FIRE PROTECTION SYSTEM


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ABSTRACT
A system for protecting a structure and its contents from fire wherein a plurality of extinguishant discharge heads are disposed in the space defined by the structure, with each head being responsible for a particular portion of said space. A fire responsive device is automatically responsive to a predetermined temperature existing in one or more portions of the space at a distance of less than six inches from the ceiling of the structure, for actuating the head responsible for the space and causing a resultant discharge of extinguishant from the head.

1 Claim, 3 Drawing Figures
BACKGROUND OF THE INVENTION

This invention relates to a fire protection system, and more particularly to such a system utilizing critical spacing of the discharge heads with respect to the ceiling of the structure to be protected, with each head being adapted to be actuated in response to a relatively high temperature.

There are numerous fixed fire extinguishing systems in existence today in which a plurality of sprinkler heads are mounted at a fixed relation from the ceiling of the structure to be protected from fire. Each sprinkler head is usually actuated by a thermal fuse element which is adapted to fuse and cause the discharge of extinguishing agent from a deflector disc to create a mist-like spray pattern. The great majority of these systems dispose their sprinkler heads in a manner whereby the thermal fuse elements extend a distance from 6 to 18 inches from the ceiling of the structure. Also, the thermal fuse elements are usually adapted to fuse at a temperature slightly less than 300°F, with a temperature of 285°F being common.

It has been discovered that, upon a fire of a large magnitude occurring in the space to be protected by a prior art system of the above type, too many of the sprinkler heads are often actuated. This results in a relatively inefficient operation, since a sprinkler head located at a relatively long distance from the fireball, but yet close enough to be actuated due to the high pressures occurring throughout a large portion of the space, robs a sprinkler head extending directly over the fireball from valuable extinguishing agent and extinguishing pressure.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a fixed fire extinguishing system in which the heads are more discriminating in nature, i.e., only the heads located at critical portions relative to the fire are actuated, while heads more removed from the fire are maintained in a deactivated state.

It is a further object of the present invention to provide a fixed fire extinguishing system in which the heads located in the immediate vicinity of a fireball occurring in the structure to be protected, are actuated in a relatively short time.

Towards the fulfillment of these and other objects, the system of the present invention comprises a plurality of extinguishing discharge heads located in the space defined by the structure to be protected, each head being responsible for a particular portion of said space, means for delivering extinguishing agent from a source of supply to each of said heads, and fire responsive means automatically responsive to a predetermined temperature existing in one or more portions of said space at a distance of less than six inches from the ceiling of said structure for actuating the head responsible for said portion. The above-mentioned predetermined temperature is at least 500°F.

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 diagrammatic representation of a building employing a fixed fire extinguishing system of the prior art;

FIG. 2 depicts the building of FIG. 1 employing the fixed fire extinguishing system of the present invention; and

FIG. 3 is a vertical cross-sectional view of a discharge head utilized in the system of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 of the drawings depicts a building shown in general by the reference numeral 10 and employing a fixed fire extinguishing system of the prior art. In particular, the building 10 has a floor 12 and a ceiling 14, with the side walls of the building being cut away for convenience of presentation.

A fuel array is disposed in the building, and for the purposes of example is shown in the form of a plurality of stacked cartons referred to in general by the reference numeral 16.

The fixed fire extinguishing system of the prior art is shown mounted in the building 10 and includes a plurality of sprinkler heads 20, 22, 24, and 26 depending from a plurality of branch lines 28, 30, 32, and 34, respectively, extending perpendicular to, and registering with, a sub-main 36. The branch lines 28, 30, 32, and 34 are spaced at approximately fifteen foot intervals along the sub-main 36 and, although not shown in the drawings, it is understood that an additional number of sprinkler heads are spaced along each branch line at the same interval. It is also understood that the branch lines 28, 30, 32, and 34, and the sub-main 36, are fastened relative to the ceiling 14, and that a source of extinguishing agent, such as a water main, is connected to the sub-main 36 by means of risers, etc., all in accordance with conventional practice.

The sprinkler heads are of the conventional type normally utilized in systems of this kind and, as described above, include a deflector disc at their free ends for creating a mist-like spray of extinguishing agent. Also, a plurality of thermal fuse elements 20a, 22a, 24a, and 26a are mounted on the sprinkler heads 20, 22, 24, and 26, respectively, and are adapted to fuse in response to a predetermined selected temperature to permit the discharge of extinguishing agent from said heads, against the deflector discs, and towards the cartons 16.

As indicated earlier, the great majority of the prior art fixed fire extinguishing systems of this nature locate their piping system and sprinkler heads in such a manner that the thermal fuse elements extend a distance from 6 to 18 inches from the ceiling of the building. Also in accordance with traditional fire fighting practice, each thermal fuse element is designed to fuse, and therefore actuate its sprinkler head, at a temperature of slightly less than 300°F, such as, for example, 285°F.

In accordance with this prior art arrangement, upon a fireball 38 developing in the building 10 as a result of the ignition of a portion of the stacked cartons 16, the instantaneous temperature gradients can be typified by the temperature values shown adjacent each of the heads 20, 22, 24, and 26 in FIG. 1. In particular, it has been discovered that with a fireball temperature of approximately 2,500°F., the temperature of the head 20 immediately above the fireball typically takes a value
of approximately 2,300°F. Also, the temperature at the head 22 is approximately 900°F, the temperature at the head 24 is approximately 350°F, while the temperature at the head 26 is approximately 300°F.

It can be appreciated that, as a result of the above temperature gradient, the heads 20, 22, 24, and 26 will all be actuated in response to their respective thermal fuse elements being fused, due to the fact that each of the temperatures in the immediate vicinity of the latter heads exceeds 285°F. The actuation of the heads 24 and 26 is undesirable, since they are respectively located approximately 50 feet and 45 feet from the head 20 and therefore add very little to the fire fighting capability of the system. Thus, the actuation of the heads 24 and 26 may very well rob the heads 20 and 22, which are located immediately over the fire and a distance of fifteen feet thereto, respectively, from valuable extinguishing and, in addition, reduce the extinguishing pressure available to the latter heads.

As a further disadvantage of this prior art arrangement, there is a relatively large difference between the temperature of 900°F. occurring in the vicinity of the head 22, and the temperature of 2300°F. occurring in the vicinity of the head 26. As a result, there is a relatively long delay between actuation of the head 20 and the head 22. This delayed response of the head 22 may also curtail the fire fighting capability of the system.

It is noted that, as a result of the fireball 38, the gaseous products of combustion travel upwardly from the fireball by convection, impinge against the ceiling 14, and move radially outwardly along the ceiling. These combustion gases, along with air that is entrained in their movement, form a layer extending from the ceiling 14 for a distance of between 1 to 6 inches and shown in general by the reference numeral 39. The significance of this layer 39 will be described in detail later, it being sufficient to note for the purposes of the prior art arrangement of FIG. 1, that the heads 20, 22, 24, and 26 extend below the layer.

The fixed fire extinguishing system of the present invention is designed to overcome the above deficiencies and is shown in FIG. 2 in the same type building as depicted in FIG. 1, with identical structure being given identical reference numerals.

In particular, the system of the present invention employs a plurality of direct discharge heads 40, 42, 44, and 46 mounted relative to the ceiling 14 and having thermal responsive devices 40a, 42a, 44a, and 46a, respectively, connected thereto, with the details of a head and its thermal responsive device being described later.

In accordance with the present invention, the heads 40, 42, 44, and 46 are mounted closer to the ceiling 14 of the structure than in the prior art systems. In particular, the branch lines 28, 30, 32, and 34, as well as the sub-main 36, are located in a manner relative to the ceiling 14 so that the thermal responsive devices 40a, 42a, 44a, and 46a are spaced a distance of less than six inches from the ceiling. Also, the thermal responsive devices 40a, 42a, 44a, and 46a are adapted to respond to a higher temperature than that of the thermal fuse element of the prior art system, which higher temperature is preferably at least 500°F.

As discussed above, the fireball 38 creates the gaseous products of combustion which travel upwardly from the fireball by convection, impinge against the ceiling 14, and move radially outwardly along the ceiling and, together with the air that is entrained, form a layer 39 extending from the ceiling 14 for a distance of between 1 to 6 inches.

As shown in FIG. 2, the thermal responsive devices 40a, 42a, 44a, and 46a are located within the layer 39. This specific positioning is made as a result of the applicant having discovered that a more definable and dramatic temperature gradient exists in the layer 39 than in the relatively cold area extending below this area in which the corresponding heads of the prior art system are located.

As an example of the above-mentioned temperature gradient in the layer 39, the approximate temperatures in the immediate vicinity of the heads 40, 42, 44, and 46 are shown in FIG. 2. In particular, the approximate temperature in the immediate vicinity of the head 40 is 2,300°F., in the vicinity of the head 42 is 1,300°F., in the vicinity of the head 44 is 450°F., and in the vicinity of the head 46 is 400°F.

As a result of the above temperatures and the fact that the thermal responsive devices 40a, 42a, 44a, and 46a are adapted to actuate their respective heads at a temperature of at least 500°F., the heads 40 and 42 will be actuated, while the heads 44 and 46 will not be actuated. Since the latter heads are located a distance of 30 feet and 45 feet, respectively, from the nozzle 40, and therefore would be of little help in extinguishing the fireball 38, it is highly desirable that they not be actuated under the conditions shown, since, if actuated, they would rob the heads 40 and 42 of valuable extinguishing and extinguishing pressure.

It is also noted that the difference between the temperature in the vicinity of the head 40 and the head 42 is not as great as the temperature difference between the corresponding heads 20 and 22 of the prior art system. As a result, the time lag between actuation of the head 40 and the head 42 is reduced considerably, which further improves the fire fighting capability of the system.

The details of the discharge head 40 used in the arrangement of FIG. 2 are shown in FIG. 3, it being understood that the remaining heads utilized in the system of the present invention are constructed in an identical manner. The head 40 comprises a cylindrical body 52 having an upper end portion which is internally threaded as shown at 54 for connection to a source of extinguishing such as water, and a lower end portion which defines an outlet orifice 56 of a reduced cross-section. A pair of spiral vanes 58a and 58b are fixed within the body 52 for imparting a swirling motion to water flowing downwardly therethrough in a conventional manner. The vanes 58a and 58b support a hollow central hub 60 which, in turn, slidably supports a rod 62 having a head 64 fixed on its lower end. A pair of O-ring seals 66 and 68 extend between the head 64 and the inner wall of the body member 52, with the head serving to block the outlet orifice 56 as will be described in detail later.

The rod 62 is latched in the position shown in FIG. 3 by the thermal responsive device 40a. This device includes a rod 72 which slidably extends through an externally threaded boss 74 projecting from the side of the body 52. One end of the rod 72 extends through the vane 58a and the wall of the central hub 60 into a slot 76 in the rod 62 to latch it in the position shown in FIG. 3.
A sleeve 78 is threaded on the end of the boss 74. The outer end of the sleeve 78 is closed off by an externally threaded stub shaft 80 having a ring or yoke 82 thereon. The rod 72 slidably extends through the stub shaft 80, and the other end of the rod engages a conventional thermal fuse element 84 positioned within the ring 82. The fuse element 84 prevents movement of the rod 72 to the right as viewed in FIG. 3, until the heat of a fire fuses the element so that it collapses. Since the fuse element 84 is the standard type commonly used in conventional sprinkler heads now on the market, it will not be described in greater detail.

The rod 72 has a piston head 86 mounted thereon which slidably engages the internal wall of the sleeve 78. A spring 88 is positioned between the boss 74 and the piston head 86 to bias the piston head and the rod 72 to the right with a predetermined biasing force.

With this arrangement, the piston head 86 and the rod 72 will be driven to the right under the action of the spring 88 upon the fuse element 84 collapsing in response to the temperature in the immediate vicinity of the fuse element 84 exceeding 500°F. This unlatches the rod 62 and allows it, along with the head 64, to be expelled from the outlet orifice 56 of the body 52, and permit the water to spray out through the orifice.

It can be appreciated that the head spacing and the temperatures discussed in connection with the system of FIG. 1 and the system of FIG. 2, are based on specific test conditions which, if varied, may cause corresponding variations in the head spacing and actuation temperatures set forth.

Of course, other variations of the specific construction and arrangement of the fixed fire extinguishing system 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 system for protecting an enclosed structure having a ceiling from fire, comprising a plurality of heads located in said structure for discharging extinguishant directly towards said fire, each head being responsible for a particular portion of said space, means for delivering extinguishant from a source of supply to each of said heads, a thermal fuse member associated with each head and located less than six inches from said ceiling so that at least a portion of said fuse members will be directly exposed to the layer of hot gases that move in a generally horizontal direction along said ceiling as a result of a fire occurring at a random location in said structure, each thermal fuse member being adapted to fuse at a temperature of at least 500°F, so that the fuse members located generally over said fire will be fused while the fuse members spaced a predetermined horizontal distance from said fire will not be fused, and means associated with each of said heads for normally preventing the discharge of extinguishant from said heads, said latter means being responsive to said fusing of said thermal fuse members for permitting the discharge of extinguishant from their respective heads.

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