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Lofstrand et al.

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[54] **AUTOMATIC SPRINKLING SYSTEM**

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[52] **U.S. Cl.** ..... **169/2 R,** 169/16

[51] **Int. Cl.** **A62c 3/00**

[58] **Field of Search** ..... 169/1 R, 2 R, 16, 42

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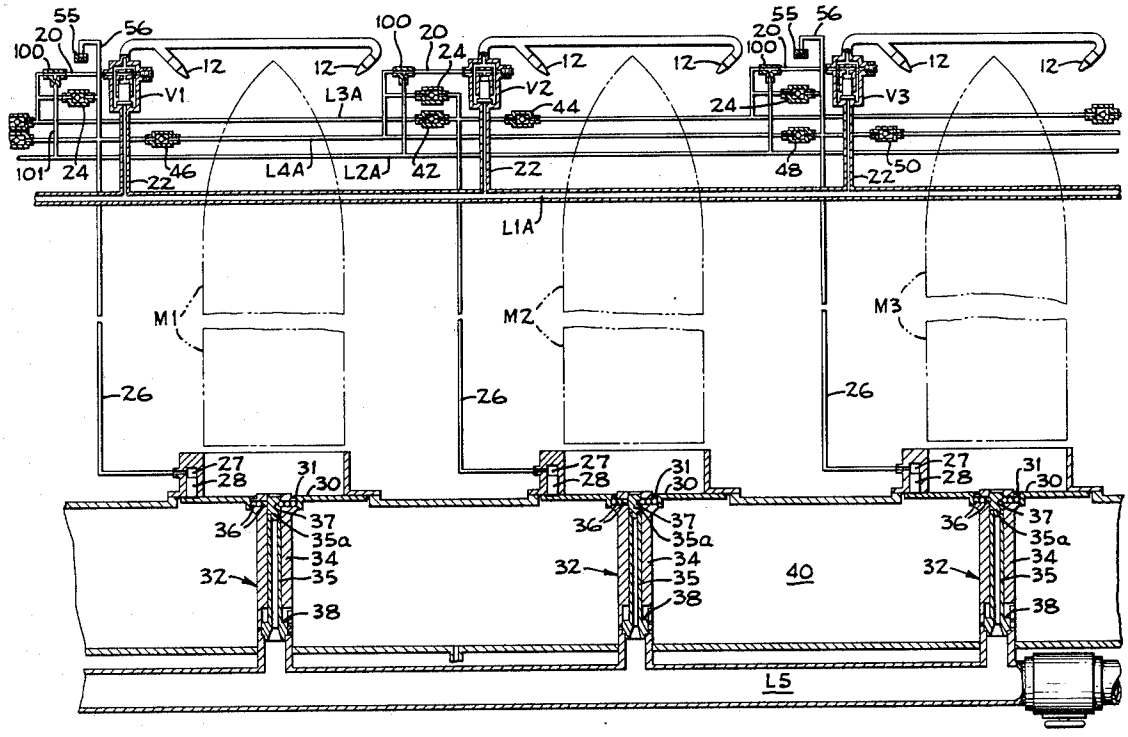
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[57] **ABSTRACT**

An automatic sprinkling system for a plurality of missiles or other highly combustible objects includes sprinkler heads arranged to supply streams of water individually to each missile. A fire detection means is provided for each missile and a control valve controls the flow of water to the sprinkler heads for each missile with the detection means being hydraulically connected with the control valve so as to open the same upon the actuation of the detection means. A system of check valves and control lines interconnects all of the control valves so that upon actuation of the detection means for any one missile the control valves of each of the adjacent valves will be opened along with the control valve for the missile which is on fire whereupon a maximum supply of water will be delivered immediately to the area where it is needed. The invention herein described was made in the course of or under a contract with the Department of the Navy.

11 Claims, 3 Drawing Figures



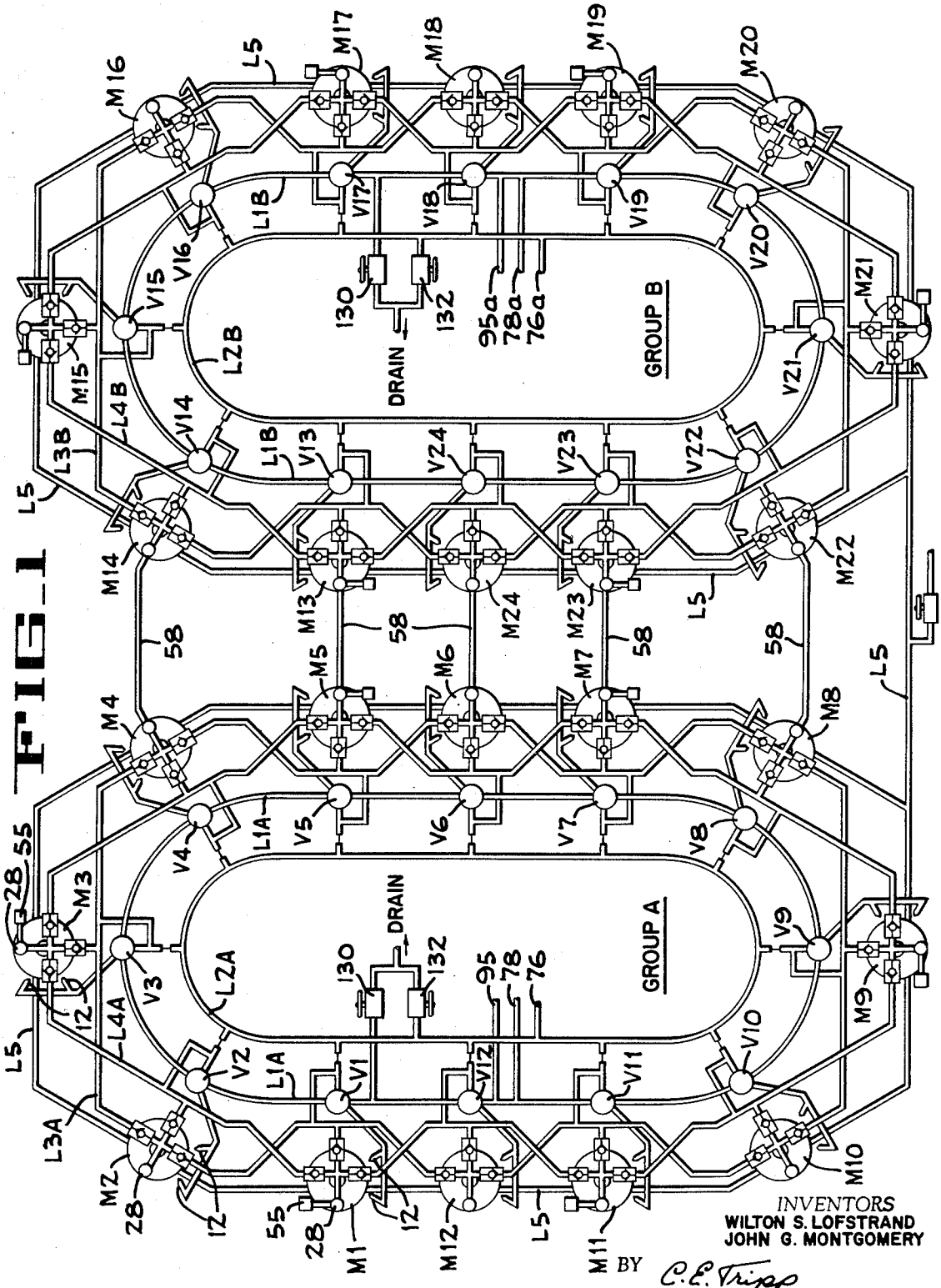


FIG_1

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FIG_2

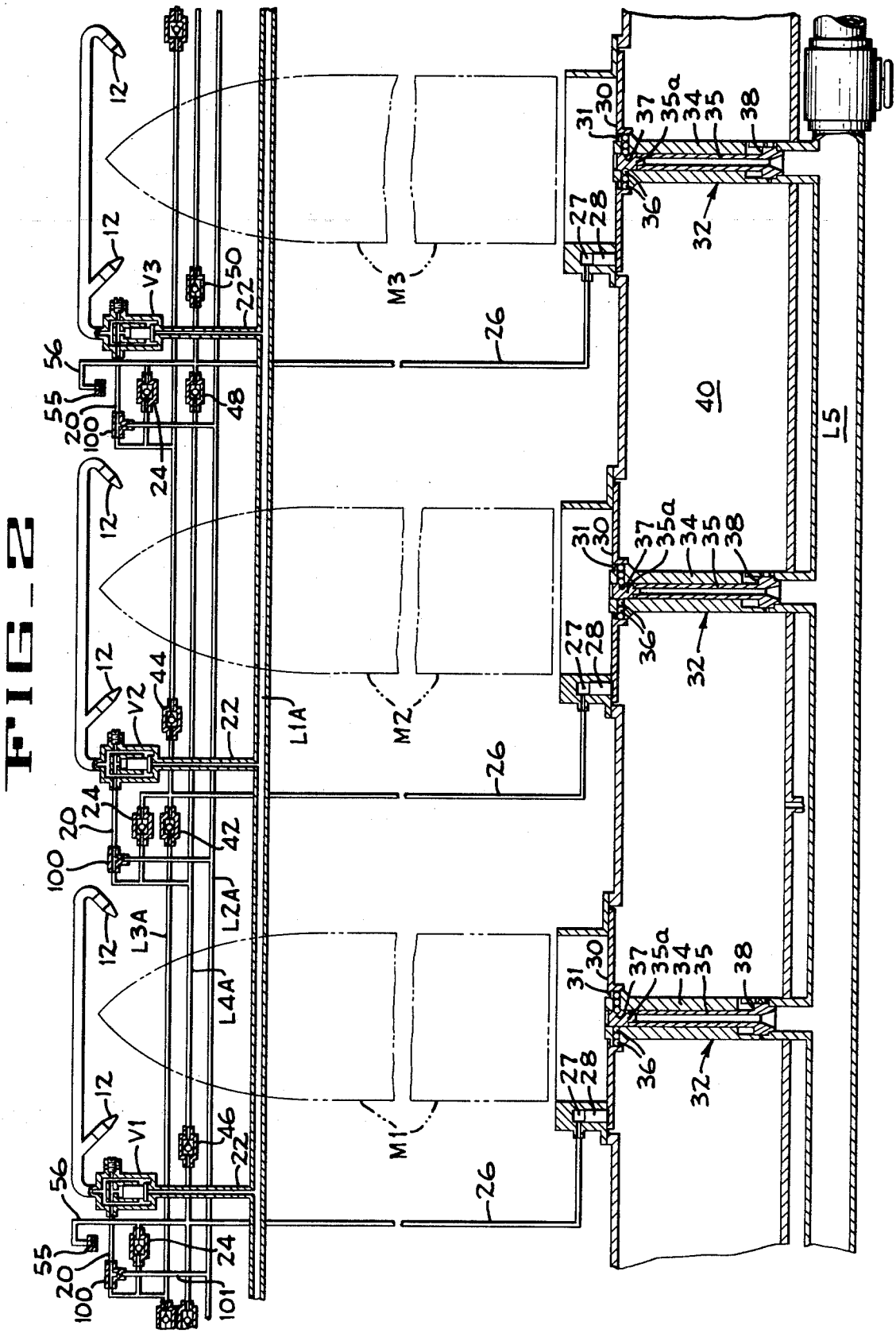
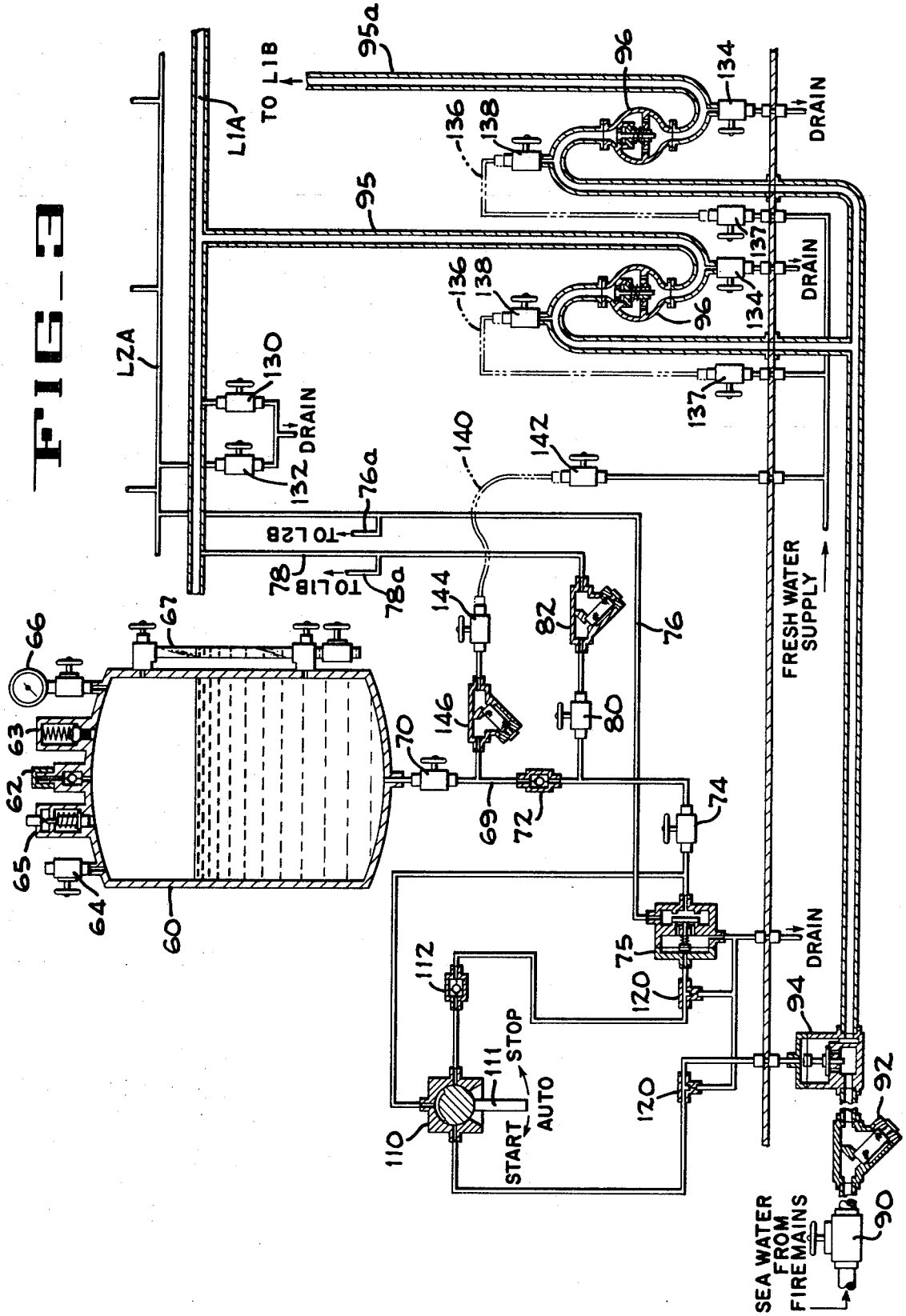

12
V3
50
22
56
55
20
100
48
24
M3
26
27
28
31
30
37
35a
34
35
38
36
32
40
L5
V2
44
L1A
M2
42
L3A
L2A
L4A
V1
46
M1
101

FIG-3


95a
TO L1B
L1A
96
134
DRAIN
136
138
95
137
L2A
130
132
DRAIN
140
142
76a
TO L2B
78
TO L1B
78a
144
82
76
FRESH WATER SUPPLY
66
67
63
62
65
64
60
146
70
80
69
72
74
112
75
120
DRAIN
94
111
STOP
START
AUTO
110
92
90
SEA WATER FROM FIREMAINS

AUTOMATIC SPRINKLING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to automatic sprinkling systems for providing a plurality of continuous streams of water or other fluids to quench fires within a predetermined area, and more particularly, it pertains to the means for controlling such automatic sprinkling systems.

2. Description of the Prior Art

The storage of a plurality of highly combustible objects within a given area poses many problems for automatic sprinkling systems which have been devised for operation upon the detection of a fire within the area to supply the necessary quantities of water to quench the flames before serious fire damage results. Typically, such sprinkling systems include a plurality of sprinkling heads which are strategically placed so as to spray water over the entire area or at least that portion thereof where a fire is likely to start. Such automatic sprinkling systems may be of the "wet type" or the "dry type." The wet type sprinkling systems provide water at each sprinkler head under the control of a valve at the sprinkler head while, in a typical dry type system, a power-operated valve in the main supply line is opened upon the detection of a fire to release water to all of the sprinkler heads at once. The dry type system obviously is the most basic and the least expensive, but it lacks the necessary speed in response to the detection of a fire condition so as to make it practical for many applications. The wet type system, on the other hand, obtains effective sprinkling sooner after the detection of the fire condition but, in order to be effective, all of the sprinkler heads are generally turned on upon the actuation of any one fire detection means.

The detection devices are often built into the sprinkler heads themselves and may comprise, for example, fusible plug valves which release control line pressure in the sprinkler head valve to open the same. Typically, the release of control line pressure in one valve results in the release of control line pressure in each of the other valves in the system to also c open these valves and obtain complete sprinkling. Since any automatic sprinkling system has only a limited amount of pumping capacity available at any given time (especially for a sudden unexpected emergency such as a fire), the amount of water which can be delivered to any given set of sprinkling heads is thereby limited; however, it may be only one set of adjacent sprinkling heads out of many heads which need be activated in order to extinguish the fire, particularly if the system response is rapid.

One particular problem in this regard occurs aboard naval vessels which may store within a given area a plurality of highly combustible objects such as solid state ballistic missiles. In case of accidental ignition of a missile, or ignition caused by enemy attack with penetrating ammunition or shrapnel, a tremendous amount of flames and heat are almost instantly given off from the ignited missile which, if unchecked, can cause serious damage to the vessel and may even result in the sinking thereof. While detection systems have been provided to detect the ignition of such a missile as quickly as possible, there is only a limited amount of water available for immediate pumping by the ship's firemains because

of the economics and practicality of keeping a pumping system in continuous operation for use solely in a fire emergency. With the sprinkling systems of the prior art the water which was delivered from the firemains had to be distributed throughout the entire sprinkler head system in any single magazine even though the ignited missile and the area immediately adjacent thereto received only a small fraction of the total water being pumped to the system. This conventional type of sprinkling system, therefore, poses a safety problem on naval vessels particularly when the vessels are carrying missiles which generate large amounts of heat and flames.

Another problem with the prior art systems is that an inherent delay occurs before actuation of the sprinkling heads since conventional heat sensors that were mounted above the missiles were used to detect the presence of an abnormal amount of heat before activating the sprinkling heads. Since missiles generally ignite at the lower ends thereof in their stored position, a serious amount of damage could already have occurred before a ceiling sensor could detect the heat generated by the ignited missile.

SUMMARY OF THE INVENTION

The primary objective of the automatic sprinkling system of the present invention is to provide for zoned sprinkling wherein, upon the detection of a fire, all of the available water in the pumping system is delivered to the area of the fire and the area immediately adjacent thereto. In the case of missiles aboard a naval vessel, this means that sprinkling will be provided only to the ignited or burning missile and to the adjacent missiles in the missile containing magazine. This sprinkling zone is always centered upon the location of the fire regardless of where the fire is located throughout the area of the automatic sprinkling system. Furthermore, the entire output from the firemains can be directed to the critical zone until and unless another fire is detected so as to expand or split the sprinkling zone accordingly.

A particular feature of the present invention is the nature of the hydraulic control system which is utilized for providing a true zoned sprinkling effect regardless of where the initial fire is located within the area of the system. A sprinkler head, or heads, are provided at predetermined locations throughout the area of the sprinkling system as with conventional automatic sprinkling systems. Where the sprinkling area includes a plurality of highly combustible objects set at predetermined locations, such as ignitable missiles in a magazine, the sprinkler heads would obviously be located so as to direct the water from the sprinkling heads upon such objects. Each sprinkling head is provided with water at a predetermined pressure with the flow from the head being monitored by a differential control valve. Sensing means are provided with each sprinkling head to sense the presence of a fire in the area adjacent to the sprinkling head, and the sensing means are hydraulically connected to the associated control valve so as to open the valve and allow water therethrough to the sprinkling head. Each of the control valves are interconnected by a series of control lines and check valves which form the hydraulic control system whereby, upon the actuation of any one

control valve, the control valves of the adjacent sprinkler heads will also be actuated while the remainder of the system is unaffected.

Another special feature of the invention is the means for detecting the presence of a fire when the sprinkling area includes a plurality of combustible objects such as ballistic missiles or the like which eject flames from the lowermost ends thereof. A plate is provided at the bottom of each missile which plate is arranged to be moved downwardly under the pressure of the flames or expanding gases ejected by the missile and, in so doing, depressurizes a control line which triggers the control valve that operates the sprinkler head providing water to the ignited missile. This event automatically actuates the control valves for the sprinkler heads located above the adjacent missiles also. Thus, the zoned sprinkling effect is provided at the earliest possible time before the heat from the ignited missile has had a chance to ignite other missiles within the area of the sprinkling system.

With the sprinkling system of the present invention all of the available pumping capacity is directed almost immediately to the area where it can do the most good. Even if the fire rapidly spreads, the adjacent areas will come under sprinkling as the fire detection means associated therewith are actuated, and hopefully, additional pumping capacity will be available by this time to handle the additional quantities of water needed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of the hydraulic circuitry for the automatic sprinkling system of the present invention.

FIG. 2 is an enlarged schematic illustration of a portion of the sprinkling system shown in FIG. 1.

FIG. 3 is a schematic illustration of the supply and external control means for the automatic sprinkling system shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The automatic sprinkling system of the present invention, the hydraulic circuitry of which is shown schematically in FIG. 1, is particularly designed for the automatic sprinkling of ballistic missiles such as those within a magazine aboard a naval vessel for example. It will be recognized, however, that the system to be described can be used for many other specific purposes particularly where a plurality of highly combustible objects are provided at spaced locations within the area of the sprinkling system and fast delivery of maximum amounts of water, of other quenching fluids, to the initial location of the fire is required. In the system shown, the objects to be protected include 24 missiles, numbered M1 through M24, arranged in two groups comprising closed loops of 12 missiles each which are indicated (in FIG. 1) as Group A and Group B. It will be noted that the missile groups are located in juxtaposition so that five of the missiles of one group are located closely adjacent to five missiles in the adjacent group. Each of the missiles is provided with a pair of overlying sprinkler heads 12 (FIG. 2) which are coupled together and which are provided with water upon the actuation of a control valve which is operatively connected to the heads to monitor water thereto. One control valve is provided for each missile, and the control valves have been numbered V1 through V24 in the drawings so that that numbering of the control valves directly corresponds to the numbering of the missiles, as shown in FIG. 1. All of the control valves in each group are interconnected by a water supply line L1A or L1B which supplies water to the sprinkler heads 12 upon actuation of one or more sets of control valves; that is to say, control valves V1–V12 of Group A are interconnected by the water supply line L1A, and control valves V13–V24 of Group B are connected by the supply line L1B.

Each of the control valves V1–V24 is a differential type valve which uses the hydraulic pressure in a control line to close off the water supply to the sprinkler heads 12. Control line pressure for all of the control valves is supplied through three separate control lines in the sprinkling system for each group of missiles including lines L2A, L3A and L4A in the system for missile Group A and including lines L2B, L3B and L4B in the system for missile Group B. As will be recognized from FIG. 1, the control lines L2A and L2B provide a uniform control pressure to each of the control valves in the group. These control lines are provided with a plurality of restricted orifice connections to the individual control valves the nature and purpose of which will be explained presently. The control lines L3A and L4A (and corresponding lines L3B and L4B), on the other hand, also interconnect the control valves of each group, but these lines are provided with a plurality of interposed check valves for controlling the flow of supply water to particular control valves in the group only; the operation of such check valves to be explained in more detail hereinafter. A continuous water supply line L5, which is entirely separate from the supply lines L1A and L1B, extends beneath each of the missiles in each group to selectively provide a supply of quenching water to the lowermost ends of the missiles in a manner to be explained in greater detail hereinafter.

Referring further to FIG. 1, the sprinkling system of the present invention is operated so that, upon actuation of the fire condition sensing means associated with any missile M1–M24, the control valve for actuating the sprinkling heads 12 above that missile and the control valves for actuating the sprinkling heads above the adjacent missiles will be activated while the remainder of the sprinkling system is unactivated, and this means that all of the available water in the supply lines L1A or L1B will be directed to the area of the fire condition where damage is most likely to occur first and from where the fire will spread. For example, if the fire condition sensing means associated with missile M1 were to be actuated, the control valves V1, V2 and V12 would be operated so as to supply all of the available water to the missiles M1, M2 and M12, respectively. If the fire condition sensing means associated with the missile M2 were to be activated, the control valves V2, V3 and V1 would be actuated so as to supply all of the available water to the missiles M2, M3 and M1, respectively. When the fire condition sensing means which is actuated is in the area where the two missile groups are adjacent to each other a greater area must be supplied with sprinkling since there will be more missiles to be covered. For example, if the fire condition sensing

means associated with missile M5 were to be actuated the control valve V5 would be actuated in turn to supply water to missile M5, and each of the adjacent control valves V4, V6, V13, V14 and V24 would be actuated to supply water to the missiles M4, M6, M13, M14 and M24, respectively. If the fire condition sensing means associated with the missile M8 were actuated, the control valve V8 would be actuated in turn to supply water to missile M8, and the adjacent control valves V7, V9, V22, V21 and V23 would be actuated to supply water to the adjacent missiles M7, M9, M22, M21 and M23, respectively. Finally, the actuation of the fire condition sensing means associated with the missiles at the ends of the group would actuate only the control valves for the directly adjacent missiles; for example, if the fire condition sensing means associated with control valve V21 were actuated it would actuate control valves V20, V21 and V22.

The water supply to the lowermost portion of the missiles through line L5 is not a direct part of the zone sprinkling system since the zone concept applies only to the sprinkling heads 12 which overlie the missiles. Water which is delivered from line L5 to the missiles will be provided upon the blowing out of a pressure plate at the bottom of each missile that is ignited by the direct injection of water into the ignited missile all in a manner to be further explained hereinafter.

The hydraulic circuitry components and their mode of operation for obtaining a true zoned sprinkling system can be best shown with particular reference to FIG. 2 which illustrates, in enlarged schematic detail, missiles M1, M2 and M3 and the sprinkling system circuitry associated therewith. Each differential control valve V1, V2 or V3 is provided with a pressurized control line 20 which keeps the associated control valve closed against the pressure of the water in the supply line L1A acting through the individual supply lines 22 to the control valves. Each control line 20 is in direct communication with a main triggering check valve 24 which is set so as to maintain the water in the line 20 at the predetermined control pressure to keep the associated control valve V1–V3 closed. The blocking side of the triggering check valve 24 is connected to a line 26 which extends to an enclosed chamber 27 adjacent the base of the missile which chamber is closed by a removable valve plug 28 to maintain the pressure in line 26. The valve plug 28 rests upon a plate 30 which is secured by a thin annular lip 31 atop of an annular ledge of an upright injector nozzle structure 32. The injector nozzle structure is provided with a continuous supply of water from the supply line L5 which, in the system of the present invention, is supplied from means capable of delivering a sufficient quantity of water to be directed into the cone portion of an ignited missile, so as to thoroughly quench this area of the missile.

The injector nozzle structure 32 will be seen to comprise an outer sleeve 34 which is mounted in a fixed position in communication with the supply line L5 and an inner tubular section 35 which is adapted to slide longitudinally within the sleeve. The top of tubular section 35 includes a removable plug 35*a* which is adapted to be blown off when the nozzle is actuated as will be explained in greater detail hereinafter. In the inoperative position of the injector nozzle shown in FIG. 2, the interior tubular section 35 of the nozzle is held in a lowered position by a plurality of retaining balls 36 which are carried by the sleeve 34 and are wedged into an annular groove 37 in the plug 35*a* at the top of the tubular section 35 of the nozzle.

When a missile is ignited, the pressure caused by the flames or the expanding gases acting against the plate 30 will cause the thin annular flange 31 to shear off thereby dropping the plate within an enclosed plenum chamber 40 which extends beneath all of the missiles of each group. This frees the retaining balls 36 which drop out of the nozzle sleeve 34 and allow the inner tubular section 35 to rise under the pressure of the water in line L5 until an annular flange 38 on the tubular section abuts against the body of the fixed sleeve 34. The plug 35*a*, which is freed from the retaining balls 36, will be ejected so that water from the supply line L5 will be directed into the interior of the missile.

The actuation of the pressure plate 30 also sets the overhead zone sprinkling system into operation which operation will now be described with particular reference to the ignition of the missile designated M2 (FIG. 2). With the release of the plate 30 the valve plug 28, which is resting upon the plate, will drop out so as to relieve the pressure on the associated triggering check valve 24 through control line 26. This has the effect of opening the control valve V2 to the flow of supply water since the control pressure in line 20 will be relieved through the now opened triggering valve 24. It will be noted that control line L3A is in communication with the relieved control line 26 through a pair of check valves 42 and 44 and that the removal of pressure in line 26 will open both of these check valves. It will further be noted that this places line 26, which is open to the atmosphere, in direct communication with the pressure control lines 20 to each of the adjacent control valves V1 and V3 so that these control valves will also be actuated when the control valve V2 is actuated. However, since the triggering check valves 24 for each of the control valves V1 and V3 will not be actuated, the control valves adjacent to control valves V1 and V3 (other than control valve V2) will not be actuated. It will further be noted that the pressure control line 20 for control valve V2 is in direct communication through control line L4A with a second pair of check valves 46 and 48 which are in communication with the hydraulic control circuitry for the adjacent control valves V1 and V3 respectively; however, these check valves are oppositely positioned from the check valves 42 and 44 so that the relief of pressure in the line 20 will not open them.

The hydraulic control circuitry for each of the control valves V1 and V3 is precisely the same (with one exception) as the aforedescribed circuitry for control valve V2 and, therefore, will not be described in detail. These valves are operated in exactly the same way as V2. For example, if pressure is relieved in the line 26 which is associated with the control valve V3 then the control valve V3 will be opened as its associated pressure control line 20 is drained, and the adjacent control valve V2 will also be opened since the check valve 48 will now open to depressurize line 20 to valve V2. A similar check valve 50 is provided in line L4A to relieve the control pressure line for the adjacent control valve V4 (not shown in FIG. 2).

The only distinction between the hydraulic control circuitry for valve V2 and that for valves V1 and V3 is that the circuitry for the latter valves includes a sensor **55** which is adapted to be actuated by heat at the top of the missile rather than by the heat or pressure at the bottom of the missile. These sensors, which are conventional, include a fusible plug valve which opens when subjected to heat and relieves the pressure in a hydraulic line **56** that is connected thereto. The loss of pressure in line **56** relieves pressure on the triggering check valve **24** to thereby actuate the control valve associated therewith and the adjacent control valves all as described hereinbefore.

In the case of the actuation of those control valves V4–V8, V13, V14 and V22–V24, which are associated with missiles that are in the central area of the magazine where the two groups of missiles are adjacent to each other, activation of one of the aforedescribed sensing means **28** or **55** associated with a missile of one group not only actuates the sprinkling systems for one adjacent missiles in that group but also, through connecting lines **58** (FIG. 1), activates the triggering check valves **24** associated with the control systems for the adjacent missile in the other group of missiles. Thus, as many as six separate missiles can be provided with water upon the detection of a fire in any one of them.

The supply and external control means for the circuitry of the present invention is particularly shown in FIG. **3**. In order to prevent corrosion in the valves and other operating components of the hydraulic circuitry, fresh water is provided throughout the control circuitry of the present invention even though contaminated water, such as sea water, will be pumped through the supply lines and sprinkler heads during a fire. The fresh water which is in the system during its "ready" state is controlled by an accumulator control tank **60** which is filled with a sufficient quantity of water to permit operation of the system and is charged with air or an inert gas through a check valve **62** so that the pressure in the tank (and throughout the control system) is maintained at a predetermined level; for this purpose, the tank may be provided with a conventional relief valve **63** and a bleeder valve **64**. Indicating devices such as pressure switch **65** and pressure gauge **66** can also be provided so that the control system pressure can be readily checked. A gauge **67** is provided alongside the tank to indicate that the correct amount of water is present in the tank.

The control tank **60** is placed in communication with the control circuitry for all of the control valves V1–V24 through an outlet line **69** which includes therein a manual shutoff valve **70**, a check valve **72**, and a second shutoff valve **74**. Line **69** is in communication with one side of a normally-closed pressure-operated valve **75** which, when closed, diverts flow from line **69** to a line **76** and into the control line L2A that is in communication with each of the control valves V1–V12. A secondary line **76***a* branches from the line **76** to supply control pressure to the line L2B which is in communication with the control valves V13–V24. The accumulator control tank is also in communication with the supply line L1A (and L1B) through line **78** (and **78***a*) which branches from line **69** and includes therein a shut-off valve **80** and a filter **82**. This latter connection is necessary since the control system will loose pressure during the actuation of one or more sets of control valves, and it is desired that the control pressure never drop below the supply pressure so that the entire sprinkling head system will not be activated.

The water necessary for supplying the main supply lines L1A and L1B comes from the firemains through a manually operated shutoff valve **90**, a filter **92**, and a normally-open pressure-operated valve **94**. This sea water supply is then branched into two secondary supply lines **95** and **95***a* serving the supply lines L1A and L1B, respectively. Each of lines **95** and **95***a* has therein a check valve **96** which separates the control side of the circuitry from the supply side. That is to say, when the automatic control system is set, the control side is at a significantly higher pressure than the sea water supply side so that all of the hydraulic control circuitry and the circuitry and components in the supply portion of the circuitry downstream from the check valve **96** will be normally supplied with fresh water in order to prevent corrosion. When one of he sprinkler heads is actuated and water is supplied from one of the supply lines L1A or L1B, the pressure on the control side will rapidly drop until it equals the sea water supply pressure at which time the appropriate check valve **96** will open and sea water will be directed into the supply line to keep the system in operation. By way of example, the control side may be set at a pressure of about 225 psi when there is a normal sea water supply at a pressure of about 150 psi.

It will be noted from FIG. **2** that each of the control lines **20**, which relieve the pressure on the associated control valves V1, V2 or V3, has therein a restricted orifice **100** which provides communication between the line **20** and a line **101** that is in communication with the control line L2A. The orifices **100** are used in the recharging of the system, and they are restricted so that the control pressure will not drop too rapidly before it can be equalized with he supply pressure. Each of the other control valves in the system is, of course, provided with similar restricted orifice connections as shown in FIG. **1**.

Manual control of the sprinkling system is provided by a control valve assembly **110** which includes a valve member **111** which is movable into three positions designated (in FIG. **3**) as "start," "automatic," and "stop." During normal system operation, wherein all of the sprinkler heads are charged and ready to supply water upon actuation of their respective control valves, the control valve assembly **110** will be in the neutral or "automatic" position. By rotating the valve element **111** to the "start" position, communication is provided between the control line **69** and the pressure side of valve **75** through check valve **112** so as to open valve **75** and allow the control pressure in lines **76** and **76***a* to flow through valve **75** to a drain. Upon the release of the control pressure from lines **76** and **76***a*, all of the control valves V1–V24 will be actuated and all of the sprinkler heads **12** will consequently be turned on.

When it is desired to stop the sprinkling system, or to lock it out, the valve member **111** of the control valve assembly **110** is moved into the "stop" position wherein water from the control tank is diverted from the line **69** through the control valve assembly **110** to the pressure side of the pressure-operated valve **94** so

as to close this valve and prevent the water from flowing into the system from the firemains. It will be noted that restricted orifices **120** are provided in each of the lines connected to the "start" and "stop" sides of the valve assembly **110** to provide communication between these lines and a drain. These restricted orifices allow leakage from these lines in case there is leakage from the control circuitry through the control valve assembly **110** so that the pressure-operated valves **75** and **94** will not be actuated inadvertently.

The moving of the control valve assembly **110** into the "stop" position is, generally speaking, the first step in the recharging or resetting of the automatic sprinkling system after it has been in operation due to a fire or other cause. As pointed out hereinbefore, this action results in the closing of the pressure-operated valve **94** to block the firemains. Alternatively, the manual control valve **90** can be closed. The next step in recharging the system (assuming by way of example that only certain of the sprinkler heads associated with the missiles of Group A were actuated) is to first drain the sea water from both the supply line L1A and the control circuitry through the control line L2A. Lines L1A and L2A are drained through the manually operated drain valves **130** and **132**, respectively (FIG. 3). A similar draining system is provided for the supply line L1B and the control circuitry associated with control line L2B, as shown in FIG. 1. Next, the inlet supply line **95** and the check valve **96** therein are cleared of sea water through the manually operated drain valve **134**. All of the control circuitry and supply circuitry of the automatic sprinkling system of the present invention should now be free of the sea water which came into the system from the firemains during actuation of one or more of the sprinkler head control valves.

The next step in the recharging procedure is to supply all of the circuitry which was just drained with fresh water from a separate fresh water supply source. In order to supply fresh water to the control side of the circuitry one of end of a detachable hose **140** is connected to a manually operated shutoff valve **142** that is in communication with a fresh water supply line. The other end of the hose **140** is connected to a manually operated shutoff valve **144** which directs the fresh water through a filter **146** into the control line **69**. This supplies water through line **76** to control line L2A which directs the water through the restricted orifices **100** to the control circuitry for each of the control valves so as to reset these valves. Next, a pair of flexible hoses **136** are connected between manually operated shutoff valves **137** and **138** which are connected to the fresh water supply line and to the inlet supply line **95**, respectively. By this means, fresh water is supplied to the line L1A and up to each of the control valves associated with each of the sprinkler heads. Once the system has been completely recharged with fresh water, the shutoff valves **137**, **138**, **142** and **144** are closed and the hoses **136** and **140** can be detached. The system is then reset ready for actuation when one of the sensing means **55** or **28** associated with one of the missiles M1–M24 actuates the associated sprinkling head control valve in the manner aforedescribed.

With the automatic sprinkling system of the present invention it will be recognized that a true zoned sprinkling system is provided that will direct water from an overhead sprinkling system to the area where a fire is started and to the immediately adjacent areas where the fire is most likely to spread while the remainder of the sprinkler heads in the sprinkling system remain inactive. In this way, the total available water is directed to the area where it will do the most good and it will be noted that the spray area, or zone, will change in accordance with the location of the fire condition sensor that is activated. It will further be recognized that a means is provided for supplying large quantities of water immediately at the base of a combustible object such as a missile by means of a very rapidly actuated and pre-charged injection nozzle so that critical time is not lost in allowing for the heat of the ignition object to rise to actuate a conventional overhead sensor.

Although the best mode contemplated for carrying out the present invention has been herein shown and described, it will be apparent that modifications and variations may be made without departing from what is regarded to be the subject matter of the invention.

What is claimed is:

1. An automatic sprinkling system comprising a plurality of spaced sprinkling heads with each head being arranged to deliver water to a predetermined area, a control valve for each sprinkling head connected so as to control the flow of water thereto, a water supply line for supplying water to each of said control valves, control means for each control valve for actuating the valve to permit water to flow therethrough, fire condition sensing means associated with each control valve to sense the presence of a fire in the area associated therewith for operating the associated control means so as to permit flow through the sprinkler head which delivers water to the area with a fire condition and for simultaneously operating the control means associated with each adjacent area to deliver water to each area immediately adjacent to the area with a fire condition and to no other area without the actuation of further fire condition sensing means.

2. An automatic sprinkling system according to claim **1** wherein each of said control valves comprise a differential pressure valve which is hydraulically controlled through the pressure in a hydraulic control line and wherein each of said control means comprises said hydraulic control line, a trigger valve for relieving pressure in said hydraulic control line, means connecting said fire condition sensing means to said trigger valve to open the trigger valve upon the actuation of the sensing means, and at least a pair of secondary valves hydraulically connecting said trigger valve with each of the hydraulic control lines associated with the control valves of the sprinkling heads of the said immediately adjacent areas.

3. An automatic sprinkling system according to claim **2** wherein both said trigger valve and said secondary valves comprise check valves.

4. An automatic sprinkling system according to claim **1** wherein said fire condition sensing means comprises a pressure actuated sensor positioned beneath a combustible object located in the area associated therewith.

5. An automatic sprinkling system according to claim **1** wherein said fire condition sensing means comprises a heat actuated sensing means located at an elevated position in the area associated therewith.

6. An automatic sprinkling system according to claim 1 wherein said fire condition sensing means comprises both a heat actuated sensing means located in an elevated position in the area associated therewith and a pressure actuated sensing means positioned beneath a combustible object in said area associated therewith.

7. An automatic sprinkling system according to claim 2 including a control tank charged too a predetermined pressure, a primary control line connecting each of said hydraulic control lines to said control tank, and means providing communication between said primary control line and said water supply line.

8. An automatic sprinkling system according to claim 7 including a check valve in said water supply line allowing water to be delivered thereto at a pressure which is less than said predetermined pressure after the actuation of one of said fire condition sensing means.

9. An automatic sprinkling system according to claim 7 including means for simultaneously relieving the pressure in each of said hydraulic control lines for actuating all of said control valves and the sprinkler heads connected thereto.

10. An automatic sprinkling system for providing continuous sprinkling to an area which includes a plurality of combustible objects located at predetermined spaced positions, a water supply line for supplying water to each of said positions, a plurality of injector nozzles positioned beneath each of said objects and connected to said water supply line to deliver water therefrom to the lowermost surfaces of said objects, a pressure responsive member operatively associated with each of said nozzles to normally prevent the passage of water therethrough but which is arranged to be moved under the pressure of flames or expanding gases emanating from the associated combustible object to open said nozzle, hydraulic means connecting each of said pressure responsive members to an overlying sprinkling system, said sprinkling system being provided with a plurality of sprinkling heads arranged so as to overlie each of said combustible objects, and control means operable through the actuation of one of said hydraulic means to provide automatic sprinkling to the combustible object associated with said hydraulic means and to the combustible objects in said area which are immediately adjacent to said combustible object associated with said hydraulic means.

11. An automatic sprinkling system for providing continuous sprinkling to an area which includes a plurality of combustible objects located at predetermined spaced positions, a water supply line for supplying water to each of said positions, a plurality of injector nozzles positioned beneath each of said objects and connected to said water supply line to deliver water therefrom to the lowermost surfaces of said objects, a pressure responsive member operatively associated with each of said nozzles to normally prevent the passage of water therethrough but which is arranged to be moved under the pressure of flames or expanding gases emanating from the associated combustible object to open said nozzle, a sprinkling head overlying each of said combustible objects, a control valve operatively associated with each sprinkling head to control the flow of water thereto, a hydraulic control line connecting the pressure responsive member and the control valve associated with each of said combustible objects, and means operatively associated with each of said pressure responsive members for relieving the pressure in the associated hydraulic line to open the control valve and permit the flow of water through said sprinkling head.

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