

United States Patent

Livingston

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[54] FIRE CONTROL SYSTEM

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[52] U.S. CL. 169/14, 169/1 A, 169/1 R,
239/597

[51] Int. Cl. A62c 35/00

[58] Field of Search 169/14, 16, 2 R, 1 R, 19, 15,
169/1 A; 239/597, 38; 160/1; 49/1, 7

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[57] ABSTRACT

A fire control system in which two fluids are dispensed from two pressurized tanks into a mixing chamber disposed at an elevated position with respect to the floor of the structure to be protected, where they are mixed to form a gel. The gel is continuously discharged from the chamber and forms a gas-impervius sheet extending to the floor to act as a fire barrier.

9 Claims, 5 Drawing Figures

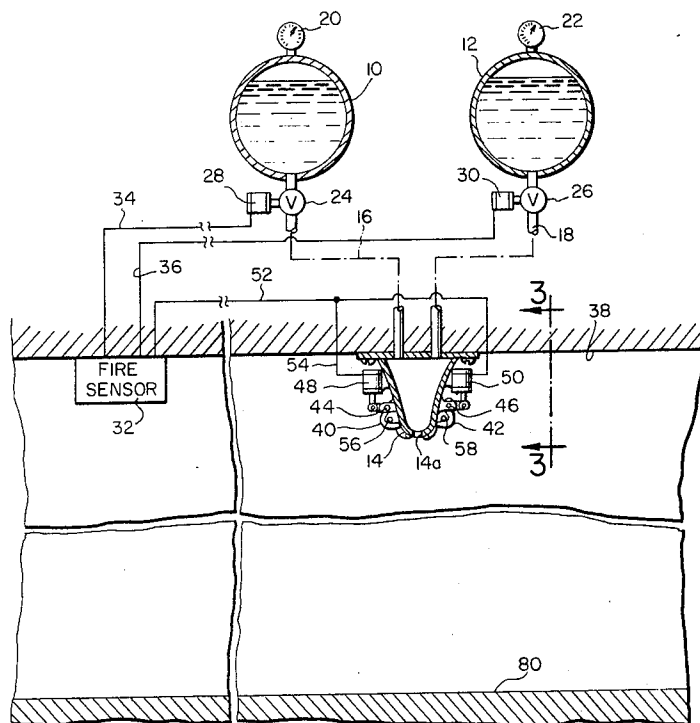


FIG. 1.

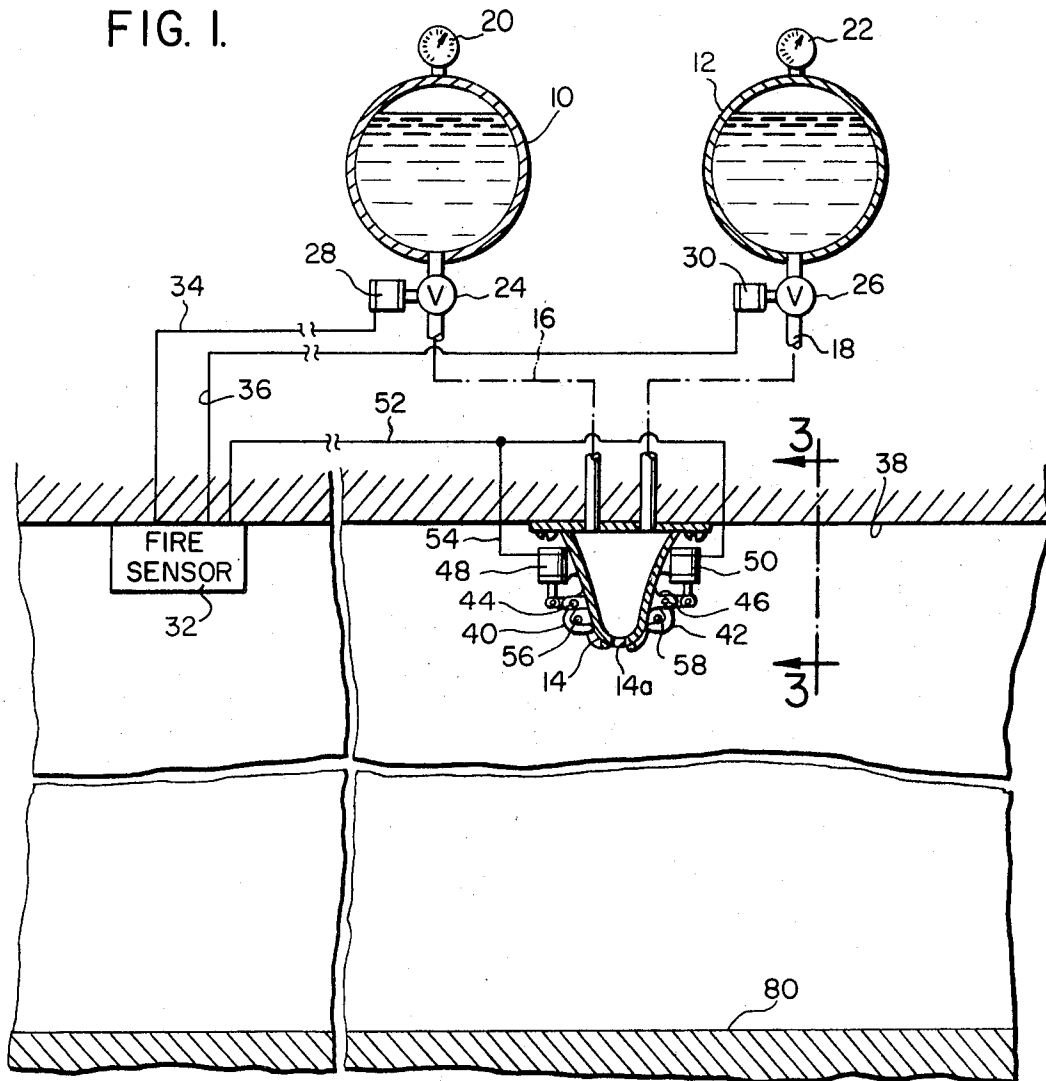
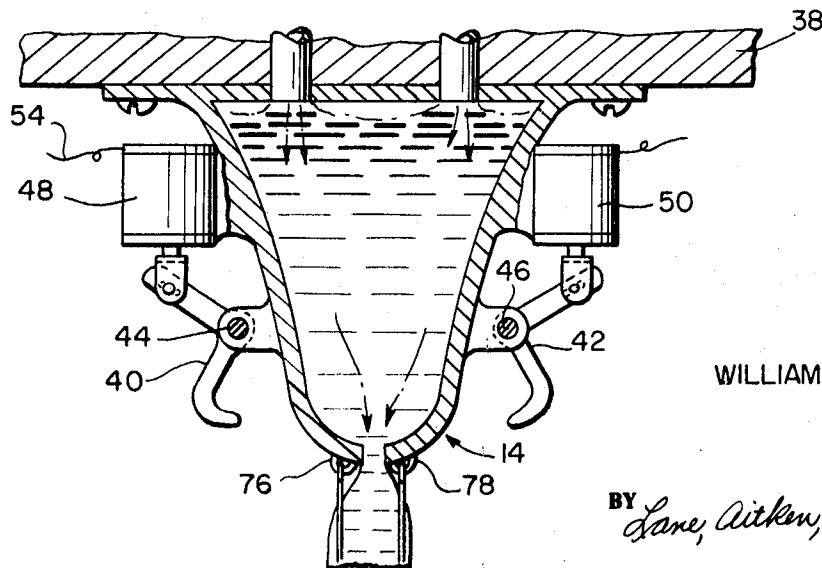


FIG. 2.



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SHEET 2 OF 2

FIG. 3.

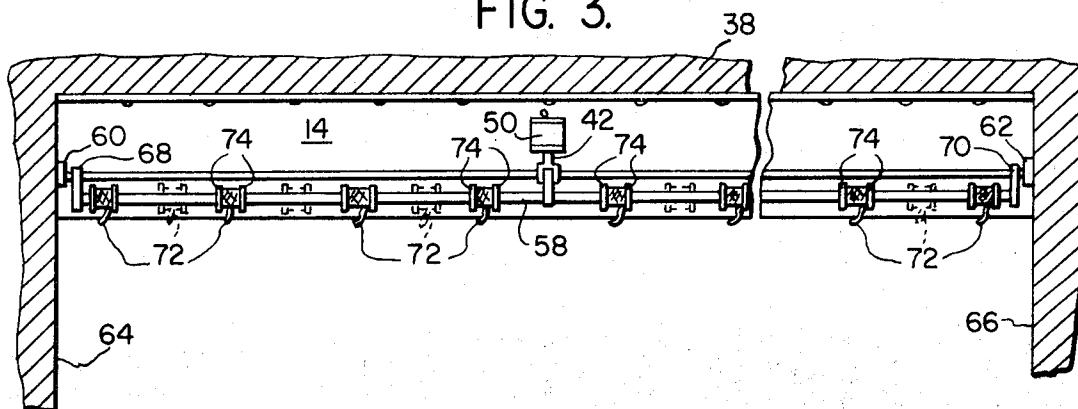


FIG. 4.

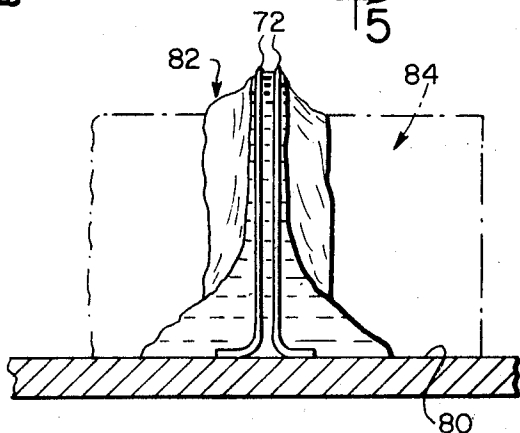
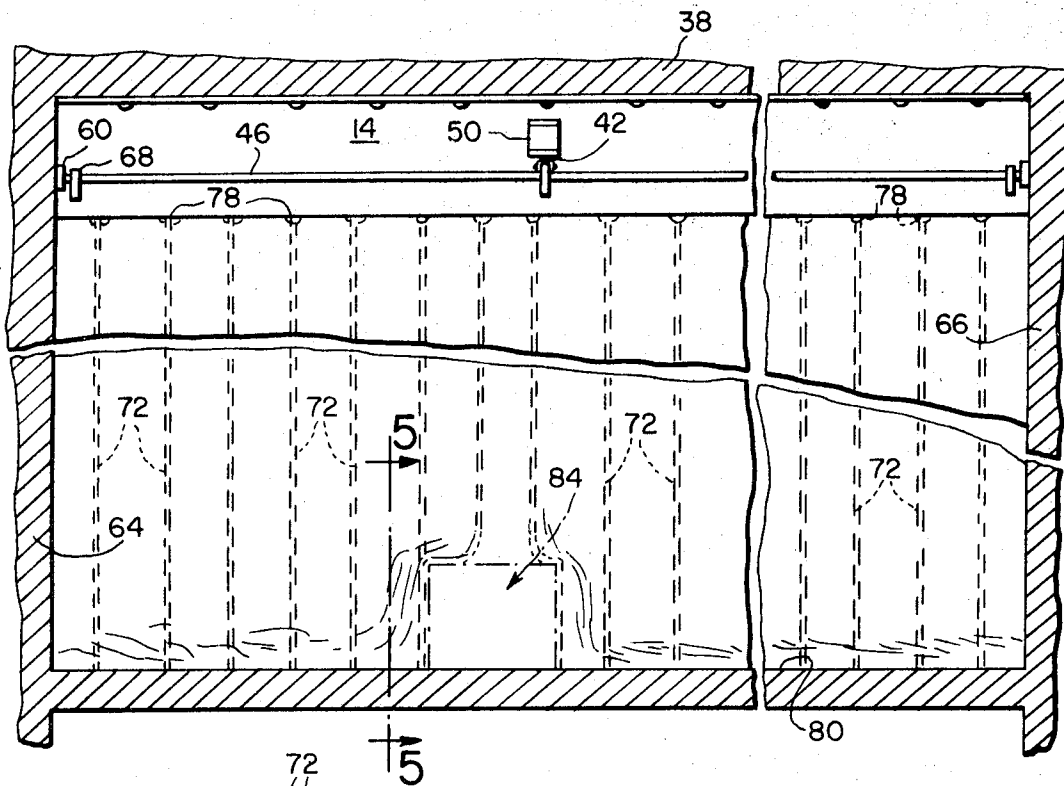


FIG. 5.

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FIRE CONTROL SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to a fire control system, and more particularly, to such a system in which a gas-impervious sheet is formed in the vicinity of the fire to act as a barrier to the spread of the fire.

Although the use of fire walls, and the like, to provide a physical barrier to the spread of fire are well known, there are several disadvantages associated with their use. For example, the walls are normally constructed of a rigid, heavy material which severely restricts the flexibility of the layout of the building in which they are used. Also, they are expensive to construct, have a limited fire control, and restrict access to the fire.

SUMMARY OF THE INVENTION

The present invention is directed to a system for automatically creating a fire barrier in response to predetermined fire conditions, and features the use of two low-viscosity fluids which are normally disposed in a pair of storage tanks and which are discharged into a mixing chamber in response to the fire conditions. The mixing chamber is disposed in an elevated position in the structure to be protected, and continuously discharges a composite of the fluids therefrom, which composite is a dilatant, highly viscous gel sheet extending to the floor of the structure.

Among the objects of the invention, therefore, are the provision of a low-cost system for creating a fire barrier which does not restrict the layout of the structure in which it is used. It is a further object of the present invention to provide such a system in which the barrier itself aids in fire control due to its ablative properties, while permitting unlimited access to the fire and being easily disposable after use.

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 schematic diagram of the fire control system of the present invention, with the mixing chamber and the storage tanks being shown in cross section;

FIG. 2 is an enlarged view of the mixing chamber shown in FIG. 1;

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a view similar to FIG. 3 but depicting the system of the present invention after actuation thereof; and

FIG. 5 is an enlarged cross-sectional view taken along the line 5—5 of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. 1, the system of the present invention comprises a pair of pressurized storage tanks 10 and 12, which are connected to an elongated mixing chamber 14 by means of a pair of conduits 16 and 18, respectively. Each of the tanks 10 and 12 contains a fluid which is maintained under pressure in any known manner, such as by the use of a gas, the pressure being indicated by the dials 20 and 22. The fluids in the containers are of a type that, when mixed, form an ablative gel which is discharged in the form of a continuous viscous sheet from an elongated slot 14a extending through the mixing chamber 14, as will be described in detail later.

A pair of valves 24 and 26 are disposed in the conduits 16 and 18 respectively, and are normally closed to prevent the flow of the fluids from the tanks 10 and 12 into the mixing chamber 14. Two solenoids 28 and 30 are adapted to open the valves 24 and 26 upon a signal from a fire sensor 32 which is electrically connected to the solenoids by means of a pair of

electrical conductors 34 and 36, respectively. It is understood that the fire sensor may be of any known type, and is adapted to provide an output signal in response to a predetermined fire condition, such as the existence of an elevated temperature in its immediate vicinity.

The mixing chamber 14 and the sensor 32 are both mounted with respect to the ceiling 38 of the structure to be protected, it being understood that the pressurized tanks 10 and 12, the conduits 16 and 18, and their associated structure may all be mounted in a convenient accessible portion of the structure.

As better shown in FIG. 2, a pair of crank levers 40 and 42 are fixed with respect to a pair of shafts 44 and 46 which, in turn, are rotatably mounted in corresponding brackets extending from the sidewalls of the chamber 14. An additional pair of solenoids 48 and 50 are also mounted with respect to the sidewalls of the chamber 14, and are electrically connected to the sensor 32 by means of a main electrical conductor 52 and a branch conductor 54, as shown in FIG. 1. One end of each of the levers 40 and 42 is connected to a corresponding plunger of the solenoids 48 and 50, and the other end of each of the levers is bent to form a hook which normally carries a pair of elongated rods 56 and 58, respectively, as shown in FIG. 1.

Referring to FIG. 3, the ends of the shaft 46 are rotatably mounted in a pair of journal boxes 60 and 62 which are respectively fixed to two opposite walls 64 and 66 of the structure. The rod 58 extends for substantially the entire distance between the walls 64 and 66, and its ends are carried by a pair of auxiliary hooks 68 and 70 fixed near the ends of the shaft 46.

A plurality of strands of flexible material 72 are wound around the rod 58, each strand being disposed between a pair of flanges 74 mounted on the rod. It is understood that structure similar to that associated with the shaft 46 and the rod 58, as just described, is also associated with the shaft 44 and the rod 56 on the other side of the chamber 14. As shown in FIG. 3, the strands 72 are staggered along the lengths of the rods 56 and 58, and the exposed ends of the strands 72 are tied to a plurality of hooks 76 and 78 which are fixed to either side of the chamber 14, as better shown in FIG. 2.

The fluids disposed in the tanks 10 and 12 may be of the type which when mixed, form a macrogel which, for the purpose of this application, will be defined as an infinite network structure of high molecular polymer chains which extend to its limiting boundaries. The macrogel thus formed is of a dilatant nature, that is, the viscosity thereof increases with corresponding increases in molecular shear stress imposed thereon. In this respect, the macrogel behaves very much like "silly putty," a well-known composition sold commercially as a play-toy for children. In the present application, this characteristic enables the sheet discharging from the slot 14a to flow downwardly by gravity to form a gas-impervious wall. During cleanup after its use as a firewall is no longer needed, however, the macrogel can be shoveled or otherwise picked up very easily because such handling causes it to increase in viscosity to a point where it behaves like a rigid gel.

Also, the macrogel sheet thus formed is ablative, that is, it will permit thermal energy to be transmitted through its exposed outer surface, but not completely through its thickness, said thermal energy being absorbed within said sheet so as to immediately transform the material of said sheet into vapor without internal convection of said material, said vapor leaving said sheet through its outer surface. Hence, not only is the sheet extending from the slot 14a gas impervious, but also, it is in itself a fire extinguishant due to its ablative characteristics.

As an example of the types of fluids which will form an ablative macrogel sheet in the above manner, a solution of 4 percent polyvinyl alcohol in water may be disposed in one of the tanks, while a suitable catalyst for the polyvinyl alcohol, such as a solution of 1 percent borax in water, may be disposed in the other tank.

In operation, the existence of a predetermined fire condition in the immediate vicinity of the sensor 32 will cause the latter to actuate the solenoids 28 and 30 to open the valves 24

and 26, respectively. This permits the flow of the fluids contained in the tanks 10 and 12 through the conduits 16 and 18, respectively, and into the mixing chamber 14.

Also, the solenoids 48 and 50 will be actuated in a similar manner, causing a consequent pivoting of the levers 40 and 42, respectively. The rods 56 and 58 are thus released and fall to the floor 80, while the strands 72 unwind from the rods and hang from the hooks 76 and 78 to either side of the chamber 14. The fluids mix together in the chamber 14 to form a macrogel which continuously discharges from the chamber through the slot 14a and forms a continuous sheet extending over the strands 72. The strands 72 provide reinforcement for the sheet, and thus reduce tearing and failure thereof, especially when the wall heights are such that the weight of the sheet is greater than its tensile strength.

It is noted that the gradual decrease of the quantity of fluids in the tanks 10 and 12 causes the pressures in the latter to decrease accordingly, which automatically reduces the flow rates with time so that, once formed, the sheet is replenished at a slower rate to make up for ablation and any holes, etc., that may develop.

As shown in FIGS. 4 and 5, the resulting sheet formed by the macrogel and the strands, and shown by the reference numeral 82, extends from the chamber 14 to the floor 80. The sheet will drape over any structure located immediately below the chamber 14, such as a desk 84, or the like, without causing damage.

It is contemplated that a thin membrane (not shown), such as a plastic film sock, may extend over the slot 14a during nonuse of the system, in order to seal the chamber 14 from impurities, etc. Of course, the membrane will rupture by pressure when the system is energized.

Thus, with the system of the present invention two low viscous fluids are utilized which are easily stored and transferred to a mixing chamber, where they will for a highly viscous ablative sheet upon combining and discharging from the chamber, resulting in a low-cost barrier to the spread of fire. Also, the system of the present invention does not disturb the existing layout of the structure to be protected, and permits easy access to the fire. Further, the sheet is easily cleaned up after the fire has been extinguished since it is in a dry form.

Several variations in the above may be made within the scope of the invention. For example, the use of the reinforcing strands of the flexible material is not absolutely necessary, especially when the tensile strength of the macrogel sheet exceeds its weight. Also, the elongated slot formed in the mouth of the mixing chamber may be replaced by a plurality of perforations. Further, any other means to dispense the strands of flexible material may be utilized, as well as other fluids to form the macrogel sheet, such as polyethylene oxide, pectin, or carboxy methyl cellulose, along with their appropriate catalysts. Also, the system is well suited for outdoor applications as well as indoor applications.

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 control system for controlling the spread of a fire in a space to be protected, comprising means responsive to a

predetermined fire condition in said space for generating a signal, means responsive to said signal for releasing a solid sheet from an upper portion of said space towards a lower portion of said space, said sheet including an ablative gel material to form a fire-resistant wall, and discharge means responsive to said signal for discharging reinforcing material for said sheet.

2. The system of claim 1 including means for applying additional ablative gel material to said sheet to replenish ablative gel material removed by the fire so as to maintain the firefighting characteristics of said fire-resistant wall.

3. The system of claim 1, wherein said reinforcing material is in the form of a plurality of strands of flexible material which are normally stored by said discharge means in said upper portion of said space.

4. The system of claim 1, wherein said means for releasing a solid sheet comprises at least two fixed storage means, a fluid disposed in each of said storage means, a mixing chamber disposed at an elevated position with respect to the structure to be protected and having at least one discharge opening, and means responsive to said signal for connecting each of said storage means to said chamber, said fluids adapted to flow from said storage means to said chamber and form said sheet upon mixing in and discharging from said chamber.

5. The system of claim 4, wherein one of said fluids is in the form of a polyvinyl alcohol solution and the other is in the form of a catalyst for said polyvinyl alcohol.

6. A fire control system comprising at least two fixed storage means, a fluid disposed in each of said storage means, a mixing chamber disposed at an elevated position with respect to the structure to be protected, said chamber having at least one discharge opening, means responsive to predetermined fire conditions for connecting each of said storage means to said chamber and form a gel sheet upon mixing in and discharging from said chamber, and means responsive to said predetermined fire conditions for discharging a plurality of strands of flexible material from the vicinity of said chamber, one end of each of said strands being fixed with respect to said chamber to form a reinforcement for said sheet, said sheet extending to said floor to act as a fire barrier.

7. A method of controlling a fire in a space to be protected, comprising the steps of generating a signal in response to a predetermined fire condition in said space, releasing a solid sheet from an upper portion of said space towards a lower portion of said space in response to said signal, said sheet including an ablative gel material to form a fire-resistant wall, and releasing a reinforcing material for said ablative gel material.

8. The method of claim 7 further comprising the step of applying additional ablative gel material to said sheet to replenish the ablative gel material removed by the fire so as to maintain the firefighting characteristics of said fire-resistant wall.

9. A method of controlling a fire comprising the steps of storing a sheet-forming material at an elevated position with respect to the floor of a structure to be protected, releasing said sheet-forming material towards the floor of said structure to form a sheet extending between said elevated position and said floor, said sheet including an ablative gel material, and releasing a reinforcing material for said sheet to form a fire-resistant wall.

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