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[54] **METHOD OF FIRE PROTECTION USING RECIRCULATION OF COMBUSTION PRODUCTS TO DISCHARGE A FOAM EXTINGUISHANT**

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Related U.S. Application Data

[62] Division of Ser. No. 277,495, Aug. 3, 1972, Pat. No. 3,780,811, which is a division of Ser. No. 198,386, Nov. 12, 1971, Pat. No. 3,708,015.

[52] **U.S. Cl.** **169/44,** 169/12, 169/42

[51] **Int. Cl.** **A62c 1/14**

[58] **Field of Search** ..... 169/1 A, 12, 41, 42, 37, 169/38

[56] **References Cited**

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[57] **ABSTRACT**

A method of fire protection in which a foam extinguishant is discharged towards the fire in response to a predetermined fire condition in the space to be protected. At least a portion of the foam discharge is terminated and a fluid extinguishant is discharged towards the fire in response to an additional predetermined fire condition.

14 Claims, 3 Drawing Figures

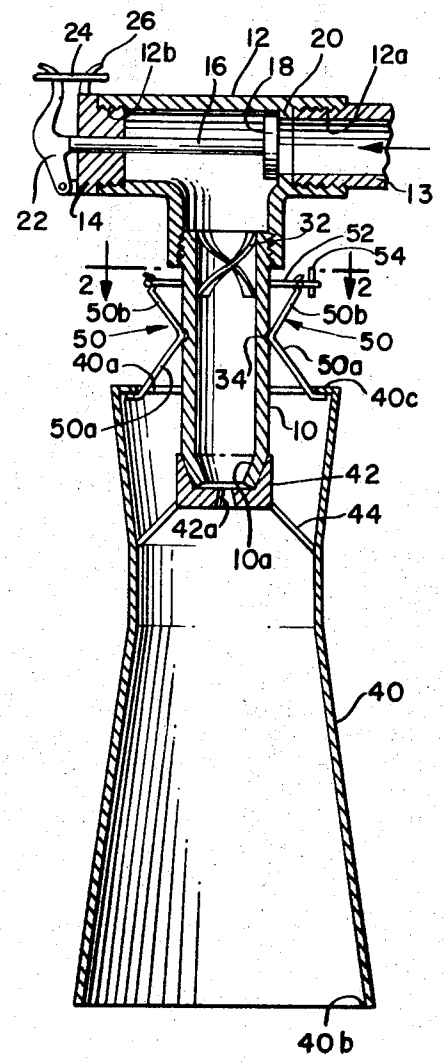


FIG. 1.

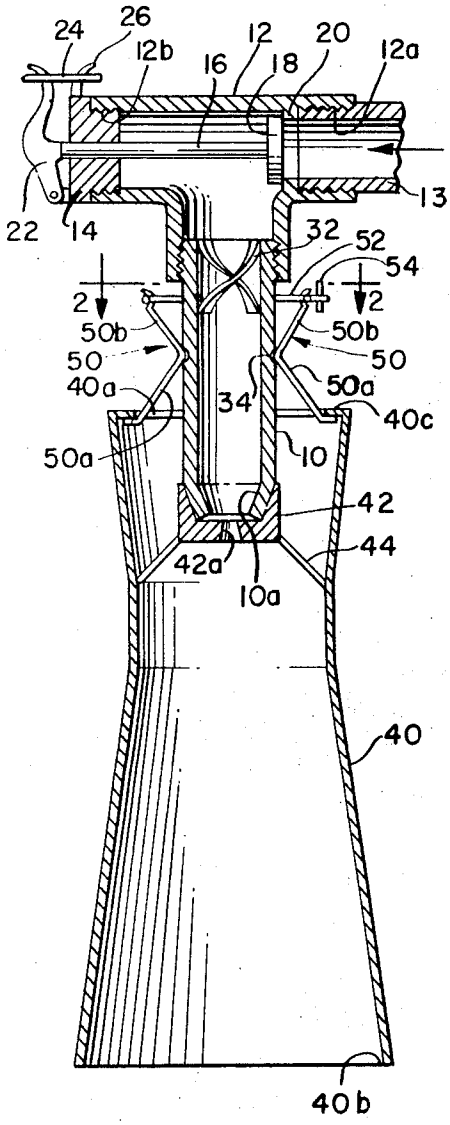


FIG. 3.

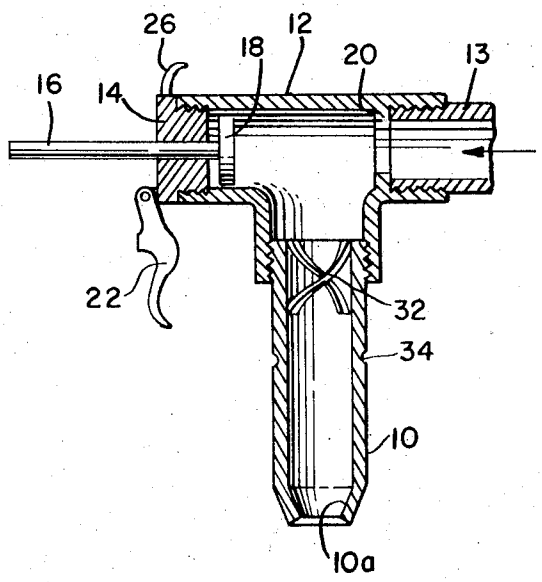
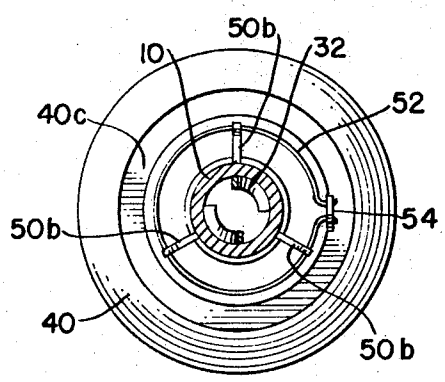


FIG. 2.



METHOD OF FIRE PROTECTION USING RECIRCULATION OF COMBUSTION PRODUCTS TO DISCHARGE A FOAM EXTINGUISHANT

CROSS-REFERENCE TO RELATED APPLICATION

This application is a division of application Ser. No. 277,495 filed Aug. 3, 1972 now U.S. Pat. No. 3,780,811, which, in turn, is a division of application Ser. No. 198,386 filed Nov. 12, 1971 now U.S. Pat. No. 3,708,015.

This application also relates to U.S. patent application Ser. No. 131,988 filed on Apr. 7, 1971 now U.S. Pat. No. 3,692,118, by the same inventor as the present invention and assigned to the same assignee as the present invention. The disclosure of the latter application is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

This invention relates to a method for fire protection, and more particularly to such a method which utilizes the products of combustion from a fire to aid in extinguishing the fire.

In the above-mentioned related application Ser. No. 131,988, a fixed fire extinguishing system is disclosed in which the combustion products of a fire developing in the enclosure to be protected are circulated back towards the fire at the early stage of the fire development to prevent the ingress of air to the fire. The circulation of the combustion products is achieved by the use of a plurality of aspiration-type nozzles which are mounted near the ceiling of the enclosure, with each having an inlet opening for receiving the products of combustion and a discharge opening for discharging the products of combustion. When actuated, the nozzles discharge an extinguishant towards the fire which creates an aspiration effect and circulates the products of combustion in a path upwardly from the fire, through the nozzles, and downwardly into the fire. In this manner, air entering the building through its windows and doors and passing towards the fire is blocked by the barrier created by the products of combustion.

Although the above arrangement was found to be effective in extinguishing fires, it suffered from the fact that the extinguishant discharge velocity from the nozzles had to be set at a relatively high value in order to obtain the aspiration effect. Since this was accomplished by utilizing a relatively small discharge opening, the extinguishant discharge from the nozzles was ineffective in directly fighting the fire, since it was unable to penetrate the fire plume. This, of course, imposed limitations on the fire-fighting capability of the system, especially in fire situations in which the recirculation of the combustion products around the fire could not achieve total fire extinction.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method of the above type in which the combustion products from the fire are circulated in a path including said fire, with the circulation aiding in producing a foam extinguishant and being reduced or terminated in response to additional information received from the fire.

It is a further object of the present invention to provide a method for fighting a fire in which at least a portion of the discharge of foam extinguishant is replaced by a discharge of fluid extinguishant in response to the additional information received from the fire.

Towards the fulfillment of these and other objects of the present invention, the method of the present invention comprises the steps of discharging a foam extinguishant towards the fire in response to a predetermined fire condition in the space to be protected, changing said discharge in response to an additional predetermined fire condition in said space, and discharging a fluid extinguishant towards said fire in response to said additional predetermined fire condition.

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 discharge device of the present invention;

FIG. **2** is a cross-sectional view taken along the line **2—2** of FIG. **1**; and

FIG. **3** is a view similar to FIG. **1**, but showing the device of the present invention after responding to a fire condition.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A discharge device for carrying out the method of the present invention is depicted in FIG. **1** of the drawings and includes a nozzle unit **10** defining a discharge outlet **10***a* at its lower end as viewed in FIG. **1** and having a T-shaped coupling member **12** threadably connected to its upper end. One end portion of the coupling member **12** is internally threaded as shown at **12***a* for connection to a branch line **13** for supplying an extinguishant such as water, it being understood that a typical fire protection system will include several discharge devices and branch lines, along with submains, risers, and a main, to supply the branch lines with an extinguishant, such as a mixture of water and a foaming compound, in a conventional manner, and as shown and described in the above-mentioned related application.

A closure plug **14** is threadably engaged in the other end portion **12***b* of the coupling member **12** and defines a central opening which receives a valve stem **16** slidably extending therethrough. A valve head **18** is connected to one end of the valve stem **16** and is adapted to engage a cooperating seat **20** supported by the internal wall of the coupling member **12** to block the flow of extinguishant through the coupling member.

A lever arm **22** is pivotally mounted to the plug **14** and is adapted to be connected, by means of a fusible link **24**, to a lever arm **26** fixed with respect to the plug. The pivotal lever arm **22** has a projection engaging the other end of the valve stem **16** to maintain the valve head **18** against the seat **20** as long as the fusible link **24** maintains the connection between the levers **22** and **26**.

A pair of vanes, shown in general by the reference numeral **32**, are provided in the interior of the nozzle

unit **10** in order to impart a swirling-type motion to the extinguishant as it passes through the nozzle unit, thereby resulting in a continuous conical spray discharge from the discharge outlet **10**a, in a conventional manner.

A circumferential groove **34** is formed in the outer periphery of the nozzle unit **10** for reasons that will be explained in detail later.

An open-ended, hollow housing **40**, formed in the shape of a venturi, extends over the bottom portion of the nozzle unit **10** and has an inlet **40***a* and an outlet **40***b* for respectively receiving and discharging the products of combustion from the fire. An extension **42** for the discharge opening **10***a* is mounted relative to the housing **40** by means of a plurality of struts **44**, two of which are shown in FIG. **1**. The extension **42** extends over the discharge end portion of the nozzle unit **10** and has a discharge opening **42***a* which registers with the discharge outlet **10***a*, with the opening **42***a* being of a smaller diameter than the outlet **10***a*. In an exemplary embodiment of the present invention, the outlet **10**a would have a diameter of approximately one-half inch and would discharge the extinguishant at a spray angle of approximately 150°, while the opening **42***a* would have a diameter of approximately one-eighth of an inch and would discharge the extinguishant at a spray angle of approximately 100°.

The housing **40** is connected relative to the nozzle unit **10** by means of three substantially L-shaped connecting arms **50**. Each of the arms **50** consists of a lower portion **50***a* which engages underneath an inwardly-directed circular flange **40***c* formed on the upper end of the housing **40**, and an upper portion **50***b* which engages a split ring **52** extending around the upper end portion of the nozzle unit **10** and having its ends normally connected by a fusible link **54**. The elbow portions of the arms **50** are supported by, and extend within, the circumferential groove **34**.

Referring specifically to FIGS. **1** and **2** for a better view of the interconnection between the upper arm portions **50***b* and the ring **52**, it is seen that the arm portions are curved slightly at their upper ends so that they extend around, and over, the top surface of the ring. In this manner the ring **52** can be designed to maintain the arms **50** under a slight, inwardly directed spring tension in order to maintain the arms, and therefore the housing **40**, in the position shown in FIG. **1**. Of course, when the link **54** fuses in response to a predetermined temperature, the ends of the ring are free to separate, which will release the arms **50** and therefore permit the housing **40** to fall from the nozzle **10** under the force of gravity.

The temperatures required to fuse the fusible link **24** and the fusible link **54** may vary in accordance with particular design considerations. A preferred embodiment would have the fusible link **54** adapted to fuse at a temperature greater than the fusible link **24**, with a specific example of the fusing temperatures being 165°F. for the link **24** and 500°F. for the link **54**.

As an example of the operation of the discharge device and using a mixture of water and a foaming compound as the extinguishant, upon the temperature in the vicinity of the fusible link **24** reaching 165°F., the link will collapse and permit a pivoting of the arm **22** relative to the arm **26** under the force of the valve stem **16** as a result of the extinguishant pressure acting against the valve head **18**. This permits the valve head **18** to unseat from the seat **20** and extinguishant to flow into and through the nozzle unit **10**. The resulting discharge of the extinguishant from the device will be at a relatively high velocity, a relatively low rate, and a relatively narrow spray angle due to the presence of the relatively small discharge opening **42***a* provided by the extension **42**. This relatively high velocity is sufficient to induce the products of combustion from the fire to enter the housing **40** through its inlet **40***a*. This, plus the venturi shape of the housing **40**, creates an aspiration effect which circulates the products of combustion from the fire in a path upward from the fire, downwardly through the inlet **40***a*, and outwardly from the housing through the outlet **40***b*. The products of combustion thus mix with the extinguishant in the housing **40** and cause the foaming compound to foam, with the compound preferably being such that the resulting foam would consist of between 200–1,000 parts combustion products to 1 part of water by volume. As a result, the products of combustion will be encapsuled in the foam bubbles and will be circulated downwardly into the fire in the above manner. As emphasized in the above-cited application, in addition to the discharge of foam, this circulation of the combustion products creates a barrier which prevents air entering the building through doors, windows, etc., from passing directly into the fire. As a result, the fire will be smothered and rendered relatively easy to extinguish.

In the event the above circulation of combustion products by means of the foam does not completely extinguish the fire, and assuming the fire causes the temperature in the vicinity of the device to increase to approximately 500°F., the fusible link **54** will collapse, permitting a release of the split ends of the ring **52** and a release of the arms **50** from the ring. The housing **40** will thus be released from the position shown in FIG. **1** and will fall away from the nozzle unit **10**. As a result, the device will take the operational position shown in FIG. **3**, with the extinguishant flowing directly into the nozzle unit **10** and being directly discharged to the fire in a fluid state from the relatively large outlet **10***a* at a relatively high rate and at a relatively wide angle spray of droplets. Thus, in the latter operational mode of the device, the above-mentioned aspiration effect will be eliminated and the rate of extinguishant discharge and the area of coverage will be increased.

In a system incorporating several of the discharge devices, it is apparent that, in a typical high-challenge fire situation, the initial discharge of foam will be reduced as a result of the discharge devices directly over the fire attaining their direct discharge mode while the peripheral devices will continue to discharge foam and circulate the combustion products in the above manner. As a result the former devices will have a relatively good chance of extinguishing the fire directly since the latter devices will prevent the ingress of air to the fire. As a result, optimum fire fighting capability is achieved. Of course, if only a single discharge device is used, the initial discharge of foam will be completely terminated in response to the elevated temperature followed by a direct discharge of fluid in the above-described manner.

According to a feature of the present invention, any water based foam forming fluid may be used in accordance with the foregoing. It can be a mixture of water and a foaming compound such as any one of a number of synthetic surface active agents that are stable with

the fire products of combustion. The foaming compound could be injected into the waterline in response to a fire situation and the resulting fluid will be discharged through the outlet **42***a* in accordance with the foregoing.

Other examples of extinguishants that may be used in the present invention are water and gaseous agents such as pressurized nitrogen, carbon dioxide, halogenated hydrocarbon agents such as freon, or other similar gases, as discussed in detail in the above-mentioned application.

It is understood that several other variations may be made in the foregoing without departing from the scope of the invention. For example, the detector system disclosed in the above-mentioned related application and adapted to reduce the rate of discharge provided to each nozzle after a predetermined time delay, can be used in the method of the present invention. Also, the sizes of the outlet **10***a* and the opening **42***a*, as well as the fusing temperatures for the links **24** and **54**, may be varied in accordance with the present invention.

Still other variations of the specific construction and arrangement of the method 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 method of fighting a fire comprising the steps of discharging a foam extinguishant towards the fire in response to a predetermined fire condition in the space to be protected, terminating said discharge in response to an additional predetermined fire condition in said space, and discharging a fluid extinguishant towards said fire in response to said additional predetermined fire condition.

2. The method of claim **1** wherein the discharge of said fluid extinguishant is at a greater rate than the discharge of said foam extinguishant.

3. A method of fighting a fire comprising the steps of discharging a foam extinguishant from a plurality of sources towards the fire in response to a predetermined fire condition in the space to be protected, terminating said discharge from at least a portion of said sources in response to an additional predetermined fire condition in said space, and discharging a fluid extinguishant from said portion of sources towards said fire in response to said additional predetermined fire condition.

4. The method of claim **1** wherein the discharge of said fluid extinguishant is at a greater rate than the discharge of said foam extinguishant.

5. The method of claim **1** wherein said step of discharging a foam extinguishant is done in response to a predetermined temperature in said space and wherein said steps of terminating and discharging a fluid extinguishant is done in response to a temperature in said space greater than said predetermined temperature.

6. The method of claim **1** wherein said fluid extinguishant is a foam forming fluid and wherein said step of discharging a foam extinguishant comprises the step of discharging said foam forming fluid.

7. The method of claim **6** further comprising the step of circulating the combustion products from said fire in a path including said fire in response to said first predetermined fire condition to cause the foaming of said fluid.

8. The method of claim **7** wherein said step of discharging a fluid extinguishant includes the step of terminating said circulation of combustion products to terminate the foaming of said fluid.

9. The method of claim **8** further comprising the step of increasing said discharge of fluid extinguishant in response to said step of terminating.

10. The method of claim **3** wherein said step of discharging a foam extinguishant is done in response to a predetermined temperature in said space and wherein said steps of terminating and discharging a fluid extinguishant is done in response to a temperature in said space greater than said predetermined temperature.

11. The method of claim **3** wherein said fluid extinguishant is a foam forming fluid and wherein said step of discharging a foam extinguishant comprises the step of discharging said foam forming fluid.

12. The method of claim **11** further comprising the step of circulating the combustion products from said fire in a path including said fire in response to said first predetermined fire condition to cause the foaming of said fluid.

13. The method of claim **12** wherein said step of discharging a fluid extinguishant includes the step of terminating said circulation of combustion products to terminate the foaming of said fluid.

14. The method of claim **13** further comprising the step of increasing said discharge of fluid extinguishant in response to said step of terminating.

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