July 18, 1944. A. MATHISEN 2,353,765

FIRE EXTINGUISHING SYSTEM WITH REMOTE CONTROLLED SELECTIVE MULTIWAY DISTRIBUTION

Filed Oct. 7, 1941 2 Sheets-Sheet 1

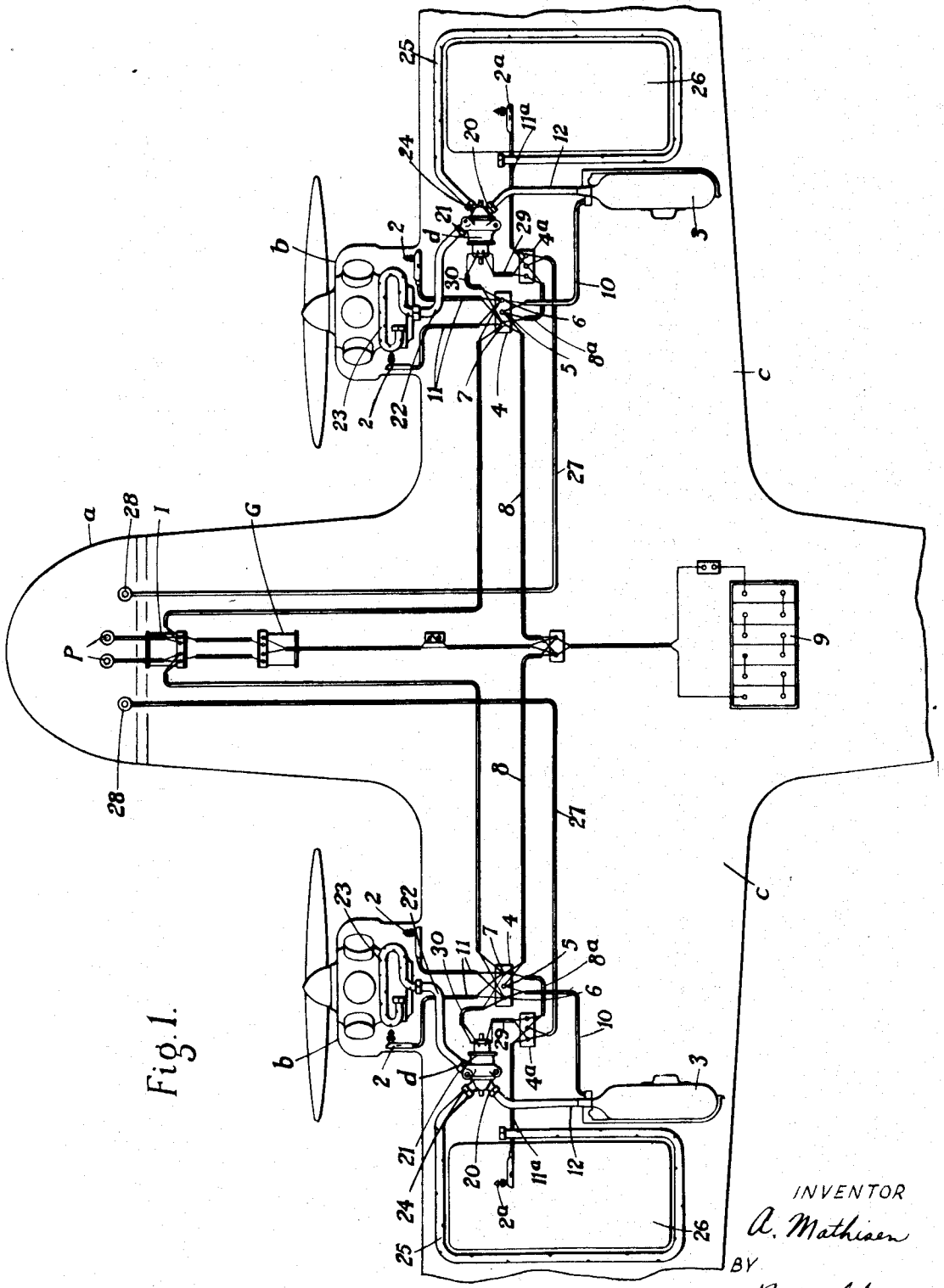

Fig. 1.

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Fig. 3.

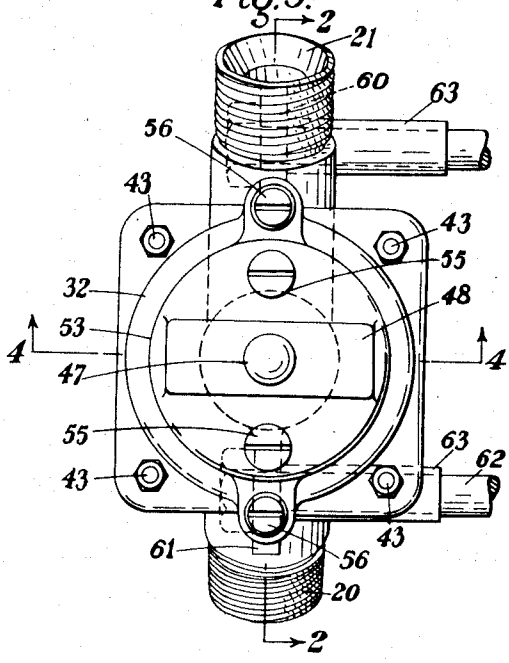


Fig. 4.

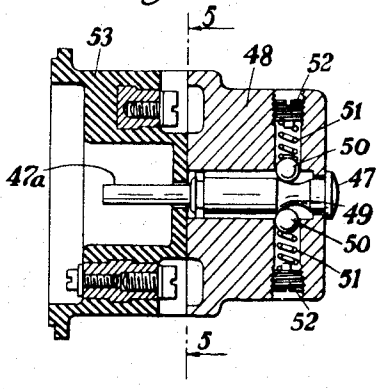


Fig. 5.

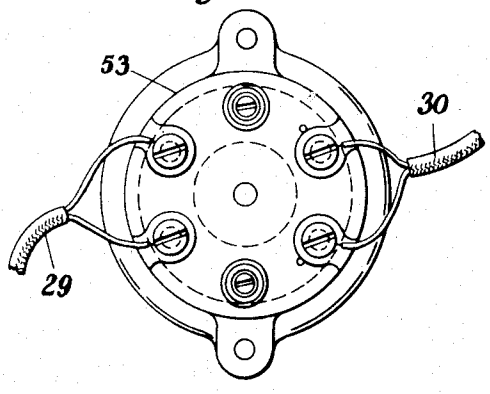
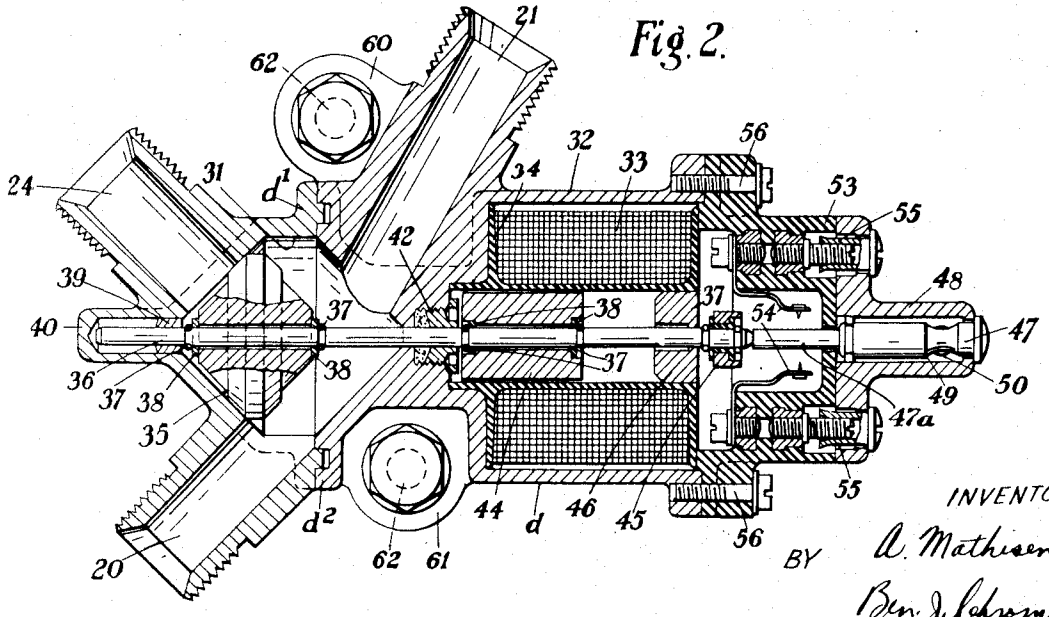


Fig. 2.



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UNITED STATES PATENT OFFICE

2,353,765

FIRE EXTINGUISHING SYSTEM WITH REMOTE CONTROLLED SELECTIVE MULTIWAY DISTRIBUTION

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11 Claims. (Cl. 169—2)

This invention relates to fire extinguishing systems, and to apparatus or devices for use in such systems, more particularly when used upon aircraft, vessels and the like.

It is an object of the invention to provide a fire extinguishing system which comprises a fire extinguishing fluid container from which two or more conduits extend to a plurality of different points of discharge, and to provide a fluid distributing cock or valve in such system having a normal position whereby discharge of fluid takes place at a selected primary point, said valve being additionally capable of operation from a remote point to divert the fire extinguishing fluid to a secondary point of discharge.

Another object of the invention is to provide a fire extinguishing system more especially for use upon aircraft, which system comprises a fire extinguisher normally connected through a valve mechanism having an inlet passage connected to a fire extinguishing fluid container and having one outlet passage connected by a pipe to a primary source of fire risk such as a motor or engine, said valve mechanism having an additional outlet connected by a pipe to a fire extinguishing fluid distributing system associated with a secondary source of fire risk such as one or more aircraft fuel tanks.

Another object of the invention is to provide manually and automatically actuated means associated with said primary source of fire risk to effect discharge of fire extinguishing fluid thereon when fire risk arises in connection therewith, and to provide other manually and automatically actuated means associated with the secondary source of fire risk for effecting diversion of the fire extinguishing fluid thereto in case fire breaks out thereon.

A further object of the invention is to provide a valve mechanism for use in systems as described above, said valve mechanism having a valve element normally closing said secondary outlet passage, the element being capable of actuation to open said passage and close the passage to the primary source of fire risk, the movement of said valve being adapted to effect discharge of the fire extinguishing fluid over the secondary source of fire risk immediately before the closure of the passage to the primary source of fire risk.

An additional object of the invention is to provide a solenoid device for actuating the above described valve device, means being provided for retaining the core or armature of said solenoid device in the position in which the outlet to the secondary fire risk source is closed.

A further object of the invention is to provide an electrically operated and controlled fire extinguishing system having a valve device therein for effecting discharge of the fire extinguishing fluid at a desired point, means being provided for conveniently restoring the valve system to normal after actuation, as will be further described hereinafter.

The invention is illustrated by way of example in the accompanying drawings in which similar reference characters relate to like parts in all the figures and in which—

Figure 1 is a wiring diagram of a fire-fighting equipment upon a twin-engined aircraft incorporating the valve device for diverting fire extinguishing fluids to the fuel tanks.

Figure 2 is a sectional view of the valve device, taken on the line 2—2 of Fig. 3,

Figure 3 is an end view of Figure 2,

Figure 4 is a sectional view of part of the mechanism shown in Figure 2, taken on the line 4—4 of Fig. 3, and

Figure 5 is a view taken on line 5—5 of Figure 4.

Referring now to Figure 1 of the drawings, *a* denotes the fuselage or hull of an aircraft and *b* the engine nacelles built out on the wings *c* of the aircraft.

The fire fighting equipment comprises a fire extinguishing liquid container 3 associated with each individual engine as disclosed in Figure 1 of my Patent No. 2,189,147 issued February 6, 1940.

Associated with each engine is one or more flame or temperature rise responsive devices 2 and the equipment in each individual engine nacelle comprises a three-way terminal block 4 provided with a center terminal 5 and outer terminals 6 and 7. A twin-lead cable 8 extending from any suitable electric current supply source such as the aircraft battery 9, has the leads connected to terminals 5 and 7, and a twin-lead cable 10 from the liquid container 3 has the leads connected to terminals 5 and 6. Devices 2 have the leads from their twin-lead cables 11 connected to terminals 6 and 7 so that closure of the contacts in the temperature responsive devices 2 energises the fire extinguisher container 3 to effect discharge thereof.

The valve *d* has an inlet conduit 20 to which is connected a discharge pipe 12 extending from the fire extinguishing fluid container 3.

The valve *d* is provided with an outlet conduit 21 from which a discharge pipe 22 extends to the fire extinguishing fluid distributing piping 23

associated with the aero engine in the nacelle *b*. The arrangement is such that the liquid from container 3 is discharged through the device *d* to the engine distributing piping if the valve *d* is in the normal unoperated position.

The valve *d* is provided with a secondary outlet conduit 24 from which perforated fire extinguisher distributing piping 25 extends over the fuel tanks 26.

To effect operation of the valve *d*, a terminal block 4*a* is provided in addition to terminal block 4, and a twin cable lead 8*a* is taken from terminals 5 and 7 upon terminal block 4 and extended to one outer terminal and the center terminal of the block 4*a*, the other outer terminal and the center terminal being connected by a lead 27 to a pilot-operated or other personnel-operated push button switch 28. The outer terminals of block 4*a* are connected by twin cable 29 to terminals in the valve *d* so that an electric coil or winding or solenoid 33 (Fig. 2) in the valve *d* can be energised by closure of push button switch 28.

Alternatively, or additionally, automatic means for effecting operation of the valve *d* may be provided by securing a flame or temperature operated device 2*a* adjacent the fuel tank 26, said temperature operated device being connected to the same terminals as cable 27 by a lead 11*a*, so that if a fire occurs upon fuel tank 26, the valve *d* will be automatically operated to effect discharge of extinguisher 3 through the fuel tank distributing system.

The valve *d* incorporates a pair of normally open contacts which are capable of closure when the said valve *d* is operated and, by means of a twin cable 30 connected to terminals 6 and 7 on terminal block 4, discharge of extinguisher 3 is effected as will be further described in detail.

The electrical equipment for effecting discharge of containers 3 additionally comprises inertia-element-operated switch I and gravity element operated switch G as well as pilot-operated or personnel-operated push button switches P, but this equipment forms no part of the present invention and will not be described in further detail.

Referring now to Figure 2, the valve device comprises the three-way union type of fitting divided into two parts d^1 and d^2 which are secured together in a fluid-tight manner by bolts 43 or the like. Part d^1 comprises inlet conduit 20 and outlet conduit 24 and has a cavity 31 formed therein. Part d^2 has a correspondingly shaped cavity formed therein from which outlet 21 extends and an external housing 32 extends therefrom for enclosing the electric coil winding or solenoid 33 wound upon spool or former 34. In the cavity 31 a valve element 35 is mounted upon a spindle 36 by means of spring clips 37 and washers 38, said spindle 36 being supported in a bearing 39 secured in a tubular extension 40 from part d^1.

The spindle 36 passes through a packing gland or like device 42 in part d^2 which prevents leakage of fluid into housing 32, and spindle 36 carries a magnetic core or armature 44, said armature being secured to the spindle by means of spring clips 37 and washers 38.

Spindle 36 also carries a metallic contactor device 45 suitably insulated therefrom and secured thereto by spring clips 37 or other means.

The winding on coil 33 on spool or former 34 and the armature 44 constitute a solenoid type of device, and a magnetic plug 46 is secured in the end of spool or former 34, so that the magnetic flux in the air gap between plug 46 and armature 44 will be intensified when winding 33 is energised so as to produce a substantial pull upon armature 44, said pull being sufficient to move spindle 36 and valve 35 from the position shown in Figure 2 in which the discharge conduit 24 is closed into a position in which this conduit is opened, and conduit 21 is closed.

It is important that means be provided for ensuring that spindle 36 and valve element 35 remain in the position shown in Figure 2 under normal flying conditions, and to this end a plunger 47 is provided in a cap device 48, said plunger being provided with a grooved recess 49 into which spring-urged balls 50 (Fig. 4) are adapted to be forced under action of springs 51 held in position by grub screws 52. The plunger 47 has an extended portion 47—*a* which projects into the terminal block 53 far enough so that it contacts the end of the spindle 36 and thereby holds the valve element 35 in the position shown in Fig. 2.

The force with which the plunger 47 is retained in the position shown in Figure 2 is thus capable of regulation by adjustment of grub screws 52 and is so adjusted that spindle 36 and valve element 35 will not be displaced due to changes in movement of the order of 3 *g* to 5 *g*, in which *g* denotes the acceleration due to gravity.

The housing 32 has secured thereto an insulated terminal block device 53 which carries a pair of spring contacts 54 with which the contactor 45 is adapted to make contact when the solenoid is energised and spindle 36 is operated, such operation causing outward displacement of plunger 47 which indicates to service personnel that the device has been operated, and after such operation spindle 36 and valve 35 is again restored by pushing the plunger 47 into normal position as shown in Figure 2 by manual operation.

The closure of contacts 54 by contactor 45 effects discharge of extinguisher 3 as previously mentioned and, as will be noted, closure of contacts 54 is not possible until conduit 24 is widely opened and when conduit 21 is practically closed. Moreover, the discharge of liquid from container 3 takes place at a high rate and with considerable impact ensuring that valve 35 is forced into the position in which conduit 21 is closed, the extinguisher fluid then discharging through conduit 24 to the fuel tank distributing pipe system 25.

As will be seen in Figure 5, cable 29 is connected to one pair of terminals upon terminal block 53, said terminals being connected to winding 33 upon spool or former 34, and by this means this winding can be energised when the push button switch 28 is closed. Contacts 54 are connected to another pair of terminals upon terminal block 53 to which the leads of cable 30 are connected and, as described in connection with Figure 1, closure of these contacts effects operation and discharge of container 3.

The cap 48 is secured by means of screw and stud arrangement 55 of known construction to terminal block 53 and this is secured to housing 32 by bolts passing through lugs or similar extensions upon these parts adapted to secure the same together.

Part d^2 is provided with suitable lugs 60 and 61 by which the device may be secured to aircraft or

other structure members by bolts 62 over which are fitted sleeve spacers 63.

As previously described, the system shown in Figure 1 incorporating the device shown in Figures 2 to 5 is adapted to ensure discharge of fire-extinguishing fluid over the aero engine after the inertia-element-operated switch I, the gravity element operated switch G, or manually operated switch P, operates the extinguisher in known manner. If on the other hand, an aircraft in aerial combat or over enemy territory has the fuel tanks perforated by incendiary bullets causing discharged or leaking petrol or fuel to burn, then the pilot or other personnel member may effect discharge of container 3 through the fuel tank distributing piping 25 by operating push button switch 28 or alternatively switch 2a will effect automatic discharge thereof. In order to distinguish between push button switch 28 and push button switch P, the former may be marked with the words "Fuel tank fire extinguisher" whereas the latter is usually marked "Engine fire extinguisher." Said switches are arranged in pairs so as to indicate to the pilot or other personnel member which engine bay or nacelle fire extinguisher is controlled thereby.

If container 3 is employed for extinguishing a fire upon a fuel tank it will be appreciated that the container will immediately empty the whole of its contents over the fuel tank and it becomes necessary as soon as the aircraft lands to replace the empty container by a charged container, and at the same time personnel members must restore the valve *d* by pushing plunger 47 into the position shown in Figure 2.

Having thus fully described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In a fire extinguishing system, a fluid container, a two-position valve, a displaceable valve element in said valve, an inlet passage in said valve and two outlet passages from said valve, an inlet pipe connecting said inlet passage to said container, a first outlet pipe connecting one of said outlet passages to a primary source of fire risk and a second outlet pipe connecting the second outlet passage to a secondary source of fire risk, and means for retaining said valve element in a position to provide a normally open conduit from the container to the primary source of fire risk and to close the outlet passage to the secondary source of fire risk.

2. In a fire extinguishing system, a fluid container, a two-position valve, a displaceable valve element in said valve, an inlet passage in said valve, two outlet passages from said valve, an inlet pipe connecting said inlet passage to said container, a first outlet pipe connecting one of said outlet passages to a primary source of fire risk, a second outlet pipe connecting the second outlet passage to a secondary source of fire risk, spring-urged means for retaining said valve element in a position to provide a normally open conduit from the container to the primary source of fire risk and to close the outlet passage to the secondary source of fire risk, and electrically operated means for displacing said valve element to open the outlet passage to the secondary source of fire risk and to close the outlet passage to the primary source of fire risk.

3. In a fire extinguishing system, a fluid container, a two-position valve, a displaceable valve element in said valve, an inlet passage in said valve, two outlet passages from said valve, an inlet pipe connecting said inlet passage to said container, a first outlet pipe connecting one of said outlet passages to a primary source of fire risk, a second outlet pipe connecting the second outlet passage to a secondary source of fire risk, solenoid operated means for displacing said valve element to close the conduit to the primary source of fire risk and to open the conduit to the secondary source of fire risk, and means associated with said valve element to effect discharge of said fluid container when the valve element is about to close the outlet passage to the primary source of fire risk.

4. In a fire extinguishing system, a fluid container, a two-position valve, a displaceable valve element in said valve, an inlet passage in said valve, two outlet passages from said valve, an inlet pipe connecting said inlet passage to said container, a first outlet pipe connecting one of said outlet passages to a primary source of fire risk, a second outlet pipe connecting the second outlet passage to a secondary source of fire risk, electrically operable closure means for said fluid container, an electrical circuit connected to said electrically operable closure means, a spindle for carrying said displacable valve element, a magnetic bore carried by said spindle for operating said valve element, a contact device upon said spindle and a solenoid coil for displacing said magnetic core to effect operation of said valve element and to close said electrical circuit for effecting discharge of said fluid container.

5. In a fire extinguishing system incorporating a two-position valve according to claim 4, a plunger in said valve, a groove in said plunger, spring-urged means for engaging said groove, a projection from said plunger for engaging said spindle to retain said valve element in the position in which the outlet passage to the secondary source of fire risk is closed, and a projection upon said plunger for restoring said plunger, said spindle and said valve element to normal position after displacement by said solenoid device.

6. In a fire extinguishing system, a fluid container and a two-position valve including an inlet passage and two outlet passages, an inlet pipe connecting said inlet passage to said container, a first outlet pipe connecting one of said outlet passages to a primary source of fire risk, a second outlet pipe connecting the second outlet passage to a secondary source of fire risk, means for retaining said valve in a position to direct the fluid from the container to the primary source of fire risk under normal conditions, electrical means for moving said valve into a position to divert the fluid from the container to the secondary source of fire risk, and manually actuated control means for operating said electrical means from a remote point.

7. In a fire extinguishing system, a fluid container and a two-position valve including an inlet passage and two outlet passages, an inlet pipe connecting said inlet passage to said container, a first outlet pipe connecting one of said outlet passages to a primary source of fire risk, a second outlet pipe connecting the second outlet to a secondary source of fire risk, means for retaining said valve in a position to direct the fluid from the container to the primary source of fire risk under normal conditions, electrical means for moving said valve into a position to divert the fluid from the container to the secondary source of fire risk, and flame and temperature responsive control means associated with said secondary source of fire risk for effecting automatic actuation of said valve to divert the

fire extinguishing fluid to the secondary source of fire risk after fire breaks out thereon.

8. In a fire extinguishing system, a fluid container, a two-position valve, a displaceable valve element in said valve, an inlet passage in said valve and two outlet passages from said valve, an inlet pipe connecting said inlet passage to said container, a first outlet pipe connecting one of said outlet passages to a primary source of fire risk, automatically and manually actuated control means for effecting discharge of said fluid container after fire risk arises from said primary source, a second outlet pipe for connecting the second outlet passage to a secondary source of fire risk, and manual and automatic means associated with said secondary source of fire risk for effecting discharge of fire extinguishing fluid from said container over said secondary source of fire risk after fire breaks out thereon.

9. A fire-extinguishing system as set forth in claim 2, and adjustable means for adjusting the strength of the spring of said spring urged means for retaining said valve element in said position to provide said normally open conduit to the primary fire risk.

10. A fire extinguishing system comprising: a fluid container, multiple outlet valve means having inlet passage means and a plurality of outlet passage means, an inlet pipe connecting said inlet passage means to said fluid container, outlet pipe for connecting said outlet passage means to primary and secondary sources of fire risk respectively, a sealed closure in the outlet of said container, electrical breaking means for breaking said sealed closure and when said valve means is in normal position releasing fluid through said valve means to said primary source of fire risk, and electrical control means for said valve means for shifting the feeding of fluid from said primary source to a said secondary source of fire risk, said valve means further comprising a contact device adapted and connected upon actuation of said valve means to operate said electrical breaking means to break said sealed closure of said container.

11. A system as set forth in claim 10, said contact device being arranged to close the circuit to actuate said electrical breaking means only when the said outlet passage means to said primary source of fire risk is practically closed and said outlet passage means to the said secondary source is widely opened.

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