Jan. 9, 1951 F. B. ALLEN ET AL 2,537,009

DELAYED ACTION FIRE EXTINGUISHING SYSTEM

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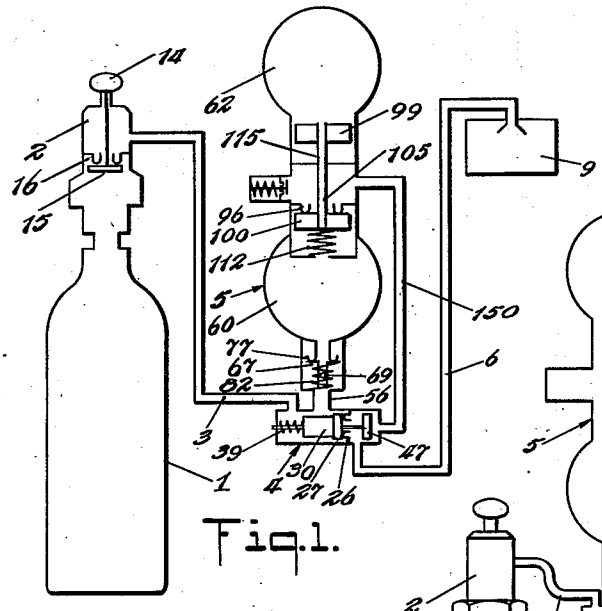


Fig. 1.

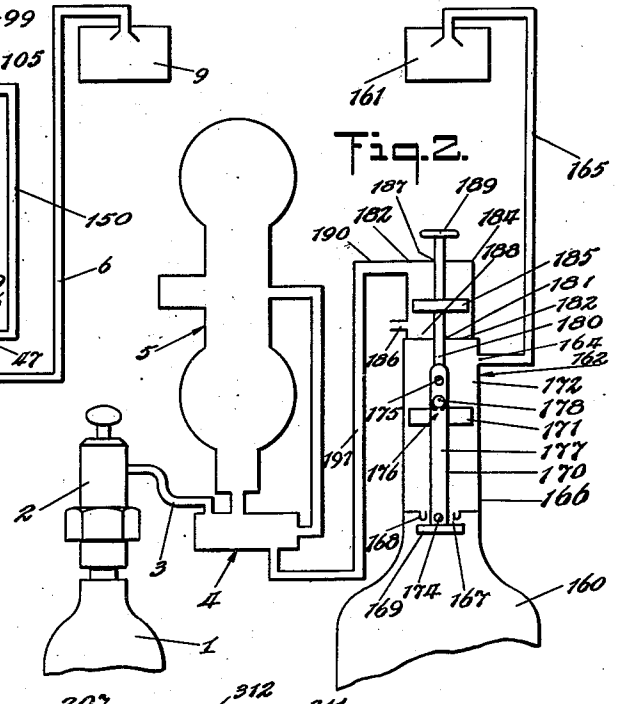


Fig. 2.

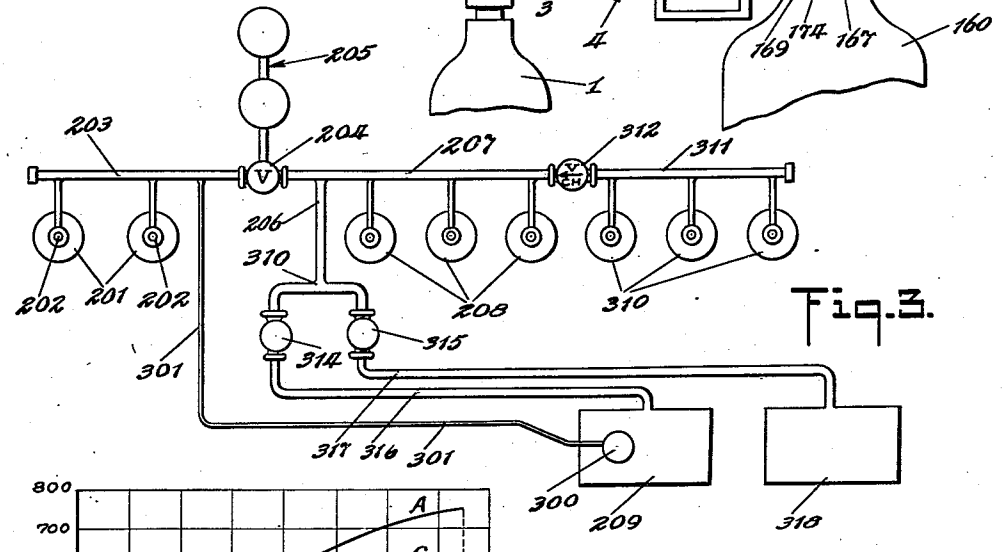


Fig. 3.

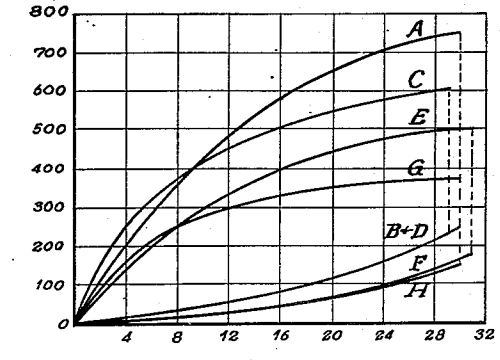


Fig. 4.

INVENTORS
FRANK B. ALLEN
NORMAN H. SIEBENS
BY Edward T. Connors

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DELAYED ACTION FIRE EXTINGUISHING SYSTEM

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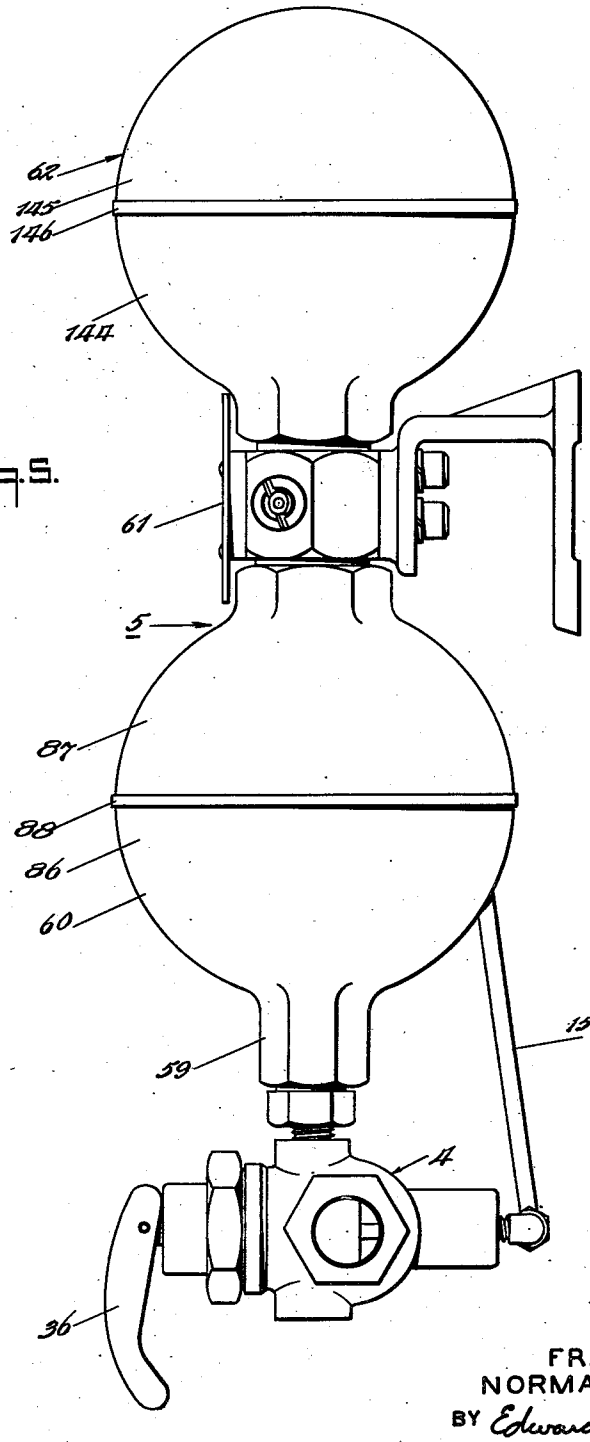


Fig. 5.

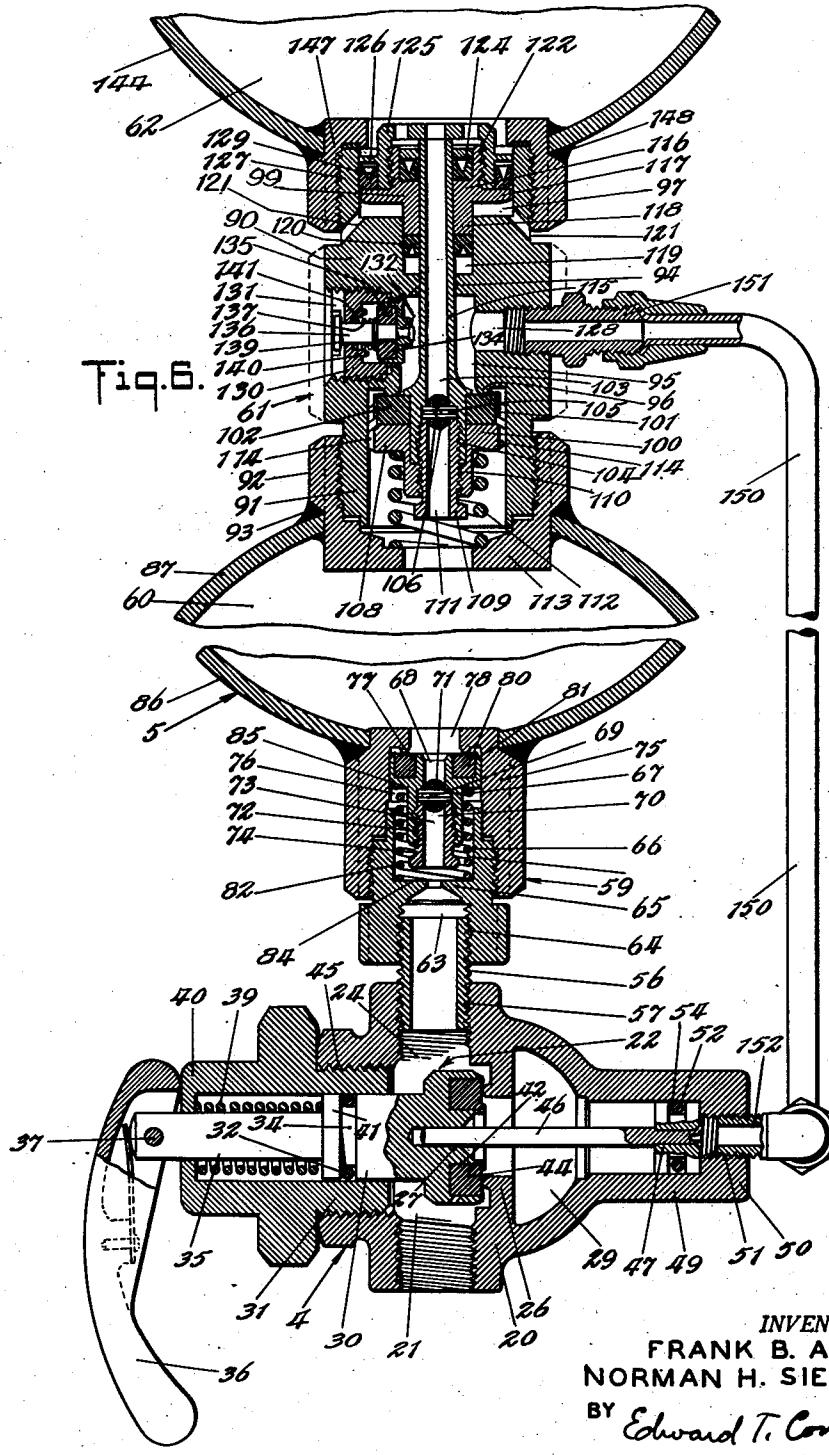
INVENTORS
FRANK B. ALLEN
NORMAN H. SIEBENS
BY Edward T. Connors

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DELAYED ACTION FIRE EXTINGUISHING SYSTEM

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Fig. 6.



INVENTORS
FRANK B. ALLEN
NORMAN H. SIEBENS
BY Edward T. Connors

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DELAYED ACTION FIRE-EXTINGUISHING SYSTEM

Frank B. Allen, Verona, and Norman Harry Siebens, Cedar Grove, N. J., assignors to C-O-Two Fire Equipment Company, Newark, N. J., a corporation of Delaware

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17 Claims. (Cl. 169—9)

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The present invention relates to improvements in fire extinguishing systems in which the discharge of the fire extinguishing fluid into a space to be protected is delayed for a predetermined time interval after the system is operated.

The system is used to flood an enclosure with a fire extinguishing fluid to provide an atmosphere incapable of supporting combustion and thus extinguishing the fire. The enclosure may be occupied and thus it is advisable to provide a delayed discharge of the fluid to allow time for a warning signal to be given and to enable the occupants of the enclosure to escape. In other cases it is advisable to withhold the discharge of the fluid until sufficient time has elapsed for ventilating fans to be shut off and for ventilating doors or the like to be closed so that the fire extinguishing fluid will be retained within the enclosure.

Heretofore, in some cases time delay systems have been provided including moving parts which have not operated effectively under adverse conditions of temperature. In other cases friction has developed due to dust accumulation resulting in a wide variation in the operating time of the system. Other systems have depended for their proper operation upon the venting of air from a bellows which, in turn, has operated linkage actuated valves for the release of the fire extinguishing fluid. Such devices have not been altogether satisfactory because the devices often get out of adjustment and thus the time interval varies considerably.

The present invention aims to overcome the disadvantages of prior devices by providing a time delay system having no external operating parts and which depends for its operation on fluid pressure.

Another object of the invention is to provide a fire extinguishing apparatus including means actuable by the fluid to delay the discharge thereof for a predetermined time.

A further object of the invention is to provide a fire extinguishing apparatus in which the time interval of a delayed discharge may be easily set and which remains constantly in adjustment during use.

Another object of the invention is to provide a time delay device including means for the automatic resetting thereof after an actuation thereof.

Another object of the invention is to provide a time delay device which is simple in construction, reliable in operation and rugged in use.

In accordance with the invention the foregoing objects are accomplished by providing a fire extinguishing system in which fluid is caused to flow through one chamber into another chamber, a time interval being required for the pressure in the second chamber to reach a value at which it overbalances a force depending upon the pressure in the first chamber and actuates means to release the fire extinguishing fluid.

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An apparatus in accordance with the invention is advantageous in that the length of a set time interval is not affected by changes of temperature within the range in which the apparatus is used. The apparatus may be operated by various types of fluid medium and when operated by non-condensible gases it may be mounted in any position without affecting the accuracy of the time interval.

Other objects and advantages of the invention will be apparent from the following description and from the accompanying drawings which show by way of example embodiments of the invention.

In the drawings:

Fig. 1 is a schematic view of a delayed action fire extinguishing system in accordance with the invention.

Fig. 2 is a schematic view of a system similar to that shown in Fig. 1 which has been modified for remote operation.

Fig. 3 is a diagrammatic view of a typical application of the invention.

Fig. 4 is a curve illustrating the relation of the operating time to pressure in the chambers of a device in accordance with the invention.

Fig. 5 is an elevational view of a time delay device in accordance with the invention.

Fig. 6 is a sectional elevational view of the device shown in Fig. 5.

Referring to Fig. 1 of the drawings there is shown a schematic view of a fire extinguishing system in accordance with the invention. The system comprises generally a container 1 adapted to retain a fluid under pressure, a valve 2 to releasably retain the fluid in the container, a fluid passage or conduit 3 to lead the discharged fluid from the container to a valve 4 adapted to close the passage against the discharge of the fluid, a time delay device 5 to release fluid to open the valve 4 at the end of a predetermined time interval, and a conduit 6 to conduct the fluid to an enclosure 9 illustrated reduced in size.

The container 1 is of the usual type for storing fire extinguishing fluid under pressure such as nitrogen, carbon dioxide or any other compressible fire extinguishing fluid medium. The valve 2 is of the usual type for releasing high pressure fluid and is shown as arranged to release the fluid by

turning a handle 14 on the top thereof unseating a valve member 15 from a set 16 releasing the fluid through conduit 3 to the time delay device 5.

The valve 4 is adapted to restrain the flow of fluid from conduit 3 to the enclosure 9 until the end of a predetermined time interval. The valve is shown in detail in Fig. 6 and comprises a body 20, an inlet 21 for fluid released from the container 1, a valve chamber 22 in fluid communication with the inlet 21, an outlet 24 to lead fluid from the valve chamber 22 to the time delay device 5. The valve also includes a valve seat 26 and a valve member 27 seating thereon and adapted to releasably close the fluid passage from the chamber 22 to an outlet 29 which is provided with a threaded portion (not shown) for connection to conduit 6.

The valve member 27 is slideably mounted in the valve chamber 22 by its piston extension 30 adapted to be received in and reciprocate in a cylindrical portion 31 of the valve body 20. An O-ring seal 32 is carried in a groove 34 in the wall of the piston extension 30 to provide a fluid tight seal between the valve chamber 22 and the atmosphere. The valve member 27 is provided with means for manual operation by a valve rod 35 attached to, or forming part of the cylindrical extension 30. A manual operating handle 36 is pivotally mounted on a pin 37 extending through the valve rod 35. In order that the valve member 27 will be normally seated a compression spring 39 is placed around the valve rod 35 and compressed between the inside of a valve cap 40 and end 41 of the piston 30. To provide a fluid-tight seat for the valve member 27 with its seat 26, a recess 42 is formed in the face of the valve member adapted to receive a seat material 44 such as nylon or the like. To facilitate manufacture the valve cap 40 and the body 20 are shown as made separately and assembled by means of a threaded connection 45.

Means for operating the valve member 27 by fluid pressure comprises a push rod 46 having one end received in an elongated recess in the valve member, the push rod forming an extension of a piston 47 adapted to reciprocate in a cylinder 49 formed in end 50 of the body 20. Fluid may be admitted to the cylinder 49 through an inlet 51. The piston is made fluid-tight by an O-ring gasket 52 received in a groove 54 in the wall thereof. The diameter of piston extension 30 is made slightly greater than the diameter of the seat 26 so that the effects of the spring 39 and the pressure in chamber 22 tending to seat the valve member 27 will be counteracted and the valve member 27 easily unseated by pressure on the piston 47 in the cylinder 49. After the valve member 27 is unseated, pressure acts on its outlet side holding it off its seat until all of the fluid has been discharged from the system, after which the valve is reset in the closed position by the action of the spring 39.

The time delay device 5 is adapted to open the valve 4 at the end of a predetermined time interval and is actuated by the pressure of fluid released from container 1 passing through the housing of valve 4 into the device from the inlet side of the valve member 27. The device 5 receives the fluid through a pipe connection 56 positioned in the threaded end 57 of the outlet 24 of the valve 4. The device comprises a lower body portion 59, a storage means or chamber 60, an upper body portion 61, and a second storage means or chamber 62.

The lower body portion 59 is provided with an inlet 63 having a threaded surface 64 for engagement with the pipe connection 56. Inlet 63 is narrowed at its upper end to provide a shoulder 65 and is thereafter enlarged to provide a chamber 66 adapted to receive a valve member 67. The valve member 67 has a passage 68 extending therethrough. An orifice disc 69 is positioned in an enlarged portion 70 of the passage 68. The orifice 69 is protected against obstructions blocking its opening by strainers 71 of hemispherical shape positioned on either side thereof. A threaded member 72 having a passage 73 therethrough supports the orifice disc 69 with the strainers 71 in the enlarged portion 70 of the passage. A second portion 75 of body 59 is formed with a passage 76 extending therethrough. A seat 77 is positioned adjacent an outlet 78 for the passage of fluid from the body to the chamber 60. Valve member 67 is made with a somewhat smaller diameter than the diameter of passage 76 in which it is positioned in order that fluid medium may pass between the wall of the passage and the valve member when it is in the open position. The valve member 67 is adapted to engage with the seat 77, and in order to provide a fluid-tight seat, a seating material 80 is positioned in a recess 81 in the face of the valve member. The valve member 67 is normally urged against seat 77 by a light spring 82 positioned about the valve member and engaged between the shoulder 65 of body 59 and an annular wall 85 of the valve member. The upper portion 75 of the body member 59 acts as a support for the wall of chamber 60 which may be welded or otherwise attached thereto.

The chamber 60 is adapted to receive fluid restricted in flow by the orifice disc 69 and is shown as made spherical in shape for economy of material in the manufacture thereof. The sphere may be formed with a lower portion 86 and an upper portion 87 which are shown as welded together at joint 88.

The upper body portion 61 serves to support chamber 62 and provides a fluid passage between the fluid chambers. The upper body portion also acts as a housing for a pressure operable valve responsive to the relationship of the pressures in chambers 60 and 62, the valve being adapted to release fluid stored in chamber 60. The upper body portion 61 is formed of a central member 90 having a passageway extending therethrough and is shown as provided with a threaded end 91 adapted to be received in a fitting 92 shown as attached to the top portion 87 of chamber 60 by a welded joint 93 or the like. The body 90 has a bore 94 extending therethrough having a center or chamber portion 95 encircled at its inlet end by a valve seat 96 and having an enlarged portion 97 at its upper end adapted to receive a piston member 99. A valve member 100 is adapted to engage with the seat 96. The valve member 100 is provided with a recess 101 on its face adapted to receive a seat material 102 to provide a fluid-tight seal between the valve member and its seat. The valve member 100 is also provided with a bore 103 in an enlarged portion 104 of which is positioned an orifice member 105 protected against obstructions blocking the opening therein by hemi-spherical screens 106. The screens and orifice are held in position by a plug 109 which is shown as provided with a threaded connection 110 with a threaded inner surface of bore 104. The plug has a passage 111 extending therethrough to lead fluid to the orifice 105. In order that the valve member 100 may be normally held against its seat, a light spring 112

is positioned about the lower end thereof engaging between end wall 113 of fitting 92 and a shoulder 108 of the valve member. Fluid pressure may pass between the wall of bore 94 and the valve member 100 through longitudinally extending slots 114 in the shoulder 108 of the valve member. The valve member 100 is adapted to be opened by fluid pressure in chamber 62 acting against the surface of piston 99. The valve member 100 has a hollow tubular extension 115 adapted to provide means for actuation of the valve member by the piston 99. The piston is shown with a base portion 116 having an annular wall 117 and a reduced portion 118. The tubular extension 115 extends upwardly through the passage 94 and the base portion 116 of the piston from the valve member 100. The reduced end 118 of the piston is adapted to slide in an enlarged portion 119 of the bore 94. A gasket 120 provides a fluid-tight seal between chamber 95 and the underside of the piston 99 which is open to the atmosphere by vents 121. Base portion 116 is also provided with an upwardly extending cylindrical portion 122 adapted to receive a gasket 124 between its inner wall and the outer wall of tubular extension 115. The outer surface of cylindrical portion 122 is shown as threaded to receive an apertured cap member 125 having an annular flange 126. The piston 99 is adapted to reciprocate in a cylinder 127 formed in the upper end of body 90. A gasket 129 seals the piston against fluid leakage while the annular flange 126 slides against the surface of the cylinder wall 127 guiding the piston in its movement. The area of the operating surface of piston 99 is made larger than the area of the fluid passage closed by valve member 100 in order that a predetermined relationship of pressures in chambers 60 and 62 will cause the piston to move the valve member from its seat against the pressure on the valve member from chamber 60 and from spring 112. Fluid is thus released from chamber 60 through chamber 95 to an outlet 128.

To provide for a possible slow leak past valve seat 96 resulting in fluid entering chamber 95 during the delay interval, means are provided for discharging the fluid to the atmosphere without permitting it to accumulate and render the time delay device inaccurate. The means for venting chamber 95 is provided in the wall thereof and includes a plug 130 shown as threadedly engaged in a bore 131 in the side wall of body 90. The plug 130 carries a check valve member 132 having a recess 134 to receive the usual seating material 135 and is supported by an extension 136 loosely extending through a bore 137 in the plug 130 and held in position by an enlarged end portion 139. The check valve 132 is normally held away from its seating surface 140 by a spring 141 engaging between the surface of plug 130 and the valve member. Any leakage past valve seat 96 is vented to the atmosphere through the space between the walls of bore 137 and extension 136. The vent is rendered ineffective during operation of the time delay device by pressure against the bottom of the check valve member 132 which overcomes the action of spring 141 and moves the valve member against its seat 140.

Chamber 62 is also shown as spherical in form and is comprised of hemispherical portions 144 and 145 joined by a welded junction 146. Chamber 62 is shown as approximately the same size as chamber 60. The chamber is supported on the upper body portion 61 by a fitting 147 shown attached to the chamber by a welded joint 148. The fitting is tubular and is shown threaded on its inner surface for engaging with the threaded outer surface of the cylindrical portion 127 of the body 61. The outlet 128 for chamber 95 of the upper body portion 61 is connected to the inlet 51 of cylinder 49 by a conduit 150 having end fittings 151 and 152.

The operation of the system in accordance with one form of the invention may be understood more readily by reference to Fig. 1. Fire extinguishing fluid stored under pressure in container 1 is released by valve 2 allowing the fluid to pass through conduit 3 to valve 4. The passage of the fluid to discharge conduit 6 is blocked by valve member 27 positioned on its seat 26. However, fluid may pass from the valve 4 through pipe connection 56 to the time delay device 5. Upon entering the device, the fluid pressure aids the spring 82 in seating the valve member 87 on its seat 77. The fluid medium flows through the orifice 69 into the storage chamber 60, the orifice restricting the flow of the fluid. As fluid pressure gradually builds up in the chamber 60, the pressure aids the spring 112 in seating the valve member 100 on its seat 96. The fluid medium flows through orifice 105 and through tubular extension 115 of the valve member into the second storage chamber 62. As fluid pressure gradually builds up in chamber 62, piston 99 is actuated downwardly to move valve member 100 from its seat 96. The fluid medium stored in the chamber 60 is then released through the conduit 150 to the valve 4 to cause the piston 47 to unseat valve member 27 from its seat 26. The fluid medium will then flow through the conduit 6 to the enclosure 9. Valve member 27 remains off its seat 26 until all fluid medium has been discharged from the system after which the time delay device 5 and the valve 4 are automatically reset by the action of the various springs.

The time delay of the discharge occurs while pressure is building up in the second chamber 62 against the surface of piston 99 to actuate the valve member 100. As has been previously stated, the area of the operating surface of piston 99 is made with a larger area than the area of the fluid passage closed by the valve member 100 in order that a predetermined pressure relationship in the chambers 60 and 62 will cause the piston to move the valve member 100 from its seat against the pressure against its surface from chamber 60 and against the slight force exerted by spring 112. The time interval required for the operation of the device has been found to depend primarily upon the size of the orifice leading to the second chamber when the two chambers are of approximately the same size. It has been found that the operating time of the device does not vary appreciably within the pressures generally available in a system of this type.

In Fig. 4 there is shown a set of curves of pressures in the two chambers plotted against time in seconds for a device nominally set for a delayed operation interval of thirty seconds. Curve A represents the pressure in the first chamber 60 while curve B represents the pressure in the second chamber 62. The device was operated with carbon dioxide vapor at a pressure of 850 pounds per square inch at a temperature of 70° F. The operating time of the device was found to be thirty seconds. A second set of curves, C and D, show respectively the pressure-time relationships in the two chambers for operation by carbon dioxide liquid at a pressure of 900 pounds per square inch at 75° F. A third set of curves, E and F,

shows the pressure-time relationships for operation by carbon dioxide vapor at a pressure of 515 pounds per square inch at 30° F. The fourth set of curves, G and H, shows the respective pressure-time relationships for carbon dioxide liquid at 30° F. It will be noted that the delayed action intervals did not vary more than one second plus or minus from the optimum time of thirty seconds. The ratio of the pressures in chambers 60 and 62 was the same at the time of operation under the various conditions.

In some installations it may be preferable to provide means for releasing the fire extinguishing fluid from a location remote from the enclosure to be protected. This may be accomplished by using a small container of fluid to act as a control fluid source. This container may be positioned at the desired control location, while a larger container of fire extinguishing fluid is positioned near the enclosure to be protected. In Fig. 2 there is shown a system in accordance with the invention, in which the control cylinder 1 is shown smaller in size than in Fig. 1. The container may be charged with any compressible fluid such as nitrogen, carbon dioxide air, or the like. The conduit 3 is made of the necessary length so that a secondary container 160 containing fire extinguishing fluid under pressure may be positioned near an enclosure 161. The secondary container is provided with pressure operable valve 162, the outlet 164 of which is connected with a conduit 165 leading to the enclosure 161.

The valve 162 is formed of a housing or body 166 having a passage 167 therethrough for the fluid. A seat 168 is formed at the lower end of the valve and is adapted to be contacted by a valve member 169 to releasably retain the fluid in the container. The valve member 169 is actuated by a hollow extension rod 170 attached to a piston 171, positioned for reciprocal movement in a cylinder 172 formed in the upper part of the valve body and in fluid communication with outlet 164. The hollow rod 170 has openings 174 at its lower end and a second opening 175 spaced a short distance below its upper end and above the top surface of piston 171, opening into a passage 177 therein. A constricted portion 176 of the passage 177 in the hollow rod acts as a seat for a ball valve 178. The ball valve is held on its seat by gravity and is adapted to be forced upwards by fluid released from the container which leaves the rod through openings 175. The extension rod 170 has a solid extension 180 on the upper end thereof passing through a fluid-tight opening 181 in a wall 182 forming the upper end of cylinder 172. An extension of the body 166 forms a second cylinder 184 in which is positioned a piston 185 fixedly mounted to the solid extension 180. The lower end of the cylinder 184 is vented by an opening 186 to prevent back pressure on the underside of piston 185. The upper end of the solid extension extends through another fluid-tight opening 187 in the top wall 188 of the first cylinder 172 and has affixed thereto a knob 189 providing manual means for the unseating of the valve member 169. The valve member 169 may be unseated by fluid pressure entering cylinder 184 through an inlet 190 to which is connected a conduit 191 leading from the outlet of valve 4.

This system is operated in a manner similar to the operation previously deescribed for the system shown in Fig. 1 excepting that the fluid released from the outlet of the discharge valve 4 is led through the conduit 191 to the pressure operated valve 162. The fluid enters the valve through the inlet 190 and causes the piston 185 to unseat the valve 169. The fire extinguishing fluid is released to pass around the valve member 169 and enter the openings 174 to the passage 177 in the hollow rod 170. The fluid unseats the ball valve 178 and leaves the passage through its upper openings 175. Fluid pressure builds up in the cylinder 172 against the top of the piston 171 assuring the complete opening of the valve member 169. The fluid then passes from the cylinder 172 through the outlet 164 and the conduit 165 to the enclosure 161.

Another fire extinguishing system in accordance with the invention is shown in Fig. 3 in which corresponding parts are designated by the same reference numerals as in Figs. 1 and 2 with the addition of 200. The system shown in Fig. 3 is advantageous for use in protecting two enclosures, one of which is occupied and, because of its size, requires only a portion of the capacity of the bank of containers of fire extinguishing fluid which is to be discharged after a warning signal has been given. The other enclosure requires the immediate discharge of the full bank of containers. By utilizing the invention the full bank may be discharged without actuation of the time delay device. Referring to Fig. 3 there is shown a pair of control containers 201 adapted to contain fire extinguishing fluid under pressure, each of which is provided with a pressure-operated valve 202 having a construction similar to valve 162 and adapted to releasably retain the fluid in the containers, a conduit 203 adapted to receive discharged fluid, a valve 204 to close the discharge conduit against the flow of discharged fluid, a time delay device 205 to open the valve at the end of a predetermined time interval, a main conduit 206, a branch supply conduit 207, one or more containers 208 adapted to feed into the main conduit 206 through the branch conduit 207. The containers 208, with containers 201, form the required capacity for an enclosure 209. A warning device 300 positioned in the enclosure 209 is operated by released fluid in the conduit 203. The fluid is passed to the warning device by means of a conduit 301 connected into the discharge conduit 203 ahead of the valve 204. A second group of one or more containers 310 is connected to a manifold 311, which in turn, is connected through a standard unidirectional check valve 312 with the branch conduit 207. The check valve is of the usual type permitting fluid to flow in one direction while obstructing the flow of fluid in the reverse direction. The main conduit 206 is T-connected by a connection 310 to valves 314 and 315 to supply conduits 316 and 317. The conduit 316 extends into the enclosure 209, while the conduit 317 feeds into a second enclosure 318. The second enclosure 318 requires the entire capacity of containers 201, 208 and 310. The valves 202 for containers 201, as stated before, are constructed the same as the valve 162. In using the valve 202 in the system shown in Fig. 3, the pressure fluid inlet 190 may be closed with a vented plug to keep out dirt and other foreign matter as the top portion of the control for the valve is not necessary unless it is desired to operate the valve by fluid pressure rather than manually. The valves for containers 208 and 310 are of like construction as the valve 162, while the valve 204 is constructed in the same manner as valve 4 shown in Figs. 1 and 2.

In operating the system shown in Fig. 3 to flood the enclosure 209, the valve 314 is placed in the

open position and the valve 315 leading to the second enclosure is closed. One of the valves 202 is opened releasing fluid into conduit 203. A portion of the fluid will flow through conduit 301 to actuate the warning device 300. By reason of the back pressure in conduit 203, the other valve 202 will be actuated discharging the second control container. For an explanation of the back pressure operation reference may be made to Fig. 2 showing valve 162 which is of the same construction as valves 202. Back pressure in conduit 165 causes a pressure in cylinder 172 on the top side of piston 171. The piston is then actuated unseating the valve member 169 permitting fluid to escape from the container 166. Referring back to Fig. 3, upon the discharge of the containers 201, pressure is built up in conduit 203 and time delay device 205 operates as previously described in the description of the operation of time delay device 5, finally allowing the fluid from containers 201 to pass through conduits 206 and 316 to the enclosure 209. By reason of the building up of pressure in conduit 207 upon the actuation of valve 204, the valves of the containers 208 will also be actuated allowing the fluid contained therein to flow to enclosure 209. However, because of check valve 312, no pressure will build up in conduit 311 and containers 310 will not be discharged. The pressure in conduit 207 will hold valve 204 in the open position by pressure on the bottom side of the valve member 27 (Fig. 6). After the fluid has been discharged and the pressure in conduit 204 has dropped, the valve 204 will be automatically closed and reset for another operation by the spring 39.

In operating the system shown in Fig. 3 to flood the enclosure 318, the valve 314 is placed in the closed position and valve 315 leading to the enclosure 318 is opened. One of the valves on containers 310 may then be actuated causing pressure to build up in conduits 311 and 207 and thus cause the remaining containers 310 and containers 208 to be discharged as check valve 312 offers no obstruction to the passage of fluid from containers 310. Fluid from conduit 207 also flows through valve 204 to discharge containers 201. The operation of valve 204 in this case may be understood by referring to valve 4 in Fig. 1, in which it will be seen that back pressure in conduit 6 merely unseats valve member 27 against the spring 39 allowing fluid to flow through the valve to conduit 3, the pressure holding the valve member 27 off from its seat 26 until the discharge of the containers has been completed. Referring back to Fig. 3, it will be seen that the pressure in conduit 207 will open valve 204 and actuate the valves for containers 201 which will then be discharged. The entire bank of containers 201, 208 and 310 will then have been discharged into enclosure 318. Upon the drop of the pressure, the valve 204 will have been automatically reset by its various springs.

While the invention has been described and illustrated with reference to specific embodiments thereof, it will be understood that other embodiments may be resorted to without departing from the invention. For instance, means are shown to releasably retain the fluid in the containers comprising seated valve members. It is to be understood that the invention is likewise applicable to systems in which the fluid is retained in the containers by using closure diaphragms having pressure operated means for puncturing the diaphragms to release the fluid such as shown in Allen et al. Patent No. 1,827,723. Further, while the chambers of the time delay device of the present invention are shown of approximately equal capacity, it is to be understood that containers of unequal capacity may be utilized resulting in a method of obtaining a variation in the length of the timed interval without varying the means restricting the flow of fluid to the chambers. It is also to be understood that although the time delay unit 5 has been shown as operating a valve 4, it may also be used for operating any other device such as a switch, mechanical linkage or the like, or for controlling the operation of other types of valves such as weight operated valves. Therefore, the form of the invention set out above should be considered as illustrative and not as limiting the scope of the following claims.

We claim:

1. In a delayed discharge fire extinguishing system, a source of fluid under pressure, a conduit leading from the source to a space to be protected against fire, means for admitting the fluid from the source to the conduit, means restraining the passage of the fluid through the conduit to the space to be protected, primary fluid storage means in fluid communication with the conduit, secondary fluid storage means in fluid communication with the primary storage means, and pressure operable means controlled by the relationship of the fluid pressure in the secondary fluid storage means and the fluid pressure in the primary fluid storage means to render inoperative the means restraining the passage of the fluid through the conduit to the space to be protected.

2. In a delayed discharge fire extinguishing system, a source of fluid under pressure, a discharge conduit leading from the source to a space to be protected against fire, means admitting fluid from the source to the conduit, means restraining the discharge of fluid from the conduit to the space to be protected, primary fluid storage means in fluid communication with the discharge conduit, secondary fluid storage means in fluid communication with the primary storage means, and pressure operable means controlled by the relationship of the fluid pressure in the secondary fluid storage means and the fluid pressure in the primary fluid storage means and adapted to release fluid from the primary storage means to render inoperative the means restraining the discharge of fluid from the conduit.

3. In a delayed discharge fire extinguishing system a container for fluid under pressure, valve means for releasing fluid from the container, first chamber means, means defining a fluid passageway for fluid released from the container leading to the first chamber means, means restricting the flow of fluid into the first chamber, a second chamber means, means defining a fluid passageway leading from the first chamber to the second chamber, means restricting the flow of fluid into the second chamber, means defining a discharge conduit for fluid released from the container leading to a space to be protected against fire, and pressure operable means normally closing the discharge means to the space to be protected and responsive to the relationship of the fluid pressure in the second chamber with respect to the fluid pressure in the first chamber.

4. In a delayed discharge fire extinguishing system, a container for fluid under pressure, a

release valve for the container, a first chamber, a conduit leading from the valve to the chamber, an orifice to restrict the flow of fluid from the container to the chamber, a second chamber, a conduit leading from the first chamber to the second chamber, an orifice to restrict the flow of fluid from the first chamber to the second chamber, a discharge conduit for fluid released from the container leading to a space to be protected against fire, and a pressure operable discharge valve normally closing the discharge conduit to the space to be protected and adapted to be actuated by the pressure of fluid released from the first chamber dependent upon the relationship of the pressures in the first and second chambers.

5. In a delayed discharge fire extinguishing system, a container for fluid under pressure, a release valve for the container, a first chamber, a conduit leading from the valve to the chamber, an orifice to restrict the flow of fluid from the container to the chamber, a second chamber, a conduit leading from the first chamber to the second chamber, an orifice to restrict the flow of fluid from the first chamber to the second chamber, a discharge conduit for fluid released from the container leading to a space to be protected against fire, a pressure operable discharge valve normally closing the discharge conduit to the space to be protected, and a pressure operable valve for releasing fluid from the first chamber, said valve being responsive to fluid pressure in the second chamber, and a conduit leading from the outlet of the pressure operable valve of the first chamber to the discharge valve, whereby the discharge valve is operable by fluid released from the first chamber to release fluid from the source to the space to be protected.

6. In a delayed discharge fire extinguishing system, a control container for fluid under pressure, a release valve for the control container, a first chamber, a control conduit leading from the release valve to the first chamber, an orifice to restrict the flow of fluid from the control container to the chamber, a second chamber, a conduit leading from the first chamber to the second chamber, an orifice to restrict the flow of fluid from the first chamber to the second chamber, a discharge conduit for fluid released from the control container, a pressure operable valve normally closing the control container discharge conduit, a pressure operable valve for the first chamber responsive to the relationship of the fluid pressure in the second chamber and the fluid pressure in the first chamber, a conduit leading from the outlet of the pressure operable valve for the first chamber to the pressure operable valve for the control container discharge conduit to convey fluid pressure from the first chamber to actuate the control container discharge conduit valve, a secondary container, pressure operable release means for the secondary container, and a conduit leading from the control conduit outlet of the discharge valve to the pressure operable release means for the secondary container to convey fluid pressure to open the secondary container release means.

7. In a delayed discharge fire extinguishing system, a control container for fluid under pressure, a pressure operable release valve for the control container, a first chamber, a control conduit leading from the release valve to the first chamber, an orifice to restrict the flow of fluid from the control container to the chamber, a second chamber, a conduit leading from the first chamber to the second chamber, an orifice to restrict the flow of fluid from the first chamber to the second chamber, a discharge conduit for fluid released from the control container, a pressure operable valve normally closing the control container discharge conduit, a pressure operable valve for the first chamber responsive to the relationship of fluid pressure in the second chamber and the fluid pressure in the first chamber, a conduit leading from the outlet of the pressure operable valve for the first chamber to the pressure operable valve for the control container discharge conduit to convey fluid pressure from the first chamber to actuate the control container discharge conduit valve, a secondary container, pressure operable release means for the secondary container, a conduit leading from the outlet of the control container discharge conduit valve to the pressure operable release means for the secondary container to convey fluid pressure to open the secondary container release means, and normally closed fluid releasing means for the first chamber adapted to be rendered ineffective by fluid pressure in the first chamber exceeding fluid pressure in the control container discharge conduit, whereby fluid pressure may be rapidly released from the first chamber.

8. A fluid pressure time delay device comprising first fluid storage means having an inlet and an outlet therefor, a second fluid storage means having an inlet in fluid communication with the outlet of the first fluid storage means, fluid pressure operable means responsive to the relationship of fluid pressure in the second fluid storage means and the fluid pressure in the first fluid storage means, and fluid pressure release means for the fluid in the first storage means, said release means adapted to be actuated by said fluid pressure means.

9. A fluid pressure time delay device comprising first fluid storage means having an inlet and an outlet therefor, fluid flow restricting means in the inlet, a second fluid storage means having an inlet in fluid communication with the outlet of the first fluid storage means, fluid flow restricting means in the fluid passage between the first and second fluid storage means, fluid pressure means responsive to the relationship of fluid pressure in the second fluid storage means and the fluid pressure in the first fluid storage means, and fluid pressure release means for the fluid in the first storage means, said release means adapted to be actuated by said fluid pressure means.

10. A fluid pressure time delay device comprising first fluid storage means having an inlet and an outlet therefor, fluid flow restricting means in the inlet, a second fluid storage means having an inlet in fluid communication with the outlet of the first fluid storage means, fluid flow restricting means in the fluid passage between the first and second fluid storage means, fluid pressure means responsive to the relationship of fluid pressure in the second fluid storage means and the fluid pressure in the first fluid storage means, fluid pressure release means for the fluid in the first storage means, said release means adapted to be actuated by said fluid pressure means, and normally closed fluid pressure release means normally closing the first storage means and adapted to be rendered ineffective by pressure therein appreciably in excess of pressure in said inlet.

11. A fluid pressure time delay device comprising a hollow spherical member, a fluid inlet for the member, an orifice restricting the flow

of fluid into the inlet of the member, an outlet for the member, a second spherical member having an inlet in fluid communication with the outlet of the first spherical member, an orifice restricting the flow of fluid into the second spherical member, a normally closed pressure operated release valve for the first spherical member, and pressure operable means adapted to actuate the release valve in response to the relationship of fluid pressure in the second spherical member and the fluid pressure in the first spherical member.

12. In a fire extinguishing system, a source of fluid under pressure, a conduit leading from the source, means for admitting fluid from the source to the conduit, and a fluid pressure operable valve including a valve seat, a valve member adapted to close the valve seat and positioned between the source and the valve seat normally restraining the passage of fluid through the conduit in the direction away from the source yet allowing the passage of fluid in the conduit in the direction of the source to actuate the means for admitting fluid from the source to the conduit.

13. A fluid pressure time delay device for a fire extinguishing system comprising first fluid storage means having an inlet and an outlet therefore, a second fluid storage means having an inlet in fluid communication with the outlet of the first fluid storage means, fluid pressure operable means responsive to the relationship of fluid pressure in the second fluid storage means and the fluid pressure in the first fluid storage means, and venting means in the outlet of the first storage means normally open and adapted to be closed by normal fluid operating pressure.

14. A fluid pressure time delay device comprising a housing having a passage therethrough, one end of the passage enlarged to provide a valve chamber, a valve seat about the passage in the valve chamber, a normally closed valve member adapted to coact with the valve seat to close the passage, the other end of the passage enlarged to form a cylinder, a piston reciprocable in the cylinder, a hollow valve operating member to actuate the valve member by the piston, the piston and valve member having fluid passages therethrough communicating with the opening through the hollow valve operating member, an outlet fluid passage leading from the housing passage behind the valve seat, means providing a first chamber having as its outlet the one end of the passage through the housing, means providing a second chamber having an opening in fluid communication with the other end of the passage through the housing, means providing an inlet passage for the first chamber, a valve seat about said last-mentioned inlet passage, a valve member for the last-mentioned valve seat, means providing a main fluid passage, a valve seat about the main fluid passage, a normally closed pressure operable main valve member to coact with the valve seat to close the main valve passage, means providing a fluid passage leading from the main fluid passage ahead of the valve seat to the first chamber, and fluid passage means from the said outlet fluid passage of the housing to the pressure operable main valve, whereby fluid from the main passage may flow into the first chamber to the second chamber to actuate the piston actuated valve member for the first chamber to release fluid therefrom to open the main valve.

15. A fluid pressure time delay device comprising first fluid storage means having an inlet and an outlet therefor, a second fluid storage means having an inlet in fluid communication with the outlet of the first fluid storage means, and a pressure operable valve responsive to the relationship of the fluid pressure in the first and in the second fluid storage means and adapted to release fluid from the first fluid storage means.

16. A fluid pressure time delay device comprising first fluid storage means having an inlet and an outlet therefor, a second fluid storage means having an inlet in fluid communication with the outlet of the first fluid storage means, a first orifice member to restrict the flow of fluid into the first storage means, a second orifice member to restrict the flow of fluid from the first fluid storage means to the second fluid storage means, a pressure operable valve responsive to the relationship of fluid pressure in the first and second fluid storage means and adapted to release fluid from the first fluid storage means after a predetermined time interval.

17. In a fire extinguishing system, a first source of fluid under pressure, a conduit leading from the source, a first pressure operable valve for admitting fluid from the first source to the conduit, a second fluid pressure operable valve with conduit including a valve seat, a valve member positioned between the first source and the valve seat and adapted to engage the valve seat to normally restrain the passage of fluid through the conduit in the direction away from the first source, and a second fluid source in fluid communication with the conduit, the second fluid pressure operable valve allowing the passage of fluid in the conduit in the direction of the first source from the second source to actuate the first pressure operable valve to admit fluid from the first source to the conduit.

FRANK B. ALLEN.
NORMAN HARRY SIEBENS.

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