seating engagement with said seating surface, an auxiliary valve chamber in said frame, second fluid-pressure communication means between said chambers, means for venting said auxiliary chamber through an auxiliary valve seat, a movable auxiliary valve member mounted in said auxiliary valve chamber for movements into and out of seating engagement with said auxiliary valve seat, and temperature-responsive actuator means mounted on said frame for exposure to external ambient temperatures and having a movable output member coupled with said movable auxiliary member and forcing said auxiliary valve member into and out of said seating engagement with said auxiliary valve seat upon occurrence of predetermined low and high temperatures, respectively, whereby said piston maintains said main valving member in closed seating engagement with said main seating surface when the ambient temperatures are low and allows pressure in said inlet member to force said main valving member out of engagement with said main seating surface when the ambient temperatures reach a predetermined high level and recloses said main valving member into seating engagement with said main seating surface when the ambient temperature drops from said high level to a predetermined low temperature.

2. Automatic fire-extinguishing apparatus as set forth in claim 1, wherein said movable main valving member comprises a valve disk movable into and out of engagement with the downstream end of said inlet member.

3. Automatic fire-extinguishing apparatus as set forth in claim 1, wherein said movable auxiliary valve member comprises a valve disk movable into and out of engagement with said auxiliary valve seat in upstream relationship thereto, whereby pressures in said auxiliary valve chamber tend to close said auxiliary valve disk against said auxiliary valve seat.

4. Automatic fire-extinguishing apparatus as set forth in claim 3, wherein said temperature-responsive actuator means comprises an elongated heat-conductive tube closed at one end, a thermally-responsive fill material within said tube and exhibiting significant temperature-induced dimensional variations within a predetermined temperature range, a movable piston-seal unit disposed within said tube and sealing said tube against loss of said fill material, said output member extending partly into said tube and into force-transmitting engagement with said piston-seal unit, spring means mounted on said frame and urging said output mem-

bers into said tube and thereby urging said auxiliary valve member toward seating engagement with said auxiliary valve seat, and a hollow tubular shield fixed with said frame in spaced surrounding relation to said heat-conductive tube.

5. Automatic fire-extinguishing apparatus as set forth in claim 4, wherein said movable output member of said actuator means is coupled with said movable auxiliary valve member by a lost-motion connection, and further comprising adjustable means for setting the extent of lost motion in said connection, whereby said temperature-responsive actuator means may be set to unseat said auxiliary valve disk from said auxiliary valve seat at said predetermined high temperature by way of adjustment of the extent of said lost motion by said adjustable setting means.

6. Automatic fire-extinguishing apparatus as set forth in claim 2, further comprising a spray-forming deflector secured to said piston stem transversely in relation thereto and externally of said chamber, and flexible protective sealing means secured to said stem and extending into engagement with said frame in enclosing relation to externally-disposed surfaces of said cylinder.

7. Automatic fire-extinguishing apparatus as set forth in claim 6, wherein said protective sealing means comprises a lip-seal member having an annular portion secured to said stem and a truncated conical lip-seal portion integral with said annular portion and slidable in said cylinder chamber, said lip-seal portion extending partly out of said cylinder chamber in engagement with surfaces at the end of said cylinder chamber when said stem orients said main valving member in seating engagement with the downstream end of said inlet member.

8. Automatic fire-extinguishing apparatus as set forth in claim 7, further comprising a second lip-seal member having an annular portion movable with said piston and a truncated conical lip-seal portion integral with said annular portion and slidable in said cylinder chamber, said second lip-seal member being disposed wholly within said chamber with said lip-seal portion flaring outwardly in direction away from said piston, said lip-seal members being in a back-to-back orientation relative to one another with said piston therebetween.

9. Automatic fire-extinguishing apparatus comprising an open frame having a fluid inlet at one part thereof and a piston chamber at another part thereof in spaced relation to and in alignment with said inlet, said inlet being connectable with a pressurized water supply and having a main valve seat at its downstream end facing said chamber, a piston mated with said cylinder chamber and having a stem extending out of said chamber toward said main valve seat, a main valving member at the end of said stem disposed for movements with said stem into and out of seating engagement with said main seat, the effective cross-sectional area of said piston exposed to pressure in said chamber being greater than the effective cross-sectional area of said valving member exposed to pressure in said inlet, fluid-pressure communication means between said inlet member and said cylinder chamber, said fluid-pressure communication means comprising an opening extending from the area of said valving member exposed to pressure in said inlet and through said stem and piston into said cylinder chamber, said opening being disposed for communication with water discharged from the downstream end of said inlet when said valving member is out of seating engagement with said seat, auxiliary valve means for venting said cylinder chamber to the ambient atmosphere, and temperature-responsive actuator means for opening said auxiliary valve at a predetermined high temperature and closing said auxiliary valve at a predetermined low temperature.

10. Automatic fire-extinguishing apparatus of the type including a fluid conduit connectable with a pressurized water supply and a main valve having a movable valving member for opening and closing said conduit and, thereby, controlling release of fire-extinguishing water therefrom, said valving member being actuated to close, open and re-close said main valve solely by force of pressures associated with said water supply at the site of said valve, comprising a main valve seat fixed with said conduit and forming part of said main valve for controlled release of water therefrom, said movable valving member being disposed in downstream relation to said seat and being exposed to pressures in said conduit which tend to cause said member to separate from said seat and open said valve and conduit for release of water therefrom, a piston-cylinder unit including relatively movable piston and cylinder members forming a fluid-tight chamber therebetween, means connecting said movable valving member with said piston - cylinder unit for movements therewith to seat and unseat in relation to said seat and thereby to open and close said valve and said conduit, the effective cross-sectional area of said piston exposed to pressure in said chamber being greater than the effective cross-sectional area of said valving member exposed to said pressures in said conduit which tend to cause said valving member to open said conduit, said piston-cylinder unit being connected with said valving member to cause said valving member to close said conduit when the pressures in said chamber and conduit are substantially the same, fluid-pressure communication means between said conduit and said chamber comprising a passageway having an opening extending from said cylinder chamber to the site of said pressures in said conduit which tend to cause said valving member to open said conduit, said passageway opening at said site being disposed for exposure to pressures attendant upon forceful spray of water emitted from said conduit when said valving member is unseated from said seat, auxiliary valve means having a valve member movable to vent said chamber to the ambient atmosphere, and temperature-responsive actuator means for opening and closing said auxiliary valve at predetermined high and low temperatures, respectively.

11. Automatic fire-extinguishing apparatus comprising a fluid conduit connectable with a pressurized water supply, a main valve having a movable valving member for opening and closing said conduit, a piston-cylinder unit including relatively movable piston and cylinder members forming a fluid-tight chamber therebetween, means connecting said movable valving member with said piston cylinder unit for movements therewith to open and close said conduit, the effective cross-sectional area of said piston exposed to pressure in said chamber being greater than the effective cross-

sectional area of said valving member exposed to those pressures in said conduit which tend to cause said valving member to open said conduit, said piston-cylinder unit being connected with said valving member to cause said valving member to close said conduit when the pressures in said chamber and conduit are substantially the same, fluid-pressure communication means between said conduit and said chamber, auxiliary valve means having a valve member movable to vent said chamber to the ambient atmosphere, and temperature-responsive actuator means for opening and closing said auxiliary valve at predetermined high and low temperatures, respectively, said actuator means including an output member movable responsive to changes in ambient temperature and means including a lost-motion mechanical connection for coupling said output member in driving relation to said valve member of said auxiliary valve means.

12. Automatic fire-extinguishing apparatus as set forth in claim 11, wherein said actuator means comprises a heat conductive tube closed at one end, a thermally-responsive fill material within said tube and exhibiting significant temperature-induced dimensional variations within a predetermined temperature range, a movable piston-seal unit disposed within said tube and sealing said tube against loss of said fill material, said output member extending partly into said tube and into force-transmitting engagement with said piston-seal unit, and spring means urging said output member into said tube, said auxiliary valve member comprising a valve disk, said auxiliary valve including a valve seat in downstream relation to said chamber and to said valve disk whereby pressure in said chamber tends to close said valve disk against said valve seat, said output member being connected in driving relation with said valve disk by way of said lost-motion connection at a position exposed to ambient atmospheric pressure, and further comprising adjustable means for setting the extent of lost motion in said lost-motion connection.

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