

Aug. 6, 1963

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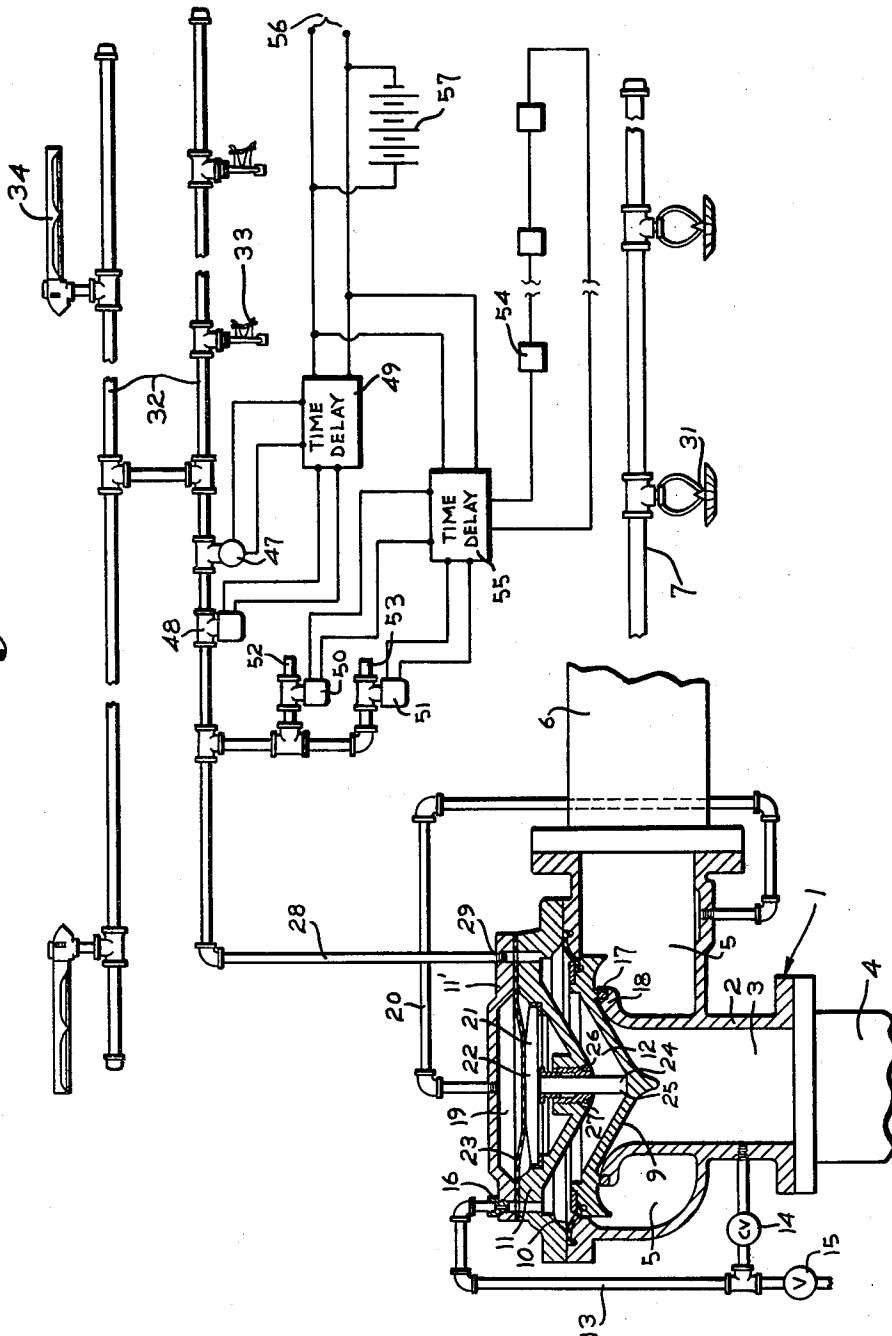
3,100,017

FIRE SPRINKLER CONTROL SYSTEM

Filed Sept. 27, 1962

3 Sheets-Sheet 1

Fig. 1.



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3 Sheets-Sheet 2

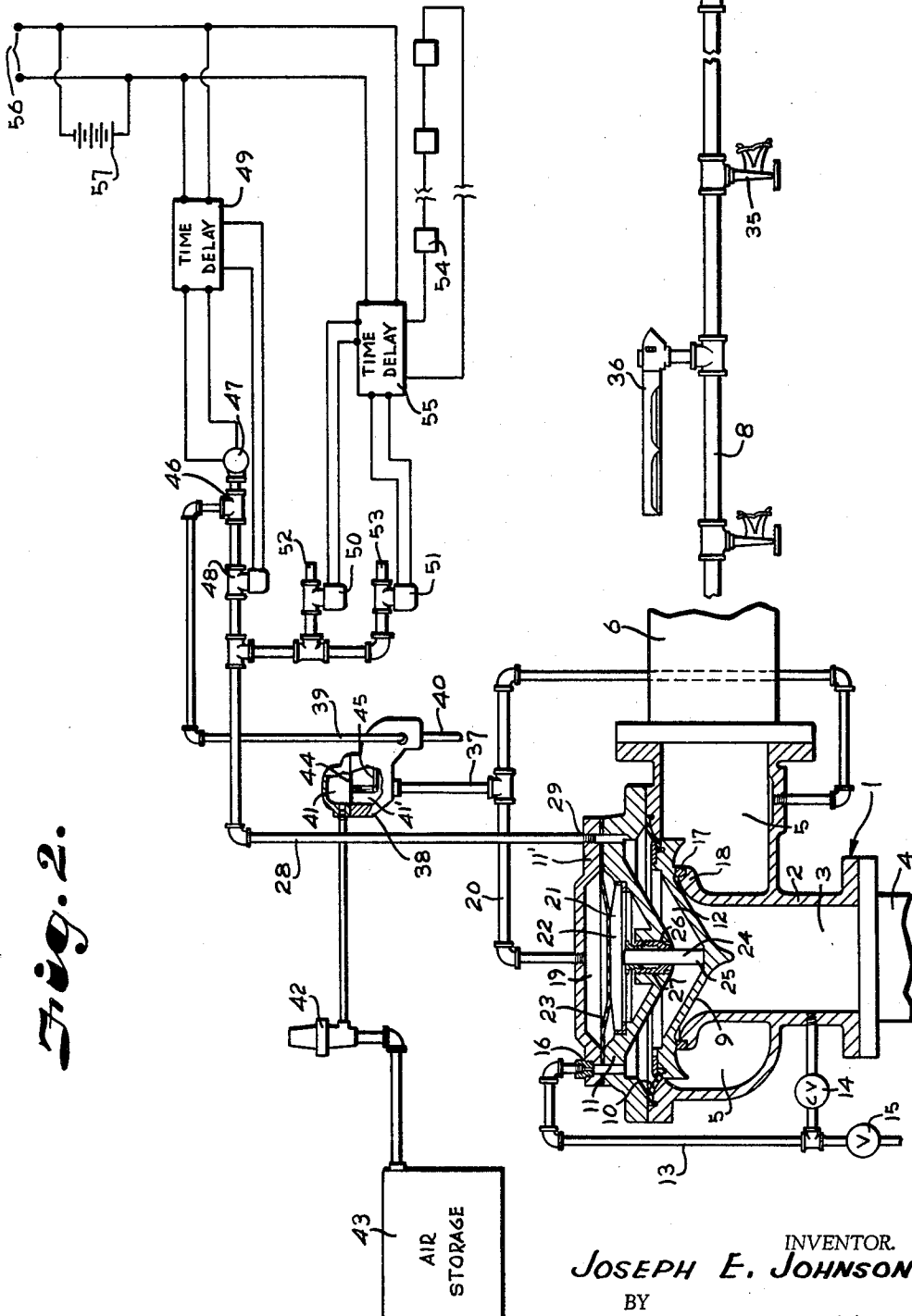


Fig. 2.

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3 Sheets-Sheet 3

Fig. 4.

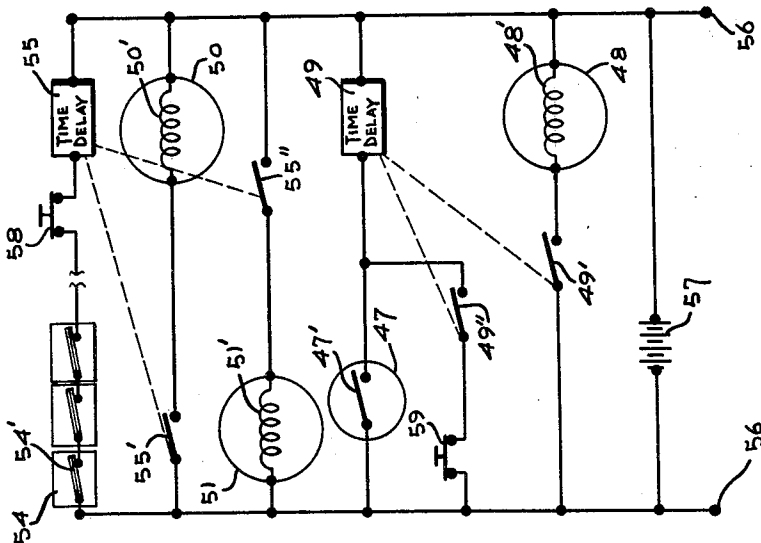
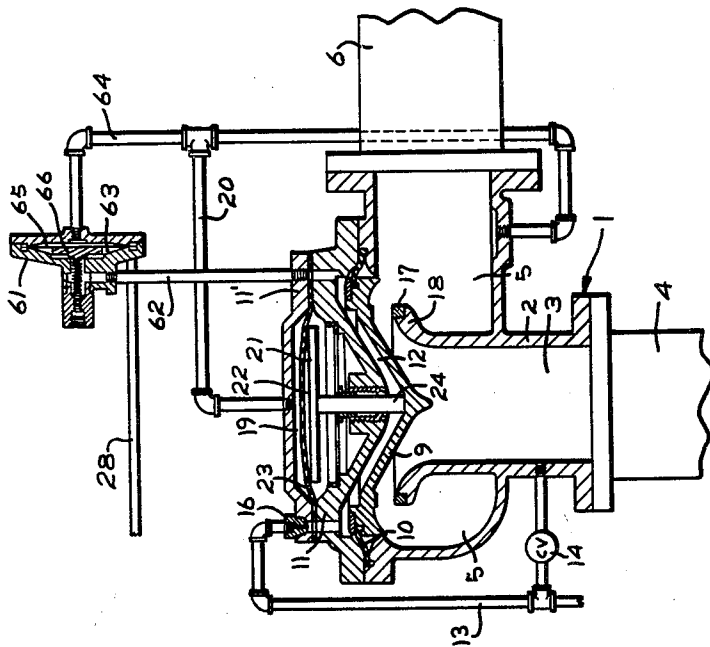


Fig. 3.



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3,100,017

FIRE SPRINKLER CONTROL SYSTEM

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9 Claims. (Cl. 169-17)

This invention relates to fire extinguishing systems and more particularly to improvements in apparatus for the automatic control of fire extinguishing fluid flow through distributor pipes.

There are three broad classes of fire extinguishing systems often referred to respectively as the "wet pipe" system, the "dry pipe" system and the "empty pipe" system. In the usual wet pipe systems water or a water-antifreeze mixture is carried in distributor pipes under supply line pressure until one or more sprinkler heads on the pipes are opened, for example, by fusing. This causes a flow in the system for discharge through the head. An automatic valve opening is often accompanied by the flow for initiating an alarm.

In common dry pipe systems no water is carried in the distributor pipes until one or more of the sprinkler heads are opened, the flow path through a main valve into the distributor being sealed off by air pressure in the distributor system bearing against a pressure sensitive clapper in the main valve. When a sprinkler head opens the air in the system escapes causing pressure to drop to a point where the clapper opens for flooding the distributor pipes with fire extinguishing fluid.

In empty pipe fire extinguishing systems, the distributor pipes often contain nothing but air under normal atmospheric pressure and may employ, in contrast to the wet and dry pipe systems described above, unobstructed or open sprinkler heads. In some instances, empty pipe systems carry closed heads whereby a slight air pressure may be maintained in the distributor pipes for supervision and/or to restrict fluid discharge to the vicinity of a fire. Triggering is often accomplished by lowering the pressure in a pilot line containing air or antifreeze solution under pressure and generally having temperature responsive valves associated therewith which operate in a similar manner to the temperature sensitive devices included in the sprinkler heads on the distribution pipes of the wet and dry pipe systems. The pilot line in many empty pipe systems contains gas and terminates in a plurality of enlarged gas filled bulbs. Triggering is then initiated by a rise in gas pressure due to bulb heating.

Various additional fire extinguishing systems have been developed which are essentially hybrids of the above described systems to overcome particular individual disadvantages thereof and many specialized control mechanisms have heretofore been used with the respective systems to provide certain refinements in operation. A serious problem or defect which has continued to exist with respect to all common types of fire extinguishing systems is that after triggering and operation manual shut-off is usually required and the manual shut-off completely deactuates the automatic features of the system. Thus, if a smoldering fire breaks out after shut-off, valuable time may be lost before manual actuation, permitting the fire to rage beyond control. Sometimes the reignited fire isolates the manual controls rendering the extinguishing system valueless to prevent total plant loss. Nevertheless, the water flow must be turned off as soon as practicable to avoid excess water damage and, where scarce, to save water. Automatic shut-off by specialized apparatus responsive to temperature or flame radiation have been suggested mainly to avoid excess water damage. Insurance and underwriting agencies have generally dis-

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approved same because they are not sufficiently reliable, they tend to shut the sprinkler off after the fire is out but still smoldering, and, as with the common systems, they offer no provision prior to complex manual resetting for automatically turning systems back on in case fire again breaks out.

The principal objects of the present invention are: to provide a highly reliable sprinkler control system which is operative to automatically turn off fire extinguishing flow but is adapted to again initiate flow in case of a re-ignition; or provide such a control system which includes time delays which continue fluid flow for a predetermined period after a signal is received that the fire is out in order to better insure against reignition but yet hold water damage to a practical minimum; to provide such a control apparatus which operates electrically but will not interfere with the usual mechanical operation of the sprinkler system in case of electrical power failure before, during or after the fire; to provide an improved control apparatus which is easily adaptable for use with wet pipe, dry pipe, empty pipe or hybrid fire extinguishing systems and which will not interfere with specialized devices refining the operation thereof; and to provide such a control system for fire extinguishing apparatus which is simple in construction and operation, low in cost and which should merit approval by even the most conservative insurance and underwriting agencies.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings, wherein are set forth by way of illustration and example certain embodiments of this invention.

FIG. 1 is a fragmentary schematic partially cross-sectional view of control apparatus embodying this invention and used on an empty pipe system.

FIG. 2 is a fragmentary schematic partially cross-sectional view of control apparatus embodying this invention and used on a wet or dry pipe system.

FIG. 3 is a fragmentary schematic partially cross-sectional main control valve shown in the open position and including a regulator for controlling output flow pressure.

FIG. 4 is a schematic wiring diagram illustrating the relationship between electrical members in an embodiment of this invention.

Referring to the drawings in more detail:

The reference numeral 1 broadly indicates a fluid actuated main control valve which may be used for controlling fluid flow into a wet pipe, dry pipe or empty pipe fire extinguishing distribution system. It is to be understood that, although the valve is shown in a single form, modifications in the relative sizes and configurations of the various parts thereof may be desirable for adaptation to the specific system involved. The valve 1 has a body 2 forming an inlet passageway 3 which is connected to a source 4 of the fire extinguishing fluid, such as water, under pressure. The body 2 also forms an outlet passageway 5 connected to the fluid input 6 of a sprinkler pipe network indicated at 7 in FIG. 1 (empty pipe system) and 8 in FIG. 2 (wet or dry pipe system). The valve 1 includes a flow controlling disk-like clapper 9 operatively located between the inlet passageway 3 and outlet passageway 5 and movably supported for axial displacement with respect to the body 2 by a flexible sealing ring 10.

The clapper 9 forms, with an intermediate wall 11 of the body 2, a main control chamber 12 which is completely isolated from the inlet passageway 3 except for a line 13 which communicates therebetween. A check valve 14 permits flow from the inlet passageway 3 through the line 13 and into the chamber 12 but prevents reverse flow.

A suitable manually operated valve 15 is provided to permit an auxiliary input of water to the line 13 for the original setting of the control valve in the usual manner.

A flow-restricting orifice member 16 is inserted between the main control chamber 12 and the line 13 to permit full line pressure to be experienced in the chamber 12 under static conditions but severely restrict the rate of inflow into the chamber 12 for creating a pressure drop therein to operate the clapper 9 as described more fully hereinafter.

The clapper 9 is normally maintained in closed position against an annular seal 17 carried on the body 2 adjacent the mouth or lip 18 of the inlet passageway 3. The clapper 9 is maintained in said closed position by the pressure in the chamber 12 caused by the bleeding in through the pipe 13 of the pressure in the inlet passageway 3 or, initially, through the manually operated valve 15. The clapper 9 is responsive to the release of pressure in the chamber 12 by rising under the force of the pressure in the inlet passageway 3 to permit flow past the lip 18 into the outlet passageway 5. The means by which the pressure is relieved in the chamber 12 will be later described.

The body 2 includes an enclosing upper wall 11' which forms an auxiliary control chamber 19 located up above and adjacent the main control chamber 12. A control flow line 20 is connected and communicates between the outlet passageway 5 and the auxiliary control chamber 19. A piston mechanism 21 includes a head 22 operatively communicating with the auxiliary control chamber 19 through a flexible diaphragm 23 which provides a seal to prevent fluid flow past the head 22 from the control chamber 19. The piston mechanism 21 also has an elongated stem 24 which at the lower end 25 thereof is separable from but is adapted to selectively about the center of the clapper 9. The stem 24 extends upwardly through suitable sealing members 26 which are threadedly engaged with the body 2 at 27 and are adapted to permit the longitudinal sliding of the stem 24.

The piston mechanism 21 is responsive to a pressure increase in the auxiliary control chamber 19 to help urge the clapper 9 toward closed position as illustrated in FIGS. 1 and 2. It is to be understood that the clapper 9 and piston head 22 only together and not separately have a total pressure exposed area sufficient to close the clapper 9. This occurs upon the introduction of inlet passageway pressure into the main control chamber 12 through the line 13 and the introduction of pressure into the auxiliary control chamber 19 caused by flow past the clapper 9 into the outlet passageway 5, which pressure is transferred to the chamber 19 through the control flow line 20. It is to be further understood that the pressure in the inlet passageway 3 which is experienced in the main control chamber 12 is alone sufficient to maintain the clapper 9 in a closed position after closure thereof. Also, a release of pressure in the main control chamber 12 is alone sufficient to permit the opening of the clapper 9 regardless of a smaller pressure which may be maintained in the outlet passageway 5 and therefore in the auxiliary control chamber 19 by air pressure used in a dry pipe system, water pressure as used in a wet pipe system or a standing water head which may be experienced under some conditions in an empty pipe system.

A release flow line 28 communicates with the main control chamber 12 at 29 and is used selectively in a manner described hereinafter for draining the chamber 12 at a faster rate than fluid can be replenished through the flow restricting member 16 for reducing the pressure in the chamber 12 to permit opening of the clapper 9.

Referring particularly to FIG. 1 which depicts one example of an empty pipe fire extinguishing system, the extinguishing fluid pipe network 7 has a plurality of spaced open sprinkler heads 31 connected in parallel relationship and adapted to simultaneously discharge a

spray of water therefrom into the protected area of a building or the like (not shown). The empty pipe system in the illustrated example has a pilot line 32 connected to the release flow line 28 and extending into the protected areas with the pipe network 7. The pilot line 32 has heat responsive normally closed release valves thereon which may be of the fusing link type as shown at 33 or the rate-of-rise type as shown at 34 or any combination of the two and/or other types of heat responsive mechanically operated release valves desired or dictated by specific conditions. The heat responsive release valves 33 and 34 are adapted to selectively open when activated by suitable environmental conditions to normally cause a pressure drop in the release flow line 28 for opening the clapper 9 which results in a fluid flow into the network input 6 and out the open sprinkler heads 31 for extinguishing a fire.

Referring to FIG. 2 a plurality of parallel connected heat responsive release valves are connected in extinguishing fluid pipe network 8 and may be of the fusing link spray head type as shown at 35 or the rate-of-rise type as shown at 36 or any combination of the two and/or other types of heat responsive mechanically operated release valves. In contrast to the empty pipe system illustrated in FIG. 1 the pipe network 8 of FIG. 2 contains liquid or air under pressure depending upon whether a wet pipe or dry pipe system is desired.

When conditions are encountered which cause an opening of one or more of the valves 35 and 36 the air or liquid contained in the network 8 bleeds therefrom causing a pressure drop in the outlet passageway 5. This pressure drop is experienced or detected in the pipe 20 and is transmitted to a pipe 37 communicating with the pipe 20. The pipe 37 in turn communicates with a suitable release device 38 which is responsive to a small drop in pressure in the pipe 37 to initiate the opening of a normally closed pipe 39 for discharging into an open or drain pipe 40.

If a dry pipe system is used the release device 38 preferably takes the form of an "accelerator" which is particularly responsive to a small drop in pressure to cause flow out of the pipe 39 long before there has been a sufficient lapse of time to significantly bleed down the pressure of the air in the outlet passageway 5, saving valuable time during which a fire could otherwise expand out of control. Such "accelerators" may be of several alternate types, however, in the illustrated example it comprises a closed chamber 41 supplied with air under constant pressure by a regulator 42 supplied by a suitable air source 43. A suitable flexible diaphragm 44, forming a portion of the chamber 41, connects with a release arm 45. The diaphragm 44 also forms a portion of a lower chamber 41' which communicates with the pipe 37. In operation, if air or liquid in the chamber 41' is lowered a predetermined amount, e.g., one p.s.i., a pressure differential is created between the chambers 41 and 41' which distends the diaphragm 44 sufficiently to move the arm 45 to a release position permitting free flow or "dumping" from the tube 39 into the tube 40. The release device 38, when once tripped, requires a manual reset before the flow path between the pipes 39 and 40 is again blocked.

The pipe 39 in FIG. 2 communicates with the release flow line 28 at 46. An actuation of one or more of the valves 35 and 36 causes a pressure drop in the outlet passageway 5 which results in flow from the pipe 39 into the pipe 40 and thereby drops the pressure in the main control chamber 12 for inducing main valve operation as noted above with respect to FIG. 1.

Referring now to the fire extinguishing systems shown in both FIGS. 1 and 2, a pressure sensitive switch 47 communicates with the release flow line 28 for sensing a drop of pressure therein signifying the opening of the clapper 9. A normally open solenoid controlled valve 48 is operatively connected in series in the release flow line

28 between the respective heat responsive release valves (33 and 34, or 35 and 36) and the main control chamber 12. It is to be understood with respect to the fire extinguishing system of FIG. 2 that the release device 38 forms a part of the operative connection between the heat responsive valves 35 and 36 and the normally open solenoid controlled valve 48. The valve 48 during electrical actuation closes to block flow and thus prevent discharge therepast from the release flow line 28.

A first time delay relay 49 described more fully hereinafter is electrically connected between the pressure switch 47 and the normally open solenoid controlled valve 48 and is of the type which is responsive, upon the sensing of a pressure drop by the pressure switch 47, to first delay for a pre-set time period and then cause the actuation (closing) of the valve 48.

Normally closed solenoid controlled valves 50 and 51 are electrically connected in parallel and are operatively connected in parallel relation on the release flow line 28 between the normally open solenoid controlled valve 48 and the main control chamber 12. The use of two valves 50 and 51, which provide duplication in function, rather than a single solenoid controlled valve is merely for the purpose of better insuring a successful operation when the needed function is called for. The normally closed valves 50 and 51, during electrical actuation, open to permit flow from the release flow line 28 out open-ended or drain pipes 52 and 53 respectively. It is noted that the valves 50 and 51 during actuation permit flow from the release flow line 28 upstream from the valve 48 to counter the effect (pressure rise in flow line 28) of a closure of the valve 48 when conditions, described hereinafter, so require.

A plurality of series connected normally closed circuit thermostats 54 are located in the areas serviced by the fluid distribution network and are adapted to selectively open at a predetermined above normal environmental temperature and close below said above normal temperature. A second time delay relay 55 is electrically connected in a manner described below between the normally closed solenoid valves 50 and 51 and the thermostats 54. The time delay relay 55 is of the type responsive upon the interruption of current flow (sensing of said above normal temperature by one or more of the thermostats 54) to immediately actuate the normally closed solenoid valves 50 and 51 to open position and maintain the actuation until the lapse of a pre-set time period following the re-establishment of current flow (closing of all the thermostats 54). The time delay relay 55 then interrupts current flow to the valves 50 and 51 causing them to return to their normally closed position whereby fluid can no longer be released from the pipe 28 through the open ended or drain pipes 52 and 53.

Electrical energy for the above described electrical components is furnished by the usual commercial or house power source indicated at 56, however, it is desirable that an auxiliary power supply schematically indicated at 57 be supplied in parallel with the house power source to operate the system for an extended period in the event of house power failure which may occur during a fire or other unusual circumstances.

Referring to the schematic wiring diagram shown in FIG. 4 the relationship between the electrical components of this invention may be more readily understood. The thermostat contacts 54' are closed below a predetermined temperature and are connected together in series with a normally closed push-button 58 and the time delay relay 55. The push-button 58 permits the testing of the time delay relay 55 without handling the thermostats which are normally at inaccessible locations. The time delay relay 55, when receiving current through the thermostat contacts 54', maintains relay contacts 55' and 55'' open which respectively interrupt circuits through the solenoid coils 50' and 51' of the solenoid controlled valves 50

and 51, maintaining the latter in their normally closed condition during monitoring. The opening of one or more of the thermostat contacts 54' causes the time delay relay 55 to close the contacts 55' and 55'' actuating the solenoid coils 50' and 51' which opens the valves 50 and 51 for dropping or maintaining the pressure in the release flow line 28 below that necessary for closure of the clapper 9. As noted above, a pre-set time delay elapses after completion of the circuit through the thermostat contacts 54' before the contacts 55' and 55'' are closed.

Normally open contacts 47' are connected in series with the time delay relay 49 and are closed when the pressure switch 47 detects a drop in pressure in the release flow line 28. The closure of the contacts 47' completes a circuit to the time delay relay 49 which, after the lapse of a pre-set time period, closes a normally open contact 49' which completes a circuit through the solenoid coil 48' of the normally open valve 48 for closing same. The current flow through the time delay relay 49 also causes an immediate closure of the normally open time delay relay contacts 49'' which bypasses the pressure switch contacts 47' for locking in the time delay relay 49. In order to reset the time delay relay 49 after actuation by the pressure switch 47, a manual normally closed reset button 59 connected in series with the contacts 49'' must be used.

The locking in of the time delay relay 49 results in the closing of the release flow line 28 upstream from the heat responsive release valves 33 or 34 (35 or 36) to permit an increase in pressure in the main control chamber 12 when the valves 50 and 51 are closed even though the release valves 33 or 34 (35 or 36) remain open.

The operation of the invention is as follows: During normal monitoring all the heat responsive release valves 33 or 34 (35 or 36) are closed, the solenoid valves 50 and 51 are closed, the solenoid valve 48 is open and the contacts 47' of the pressure switch 47 are held open by the pressure in the release flow line 28 communicating with the pressure in the main control chamber 12 which holds the clapper 9 in closed position. If a fire originates, the heat thereof causes an actuation of one or several of the heat responsive release valves or an opening of one or more of the thermostats 54 or both. If the former occurs, pressure is released through the heat responsive release valves, resulting in a rapid flow through the release flow line 28 past the release valves causing the clapper 9 to open and flood the fire extinguishing distribution system. If the latter occurs, fluid flows from the release flow line 28 out the open or drain pipes 52 and 53 and the same opening of the clapper 9 occurs. It is noted with regard to the wet or dry pipe system of FIG. 2 that no fire extinguishing fluid will be sprayed until at least one of the heat responsive release valves 35 or 36 actually opens, however, significant time may be saved in having the clapper 9 open and under line pressure prior to the actual call for liquid as signified by a release valve operation. When a drop in pressure in the release flow line 28 occurs, the pressure switch 47 energizes the time delay relay 49 which, after a pre-set time period during which fire extinguishing fluid is able to freely flow into the affected area, causes the valve 48 to close and remain closed. If the solenoid valves 50 and 51 have not been opened, or have been permitted to reclose after opening, flow through the release flow line 28 will then be stopped and pressure will build up in the main control chamber 12 which, when augmented by the pressure of the piston stem 24 against the clapper 9, will result in a closure of the main control valve 1. Should the fire not be out when the valve 48 closes, one or more of the thermostats 54 will remain open and only after a pre-set delay period for quenching flow following the closure of all the thermostats 54 will the solenoid valves 50 and 51 close to permit the closure of the main valve 1. If the sprinkler system is shut off by closure of the valves 48, 50 and 51 and a smoldering fire again ignites, one or more of the thermostats 54 will again open

resulting in an opening of the valves 50 and 51 which causes the opening of the main valve 1. This cycle is repeatable and automatically occurs as many times as is necessary for completely extinguishing the fire. If an electrical power failure occurs, the normally open solenoid controlled valve 48 opens and remains open to prevent sprinkler system shut-off except by conventional manual means (not shown).

It is noted that the use of the above described control system will result in rapid reliable actuation of the sprinklers and yet automatically initiate shut-off and subsequent cycling to minimize damage by either re-ignition or excess extinguishing fluid. It is further noted that the system is fail-safe and even in case of the remote possibility of a complete power failure before, during or after a fire, the system reverts to the same operation common prior hereto.

Referring to FIG. 3, there is illustrated the main control valve 1 with the clapper 9 in open position. Also in FIG. 3, there is illustrated the use of a pressure regulating valve 61 with the main control valve 1 for the purpose of controlling the pressure in the outlet passageway 5 during flow. In the embodiment of FIG. 3, the release flow line 28 will communicate with the valves 48, 50 and 51 in the same manner as illustrated in FIGS. 1 and 2, however, instead of opening directly into the main control chamber 12, the release flow line communicates with the pressure regulating valve 61. A release in pressure in the release flow line 28 in a manner described above causes a flow from the main control chamber 12 through a pipe 62 communicating between the chamber 12 and valve 61 and through a passageway 63 in the valve 61 and out through the flow line 28. A line 64 communicates between the control flow line 20 and the valve 61, the fluid flow in the line 64 being separated from the passageway 63 by a flexible diaphragm 65. When the pressure in the outlet passageway 5 reaches a predetermined amount, the diaphragm 65 displaces a spring-urged plug 66 into a position for restricting the flow between the pipe 62 and release flow line 28 which results in an increase of pressure in the main control chamber 12 reducing the quantity of fluid flowing through the outlet passageway 5 and thereby reducing pressure therein. An excessively reduced pressure in the outlet passageway 5 is sensed by the diaphragm 65 for again increasing flow in the line 28 which causes pressure to decrease in the main control chamber 12. Thus the pressure in the outlet passageway 5 may be regulated when flow is called for and the regulation thereof receives no functional interference from the above described valves 48, 50 and 51 located downstream on the release flow line 28.

It is to be understood that while certain forms of this invention have been illustrated and described, it is not to be limited to the specific forms or arrangement of parts herein described and shown except insofar as such limitations are included in the claims.

What I claim and desire to secure by Letters Patent is:

1. In a fire extinguishing system including a fluid actuated main control valve having a body forming an inlet passageway connected to a source of fluid under pressure and an outlet passageway connected to a sprinkler network and an operating portion, said main control valve being responsive in opening and closing operation to a respective decrease and increase of fluid pressure in said operating portion thereof;

(a) means for normally maintaining a pressure in said operating portion sufficient to maintain said main control valve closed,

(b) a normally closed release flow line communicating with said operating portion and adapted to reduce the pressure in said operating portion to open said main control valve in the event of flow through said release flow line,

(c) single operation heat responsive release means as-

sociated with said release flow line for permitting flow through said release flow line,

(d) means communicating with said release flow line for sensing a pressure drop signifying the opening of said main control valve,

(e) a normally open valve operatively connected in series in said release flow line between said heat responsive release means and said operating portion and adapted while closed to block flow past said normally open valve,

(f) means operatively connecting said pressure sensing means and said normally open valve and responsive upon the sensing of a pressure drop by said pressure sensing means to delay for a pre-set time period and then cause the closing of said normally open valve,

(g) a normally closed valve operatively connected in parallel to said release flow line between said normally open valve and said operating portion and being adapted while open to permit main control valve opening flow from said release flow line upstream from said normally open valve, and

(h) heat sensing means operatively connected to said normally closed valve and adapted to open said normally closed valve above a predetermined temperature and close said normally closed valve below said predetermined temperature,

(i) whereby after fire extinguishing flow caused by said heat responsive release means said main control valve is automatically reclosed after a predetermined time period to limit fluid damage unless the temperature remains sufficiently high for actuating said heat sensing means, and said main control valve is automatically reopened after being reclosed in case of a reignition after the temperature has been lowered.

2. The system of claim 1 wherein;

(a) said means for normally maintaining a pressure in said operating portion is a restricted line communicating with said inlet passageway.

3. The system of claim 1 wherein;

(a) said heat responsive release means are fusible link controlled valves.

4. The system of claim 1 including;

(a) means for delaying the closing of said normally closed valve after said heat sensing means signals for closing thereof to permit additional fire extinguishing flow.

5. In a fire extinguishing system including a fluid actuated main control valve having a body forming an inlet passageway connected to a source of fluid under pressure and an outlet passageway connected to a sprinkler network and an operating portion, said main control valve being responsive in opening and closing operation to a respective decrease and increase of fluid pressure in said operating portion thereof;

(a) a restricted flow line connected between said main control valve inlet passageway and said operating portion for normally maintaining said main control valve closed,

(b) a normally closed release flow line communicating with said operating portion,

(c) a plurality of parallel connected single operation heat responsive release valves operatively associated with said release flow line and adapted to selectively open to permit a fluid flow in said release flow line sufficient to normally cause a pressure drop in said operating portion for opening said main control valve,

(d) a source of electrical current,

(e) a pressure switch communicating with said release flow line and said current source and adapted to produce an electrical signal upon sensing a pressure drop signifying the opening of said main control valve,

(f) a normally open solenoid controlled valve operatively connected in series in said release flow line between said heat responsive release valves and said

- operating portion and being adapted only while electrically actuated to close and block flow downstream therefrom in said release flow line,
- (g) a first time delay relay electrically connected between said pressure switch and said normally open solenoid controlled valve, said first time delay relay being responsive upon the sensing of a pressure drop by said pressure switch to delay for a pre-set time period and then cause the closing of said normally open solenoid controlled valve,
- (h) at least one normally closed solenoid controlled valve operatively connected in parallel to said release flow line between said normally open solenoid controlled valve and said operating portion and being adapted only while electrically actuated to open and permit a fluid flow from said release flow line upstream from said normally open solenoid controlled valve sufficient to cause a pressure drop in said operating portion for opening said main control valve,
- (i) at least one normally closed circuit thermostat connected with said current source and adapted to open at a predetermined above normal temperature and close below said above normal temperature, and
- (j) a second time delay relay electrically connected between said normally closed solenoid controlled valve and said thermostat, said second time delay relay being responsive upon the sensing of said above normal temperature by said thermostat to immediately open said normally closed solenoid controlled valve and maintain same open for a pre-set time period following the closing of said thermostat and then permit the reclosing of said normally closed solenoid controlled valve,
- (k) whereby after fire extinguishing flow said main control valve is automatically reclosed after a predetermined time period to limit fluid damage unless the temperature remains sufficiently high for opening said thermostat, and said main control valve is automatically reopened after being reclosed in case of a reignition and remains open a predetermined period after the temperature has been lowered sufficiently for closing said thermostat.
6. The system of claim 5 including;
- (a) a plurality of said thermostats, said plurality of thermostats being series connected.
7. The system of claim 5 wherein;
- (a) said heat responsive release valves are controlled by fusible links.
8. In a fire extinguishing system including a fluid actuated main control valve having a body forming an inlet passageway connected to a source of fluid under pressure and an outlet passageway connected to a sprinkler network;
- (a) a flow controlling clapper operatively located between said inlet and outlet passageways and forming with said body a main control chamber, a restricted flow line connected between said main control valve inlet passageway and said main control chamber, said clapper being normally maintained in closed position by the inlet pressure in said main control chamber, said clapper being responsive in opening operation to the relief of pressure in said main control chamber,
- (b) said body forming an auxiliary control chamber located adjacent said main control chamber, a control flow line connected between said outlet passageway and said auxiliary control chamber, a piston mechanism having a head operatively communicating with said auxiliary control chamber and a stem engaging said clapper, said piston mechanism being responsive to a pressure increase in said auxiliary control chamber to urge said clapper toward said closed position, said clapper and piston head only together having a total pressure responsive area to close said clapper upon the introduction of inlet pas-

- sageway pressure into said main control chamber and the introduction of pressure into said auxiliary control chamber caused by flow past said clapper into said outlet passageway, the inlet passageway pressure in said main control chamber being alone sufficient to maintain said clapper in a closed position after closure thereof,
- (c) a normally closed release flow line communicating with said main control chamber,
- (d) a plurality of parallel connected single operation heat responsive release valves operatively associated with said release flow line and adapted to selectively open to normally cause a pressure drop in said release flow line in the event of fire for opening said clapper,
- (e) a pressure switch communicating with said release flow line for sensing a drop of pressure signifying the opening of said clapper,
- (f) a normally open solenoid controlled valve operatively connected in series in said release flow line between said heat responsive release valves and said main control chamber and being adapted while closed to block flow in said release flow line upstream from said normally open solenoid controlled valve,
- (g) a first time delay relay operatively connected between said pressure switch and said normally open solenoid controlled valve, said first time delay relay being responsive upon the sensing of a pressure drop by said pressure switch to delay for a pre-set time period and then cause the closing of said normally closed solenoid controlled valve,
- (h) a normally closed solenoid controlled valve operatively connected in parallel to said release flow line between said normally open solenoid controlled valve and said main control chamber and being adapted while open to permit flow from said release flow line upstream from said normally open solenoid controlled valve,
- (i) a plurality of series connected normally closed circuit thermostats adapted to selectively open at a predetermined above normal temperature and close below said above normal temperature, and
- (j) a second time delay relay connected between said normally closed solenoid controlled valve and said thermostats, said second time delay relay being responsive upon the sensing of said above normal temperature by one or more of said thermostats to immediately open said normally closed solenoid controlled valve and maintain said latter valve open for a pre-set time period following the closing of all of said thermostats and then cause the closure of said normally closed solenoid controlled valve,
- (k) whereby after fire extinguishing flow said main control valve is automatically reclosed after a predetermined time period to limit fluid damage unless the temperature remains sufficiently high for actuating one or more of said thermostats, and said main control valve is automatically reopened in case of a reignition and remains open a predetermined time period after the temperature has lowered sufficiently for closing all of said thermostats.
9. In a fire extinguishing system including a fluid actuated main control valve having a body forming an inlet passageway connected to a source of fluid under pressure and an outlet passageway connected to a sprinkler network and an operating portion, said main control valve being responsive in opening operation to a decrease of fluid pressure in said operating portion;
- (a) means for normally maintaining a pressure in said operating portion sufficient to maintain said main control valve closed,
- (b) a normally closed release flow line communicating with said operating portion and adapted to reduce the pressure in said operating portion to open said

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- main control valve in the event of flow through said release flow line,
- (c) single operation heat responsive release means associated with said release flow line for permitting flow through said release flow line, 5
- (d) means for sensing the opening of said main control valve,
- (e) means for closing said main control valve,
- (f) means operatively connecting said sensing means and said means for closing said main control valve and responsive upon the sensing of the opening of said main control valve to delay for a pre-set time period and then cause the closing of said main control valve, 10
- (g) means for selectively overriding the closing of said main control valve, and
- (h) heat sensing means operatively connected to said overriding means and adapted to cause said over-

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- riding means to open said main control valve above a predetermined temperature and close said main control valve below said predetermined temperature,
- (i) whereby after fire extinguishing flow caused by said heat responsive release means said main control valve is automatically reclosed after a predetermined time period to limit fluid damage unless the temperature remains sufficiently high for actuating said heat sensing means, and said main control valve is automatically reopened after being reclosed in case of a reignition after the temperature has been lowered.

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