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Mears et al.

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[54] **ON-OFF SPRINKLER**

[75] Inventors: **James W. Mears**, Warwick; **William J. O'Brien**, Barrington, both of R.I.

[73] Assignee: **Grinnell Fire Protection Systems Company, Inc.**, Providence, R.I.

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Related U.S. Patent Documents

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Filed: **Nov. 8, 1971**

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[51] **Int. Cl.²** **A62C 37/08**

[58] **Field of Search** 169/19, 37, 56, 60, 169/90; 137/457; 239/569, 75

[56] **References Cited**

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Primary Examiner—Robert S. Ward, Jr.

[57] **ABSTRACT**

An improved sprinkler for a fire protection sprinkler system in which the sprinkler opens to discharge water at one temperature and closes to stop the flow of water at a lower temperature. A pilot valve is actuated by a bimetal disc which also resiliently biases the pilot valve in a closed position. The bimetal disc has a snap action resulting in better control of the "on" and "off" temperatures of the sprinkler. A thermal delay for closing is obtained by the hysteresis which is designed into the bimetal disc.

7 Claims, 3 Drawing Figures

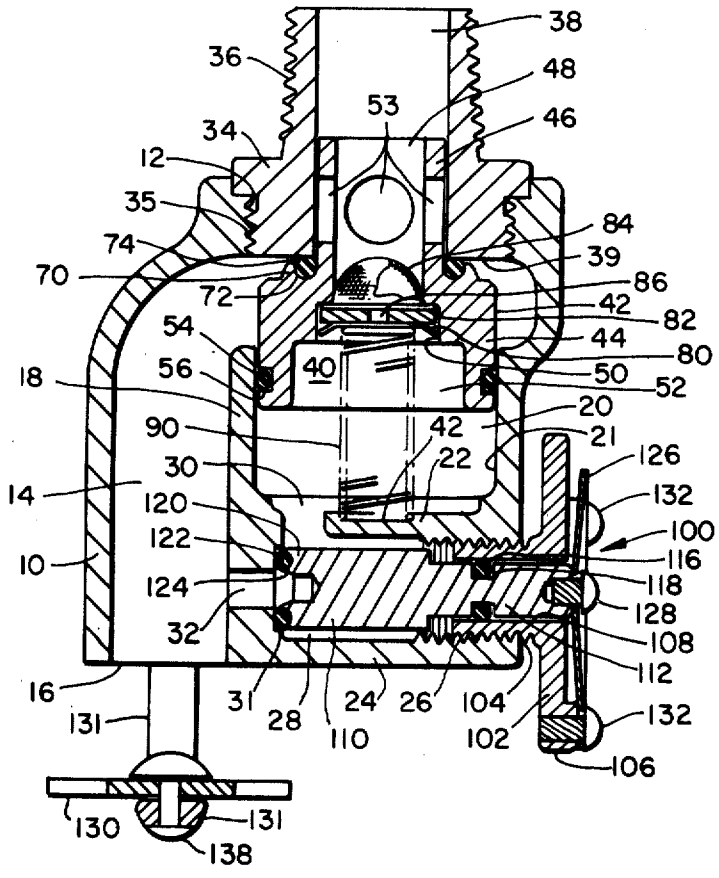


FIG. 1

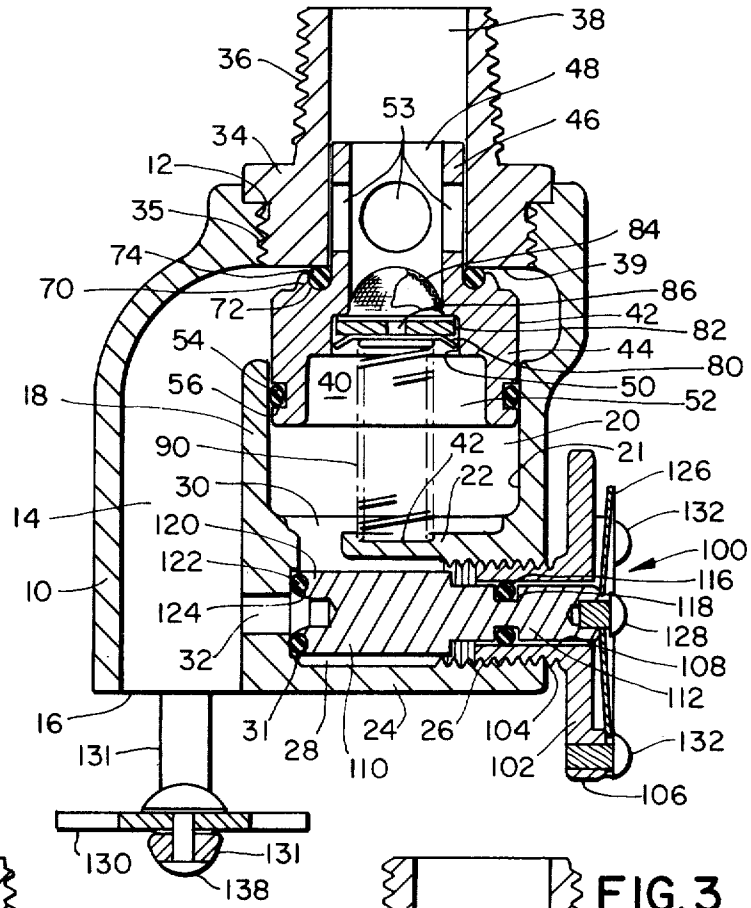


FIG. 2

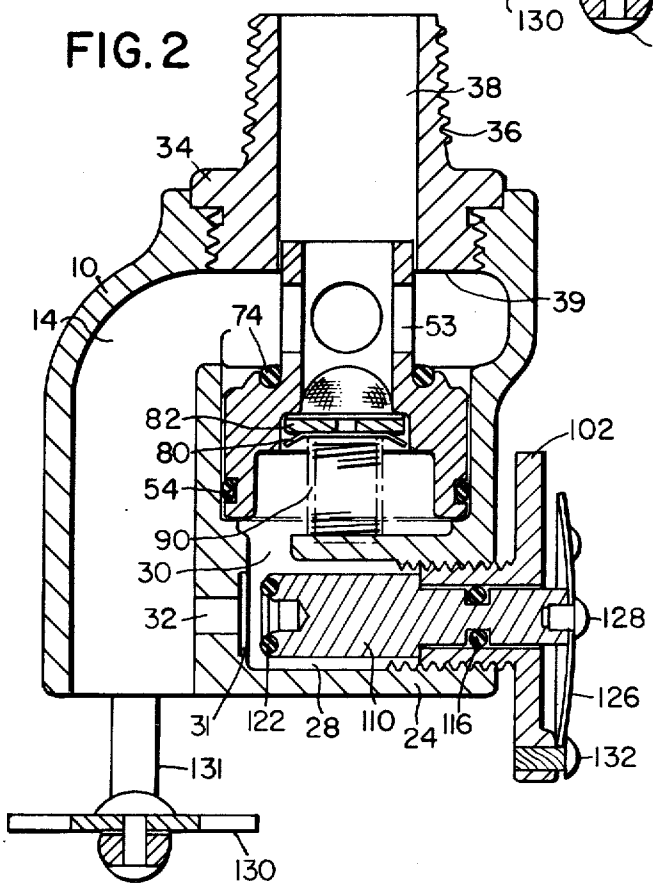
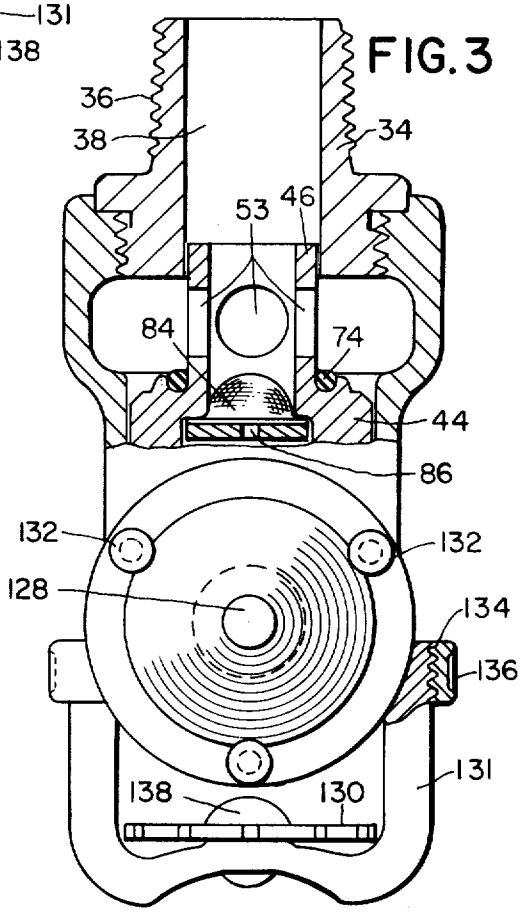


FIG. 3



ON-OFF SPRINKLER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BRIEF SUMMARY OF THE INVENTION

Conventional sprinklers for fire sprinkler systems are single operation devices wherein a heat responsive member releases a plug which is positioned to prevent the flow of water from the sprinkler. When the plug is released, water flows against a deflector which disperses the water in a desired pattern. Such a sprinkler must be replaced after a fire and the entire sprinkler system must be shut off to replace the sprinkler.

Many attempts have been made to produce a sprinkler which would shut itself off after a fire is extinguished. Such a sprinkler would conserve water because the flow of water is shut off, and it would be ready to operate immediately if the fire should start up again. In one design a fluid balanced piston valve is utilized to control flow of the extinguishing fluid from the sprinkler. A pilot valve controls the fluid balance and, thus, the position of the piston valve in either an open or a closed position. The pilot valve in turn is positioned by a leaf bimetal member which is responsive to atmospheric temperature. (See U.S. Pat. No. 917,292.)

The present invention provides an improved pilot valve arrangement in which a bimetal snap disc is used to position the pilot valve. The bimetal disc is positioned to load or resiliently bias the pilot valve toward a closed position. A hysteresis is built into the disc and is utilized to move the pilot valve to its closed position at a temperature lower than that at which the pilot valve is moved to an open position. With this built-in thermal delay, the sprinkler is not shut off until the surrounding temperature is low enough to assure that the fire is out.

An object of the present invention is to provide an improved on-off sprinkler having a fluid balanced main valve and a pilot valve for controlling the fluid balance on the main valve, in which the operating temperature of the sprinkler is controlled to close tolerances for both an "on" operation and an "off" operation.

Another object is to provide an improved on-off sprinkler in which the pilot valve is moved with a snap action.

Another object is to provide an improved on-off sprinkler in which the pilot valve is resiliently biased in a closed position at temperatures below a predetermined operating temperature by a bimetal disc.

Another object is to provide an improved on-off sprinkler which opens at one predetermined temperature and closes at a second, lower predetermined temperature.

Other advantages and features of the invention will be apparent from the following description and accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a sectional, front view of an on-off sprinkler embodying the present invention, in which the sprinkler is shown in an "off" position;

FIG. 2 is a sectional, front view of the sprinkler shown in FIG. 1, in which the sprinkler is shown in an "on" position; and

FIG. 3 is a partially sectioned right side view of the sprinkler shown in FIG. 2.

Referring first to FIG. 1, the improved sprinkler embodying the present invention is shown in a pendent position. The sprinkler has a body **10** defining a circular, threaded opening **12**, a flow passage **14**, and an outlet **16**, spaced from the opening **12**. The body **10** is preferably formed by a casting of a suitable material such as bronze. An inner wall **18** cooperates with an inner wall **22** and the outer wall of the body **10** to define a cylindrical chamber **20**, the axis of which passes through the center of the threaded opening **12**. The threaded opening **12** has a diameter which is at least as great as the diameter of the cylindrical chamber **20**. The second inner wall **22**, which is positioned at the lower end of the chamber **20**, cooperates with a lower wall **24** of the body **10** to define a threaded opening **26** and a chamber **28**. The chamber **28** is aligned with a passage **30** and communicates through the passage **30** with the chamber **20** and the chamber **28** communicates with the flow passage **14** through a passage **32** in the wall **18**. The cylindrical surface **21** of the chamber **20** is finished smooth, and a smooth seating surface is formed on the area **31** of the wall **18** surrounding the entrance to the passage **32**.

An inlet member **34** has an externally threaded end **35** which mates with the threaded opening **12** to secure the inlet member **34** in the opening **12** of the body **10**. A second externally threaded end **36** is of a size which is suitable for connecting the sprinkler to a sprinkler piping system.

The inlet member **34** further has a cylindrical passage **38** which provides an axial passage for fluid through the inlet member to the flow passage **14**. The diameter of the flow passage **38** is less than the diameter of the chamber **20**. An annular surface **39** at the inner end of the inlet member **34** is smooth and functions as a seating surface, as will be explained hereinafter.

A piston assembly **40** is received in the chamber **20**, and closes the upper end of the chamber **20**. The piston assembly **40** comprises a piston **42** having a first cylindrical portion **44** and a second, smaller cylindrical portion **46**. An axial bore **48** through the second cylindrical portion **46** and axial counterbores **50** and **52** in the first cylindrical portion **44** provides a passage axially through the piston **42**.

The first cylindrical portion **44** of the piston **42** has a diameter which is sized to be slideably received in the passage **20** of the inlet member **34**. The second cylindrical portion **46** of the piston **42** has a diameter which is sized to be slideably received in the cylindrical chamber **38**. In this manner, the piston **42** is mounted for axial movement toward and away from the inlet member **34**. The second cylindrical portion is provided with ports **53** positioned to permit a fluid to pass from the axial passage **38** to the flow passage **14** only when the piston **42** is positioned in its lower position of travel.

An O-ring **54** in a groove **56** in the outer surface of the first cylindrical portion **46** prevents fluid flow through the annular space between the wall **21** and the first cylindrical portion **44**.

An annular lip **70** projects from the surface which connects the outer surface of the first and second cylindrical portion **46** to form, with the cylindrical portion **46**, an annular groove **72**. This groove **72** receives an

O-ring **74** which engages and seats against the surface **39** of the inlet member **34** when the piston **42** is moved axially toward the inlet member to provide a fluid seal.

A restriction member **82** and a strainer **84** are secured in the counterbore **50** of the piston **42** by a retaining ring **80**. The restriction member **82** has an orifice **86** to control fluid flow from the inlet port to the chamber **20**. The strainer **84** will prevent the obstruction of the orifice **86** by foreign materials which may enter the sprinkler from the sprinkler system to which the sprinkler is connected. The strainer **84** has a domed portion to provide an increased area and flow passages through the strainer. Both strainer **84** and the restriction member **82** are formed of non-corrosive materials such as brass or bronze.

A coil spring **90** is positioned between the retaining ring **80** and the inner wall **22** to provide a resilient bias to the piston **40** toward the inlet member **34**. The lower end of the spring **90** fits into a recess **92** in the wall **22** to keep the spring in position.

It will be noted that the area of the piston assembly **40**, which can be acted on by fluid pressures in the passage **38**, is considerably less than the area of the piston assembly which can be acted on by fluid pressures in the chamber **20**, so that when the inlet fluid pressure and the fluid pressure in the chamber **20** are equal, the balance of fluid pressures will hold the piston **42** in its closed position.

In accordance with the present invention, an improved pilot valve assembly **100** is provided for controlling fluid flow from the chamber **20**, the passage **30**, the chamber **28**, and through the passage **32** to the flow passage **14**. The pilot valve assembly **100** comprises a retainer member **102** having an externally threaded cylindrical portion **102** which is of a suitable size for engaging the threads of the threaded opening **26** of the body **10**. The retainer member **102** has a radial flange portion **106** which is positioned a short distance away from the body **10** when the retainer member **102** is threaded into the opening **26**. A bore **108** extends axially through the retainer member **102**.

A pilot valve **110** having a cylindrical portion **112** fits loosely for axial movement in the bore **108** and in the cavity **28**. An O-ring **116** fits in a recess **118** in the outer surface of the cylindrical portion **112** to provide a fluid seal between the cylindrical portion **112** and the surface of the bore **108**.

The valve **110** has an axial length which permits the inner end **120** to touch the seat surface **31** surrounding the passage **32**. An O-ring **122** in an annular groove **124** in the surface of the end **120** provides a fluid seal with the seat surface **31** when the valve **110** is urged axially thereof toward the seat surface **31**.

A bimetal disc **126** is centrally connected to the outer end of the valve **110** by a drive screw **128** which passes through a central opening in the disc **126** and into a drilled hole in the outer end of the valve **110**. The edges of the disc **126** are secured to the radial flange **106** by drive screws **132**. Preferably, the area of contact of the drive screws **132** with the bimetal disc is held to a minimum so that heat flow from the bimetal disc **126** to the flange **106** is at a minimum. A thermal insulator (not shown) could be installed between the contact points of the disc with the drive screws **132**, if desired.

A conventional deflector **130** is spaced from the outlet **16** of the flow passage **14** and perpendicular to the projected axis of the flow passage **14** by a yoke **131** which is generally U-shaped.

The free ends of the yoke **131** are serrated and secured in openings **134** which are drilled therefor in the body **10** by swaging, as at **136**, the body **10** against the serrations, as seen in FIG. **3**. The deflector **130** is secured to the yoke **131** by a rivet **138**.

In accordance with the present invention, the bimetal disc **126** is cupped and is designed to move with a snap action toward a reverse cup shape at one temperature, for example 185° F, and when in the reversed shape, to return to its original shape at a second, lower temperature, for example 100° F. Further, the bimetal disc **126** is positioned with its concave surface facing the pilot valve **110** and is urged against the valve **110** to resiliently bias the valve **110** toward its closed position.

To compensate for the stress loading of the bimetal disc **126**, a temperature rating is selected for the bimetal disc **126** which is higher than the desired operating temperature. In order to position the pilot valve assembly **100** in the body **10**, to provide a resilient bias on the valve **110** and to obtain operation of the pilot valve at a desired temperature, the assembly **100** and the body **10** are put in a heated environment at the desired operating temperature of the sprinkler. The retainer member **102** is threaded into the opening **26** and tightened until the O-ring **122** is pressed against the seating surface **31** with sufficient pressure at the desired operating temperature of the sprinkler to cause the bimetal disc **126** to snap to the position to open the pilot valve. The pilot valve assembly is now installed in its proper position with the desired bias provided by the bimetal disc **126**.

An anaerobic plastic, such as "Loctite" No. 70, is applied to the threads of the retainer member **70** prior to its being put in the heated oven for installation. This anaerobic plastic will harden to lock the threads in this position.

It will be recognized that the pilot valve **110** can be resiliently biased toward its closed position by a separate spring and that it is not necessary to obtain the bias from the bimetal disc **126**.

In operation, the sprinkler is installed in a sprinkler system in pendent position. When the water is turned on, water flows into the passage **38**, the axial bore **48**, through the strainer **84** and the orifice **86** in the restriction member **82**, to fill the chambers **20** and **28**. The pilot valve **110** is held in a closed position by the resilient force of the bimetal disc **126** so that no water discharges through the passage **32**. When the chambers **20** and **28** have filled with water, equal fluid pressure is established above and below the piston **42**.

Because the area of the piston assembly **40** which is exposed to fluid pressure in the chamber **20** is greater and produces a greater force on the assembly **40** tending to move the piston assembly axially toward the inlet member **34** than the area and the force which is produced by the fluid tending to move the piston assembly **40** axially away from the inlet member **34**, the O-ring **74** is pressed tightly against the surface **39** to close the sprinkler.

In the event of a fire, the temperature surrounding the bimetal disc **126** will rise. As the bimetal disc **126** reaches its operating temperature, the disc snaps to a reverse cup shape, moving the pilot valve **110** with it and moving the O-ring **122** off its seat **31**. Immediately water discharges from the chamber **28**, through the passage **32**, thereby lowering the pressure sufficiently in the chamber **20** so that its force against the area of the piston assembly **40** becomes less than the force of

fluid in the inlet member. Restriction member **82** prevents fluid pressure from building up in chamber **20.** At a point, the fluid pressure against the top of the piston assembly is sufficient to overcome the force of the spring **90** causing piston assembly **40** to move axially downward to an open position, as shown in FIG. **2.**

With the piston assembly in this position water flows through ports **53,** and along the flow passage **14** to discharge against the deflector **130.** As the deflector is below the bimetal disc **126** with the sprinkler in a pendent position, the discharging water will not cool the bimetal disc **126** as long as the fire continues to burn.

After the fire is extinguished, the bimetal disc **126** cools and, upon reaching its lower operating temperature, snaps to its original position to move the pilot valve **110** to a position to close the passage **32.** As the chambers **28** and **20** fill with water, the pressure in the chamber **20** increases until it produces a force which moves the piston assembly **40** axially toward the inlet member **34** to stop further flow through the sprinkler.

The invention is not intended to be limited to the particular embodiments thereof illustrated and described above, but only by the following claims and their equivalents.

We claim:

1. A water sprinkler device for a fire protection system coupled to a pressurized fluid supply line; comprising in combination:

a sprinkler body having an annular inlet portion adapted for coupling to said fluid supply line;

means providing an inner wall for dividing said sprinkler body into a first bifurcation, having an outlet portion that defines a main fluid flow passageway between said inlet portion and said outlet portion, and a second bifurcation that defines a control chamber;

a deflector mounted adjacent said outlet portion to deflect fluid flow therethrough;

means providing a valve seating surface abutting said inlet portion at the junction of said bifurcations;

a main valve disposed in a direction downstream from said seating surface and having a valve seat mounted in opposed relation to said seating surface so as to oppose fluid pressure from said inlet portion that tends to cause said valve seat to separate from said seating surface to open said valve;

said main valve being slideable into said control chamber for controlling fluid flow through said main passageway while maintaining said control chamber blocked to fluid flow from said outlet portion;

an aperture formed substantially centrally in said main valve to define a control passageway that couples fluid from said inlet portion to said control chamber;

said main valve exhibiting a first surface area disposed toward said control chamber that is greater than a second surface area disposed toward said inlet portion to provide a greater main valve closing pressure than opening pressure;

means providing an outlet port from said control chamber to release fluid pressure therefrom to open said main valve;

pilot valve means having a valve member mounted to control fluid flow through said outlet port and including a bimetallic disc centrally connected to said valve member, and

means for securing the peripheral edges of said bimetallic disc against movement relative to said sprinkler body so as to flex said disc in a manner to resiliently bias said valve member to close said outlet port, said disc responding to temperature rise to snap to an opposite flexure to open said outlet port to release fluid from said control chamber to open said main valve.

2. The combination in accordance with claim [4] *1* wherein said bimetallic disc exhibits a hysteresis effect wherein said disc flexes in one direction to open said pilot valve means upon the occurrence of a first predetermined temperature but flexes in the reverse direction to close said pilot valve means upon the occurrence of a second temperature lower than said first predetermined temperature.

3. A water sprinkler device for a fire protection system coupled to a pressurized fluid supply line; comprising in combination:

a sprinkler body having an annular inlet portion adapted for coupling to said fluid supply line;

means providing an inner wall for dividing said sprinkler body into a first bifurcation, having an outlet portion that defines a main fluid flow passgeway between said inlet portion and said outlet portion, and a second bifurcation that defines a control chamber;

a deflector mounted adjacent said outlet portion to deflect fluid flow therethrough;

means providing a valve seating surface abutting said inlet portion at the junction of said bifurcations;

a main valve disposed in a direction downstream from said seating surface and having a valve seat mounted in opposed relation to said seating surface so as to oppose fluid pressure from said inlet portion that tends to cause said valve seat to separate from said seating surface to open said valve,

said main valve being slideable into said control chamber for controlling fluid flow through said main passageway while maintaining said control chamber blocked to fluid flow from said outlet portion,

an aperture formed substantially centrally in said main valve to define a control passageway that couples fluid from said inlet portion to said control chamber;

said main valve exhibiting a first surface area disposed toward said control chamber that is greater than a second surface area disposed toward said inlet portion to provide a greater main valve closing pressure than opening pressure,

means providing an outlet port from said control chamber to release fluid pressure therefrom to open said main valve,

pilot valve means having a valve member mounted to control fluid flow through said outlet port and including a bimetallic disc operatively connected to said valve member,

said disc responding to temperature rise to snap in a direction to open said outlet port to release fluid from said control chamber to open said main valve.

4. The combination in accordance with claim 3, wherein said bimetallic disc exhibits a hysteresis effect wherein said disc flexes in one direction to open said pilot valve means upon the occurrence of a first predetermined temperature but flexes in the reverse direction to permit closing of said pilot valve means upon the occurrence of a second temperature lower than said first predetermined temperature.

5. The combination in accordance with claim 3, wherein the bimetallic disc is mounted externally of the sprinkler body and at a position above the deflector, whereby the disc is exposed to ambient temperature and does not come into contact with discharge fluid.

6. The combination in accordance with claim 3, wherein the pilot valve means additionally comprises a retainer member having a radial flange portion spaced from the sprinkler body, said flange portion protects the disc from discharge fluid.

7. A water sprinkler device for a fire protection system coupled to a pressurized fluid supply line, comprising in combination:

a sprinkler body having an annular inlet portion adapted for coupling to said fluid supply line;

means providing an inner wall for dividing said sprinkler body into a first bifurcation, having an outlet portion that defines a main fluid flow passageway between said inlet portion and said outlet portion, and a second bifurcation that defines a control chamber;

a deflector mounted adjacent said outlet portion to deflect fluid flow therethrough;

means providing a valve seating surface abutting said inlet portion at the junction of said bifurcations;

a main valve disposed in a direction downstream from said seating surface and having a valve seat mounted in opposed relation to said seating surface so as to oppose fluid pressure from said inlet portion that tends to cause said valve seat to separate from said seating surface to open said valve,

said main valve being slideable into said control chamber for controlling fluid flow through said main passageway while maintaining said control chamber blocked to fluid flow from said outlet portion,

an aperture formed substantially centrally in said main valve to define a control passageway that couples fluid from said inlet portion to said control chamber;

said main valve exhibiting a first surface area disposed toward said control chamber that is greater than a second surface area disposed toward said inlet portion to provide a greater main valve closing pressure than opening pressure,

means providing an outlet port from said control chamber to release fluid pressure therefrom to open said main valve,

a pilot valve means for closing said outlet port; and

temperature responsive means for controlling the pilot valve means including a bimetallic disc which exhibits a hysteresis effect by flexing in one direction to open said pilot valve means and release fluid from said control chamber upon the occurrence of a first predetermined temperature and flexing in a reverse direction to allow closure of said pilot valve means upon occurrence of a second temperature lower than said first predetermined temperature.

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