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[54] **METHOD OF FIGHTING A FIRE**

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[58] **Field of Search** ....169/1 R, 1 A, 2 R, 5, 14, 15, 169/16, 13

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[57] **ABSTRACT**

A method of fighting a fire comprising the steps of discharging an ablative fluid towards the fire from an elevated position relative to the floor of the structure to be protected, and manually applying an ablative fluid to the fire.

17 Claims, No Drawings

METHOD OF FIGHTING A FIRE

BACKGROUND OF THE INVENTION

An overwhelming majority of the fire fighting systems in use today employ a plurality of sprinkler heads which are located in an elevated position in the structure or building to be protected from fire. The sprinkler heads are actuated automatically in response to information received from the fire, and are adapted to apply substantially continuous sprays of water through the flames onto the exposed surfaces of any combustibles, the combustibles hereafter being referred to as a "fuel array." The water, upon contact with the burning fuel array, is converted into steam which will then serve to inert the reactants passing through the flame, interfere with the fire producing process, and remove heat from the fire through the sensible heat of the steam.

However, it has been discovered that the above-mentioned techniques of applying water are such that all of the water discharged is not effective in fighting the fire. The wastage involved results in less efficient operation. This happens primarily because water, when broken up into a spray, forms a wide distribution of droplets, a large percentage of which become airborne and never have an opportunity to reach the fuel array. Secondly, even the water which reaches the fuel array is used ineffectively since some of it quickly runs off from the fuel array and is thus not available to fight the fire.

A further limitation in the use of these overhead fixed fire extinguishing systems is encountered when the fuel array consists of a number of stacked fuel members, such as cartons, etc. In these situations, the water cannot reach all of the surfaces of each fuel member, but at best will coat the upper surface and exposed side surfaces. This, of course, does not effectively reach the shielded fires, that is, those portions of the fire that occur within the fuel array or along unexposed surfaces thereof, which cannot be reached by the extinguishant. For example, the bottom surface of a fuel member that is stacked over another or a side surface of a fuel member that is stacked against another are places where shielded fires often occur.

Therefore, after the overhead system has put out substantially all of the non-shielded portion of the fire, it is common practice for firemen to enter the building and utilize standard fire hoses to apply water directly to shielded fires in the fuel array in order to completely extinguish these shielded fires. However, the use of water in this manner suffers from the same disadvantages of the overhead system, to wit, the severe wastage of the water and the running-off of the water from the fuel due to its low viscosity.

In addition to the above disadvantages, it can be appreciated that the use of hoses in the above manner causes other problems, since the hoses must often be connected to the main source of water, and thus rob the overhead system of water which might be valuable in the event the system must later be turned on again. Also, the hoses are expensive, heavy, and cumbersome to use.

BRIEF SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method for fighting a fire wherein the above-mentioned problems are eliminated, while permitting the use of an overhead system and a manual technique to fight a fire.

Towards the fulfillment of this and other objects, the method of the present invention comprises the steps of disposing a fixed fire extinguishing system in an elevated position relative to the floor of the structure to be protected from fire, discharging extinguishant of a viscosity greater than water from said system in response to a fire situation occurring in a particular area of said structure, and manually applying an extinguishant of a viscosity greater than water to said area.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to the present invention an extinguishant, preferably in the form of an ablative fluid, is discharged towards the fire from an overhead fixed fire extinguishing system and is also manually applied to the fire. The ablative fluid is preferably of the type disclosed in U.S. patent application Ser. No. 766,475 filed Oct. 10, 1968, now U.S. Pat. No. 3,605,900, by William L. Livingston and Russell W. Pierce, and assigned to the same assignee as the present invention. As disclosed in this application, the ablative fluid is obtained by mixing an ablative material with water. An ablative material as comprehended within the above application, as well as the present application, is a material which, when present in a layer of sufficient thickness, will permit thermal energy to be transmitted through its exposed outer surface but not completely through said layer, said thermal energy being absorbed within said layer so as to immediately transform the material of said layer into vapor without internal convection of said material, said vapor leaving said layer through its outer surface. When used in this specification and claims, the term "ablative" shall be so construed.

Materials which will cause water to become ablative by virtue of increasing its thickness in the direction of the incident radiation and which are useful in the process of the present invention are readily available. One such material is a cross-linked ethylene maleic anhydride such as a material sold by the Monsanto Company under the designation EMA–91. Another such material which is useful is the diammonium-sodium salt of EMA–91, which is sold by the Monsanto Company under the designation EMA–94. The fluids which are formed from such materials when they are mixed with water are extremely homogenous (they are non-particulate in the sense that discrete particles are not visible to the naked eye), they can be easily pumped and sprayed in the form of desirable spray patterns with low pressure drops across the spray heads, and they adhere well to vertical surfaces.

Other materials, such as a water-swellable, cross-linked polymer sold by the B. F. Goodrich Chemical Company under the designation "Carbopol–960," are also useful, as are materials such as those described in Katzer U.S. Pat. No. 3,354,084 and Bashaw et al U.S. Pat. No. 3,229,769. The ablative fluids formed when these materials are mixed with water in appropriate quantities are in a gel-like form and when applied to a burning object in sufficient thickness possess ablative properties as defined above.

As disclosed in the above application, the use of such materials as the foregoing to combat fires provides many advantages not obtainable through the use of conventional fire extinguishants such as water, while retaining all the attributes of water as an extinguishant. Thus, because of the gel strength of the ablative material as compared with water, an ablative fluid applied to the fuel array will not run off from the array as does water, eliminating much of the conventional wastage involved in the present fire suppressant systems. In addition, when applied to the fuel array, an ablative fluid is capable of being projected in the form of large droplets with practically no fines, such droplets being at least an order of magnitude (10 to 1) greater in diameter for the same flow rates and nozzle characteristics than water droplets. As a result, there is a minimum of airborne materials, thus eliminating the inefficiency resulting from the use of water in which most of the water (viz., 90 percent or more for a 30-foot high fire plume) never has an opportunity to reach the fuel array. Furthermore, because such materials are comprised of approximately 90% water, they are characterized by the same low thermal conductivity and high heat of vaporization which characterize water. At the same time, the use of an ablative fluid produces large quantities of steam and, because a much larger percentage of such material reaches the burning fuel array than would have been reached by an equivalent quantity of water, the steam is better able to perform an inerting and heat removal function than would the water.

Also, because the ablative fluid of the present invention is much more viscous than conventional suppressants such as water, water damage which ordinarily results from large fires is significantly reduced. More specifically, because of the high gellation of the ablative fluid, such fluid is not absorbed as readily by the combustibles and, therefore, water damage of the combustibles is significantly reduced.

A system for mixing an ablative material and water and discharging the resulting ablative fluid is disclosed in application Ser. No. 864,757 filed on Oct. 10, 1969 by William L. Livingston and also assigned to the assignee of the present invention. In this system, an additive of water-swellable polymer or gelling agent is injected automatically into a line supplying a riser with water from a water supply main through auxiliaries such as cut-off valves and the like. In general the system operates to sense the flow of water called for by the opening of one or more sprinkler heads in the overhead system and energizes a power source, such as a motor, to pump or inject the additive through a mixer into the line. The heads are each provided with a conventional thermal sensing element so that, upon a fire occurring in a particular vicinity of the structure, only a portion of the heads immediately above the fire will be actuated.

The particular structure of each of the heads utilized to discharge the mixture of ablative material and water may vary considerably without departing from the spirit and scope of the present invention, but the direct spray nozzle illustrated and described in copending application Ser. No. 846,756 filed Oct. 8, 1969 by William L. Livingston and assigned to the same assignee as the present invention is preferred.

Tests prior to and following the filing of the above-mentioned applications revealed that the use of an ablative fluid in the above manner results in a dramatic improvement of the fire-fighting capability of the system. However, although the non-shielded portions of the fire were often completely extinguished in a relatively short period of time, there was no effective extinguishment of the shielded portions thereof. Therefore, there was a distinct possibility that after the overhead system was shut off, the shielded portions of the fire would spread to such an extent that they could very possibly burn off or break through the coating of ablative material on the fuel array and again develop into a high-challenge fire.

Therefore, it was initially proposed to manually apply water through one or more standard water hoses to the unexposed surfaces of the fuel array after the overhead system had been turned off. However, it was discovered that the water actually hindered the containment of the fire, since it washed off the coating of ablative material that had built up upon the exposed surfaces of the fuel array. Also, since the water was obtained from the same source that supplied the water to make the ablative fluid for the overhead system, it would very possibly severely curtail the future effectiveness of the latter.

Therefore, the present invention contemplates the manual application of an ablative fluid to the unexposed surfaces of the fuel array after or during the time that the overhead system discharges ablative fluid towards the exposed surfaces of the burning fuel array. In this manner, the manually applied ablative fluid does not wash off the ablative fluid that builds up upon the exposed surfaces of the fuel array, but rather adds to it, while enabling a fireman to manually direct the extinguishant into hard-to-reach, unexposed portions of the fuel array.

The source of the ablative fluid used in the manual operation, and the manner in which it is applied, can vary. According to one embodiment of the present invention, the ablative fluid that is discharged from the overhead system provides the source of ablative fluid used in the manual operation. This is particularly efficient, since, due to the high viscosity of the ablative fluid, it will build up on the floor of the structure as a result of its missing the fuel array during discharge from the overhead system, or of its falling off the fuel array.

Therefore, according to the present invention, one or more firemen will enter the building, with each man carrying a portable pump. The pump has a hose extending from the intake portion thereof to the floor, and a discharge nozzle extending from the output of the pump. In this manner, after the overhead system has been actuated and has discharged the ablative fluid towards the floor for a predetermined time, preferably until the exposed fire plume has been completely extinguished, the fireman can enter the building and walk along carrying the pump and direct the hose to the ablative fluid that has built up on the floor. The pump will recycle the fluid to the nozzle which, in turn, can be directed to the abovementioned unexposed surface of the fuel array.

As an alternate embodiment, the fireman could manually couple a hose to the overhead system at a point between where the ablative material is mixed with the water in the system and where the resulting ablative fluid is discharged. Of course, the hose would be equipped with a nozzle which would enable the fireman to direct the ablative fluid to the shielded portion of the fire, as in the previous embodiment.

Also, the source of extinguishant for the manual operation could be from a separate, central hose system which includes an injector of a smaller size than that disclosed in the abovementioned application Ser. No. 864,757, and especially adapted to inject the ablative material into the hose system. In this embodiment, the ratio of ablative material to water could be different from that in the ablative fluid discharged from the overhead system as the need may be.

It can be appreciated that in the two embodiments immediately preceding, the length and hauling weight of the hoses would be vastly reduced from a system wherein the source of extinguishant is supplied from a point external of the building, such as the main source for the overhead system.

The point in time at which the firemen enter the building for the manual operation can vary according to the present invention. According to one possibility, the firemen may enter the building after one or more nozzles of the overhead system have been actuated in response to a fire condition, but prior to their being turned off. Since the overhead system is automatic, i.e., only those portions of the nozzles which are located directly over the fire will be actuated, an advantage for the firemen entering the building at this time would be that the overhead system would still be operating, and the firemen could therefore readily ascertain the almost exact location of the fire by simply observing the nozzles that are in operation.

According to another possibility, the overhead system may be of the type described in U.S. Pat. application 770,248 filed on Oct. 24, 1968 by the same inventor, now U.S. Pat. No. 3,592,270 issued July 13, 1971, and assigned to the same assignee, as the present invention. In this application a double rate flow controller is shown associated with each discharge nozzle, and operates to change the extinguishant flow through the nozzle from an initial relatively high flow rate to a subsequent relatively low flow rate in order for the ablative material to build up to a maximum concentration level as fast as possible, yet sustain the fire extinguishing capabilities of the system. The method of the present invention is compatible with the use of this nozzle, since the firemen could enter the building after the high flow rate has been terminated and the low flow rate begun. In this manner, they would still have the advantage of being able to ascertain the approximate, if not exact, location of the fire while being assisted by the overhead system, yet their work would not be hindered by the high rate of discharge from the overhead system.

According to a final possibility, the overhead system could be turned off manually, or by an automatic system, before the firemen enter the building.

Also, in these experiments it has been noted that the fire plume, whether internal or external, takes the path of least resistance with respect to a fuel array, that is, it moves away from the extinguishant. Therefore, if a single nozzle were utilized to manually apply the extinguishant in the manner described above, any fire plume would tend to move to another surface of the fuel array, and probably to a surface opposite from the surface upon which the ablative fluid is initially directed. Therefore, according to the present invention it is contemplated that more than one fireman attack the same fuel array area at the same time and preferably surround or enclose any internal fire plume, thus preventing it from again spreading outwardly from the fuel array.

It can be appreciated that the advantages of the method of the present invention are many. First of all, it enables the extinguishant to be automatically applied to the exposed surfaces of the fuel array and manually applied to the exposed surfaces thereof in an effective manner. Also, it enables a fireman to selectively direct the extinguishant into the portions of the fuel array where, in his judgment, the shielded portions of the fire are probably located. Further, a preferred embodiment of the present invention enables the fireman to dispense with the hoses which are normally involved in a similar type of manual operation, and rather utilize a relatively light, portable system which can be carried into any area of the building. Also, the latter embodiment permits efficient use of an ablative fluid by recycling that portion of the ablative fluid which did not reach the unexposed portions of the fuel array upon discharge from the overhead fixed system.

It is understood that variations in the foregoing method can be made without departing from the scope of the invention. For example, the present invention is not limited to the use of ablative fluid. Rather, a broader application of the present invention would contemplate the use of other known fire extinguishants, as long as the extinguishant used in the manual operation overcomes the problems with water as set forth above. Therefore, two requirements of the latter extinguishant would be that it have a viscosity greater than water to aid in enabling it to build up on the surfaces of a fuel array, and that it be compatible with the pumps, hoses, and nozzles contemplated above. For the purposes of the first requirement, a buildup of a one-sixteenth inch layer will suffice. The other requirements of the latter extinguishant would simply be that it be otherwise compatible with a fire fighting operation of this type.

Of course, other variations of the method of the present invention 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 protecting a structure and the materials stored therein from fire, comprising the steps of disposing a fixed fire extinguishing system in an elevated position relative to the floor of said structure, discharging an extinguishant of a viscosity greater than water from said system towards said materials in response to a fire situation occurring in a particular area of said structure, and manually applying to said materials that portion of said extinguishant that accumulates on said floor.

2. The method of claim 1 wherein the extinguishant applied in said step of discharging and in said step of manually applying is an ablative fluid.

3. The method of claim 1 wherein said step of manually applying comprises the step of directing said portion of said extinguishant towards portions of said fire shielded by said materials.

4. The method of claim 1 further comprising the step of terminating said step of discharging prior to said step of manually applying.

5. The method of claim 1 further comprising the step of reducing the discharge rate of extinguishant prior to said step of manually applying.

6. The method of claim 1 wherein said step of manually applying is done during said step of discharging.

7. A method of fighting a fire comprising the steps of disposing a fixed fire extinguishing system in an elevated position relative to the floor of the structure to be protected from fire, discharging an extinguishant from said system at a predetermined rate in response to a fire situation occurring in a particular area of said structure, reducing said predetermined rate of extinguishant discharge, and then manually applying an extinguishant of a viscosity greater than water to said area.

8. The method of claim 7 wherein said predetermined rate is reduced to zero.

9. The method of claim 7 wherein the extinguishant applied in said step of discharging and in said step of applying is an ablative fluid.

10. The method of claim 7 wherein said step of manually applying comprises the step of directing said extinguishant towards portions of said fire shielded by materials stored in said area.

11. A method of fighting a fire comprising the steps of disposing a fixed fire extinguishing system in an elevated position relative to the floor of the structure to be protected from fire, connecting said system to a first source of extinguishant, discharging said extinguishant from said system in response to a fire situation occurring in a particular area of said structure, and manually applying a second source of extinguishant of a viscosity greater than water to said area.

12. The method of claim 11 wherein said first source of extinguishant is directed to predetermined areas within said structure and wherein said second source of extinguishant is directed towards portions of said fire shielded by the materials stored in said structure.

13. The method of claim 11 wherein each of said sources of extinguishant is an ablative fluid formed by the step of mixing an ablative material and water prior to said step of discharging.

14. The method of claim 13 wherein the ratio of ablative material to water for said first source of extinguishant is different than the ratio of ablative fluid to water for said second source of extinguishant.

15. The method of claim 11 further comprising the step of terminating said step of discharging prior to said step of manually applying.

16. The method of claim 11 further comprising the step of reducing the discharge rate of extinguishant prior to said step of manually applying.

17. The method of claim 11 wherein said step of manually applying is done during said step of discharging.

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