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W. L. LIVINGSTON
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AND FILL-IN SPRINKLER HEADS

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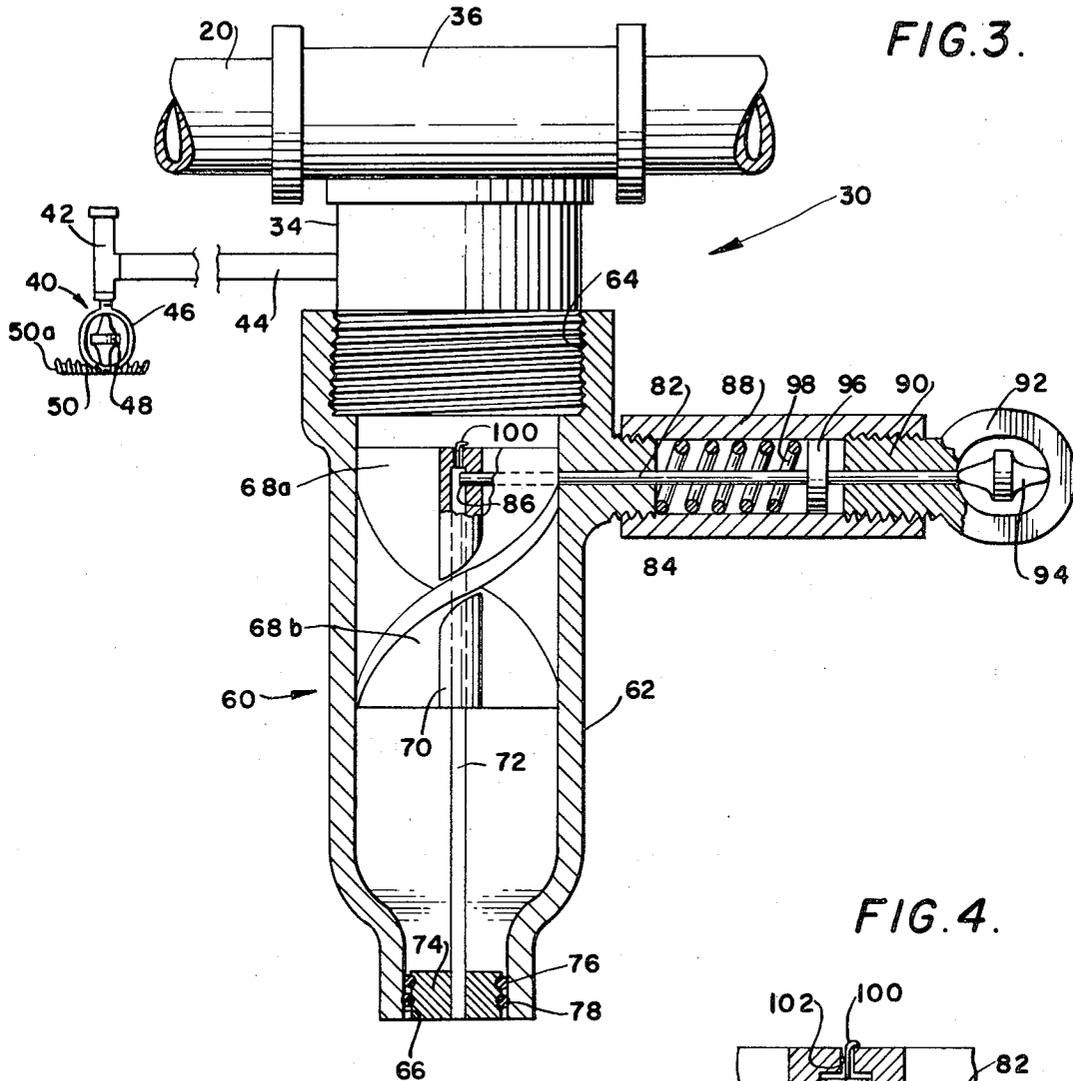


FIG. 3.

FIG. 4.

INVENTOR

WILLIAM L. LIVINGSTON

BY *Lane, Aitken, Dunner & Ziems*
ATTORNEYS

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FIRE PROTECTION SYSTEM UTILIZING DIRECT DISCHARGE NOZZLES AND FILL-IN SPRINKLER HEADS

William L. Livingston, Sharon, Mass., assignor to Factory Mutual Research Corporation, Norwood, Mass.
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40 Claims

ABSTRACT OF THE DISCLOSURE

A fire protection system for buildings and the like wherein a plurality of extinguishant discharge heads are mounted in the building and are connected to a source of extinguishant. Each head has a direct discharge nozzle and a sprinkler head for discharging a continuous supply of extinguishant across the area to be protected.

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of applicant's application Ser. No. 148,480, filed June 1, 1971.

BACKGROUND OF THE INVENTION

This invention relates to a fire protection system and, more particularly, to such a system employing a plurality of extinguishant discharge heads for discharging extinguishant towards the fire in the space to be protected in response to predetermined conditions.

Recent improvements in fire protection systems have included the use of direct discharge nozzles which directly discharge an extinguishant towards the fire in response to predetermined fire conditions, rather than the use of the traditional sprinkler heads which employ a deflector plate, or the like, to break the extinguishant up into a fine mist-like spray.

For example, in copending U.S. patent application Ser. No. 864,756, filed Oct. 8, 1969, and assigned to the same assignee as the present invention, a fire responsive nozzle is disclosed which includes a body member defining an inlet and an outlet, with a plug being normally disposed in the outlet and adapted to discharge from the outlet in response to a predetermined fire condition. A vane is disposed in the nozzle for imparting a swirling action to the extinguishant as it passes therethrough to impart a conical-like divergent pattern to the spray of extinguishant.

Other recent improvements in fire protection systems have featured the addition of a swellable polymer agent to the water flowing through the system with the mixture forming an ablative gel which is discharged towards the fire. For example, in copending application Ser. No. 766,475, filed Oct. 10, 1968, and assigned to the same assignee as the present invention, a system is disclosed in which a swellable polymer agent is introduced to the water main supplying the discharge heads of the system upon actuation of the heads in the event of fire, so that the extinguishant dispersed from the heads is in the form of an ablative gel.

Such ablative gel extinguishants have been found to be more effective than plain water in extinguishing a fire

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because of their ability to penetrate large fire plumes and because of their absorption characteristics. Also, the relatively high viscosity of the ablative gel extinguishant enables it to adhere to vertically disposed surfaces of the fuel array.

The above-mentioned direct discharge nozzles are especially effective in discharging the ablative gel due to the increased size of the nozzles which enables them to discharge the gel in greater quantities and at higher rates which is particularly attractive when the building to be protected is a warehouse, or other storage facility, having a relatively large volume of combustible materials. However, the discharge of the gel from the nozzle in the conical divergent pattern discussed above often results in gaps, or dry spots, occurring between the spray patterns of adjacent nozzles at or near the upper surfaces of the combustible materials stored in the building. One of the reasons for this is that the nozzles usually must be spaced no less than fifteen feet apart, largely due to economical considerations. Since the combustible materials may be stored as high as three feet from the lowest point that the discharge heads extend from the ceiling of the building under most fire insurance regulations, these spaced divergent patterns of spray may not extend across the entire area defined by the upper surfaces of the combustible materials.

Since a fire occurring in a particular location will tend to spread towards the areas of least resistance, it will thus move towards these dry areas or gaps and very probably develop to the point that it is uncontrollable.

SUMMARY OF THE PRESENT INVENTION

It is therefore an object of the present invention to provide a fire protection system which employs a plurality of extinguishant discharge heads which are adapted to disperse a continuous supply of ablative gel across the entire area to be protected without the necessity of increasing the number of branch lines and direct discharge nozzles.

It is a still further object of the present invention to provide a system of the above type in which a plurality of discharge heads are provided, each having two extinguishant discharge members, with one discharge member being adapted to open in advance of the opening of the other discharge member.

A still further object of the present invention is to provide a discharge head for use in systems of the above type.

Towards the fulfillment of these and other objects, the fire protection system of the present invention comprises a plurality of discharge heads located in the space to be protected, each head including a direct discharge nozzle for discharging extinguishant in a divergent pattern towards a predetermined assigned area in said space and a sprinkler head for discharging extinguishant in the gaps between the assigned areas of said direct discharge nozzles. First thermal responsive means permits said direct discharge heads to open in response to a relatively low temperature, and second thermal responsive means permits said sprinkler heads to open in response to a relatively high temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference is now made to the accompanying drawings for a better understanding of the nature and objects of

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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 schematic view of a prior art fire protection system shown mounted in a space to be protected;

FIG. 2 is similar to FIG. 1, but shows the fire protection system of the present invention;

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

FIG. 4 is an enlarged partial view of a portion of the head of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A fire extinguishing system utilized in recent prior art arrangements is shown in FIG. 1 installed in a building space, a portion of which is generally designated by the reference numeral 10 and defined by a floor 12, a ceiling 14, and a pair of side walls (not shown). The stacks or piles bearing reference letters A, B, C, D, E, F and G represent combustible materials or fuel piles to be stored within the space 10 in the manner of a conventional warehouse, or other type of storage facility.

Supported in depending fashion from the ceiling 14 are a plurality of spaced heads 18, each having a thermally responsive fusible link 18a and a discharge orifice 18b. Each head 18 is supplied by extinguishant from a source via a riser 20 and a branch line 22. The structural details of the heads 18 are described in the first of the above-mentioned applications, it being sufficient for purposes of a general understanding to note that when the ambient temperature in the vicinity of a fusible link 18a reaches a pre-established point, the discharge orifice 18b on the corresponding head is opened. The heads are adapted to discharge the extinguishant in a divergent pattern, shown in general by the letter K, which pattern may have a circular or rectangular cross-section.

Assuming that the uppermost surfaces of the highest stacks A and D of the combustible material are located at the above-mentioned upper limit of approximately three feet from the lowest point of the heads 18, a plurality of dry areas or gaps, shown by the reference letters L and M, are created between the adjacent spray patterns in the upper portion of the space 10 which lead to the disadvantages discussed above.

The system of the present invention is shown installed in an identical building space in FIG. 2, with similar structure to that of FIG. 1 being given identical reference characters.

However, according to the present invention, a plurality of two-way heads 30 are mounted on the branch line 22. As will be described in detail later, each head 30 has two outlets—one directed towards the lower portion of the space 10 to discharge the extinguishant in a divergent pattern shown by the letters X, and the other in a pattern shown by the letters Y. As emphasized above, this provides a continuous supply of extinguishant across the upper surfaces of the combustible materials.

The system of the present invention incorporates the additive injection apparatus of the second of the above-cited applications which is shown schematically by the legend-bearing blocks in FIG. 2. In general, the apparatus includes a flow sensor which senses the flow of water called for by the opening of a head 30 and energizes a power source, such as a motor, which drives an injector for pumping or injecting a supply of additive through a mixer and to the line 20. As is fully described in the aforementioned copending application, the injection system operates on a no-inject failure mode to insure that an adequate supply of at least plain water will pass from the water supply main through the lines 20 and 22 and to the heads 30.

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A head 30 is shown in detail in FIG. 3, and comprises a nipple 34 which extends from a T 36 connected in the branch line 20, as well as a sprinkler head and a direct discharge nozzle shown generally by the reference numerals 40 and 60, respectively, which are connected to the nipple 34 to provide two outlets for the extinguishant passing through the branch line 20.

The sprinkler head 40 comprises a T portion 42 connected to the nipple 34 via pipe 44, a yoke portion 46 disposed at one end of the T portion 42, and a fusible link 48 disposed within the yoke portion 46. A serrated deflector plate 50 having a flange 50a extending upwardly therefrom is connected to the end of the yoke 46. When the fusible link 48 fuses, or melts, in response to a pre-determined temperature in its vicinity, it will permit extinguishant flow through the T portion 42 and against the deflector plate 50. It is noted that the sprinkler head 60 is of a conventional type normally utilized in an upright position but, for the purposes of this application, is mounted in the pendant position shown so that extinguishant passing therethrough will be deflected generally radially outwardly by the deflector plate 50 and the flange 50a for reasons that will be explained in detail later.

The direct discharge nozzle 60 comprises a cylindrical body 62 having an upper end portion which is internally threaded as shown at 64 for connection to the nipple 34, and a lower end portion which defines an outlet orifice 66 of a reduced cross-section. A pair of spiral vanes 68a and 68b are fixed within the body 62 for imparting a swirling motion to water flowing downwardly therethrough in a conventional manner. The vanes 68a and 68b support a hollow central hub 70 which, in turn, slidably supports a rod 72 having a piston head 74 fixed on its lower end. A pair of sealing rings 76 and 78 are positioned about the periphery of the head 72 and sealingly engage the inner wall of the body 62 near the outlet orifice 66.

The rod 72 is latched in the position shown in FIG. 3 by a rod 82 which extends slidably through an externally threaded boss 84 projecting from the side of the body 62. One end of the rod 82 extends through the vane 68a and the wall of the central hub 70 into a slot 86 in the rod 72 to latch it in the position shown in FIG. 3.

A sleeve 88 is threaded on the end of the boss 84. The outer end of the sleeve is closed off by an externally threaded stub shaft 90 having a ring or yoke 92 thereon. The rod 82 slidably extends through the stub shaft 90, and the other end of the rod engages a conventional thermal fuse element 94 positioned within the ring 92. The fuse element 94 prevents movement of the rod 82 to the right as viewed in FIG. 3, until the heat of a fire fuses the element 94 so that it collapses. Since the element 94 is the standard type commonly used in conventional sprinkler heads now on the market, it will not be described in greater detail.

The rod 82 has a piston head 96 mounted thereon which slidably engages the internal wall of the sleeve 88. A spring 98 is positioned between the boss 84 and the piston head 96 to bias the piston head and the rod 82 to the right with a pre-determined biasing force.

With this arrangement, the piston head 96 and the rod 82 will be driven to the right under the action of the spring 98 upon the fuse element 94 collapsing in response to the heat of the fire and thus unlatch the rod 72.

As better shown in FIG. 4, a thread 100 is provided which has one end fastened to the upper end of the rod 72. The thread 100 extends through an opening 102 formed in the upper vane 68a 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. 3 and 4 to avoid any unwanted tension being placed thereon due to slight

dimensional variations of the other components of the nozzle.

Although the relative sizes of, and the distance between, the sprinkler head 40 and the nozzle 60 of each discharge head 30 can vary, a preferred embodiment would include a nozzle 60 having a body member 62 approximately ten inches in length, with the distance between the axes of the head 40 and the nozzle 60 of each head 30 also being approximately ten inches.

Also according to a preferred embodiment, the fusible link 94 of the nozzle 60 is adapted to fuse at approximately 285° F., while the fusible link 48 of the sprinkler head 40 is adapted to fuse at approximately 500° F. The use of a relatively high fusion temperature of the link 48 is possible due to the fact that it is often not necessary to fill in the gaps between adjacent spray patterns from the nozzle 60, since the nozzles 60 alone can usually control the fire.

In operation, the heads 30 are installed in the position shown in FIG. 2, preferably at approximately fifteen-foot spacings with the nozzles 60 being placed in the condition shown in FIGS. 3 and 4, i.e., with the rod 72 latched in the body member 62 by the rod 82, and with the thread 100 fixed to the rod 72 and the vane 68a.

If the fusible link 94 is thermally actuated in response to the above-mentioned temperature of 285° F. in its vicinity, the tension of the spring 98 causes the rod 82 to release the rod 72 from its latched condition. The extinguishant pressure in the body member 62 acting on the inner end face of the plug 74 forces it downwardly as viewed in FIG. 3, and causes a tension to be applied to the thread 100 in direct proportion to the amount of pressure. The thread 100 can be designed to fail, or break, in response to a precise predetermined pressure, which will release the rod 72 and therefore the plug member 74, and permit them to be discharged outwardly from the body member 62. The water discharging from the outlet orifice 66 of the nozzle 60 will take a substantially conical pattern, as shown by the reference letters X in FIG. 2, with the spray angle being substantially less than 180°. Of course, if the extinguishant pressure is not sufficient to break the thread 100, the plug will not be expelled from the body portion 62 despite release of the fuse element 94 and the fusible nut 106.

Assuming that a plurality of nozzles 60 are in fact actuated in accordance with the foregoing, gaps will occur between the spray patterns X from the nozzles in the upper portions of the space 10 due to the fact that the nozzles 60 are normally spaced a relatively large distance apart, as discussed above. Since fire insurance regulations will often permit storage of the combustible materials to heights as high as three feet below the lowest point that a sprinkler system extends from the ceiling of the building, it is apparent that the spray patterns will not reach some of the combustible materials stored in the upper portion of the building.

However, if the thermal link 48 of the sprinkler head 40 is thermally actuated in response to the above-mentioned temperature of approximately 500° F. in its vicinity, the link will free the discharge end of the T 42 and permit a discharge of extinguishant from the latter end and against the deflector plate 50. The sprinkler heads are designed so that the spray pattern from each extends radially outwardly and downwardly as shown by the reference letters Y in FIG. 2, with the spray angle being greater than 180°. The design is such that the spray patterns Y fill in the gaps between the spray patterns X across a horizontal plane spaced approximately three feet below the lowest point that the heads 18 extend from the ceiling.

According to a preferred embodiment, each spray pattern Y completely surrounds its corresponding spray pattern X, and the adjacent spray patterns Y overlap slightly, at the above-mentioned horizontal plane, as shown in FIG. 2.

Preferably, the rate of extinguishant discharge from

the nozzles 60 is substantially greater than the rate of extinguishant discharge from the sprinkler heads 40 and, according to a preferred embodiment, the former rate is four times greater than the latter rate.

As a result of the above, it is appreciated that not only do the nozzles 60 discharge extinguishant directly towards the fire, but in the event the temperature in proximity to the heads reaches a relatively high value, the sprinkler heads 40 will insure that a continuous supply of extinguishant will be discharged across the combustible materials, even if the latter are stacked relatively high in the building. Also, this is achieved without the expensive addition of any branch lines, direct discharge nozzles, etc. Of course, the injection of the ablative gel into the system provides for even further increased fire fighting capability.

It can be appreciated that several variations may be made in the above without departing from the scope of the invention. For example, a pressure transducer may be associated with the T 42 in order to render the sprinkler heads 40 controlled by a pressure floor, as in the nozzle 60 discussed above. Also, the fusion temperatures of the links 48 and/or 94 may be changed in accordance with particular design requirements. Further, a plurality of grooves may be formed throughout the outlet orifice 66 of the nozzle 60 to provide a square divergent spray pattern rather than a circular pattern, in a conventional manner.

Of course, other variations of the specific construction and arrangement of the 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 fire protection system for buildings and the like comprising a plurality of extinguishant discharge heads located in the space to be protected, means for connecting said heads to a source of extinguishant, said heads defining a first discharge means for discharging a spray of extinguishant towards assigned areas established by the intersection of said sprays with a horizontal reference plane positioned at a predetermined height in said space below said first discharge means, said areas being spaced apart at said reference plane, and a second discharge means above said reference plane for discharging said extinguishant towards the spaces between said areas to achieve a continuous discharge of extinguishant across said reference plane.

2. The system of claim 1 wherein each of said discharge heads comprises one of said first discharge means and one of said second discharge means.

3. The system of claim 1 wherein said reference plane is located at the uppermost surface of combustible materials which can be stored in said space.

4. The system of claim 1 further comprising first control means automatically responsive to a fire in said space for controlling the opening of said first discharge means, and second control means automatically responsive to a fire in said space for controlling the opening of said second discharge means.

5. The system of claim 4 wherein said first control means is adapted to open said first discharge means in advance of the opening of said second discharge means by said second control means.

6. The system of claim 5 wherein said first control means comprises a fuse member adapted to open said first discharge means in response to a first predetermined temperature in its vicinity, and wherein said second control means comprises a fuse member adapted to open said second discharge means in response to a second predetermined temperature in its vicinity, said second predetermined temperature being greater than said first predetermined temperature.

7. The system of claim 6 wherein said first predetermined temperature is approximately 280° F. and said

second predetermined temperature is approximately 500° F.

8. The system of claim 1 wherein said extinguishant is in the form of an ablative gel.

9. The system of claim 2 wherein each of said first discharge means discharges a spray of extinguishant having a predetermined spray angle substantially less than 180° and each of said second discharge means discharges of spray of extinguishant at a spray angle greater than said predetermined spray angle, each of said second discharge means being positioned to cover an area in said reference plane surrounding the assigned area of the first discharge means associated therewith.

10. The system of claim 9 wherein said area covered by the spray from each of said second discharge means overlaps said area covered by the spray from its adjacent second discharge means.

11. The system of claim 8 wherein each of said first discharge means comprises a direct discharge nozzle for producing a downwardly directed solid cone spray of extinguishant and each of said second discharge means comprises a conventional sprinkler head having a deflector plate associated therewith for deflecting the extinguishant laterally outward.

12. The system of claim 11 wherein each of said nozzles has one of said sprinkler heads mounted thereon.

13. The system of claim 2 wherein each of said first discharge means comprises a direct discharge nozzle for producing a downwardly directed solid cone spray of extinguishant having a predetermined spray angle substantially less than 180°, and each of said second discharge means comprises means on each of said nozzles for producing a laterally outward spray of extinguishant at an angle greater than said predetermined spray angle for covering an area in said reference plane surrounding the assigned area of the nozzle on which it is mounted.

14. The system of claim 13 wherein each of said nozzles discharges extinguishant at a rate substantially greater than the rate of discharge of each of said second discharge means.

15. The system of claim 14 wherein each of said nozzles discharges extinguishant at a rate about four times as great as the discharge rate of the extinguishant from each of said second discharge means.

16. The system of claim 1 wherein each of said first discharge means discharges extinguishant at a rate substantially greater than the rate of discharge of extinguishant from each of said second discharge means.

17. The system of claim 16 wherein each of said first discharge means discharges extinguishant at a rate about four times as great as the discharge rate of the extinguishant from each of said second discharge means.

18. The system of claim 2 wherein each of said first discharge means discharges extinguishant at a rate substantially greater than the rate of discharge of extinguishant from each of said second discharge means.

19. The system of claim 18 wherein each of said first discharge means discharges extinguishant at a rate about four times as great as the discharge rate of the extinguishant from each of said second discharge means.

20. A discharge head for use in a fire protection system for buildings and the like, comprising an inlet adapted for connection to a source of extinguishant, a first discharge means for discharging a spray of extinguishant towards an assigned area established by the intersection of said spray with a horizontal reference plane positioned at a predetermined height in said space, said spray having a predetermined spray angle substantially less than 180°, and a second discharge means for discharging said extinguishant towards an assigned area immediately adjacent said assigned area of said first discharge means to achieve a continuous discharge of extinguishant across said reference plane.

21. The head of claim 20 wherein said reference plane

is located at the uppermost surface of combustible materials which can be stored in said space.

22. The head of claim 20 further comprises first control means automatically responsive to a fire in said space for controlling the opening of said first discharge means, and second control means automatically responsive to a fire in said space for controlling the opening of said second discharge means.

23. The head of claim 22 wherein said control means is adapted to open said first discharge means in advance of the opening of said second discharge means by said second control means.

24. The head of claim 23 wherein said first control means comprises a fuse member adapted to open said first discharge means in response to a first predetermined temperature in its vicinity, and wherein said second control means comprises a fuse member adapted to open said second discharge means in response to a second predetermined temperature in its vicinity, said second predetermined temperature being greater than said first predetermined temperature.

25. The head of claim 24 wherein said first predetermined temperature is approximately 280° F. and said second predetermined temperature is approximately 500° F.

26. The head of claim 21 wherein each of said first discharge means discharges a spray of extinguishant having a predetermined spray angle substantially less than 180° and each of said second discharge means discharges a spray of extinguishant at a spray angle greater than said predetermined spray angle, each of said second discharge means being positioned to cover an area in said reference plane surrounding the assigned area of the first discharge means associated therewith.

27. The head of claim 26 wherein said area covered by the spray from each of said second discharge means overlaps said area covered by the spray from its adjacent second discharge means.

28. The head of claim 26 wherein each of said first discharge means comprises a direct discharge nozzle for producing a downwardly directed solid cone spray of extinguishant and each of said second discharge means comprises a conventional sprinkler head having a deflector plate associated therewith for deflecting the extinguishant laterally outward.

29. The head of claim 28 wherein each of said nozzles has one of said sprinkler heads mounted thereon.

30. The head of claim 21 wherein each of said first discharge means comprises a direct discharge nozzle for producing a downwardly directed solid cone spray of extinguishant having a predetermined spray angle substantially less than 180°, and each of said second discharge means comprises means on each of said nozzles for producing a laterally outward spray of extinguishant at an angle greater than said predetermined spray angle for covering an area in said reference plane surrounding the assigned area of the nozzle on which it is mounted.

31. The head of claim 30 wherein each of said nozzles discharges extinguishant at a rate substantially greater than the rate of discharge of each of said second discharge means.

32. The head of claim 31 wherein each of said nozzles discharges extinguishant at a rate about four times as great as the discharge rate of the extinguishant from each of said second discharge means.

33. The head of claim 20 wherein each of said first discharge means discharges extinguishant at a rate substantially greater than the rate of discharge of extinguishant from each of said second discharge means.

34. The head of claim 33 wherein each of said first discharge means discharges extinguishant at a rate about four times as great as the discharge rate of the extinguishant from each of said second discharge means.

35. The head of claim 21 wherein each of said first discharge means discharges extinguishant at a rate substan-

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tially greater than the rate of discharge of extinguishant from each of said second discharge means.

36. The head of claim 35 wherein each of said first discharge means discharges extinguishant at a rate about four times as great as the discharge rate of the extinguishant from each of said second discharge means.

37. The system of claim 1 further comprising control means automatically responsive to a fire in said space for controlling the opening of said first and second discharge means.

38. The system of claim 1 wherein said first discharge means discharges its spray of extinguishant in a generally vertical direction and said second discharge means discharges its spray in a generally horizontal direction.

39. The head of claim 20 further comprising control means automatically responsive to a fire in said space for controlling the opening of said first and second discharge means.

40. The head of claim 20 wherein said first discharge

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means discharges its spray of extinguishant in a generally vertical direction and said second discharge means discharges its spray in a generally horizontal direction.

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M. HENSON WOOD, JR., Primary Examiner

T. C. CULP, JR., Assistant Examiner

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