Sept. 17, 1968 J. W. LOFTIN ET AL 3,401,751

DRY PIPES SPRINKLER SYSTEM

Filed April 22, 1966 2 Sheets-Sheet 1

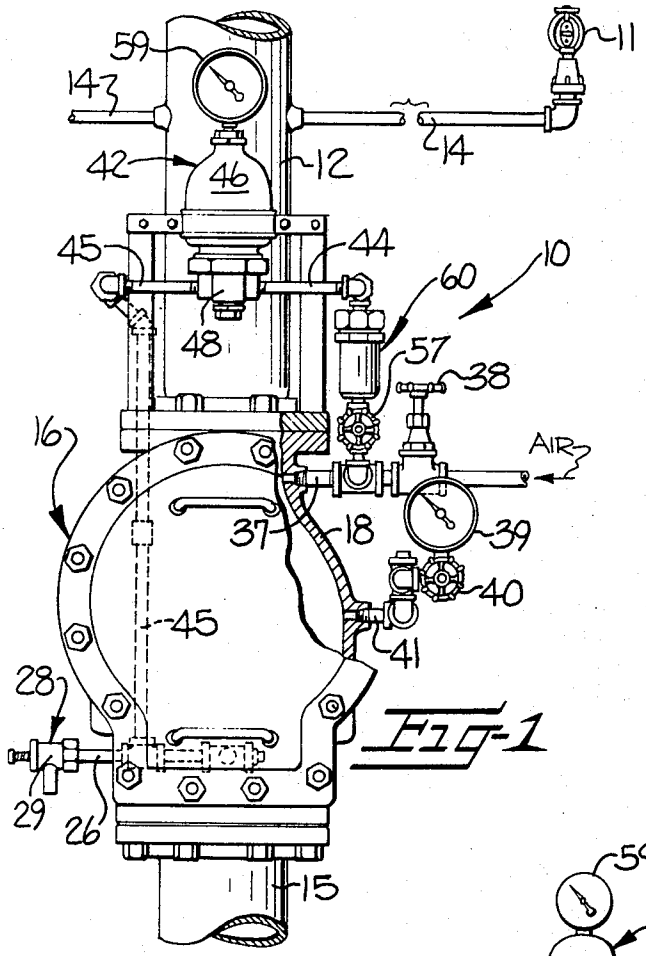

Fig-1

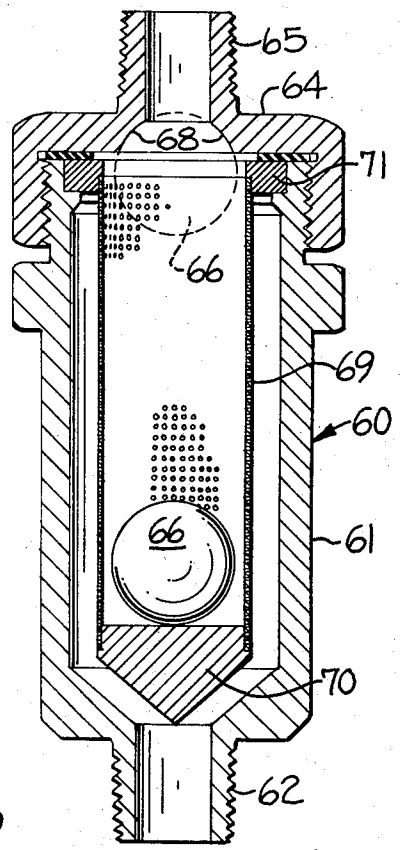

Fig-3

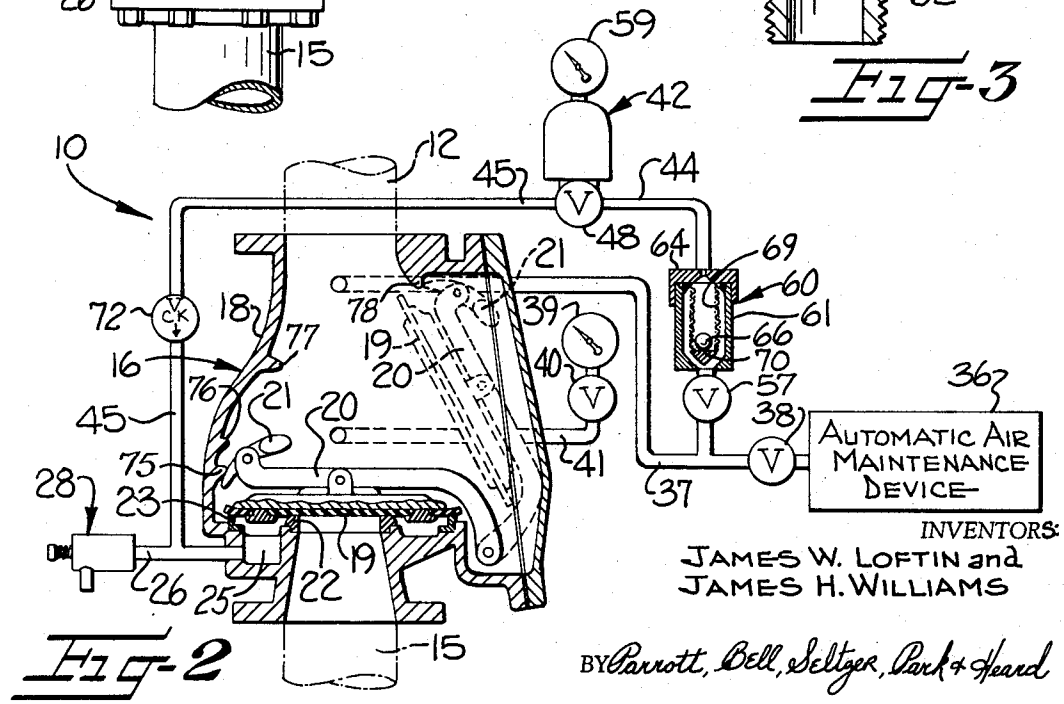

Fig-2

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Filed April 22, 1966 2 Sheets-Sheet 2

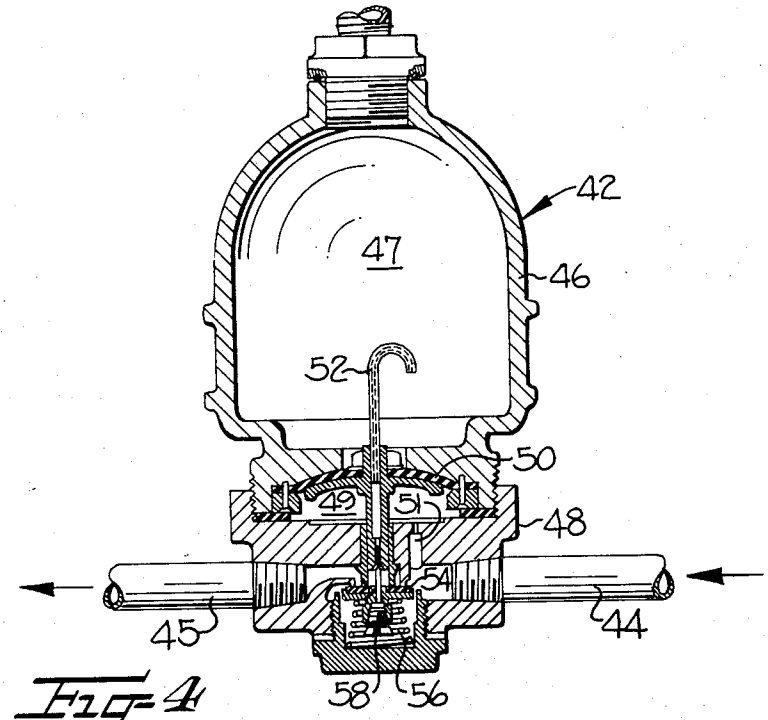

Fig-4

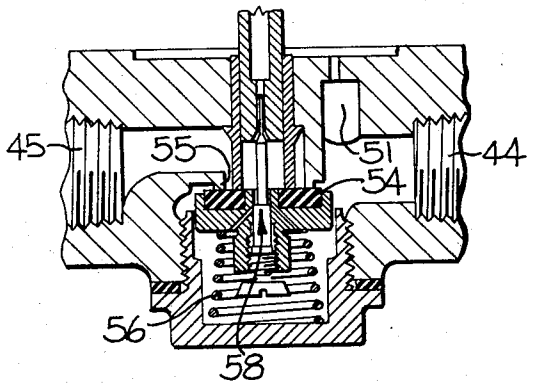

Fig-5

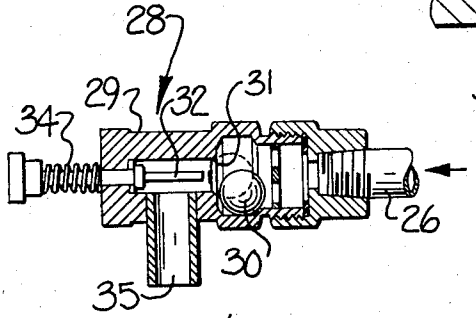

Fig-6

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DRY PIPES SPRINKLER SYSTEM

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ABSTRACT OF THE DISCLOSURE

A dry pipe sprinkler system including a dry pipe valve controlling the admission of water under pressure to a sprinkler pipe and a plurality of normally closed sprinkler heads and having an accelerator valve for facilitating opening of the dry pipe valve and wherein means are provided in combination with the system for protecting the accelerator valve from damage and the collection of debris therein.

Sprinkler systems are widely required by fire insurance companies and used to extinguish or at least limit the damage caused by fire, and may be broadly catagorized as of two types, known as wet pipe systems and dry pipe systems. In a dry pipe system, such as that with which this invention is concerned, a number of spray devices, including normally closed temperature responsive valves and known as sprinkler heads, are mounted throughout an area to be protected, and communicate with a sprinkler pipe. The sprinkler pipe is normally filled with air under pressure, but upon opening of one of the sprinkler heads, in response to a fire in the vicinity of that head, the air within the sprinkler pipe is released and water is admitted to the sprinkler pipe to be sprayed from an open sprinkler head to extinguish the fire or minimize the damage caused thereby.

Dry pipe sprinkler systems of the type described have heretofore been known and widely used where the ambient temperature at the sprinkler pipe may drop below freezing for substantial periods of time. In such a system, a dry pipe valve provides a point of separation between a water pipe, connected to a service water supply and adapted to contain water under pressure, and the sprinkler pipe, which is normally filled with air under pressure. A movable valve member within the dry pipe valve is normally maintained in a seated position, precluding the admission of water to the sprinkler pipe, by a balance of the forces imposed thereon by gravity and by air and water pressures acting on areas of opposite sides of the valve member. In order to facilitate opening of the dry pipe valve upon a drop in air pressure within the sprinkler pipe such as occurs upon the opening of a sprinkler head, to admit water into the sprinkler pipe, an accelerator valve may be employed, which operates in response to a drop in air pressure within the sprinkler pipe to apply that pressure to the water pressurized side of the movable valve member of the dry pipe valve, thereby permitting the water pressure applied to the valve member to more readily open the valve.

Inasmuch as the primary function of an accelerator valve is to apply air pressure to the water pressurized side of the movable valve member of the dry pipe valve, accelerator valves are designed and intended for the flow of air therethrough. However, the connection of an accelerator valve to the other elements of a dry pipe sprinkler system is such that, when the system "goes wet" and water is admitted into the sprinkler pipe, water may reach the accelerator valve. As a result of the admission of water to the accelerator valve upon operation of a dry pipe sprinkler system, it is necessary to assure that the accelerator valve is drained of water at the time that the system is returned to the normal condition of readiness for operation. Further, as the water admitted to the accelerator valve upon opening of the dry pipe valve frequently is contaminated with debris, such as rust formed in the sprinkler pipe which has fallen into the dry pipe valve, paper scraps, cigarette butts, and other such objects, cleaning of the accelerator valve frequently entails considerably more than merely draining water therefrom. In fact, it is frequently necessary to disassemble the accelerator valve from the other elements of a dry pipe sprinkler system is returning the system to normal condition subsequent to the admission of water to the sprinkler pipe. Disassembly of an accelerator valve for purposes of cleaning is an arduous task, particularly in systems where the valve structure is heavy and/or complicated. In such systems where the pressure of the service water supply is relatively high, a further danger is that of impact damage to delicate and precisely assembled portions of the accelerator valve upon the sudden application of high water pressures to the accelerator valve on admission of water to the sprinkler pipe.

It is an object of this invention to provide a means, in combination with a dry pipe sprinkler system, for precluding the admission of water to an accelerator valve while permitting that valve to perform the intended function of applying air pressure to unbalance the forces imposed on a movable valve member of the dry pipe valve means, as required for facilitating operation of the system.

A more specific object of this invention is to provide, in combination with a dry pipe sprinkler system of the type described, a water responsive valve means interposed between an accelerator valve and the point of operative communication of the accelerator valve with one side of the movable valve member of the dry pipe valve, with the water responsive valve means permitting free flow of air and precluding admission of water to the accelerator valve upon opening of the valve member of the dry pipe valve.

Some of the objects and advantages of the invention having been stated, others will appear as the description proceeds, when taken in connection with the accompanying drawings, in which:

FIGURE 1 is an elevation view of elements of a dry pipe sprinkler system including the present invention;

FIGURE 2 is a schematic illustration of the dry pipe sprinkler system of FIGURE 1, including sectional views of a dry pipe valve and a water responsive valve means in accordance with this invention;

FIGURE 3 is an enlarged scale cross section view of the water responsive valve means of FIGURE 2;

FIGURE 4 is a cross section view of the accelerator valve of FIGURES 1 and 2;

FIGURE 5 is an enlarged scale view of a portion of the accelerator valve of FIGURE 4; and

FIGURE 6 is a section view of a velocity check and draining valve.

Referring now more particularly to the drawings, the dry pipe sprinkler system of this invention is there shown and indicated generally at **10**. For purposes of clarity in explaining the necessary elements of the present invention, certain conventional elements frequently included in such a dry pipe sprinkler system, such as a priming system and a water alarm system, have been deleted to permit concentration of attention upon the combination of this invention. It is to be understood, however, that the dry pipe system **10** of this invention may incorporate such additional elements as desired or necessary.

Broadly, the dry pipe sprinkler system **10** of this invention includes a plurality of normally closed and temperature responsive sprinkler heads **11** (only one of which is shown), which operatively communicate with a

sprinkler pipe 12, as through sprinkler head branch pipes 14 extending therebetween. The sprinkler pipe 12 and branch pipes 14 normally contain air under pressure, which is released upon opening of a sprinkler head 11. A water pipe 15 is adapted to operatively communicate with a service water supply or source of water under pressure, such as community water system or a water tank, and to normally contain water under pressure. The sprinkler pipe 12 and water pipe 15 are connected by a dry pipe valve, indicated generally at 16, which provides a point of separation of the air and water under pressure and controls communication therebetween as will be described in greater detail hereinafter. The dry pipe valve 16 includes a valve body 18, a clapper valve member 19 supported therein, and valve seats to be engaged by the valve member 19. Preferably, the valve member 19 is supported for pivotal movement within the casing 18 by a clapper arm 20 overlying the valve member 19 and pivotally connected at one end thereof within the casing 18. At the opposite end of the clapper arm 20 from the pivotal connection to the casing 18 is provided a gravity clapper latch 21, for purposes to be described more fully hereinafter.

In the normal condition of the dry pipe sprinkler system 10, the valve member 19 is maintained in a seated position on a water seat ring 22 and an air seat ring 23 encircling the water seat ring 22. Preferably, the lower surface of the valve member 19 is covered by a resilient gasket material to assure leakproof seating on the valve seats 22, 23. The portion of the valve body 18 surrounding the connection with the water pipe 15, and intermediate the valve seats 22, 23, defines an intermediate chamber 25, for purposes to be described more fully hereinafter. The intermediate chamber 25 normally contains air at ambient atmospheric pressure, and operatively communicates with the ambient atmosphere by way of a conduit 26 and a velocity check valve 28. The velocity check valve 28 (FIGURE 6) includes a housing 29 and a ball valve member 30 movable within the housing and to a seated position on a valve seat 31 provided therein. A relief piston member 32 penetrates the housing 29 centrally of the valve seat 31, and is biased outwardly by suitable means such as a compression spring 34. The casing 29 has an outlet opening 35 therein, communicating with the ambient atmosphere, and communicates with the intermediate chamber 25 of the dry pipe valve 16 through the conduit 26. The ball valve member 30 normally is loosely disposed within the housing 29, rather than being seated on the seat 31, so that the communication of the intermediate chamber 25 with the atmosphere is unimpeded. Upon a sudden inrush of fluid into the velocity check valve 28 through the conduit 26, the ball valve member is seated by the fluid pressure on the seat 31, and the fluid pressure is contained within the conduit 26.

As mentioned above, the sprinkler pipe 12, sprinkler head branch pipes 14, and sprinkler heads 11 are adapted to contain and normally have applied thereto air under pressure, which is admitted thereto from a suitable compressed air source (not shown) through an automatic air maintenance device 36 (FIGURE 2) and a conduit 37 operatively connecting that device and the interior of the dry pipe valve body 18 at a point above the valve seats 22, 23, and thereby communicating with one side of the valve member 19 when that member is in a seated position. Automatic air maintenance devices, such as the device 36, are well known, conventionally used, and, inasmuch as that device forms no major portion of the combination of this invention, need not be shown or described in detail. A manually operable valve 38 is connected to the conduit 37 to permit separation of the device 36.

When the dry pipe sprinkler system 10 is in a normal condition (FIGURE 2), it is usual to provide a priming water charge overlying the valve member 19 and filling a portion of the dry pipe valve body 18. A suitable gauge

39 is connected by means of a valve 40 and conduit 41 to operatively communicate with the interior of the body 18 above the level of the priming charge, in order to provide a means for checking the pressure present within the sprinkler pipe 12.

Upon a rise in temperature in an area where a sprinkler head 11 is located, the temperature sensitive normally closed valve means included in the sprinkler head 11 will open, causing the air pressure within the sprinkler pipe 12 to drop and bringing the sprinkler system into operation.

With a sufficient drop in the air pressure within the sprinkler pipe 12, the water pressure within the water pipe 15 will eventually overcome the downward force on the valve member 19 and force that member upwardly to admit water to the sprinkler pipe 12. In many installations, however, it is necessary that the sprinkler pipe 12 be quickly filled with water upon a drop in the air pressure therein and, accordingly, such dry pipe systems are normally provided with an accelerator valve, indicated generally at 42, for facilitating prompt opening of the dry pipe valve 16. More particularly, the accelerator valve 42 operatively communicates with opposite sides of the seated valve member 19, and operates to unbalance the forces imposed on the seated valve member 19 upon a predetermined drop in the air pressure within the sprinkler pipe 12, to permit that member to be more readily moved to an open position by the water pressure within the water pipe 15. The accelerator valve 42 controls communication between a conduit 44 which operatively communicates with the conduit 37, and thus with the interior of the valve body 18 and the upper side of the seated valve member 19, and a conduit 45 which operatively communicates with the conduit 26 and thus with the intermediate chamber 25 and the lower side of the seated valve member 19.

The particular manner in which the accelerator valve 42 operates to unbalance the forces imposed on the seated valve member 19 of the dry pipe valve 16 may best be explained after the construction of the accelerator valve 42 is described with reference to FIGURES 4 and 5. The accelerator valve 42 includes an upper casing 46 which defines an upper pressure chamber 47 therein and which is secured by a threaded engagement in a lower casing 48, to which the conduits 44, 45 are connected. The lower casing 48 includes a lower pressure chamber 49, which is divided from the upper pressure chamber 47 by a diaphragm piston member 50, the upper side of which has applied thereto any pressure present within the upper chamber 47 and the lower side of which has applied thereto any pressure present in the lower chamber 49. The lower chamber 49 communicates, through an opening 51, with the conduit 44 to which the air pressure within the sprinkler pipe 12 is applied. A hollow stem 52 penetrates the piston 50 and has, at the lower extremity thereof, a valve member 54 adapted to engage a valve seat 55 formed in the lower casing 48 to control the operative communication between the two conduits 44, 45 communicating with opposite sides of the seated valve member 19. Beneath the valve member 54 is a suitable compression spring 56, which resiliently urges the valve member 54 into a seated position. Also at the lower extremity of the hollow stem 52 is a needle flow control device indicated at 58 which controls a flow of air from the conduit 44 to the interior of the hollow stem 52 into the upper chamber 47.

Upon initial application of air pressure to the conduits 37 and 44, such air pressure is admitted to the intermediate chamber 49 through the opening 51 and joins with the resilient biasing force of the spring 56 to move the piston member 50 upwardly and the valve member 54 onto the seat 55, thereby precluding operative communication between the conduits 44 and 45. At the same time, air from the conduit 44 is slowly admitted under the control of the needle valve device 58 to the interior of the hollow stem 42, to flow into the upper chamber 47 and

create an air pressure within that space. Eventually, the air pressure within the upper chamber **47** and the air pressure within the lower chamber **49** become balanced, and the valve member **54** is held in seated position by the resilient biasing force of the spring **56**. A gauge **59** is provided for permitting observation of the pressure within the upper chamber **47**.

At some subsequent time, upon opening of a sprinkler head **11**, the pressure within the sprinkler pipe **12** is reduced and, inasmuch as the conduit **44** operatively communicates with the sprinkler pipe pressure through the conduit **37**, the pressure within the lower chamber **49** is simultaneously reduced. Upon a reduction in pressure in the lower chamber **49** of the accelerator valve **42**, the pressure present in the upper chamber **47** overcomes the biasing force of the spring **54**, moving the stem **52** and valve member **54** downwardly, and opening a path of communication between the conduits **44** and **45**. Upon opening of this path of communication, the pressure present in the sprinkler pipe is applied to the intermediate chamber **25** and the lower side of the valve member **19** through the conduits **45** and **26**, and the velocity check valve **28** is closed. Thereupon, the water pressure present in the water pipe **15** causes the valve member **19** to move upwardly and admit water into the sprinkler pipe **12**. A manually operable valve **57** is connected in the conduit **44** so that operation of the accelerator valve **42** may be selectively precluded if required, as for testing.

Upon upward movement of the valve member **19** and the pivoted arm **20** to which it is secured, such as to the position indicated in dotted lines in FIGURE 2, the gravity clapper latch **21** moves to project outwardly beyond the pivoted arm **20**, and engages one of a plurality of catch projections **75, 76, 77, 78** within the casing **18** of the dry pipe valve **16**. The valve member **19** is thus held in the open position until the sprinkler system is subsequently returned to normal operating conditions after any fire present at the open sprinkler head is extinguished.

The various elements, their construction, and the operation of the dry pipe sprinkler system **10** as described and illustrated up to this point are substantially conventional and well known. However, the discussion here given has been considered necessary in order to place the discussion which follows in the proper perspective and to permit a more ready understanding of the novel combination of this invention.

Upon movement of the valve member **19** to an open position, as just described, water is admitted into the body **18** of the dry pipe valve **16**, and will reach and flow into the conduits **37** and **44**. Similarly, water is admitted into the intermediate chamber **25** in the dry pipe valve **16**, and will reach and flow into the conduits **26** and **45**. The admission of water into the conduit **26** may operate a wet system alarm (not shown), as well known, and will result in seating the ball valve member **30** of the velocity check valve **28** if the same has not previously been seated. It is this admission of water into the conduits **44, 45** which has heretofore permitted water to reach the accelerator valve **42** and created difficulties by impact damage or by carrying debris which must be thereafter removed by disassembling a portion of the system or the accelerator valve **42**.

In accordance with this invention and in order to protect the accelerator valve **42** against impact damage and debris collection therein, means are provided in combination with the heretofore described elements of the sprinkler system for precluding the passage of water to the accelerator valve upon opening of the dry pipe valve member **19** to admit water to the valve body **18** and intermediate chamber **25** while permitting free air flow to and through the accelerator valve **42** for force unbalancing. More particularly, a normally open water responsive valve means, indicated generally at **60**, is operatively connected in one of the conduits **44, 45** communicating with the accelerator valve **42** and the opposite sides of the seated dry pipe valve member **19**. The valve means **60** preferably is connected in the conduit **44** inasmuch as the admission of water and debris carried thereby to the accelerator valve **42** through that conduit **44** would create greater difficulty in the removal thereof, as described more fully hereinafter. The operation of the water responsive valve means **60** may be better understood following a description of the construction of that means.

Referring now to FIGURE 3, the normally open valve means **60** includes a hollow casing member **61** having at one end thereof means such as a threaded nipple portion **62** adapted to be connected to a conduit. For purposes for facilitating assembly of the valve means **60**, a cap portion **64** is threadingly assembled with the body **61**, and includes a threaded nipple portion **65** adapted to be connected to a conduit. Within the casing **61** is defined a chamber, which is in operative communication with a conduit in which the valve means **60** is interposed by connection to the nipple portions **62, 65**. Within the chamber defined by the casing **61** and cap portion **64** is a flotation valve member **66**, preferably in the form of a sphere or ball of material having a specific gravity less than 1. Inasmuch as the valve member **66** must withstand many years of use and yet function properly at any time when required, it is preferred to form the valve member **66** from a long-lived plastic material, and polyethylene having a specific gravity of from 0.91 to 0.925 has been found to be suitable. Adjacent the upper extremity of the chambed defined within the housing **61** and cap portion **64** is provided a valve seat **68**, having a spherical surface mating with the spherical surface of the valve member **66**. Preferably, the valve member **66** is enclosed within a vertical cage, to restrict the movement of that member and to permit free air flow through the valve means **60** for purposes of air pressure balancing in the form of a cylindrical strainer element **69** having a bottom plug **70** at the lower extremity thereof and being secured within a support ring **71** at the upper extremity thereof which is engaged and supported by the casing **61**.

During normal conditions of the springler system **10**, and when air under pressure is present in flowing into, or flowing through the sprinkler pipe **12**, accelerator valve **42**, and the conduits **37, 44** connecting the accelerator valve with the sprinkler pipe **12**, the weight of the valve member **66** is sufficient to keep the same at the lower extremity of its permissible range of travel, resting upon the lower plug **70** of the strainer **69** (solid lines in FIGURE 3). With the valve member **66** in that position, air may freely flow through the chamber within the valve means casing **61**, the strainer **69** and the nipple connections **62, 65** as required during pressurization of the system **10** and upon opening of a springler head **11**. When the system goes wet, water flowing into the body **18** of the dry pipe valve **16** will enter the conduit **37**, and flow therethrough to enter the conduit **44** and the lower portion of the chamber within the normally open valve means **60**. The valve member **66** thereupon will float upwardly with the rising water level and become seated on the valve seat **68** (phantom lines in FIGURE 3), thereby interrupting communication between accelerator valve **42** and the valve body **18** and precluding admission of water to the accelerator valve. Water borne debris is prevented from reaching the valve seat **68** by the strainer **69**.

While the construction and cooperation of the various elements of the system **10** of this invention has been particularly described with referernce to the connection of the water responsive valve means **60** in the conduit **44** between the accelerator valve **42** and the valve body **18** and sprinkler pipe **12**, it is apparent that such a valve means may be connected in the conduit **45** between the accelerator valve **42** and the intermediate chamber **25** if rendered necessary or desirable by the details of the system configuration or circumstances of use. In the illustrated system, inclusion of such a valve means in the con-

duit 45 is not necessary as that conduit normally contains air at atmospheric pressure and may be readily drained of water through the operation of the velocity check valve 28 as described above. Due to this detail of system configuration, passage of water through the conduit 45 to the accelerator valve 42 may be prevented by a conventional check valve 72, without impairing the necessary flow of air from the sprinkler pipe 12 through the conduits 44, 45 and the accelerator valve 42 and to the intermediate chamber 25, as required upon opening of the accelerator valve 42.

In the drawings and specification there has been set forth a preferred embodiment of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. In a dry pipe sprinkler system including:
- a plurality of normally closed sprinkler heads,
- a sprinkler pipe communicating with the sprinkler heads and adapted to normally contain air under pressure,
- a water pipe adapted to contain water under pressure,
- a dry pipe valve connecting the sprinkler pipe and water pipe for controlling the admission of water into the sprinkler pipe and including a valve seat and a valve member normally maintained in a seated position by a balance of forces imposed thereon at least in part by the air and water contained in the respective pipes for normally precluding the admission of water to the sprinkler pipe, and
- means for unbalancing the forces imposed on the seated valve member upon a predetermined drop in air pressure within the sprinkler pipe as upon the opening of a sprinkler head so that the valve member is more readily moved to an open position by water pressure and water is admitted to the sprinkler pipe, said means including conduits operatively communicating with opposite sides of the dry pipe valve seat and an accelerator valve connecting the conduits for controlling communication therebetween,
- the combination therewith of means for protecting the accelerator valve from damage and the collection of debris therein, said means being connected in the one of said conduits between said accelerator valve and said sprinkler pipe for permitting free air flow through said conduits and accelerator valve for force unbalancing, being responsive to the presence of water in said one conduit for precluding passage of water to the accelerator valve upon admission of water to the sprinkler pipe, and including means for directing the flow of air through said accelerator valve protecting means in a predetermined manner so as to at least substantially preclude response of said protecting means to the flow of air therethrough.

2. The combination of claim 1 wherein said protecting means comprises:
- a casing defining a chamber communicating with said one of the conduits for the flow of air therethrough and of water thereinto, said casing having a valve seat therein, and
- a buoyant valve member disposed within said casing and freely movable within said chamber between an unseated position at which the flow of air through said casing is unimpeded and a seated position in engagement with said casing valve seat at which the flow of water through said casing is precluded, said buoyant valve member being movable to the seated position upon entrance of water into said casing.

3. The combination of claim 2 wherein said protecting means further comprises:
- a perforate cage member within said casing and enclosing said buoyant valve member for guiding the buoyant movement thereof and for precluding the passage of debris through said casing.

4. The combination of claim 1 wherein said protecting means comprises:
- a casing defining an elongate generally vertically extending chamber communicating with said one of the conduits for the flow of air therethrough and of water thereinto, said casing having an inlet, an outlet, positioned above said inlet, and a spherical valve seat therein adjacent said outlet,
- a spherical buoyant valve member disposed within said casing and freely movable vertically within said chamber between an unseated position at which the flow of air through said casing is unimpeded and a seated position in engagement with said casing valve seat at which the flow of water through said casing is precluded, said buoyant valve member moving to the seated position upon entrance of water into said chamber to fill the same and convey said buoyant valve member toward said outlet, and wherein said flow directing means included in said protecting means comprises:
  - a cage within said casing and enclosing said buoyant valve member for guiding the buoyant movement thereof and having a perforate member for precluding the passage of debris from said inlet to said valve seat and said outlet while permitting the flow of fluid through said cage.

5. The combination of claim 4 wherein said cage further comprises plug means adjacent said inlet for diverting the flow of fluid through said inlet from direct impingement on said valve member so as to preclude velocity responsive movement of said valve member upon flow of fluid into and through said protecting means.

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