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[54] PRESSURE RESPONSIVE FLUID NOZZLE

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[52] **U.S. Cl.**.....**239/452,** 137/70, 169/37

[51] **Int. Cl.**.....**B05b 1/32**

[58] **Field of Search** 169/37, 38, 39, 42; 239/452, 239/456, 534; 137/70, 71, 797

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[57] **ABSTRACT**

A pressure responsive fluid nozzle wherein an expellable plug is disposed in the outlet of a body member having an inlet adapted for connection to a source of fluid under pressure. The plug is connected relative to the body member by means of a connector which is placed under tension in response to the fluid pressure in the body member. Upon the fluid pressure attaining a predetermined magnitude, the connector is adapted to break to release the plug from the outlet and permit the fluid to be discharged from the nozzle.

10 Claims, 2 Drawing Figures

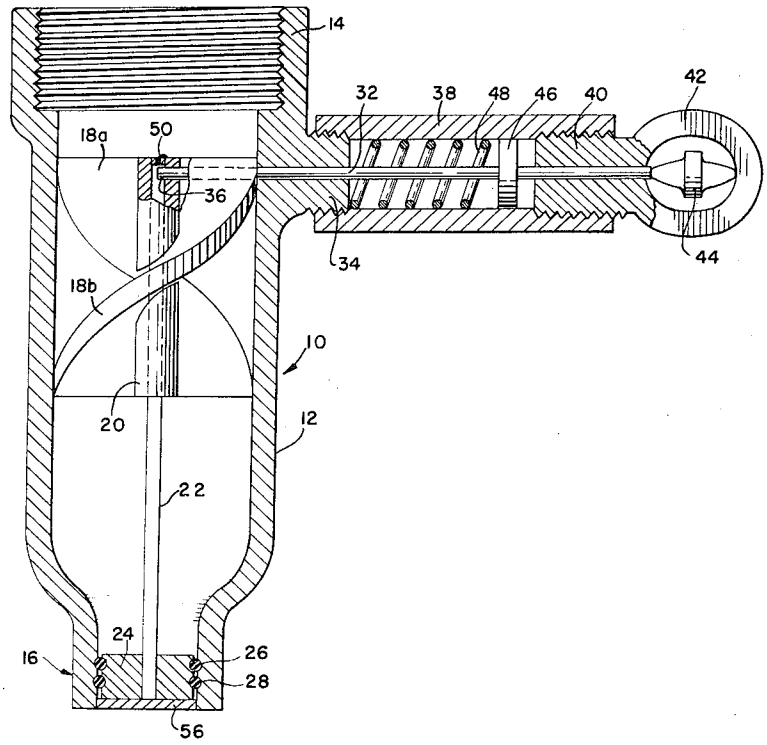


FIG. 1.

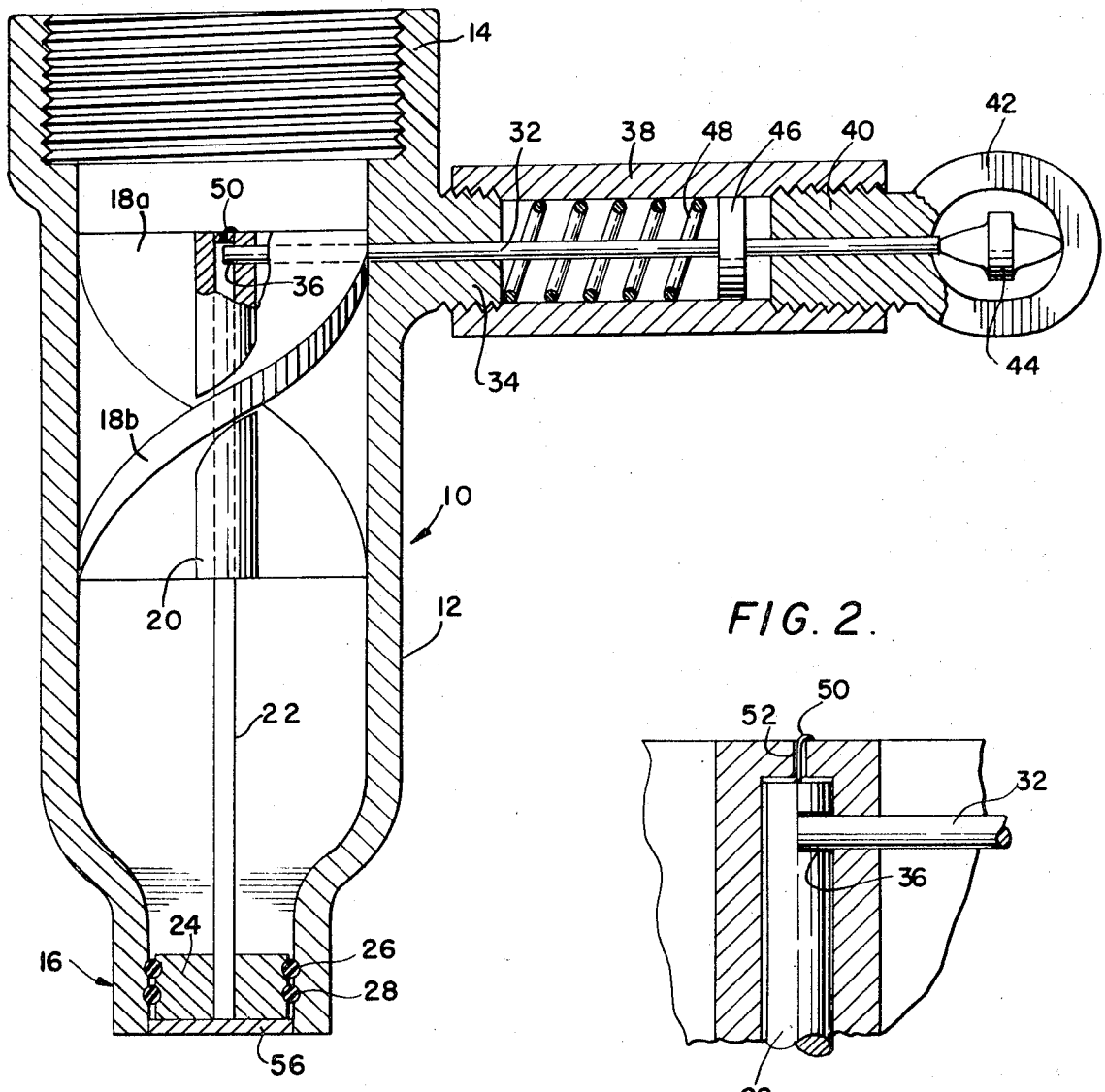


FIG. 2.

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PRESSURE RESPONSIVE FLUID NOZZLE

BACKGROUND OF THE INVENTION

Automatic sprinkler systems for protecting industrial and commercial properties normally employ thermally releasable sprinkler heads located near the top of the space being protected. The sprinkler heads are supplied with a suitable extinguishant, such as water, by a pipe network of mains, risers, cross-mains and branches. Most sprinkler heads used in these type systems have a discharge opening or throat normally closed by a plug retained by a thermal fuse and collapsible linkage bridging an external loop or yoke. Upon actuation of the head by collapse of the linkage, the extinguishant stream issuing from the throat impinges against a serrated deflector disc to form a hemispherical pattern of droplets simulating the characteristics of rain.

Because of the high degree of head standardization, design parameters for automatic sprinkler systems have, in the past, been limited to a selection of head release temperatures, head spacing and system supply capacity, including pipe sizes and the like. In the selection of a head release temperature it has been conventional practice to select sprinklers with higher temperature ratings than those which would respond quickly to the existence of a fire in the protected space. Although such a delayed response is sometimes undesirable, the disadvantages are outweighed by such advantages as avoidance of accidental release and potential loss by water damage, and the avoidance of heads located remotely from the actual fire being actuated by the effects of convection and the circulation of hot combustion products throughout the protected space. This latter factor is believed to be one of the principal causes for failure of automatic sprinkler systems, particularly in the case of intense high challenge fires where all available extinguishant is needed on and near the burning fuel surfaces to bring the fire under control.

The selections of head spacing and water supply capacity for water sprinkler systems are predicated largely on the required water density needed to extinguish the most intense fire anticipated, as well as on economic considerations. For example, since the maximum amount of extinguishant capable of being delivered by one head is relatively fixed by the size of its discharge orifice, increased densities have been achieved in the past by overlapping the floor areas to which extinguishant is directed by each of the heads. In other words, where increased densities are called for, the number of heads employed in the system is increased and the spacing between heads reduced to achieve overlapping coverage. The capacity of the water supply required to supply such heads has in the past involved the application of conventional principles of fluid flow, taking into account the flow requirements of all of the sprinkler heads when operating under the conditions presented by the most destructive fire which is anticipated.

Although automatic sprinkler systems of the type described have been an effective means for the protection of property against loss or damage by fire, the trend during recent years to higher storage enclosures coupled with the increased use of plastics has presented new challenges for such systems. For example, recent extensive studies with actual and synthetically produced fire plumes or columns have shown that in enclosed spaces of 20 feet and higher, the updraft or chimney effect caused by convection alone is sufficient to prevent the free falling water droplets produced by conventional sprinkler heads from penetrating the rising fire plume and reaching the burning fuel surfaces. Because of this phenomenon, such sprinkler systems merely operate to wet down or inhibit the spread of a high challenge fire within the space and thus provide what is referred to as exposure protection. However, the temperatures reached in a high challenge fire are sufficient to effect a self-drying of the fuel supplying the fire. Moreover, where the fuel is plastic or plastic wrapped, it is not capable of being pre-wet by the sprinkler heads around the fire plume and hence burning proceeds substantially uninhibited.

Another factor to be accounted for occurs where the heat of a localized high challenge fire establishing a fire column or plume in excess of 20 feet in height flares out beneath the ceiling of the protected space and actuates numerous sprinkler heads located at such a distance from the fire that they are ineffective to deliver water or other extinguishant to the fuel surfaces. This contributes not only to redundant and flooding use of the water, but more significantly, robs water from the heads over the fire where it is needed to extinguish the fire.

It will be apparent, therefore, that conventional automatic sprinkler systems, though adequate for the protection of buildings and other spaces with relatively low ceilings, are less effective in high challenge fire situations where there is adequate ceiling height for a strong intense fire plume or column to develop.

In U.S. Pat. application Ser. No. 72,333 filed on Sept. 15, 1970 by the same inventor and assigned to the same assignee as the present application, a fixed fire extinguishing system is disclosed which is designed to limit the number of sprinkler heads which will be activated by a fire. The heads are spaced apart greater distances and have large outlet orifices to enable greater quantities of water or other extinguishant to be delivered from each head at lower pressures. Preferably, the heads are in the form of wide angle spray nozzles which develop a downwardly directed spray having large size droplets as compared to the droplets produced by the conventional sprinkler heads.

With this arrangement, the first nozzle actuated by the fire has a much better possibility of extinguishing the fire, because of the increased ability of the larger droplets to penetrate the fire plume of a high challenge fire. If the heat of the fire spreads, additional nozzles are actuated to help the first nozzle fight the fire and to wet down areas surrounding the fire to provide exposure protection to inhibit the spread of the fire. However, the additional nozzles which are allowed to be actuated are limited to a small number to avoid the prior art problems created by too many heads being actuated; namely, interfering with the fire fighting capabilities of those heads positioned immediately above the fire and over the area immediately surrounding the fire, and causing unnecessary water damage by allowing an excessive number of sprinkler heads to be actuated at points remote from the fire. In accordance with a preferred embodiment of the above-mentioned application, the above is achieved by establishing a pressure floor so that a minimum pressure must exist at each head before it will open. The system is designed so that this minimum pressure will not be reached until a predetermined number of heads have been actuated.

Although this embodiment results in several advantages including increased fire fighting capability and significant cost savings in several respects, it suffers from one disadvantage. Specifically, in establishing the above-mentioned pressure floor, an expellable plug normally blocks the outlet of the nozzle and is adapted to be expelled from the nozzle to permit extinguishant flow therethrough upon the fusing of a conventional temperature responsive device and the presence of a fluid pressure in the nozzle of a magnitude exceeding a predetermined value. In establishing the latter value, a helical compression spring is utilized to bias the expellable plug into a closed position. The design is such that the extinguishant pressure in the nozzle acts upon the helical spring and must be of a value to overcome the force of the spring before the expellable plug can be released. However, it has been discovered that the use of the above-mentioned spring makes it extremely difficult to ascertain the precise pressure required to overcome the force of the spring. This is largely due to the fact that it is extremely difficult to obtain a compression spring that will achieve a predictable result at a cost compatible with this type of system. It can be appreciated that this renders the overall design and operation of the system extremely unpredictable.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a pressure floor system of the above type which eliminates the use of a compression spring, and which enables the plug from the nozzle to be expelled in response to a precise finite fluid pressure occurring in the nozzle.

Towards the fulfillment of this object, the nozzle of the present invention comprises a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, plug means disposed in said outlet, means for connecting said plug means relative to said body member, and means responsive to a predetermined fluid pressure in said body member for placing said connecting means in tension. The connection means is adapted to break after a predetermined tension and release the plug means from the body member to permit expulsion of the plug means from the outlet.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference is now made to the accompanying drawings for a better understanding of the nature and objects of the present invention. The drawings illustrate the best mode presently contemplated for carrying out the objects of the invention and are not to be construed as restrictions or limitations on its scope. In the drawings:

FIG. 1 is a vertical cross-sectional view of the nozzle of the present invention; and

FIG. 2 is an enlarged partial view similar to FIG. 1 and showing a detail of the nozzle of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The nozzle of the present invention will be described by way of example in connection with a fixed fire extinguishing system, wherein the nozzle is adapted for receiving and discharging a fire extinguishant in response to information received from a fire occurring in a particular structure in which the nozzle is mounted. Referring to FIGS. 1 and 2, the nozzle is shown in general by the reference numeral **10** and comprises a cylindrical body **12** having an upper end portion **14** which is internally threaded for connection to a source of extinguishant, and a lower end portion **16** which defines an outlet orifice of a reduced cross-section. A pair of spiral vanes **18**a and **18**b are fixed within the body **12** for imparting a swirling motion to water flowing downwardly therethrough in a conventional manner. The vanes **18***a* and **18***b* support a hollow central hub **20** which, in turn, slidably supports a rod **22** having a piston head **24** fixed on its lower end. A pair of sealing rings **26** and **28** are positioned about the periphery of the head **22** and sealingly engage the inner wall of the body **12** near the lower end portion **16**.

The rod **22** is latched in the position shown in FIG. **1** by a rod **32** which extends slidably through an externally threaded boss **34** projecting from the side of the body **12**. One end of the rod **32** extends through the vane **18***a* and the wall of the central hub **20** into a slot **36** in the rod **22** to latch it in the position shown in FIG. **1**.

A sleeve **38** is threaded on the end of the boss **34**. The outer end of the sleeve is closed off by an externally threaded stub shaft **40** having a ring or yoke **42** thereon. The rod **32** slidably extends through the stub shaft **40**, and the other end of the rod engages a conventional thermal fuse element **44** positioned within the ring **42**. The fuse element prevents movement of the rod **32** to the right as viewed in FIG. **1**, until the heat of a fire fuses the element **44** so that it collapses. Since the element **44** is the standard type commonly used in conventional sprinkler heads now on the market, it will not be described in greater detail.

The rod **32** has a piston head **46** mounted thereon which slidably engages the internal wall of the sleeve **38**. A spring **48** is positioned between the boss **34** and the piston head **46** to bias the piston head and the rod **32** to the right with a predetermined biasing force.

With this arrangement, the piston head **46** and the rod **32** will be driven to the right under the action of the spring **48** upon the fuse element **44** collapsing in response to the heat of the fire and thus unlatch the rod **22**.

As better shown in FIG. **2**, a thread **50** is provided which has one end fastened to the upper end of the rod **22**. The thread **50** extends through an opening **52** formed in the upper vane **18***a*, and the other end of the thread is fastened to the top surface of the latter vane. The above-mentioned fastening may be achieved in any conventional manner, such as by the use of epoxy or the like. The thread is preferably of a nylon material and its length is selected so that it will have a slight slack therein in the deactivated position of FIGS. **1** and **2** to avoid any unwanted tension being placed thereon due to slight dimensional variations of the other components of the nozzle.

A fusible nut **56** is located at the discharge end of the body portion **12** adjacent the plug **24**, to provide a safeguard against expulsion of the rod **22** in the event that the fusible element **44** is inadvertently actuated. The nut **56** also prevents an accumulation of dirt and grime in the discharge opening which might otherwise affect the expulsion of the plug **24** from the body member **12** in the event of fire.

In operation, the nozzle is installed at an elevated position in the structure to be protected in the condition shown in FIGS. **1** and **2**, i.e., with the rod **22** latched in the body member **12** by the rod **32**, and with the thread **50** fixed to the rod **22** and the vane **18***a*. If both the fusible link **44** and the fusible nut **56** are thermally actuated in response to an elevated temperature in their vicinity, the tension of the spring **48** causes the rod **32** to release the rod **22** from its latched condition, and the fusible nut **56** frees the discharge end of the body member **12**. The extinguishant pressure in the body member **12** acting on the inner end face of the plug **24** forces it downwardly as viewed in FIG. **1**, and causes a tension to be applied to the thread **50** in direct proportion to the amount of pressure. The thread **50** can be designed to fail, or break, in response to a precise predetermined pressure, which will release the rod **22** and therefore the plug member **24**, and permit them to be discharged outwardly from the body member **12**. If the extinguishant pressure in not sufficient to break the thread **50**, the plug will not be expelled from the body portion **12** despite release of the fuse element **44** and the fusible nut **56**.

In this manner, the fire fighting capability of those nozzles positioned immediately above the fire and over the area immediately surrounding the fire will not be curtailed, while unnecessary water damage resulting from an excessive number of nozzles being actuated at points remote from the fire will be eliminated, as discussed above.

It can be appreciated that several variations may be made in the foregoing without departing from the scope of the invention. For example, a nylon thread **50** may be replaced by any other suitable member which breaks at a precise stress thereon for permitting expulsion of the plug.

Of course, other variations of the specific construction and arrangement of the pressure responsive fluid nozzle disclosed above can be made by those skilled in the art without departing from the invention as defined in the appended claims.

I claim:

1. A fluid nozzle comprising a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, plug means disposed in said outlet, means for connecting said plug means relative to said body member, and means responsive to a predetermined fluid pressure in said body member for placing said connecting means in tension, said connecting means being adapted to break after a predetermined tension and release said plug means from said body member to permit expulsion of said plug means from said outlet.

2. The nozzle of claim **1** wherein said connecting means is in the form of a thread secured at each end to said plug means and said body member.

3. The nozzle of claim **1** wherein said body member includes an internal vane to impart a swirling motion to said fluid as it passes through said body portion.

4. The nozzle of claim 3 wherein said connecting means is attached to said plug means and said vane.

5. The nozzle of claim 1 wherein said fluid pressure acts on said plug means to place said connecting means in stress.

6. The nozzle of claim 1 further comprising latching means for retaining said plug means in said outlet, and means responsive to a predetermined temperature in the vicinity of said nozzle for releasing said latching means.

7. A fluid nozzle comprising a body member having an inlet for a source of fluid under pressure, an outlet for discharging said fluid, plug means disposed in said outlet, means normally connecting said plug means relative to said body member in a manner so that a predetermined fluid pressure in said body member acting on said plug means breaks the connection between said plug means and said body member to permit expulsion of said plug means from said outlet.

8. The nozzle of claim 1 wherein said connecting means is in the form of a thread secured at each end to said plug means and said body member.

9. The nozzle of claim 8 wherein said fluid pressure acts on said plug means to place said thread in tension.

10. The nozzle of claim 7 further comprising latching means for retaining said plug means in said outlet, and means responsive to a predetermined temperature in the vicinity of said nozzle for releasing said latching means.

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