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Dunphy

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[54] **FIRE DETECTION AND EXTINGUISHING SYSTEM**

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[52] **U.S. Cl.** **169/61**, 169/62, 169/9, 169/19

[51] **Int. Cl.** **A62c 37/06**

[58] **Field of Search** ..... 169/9, 26, 2 R, 5, 19, 169/4, 2 A, 20; 137/113, 60, 61, 62

[56] **References Cited**

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Assistant Examiner—Michael Mar
Attorney, Agent, or Firm—Robert E. Ross

[57] **ABSTRACT**

A fire extinguishing system in which an optical flame detector, on seeing radiation from a fire, causes energization of a solenoid valve to release an extinguishant. Means responsive to the pressure created by the released extinguishant creates an additional circuit to the solenoid to lock it in the energized condition. Manual means is provided for operating the valve, in which case the pressure responsive means energizes the solenoid to insure continuous and complete discharge of the extinguishant. Timing means is also provided to open the solenoid after a predetermined time.

6 Claims, 2 Drawing Figures

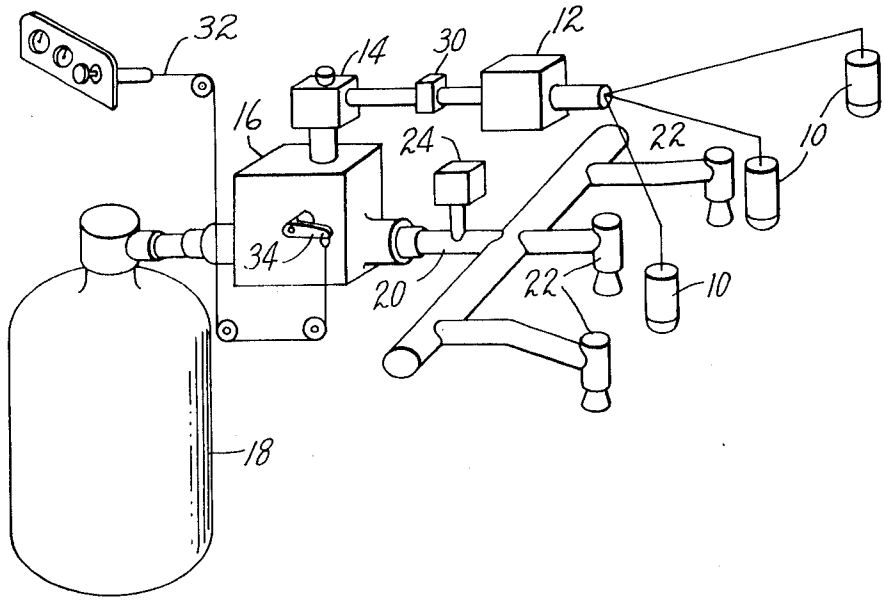


Fig. 1

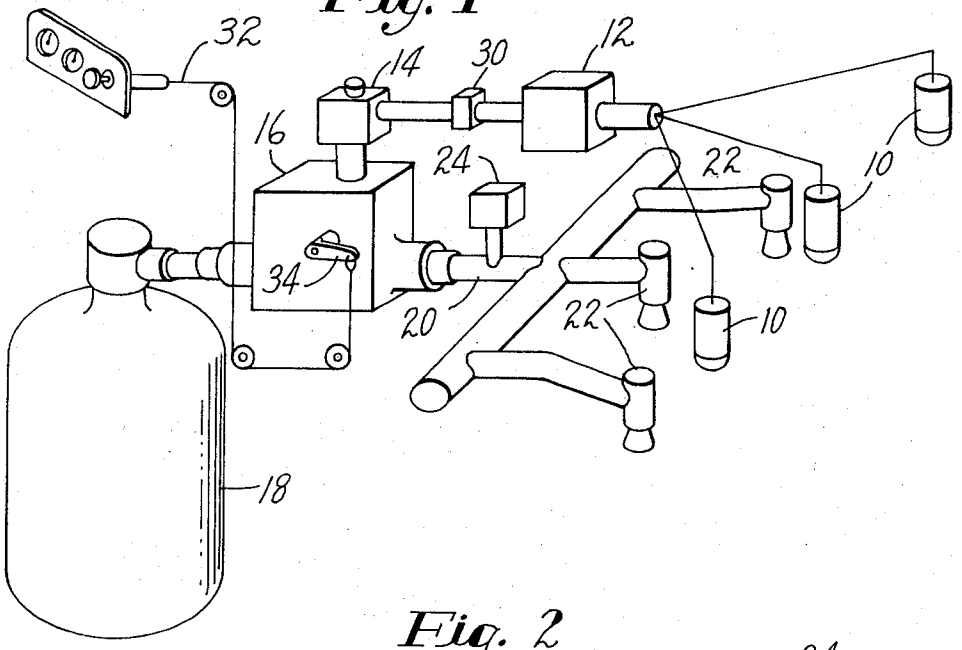
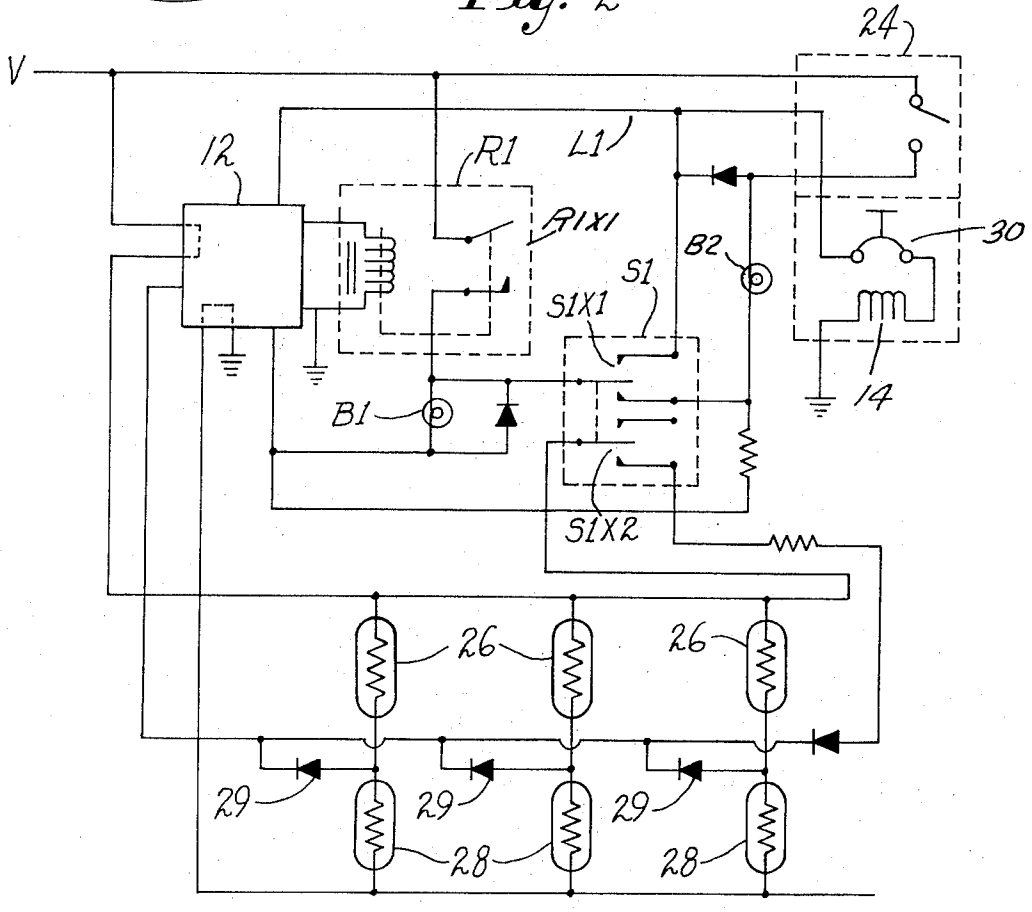

32
14
30
12
16
24
22
10
34
20
22
10
18

Fig. 2


V
24
12
R1
L1
R1X1
B2
S1
S1X1
30
B1
14
S1X2
26
26
29
29
29
28
28

FIRE DETECTION AND EXTINGUISHING SYSTEM

BACKGROUND OF THE INVENTION

The object of the invention is to provide a fire detection and extinguishing system which is particularly adapted for use on boats of the small pleasure craft type, and which is fast enough in operation to extinguish burning gasoline before there is any substantial damage to the craft. As is well known, gasoline fumes often collect in the bilges and engine compartment of such vessels, and when a spark occurs, such as from a starter relay or from generator or starter brushes, an explosion can occur.

With the advent of new types of extinguishants, and with the availability of a new type of fast-acting solenoid valve disclosed in co-pending application Ser. No. 357,924, filed May 7, 1973 now U.S. Pat. No. 3,788,400 by Howard L. Tufts and assigned to the same assignee as the present application, it has become possible to provide an optically actuated extinguishing system which is fast enough in operation to suppress explosions of the type that occur in such vessels as a result of ignition of gasoline fumes.

Although explosion suppression systems are known and used commercially, such systems have heretofore required the use of expensive and delicate pressure sensing devices to detect the pressure wave from the start of the explosion, which means that the explosion must be well started before the system is called into operation. Hence the use of a squib operated valve is required to obtain the necessary speed of valve operation. Although such valves are fast in operation, they have serious disadvantages. The squib used to actuate such valves is explosive and is sensitive to stray currents such as are generated by radio frequency signals from a transmitter on the boat; the valve operated by the squib must be disassembled after firing to replace the sealing diaphragm ruptured by the squib, and pieces of the diaphragm can jam in the discharge piping or at a discharge nozzle.

SUMMARY OF THE INVENTION

The fire detection and explosion suppression system disclosed herein utilizes an optical detection device viewing the space to be protected, said device being responsive to infra-red radiation from a fire to provide a signal to an amplifier, said amplifier actuating circuitry to energize a relay to actuate a solenoid valve of the type disclosed in the above mentioned application. The downstream pressure created by the released extinguishant operates a pressure responsive switch which locks in the circuit to the solenoid so that in case of temporary loss of signal by the optical sensor, the extinguishant will continue to flow. The solenoid is energized from a voltage source greater than the designed voltage of the solenoid coil to insure rapid operation of the valve, and timing means is provided in the solenoid circuit to de-energize the solenoid after a predetermined interval to avoid excessive heating of the solenoid coil.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 a schematic view of an extinguishing system embodying the features of the invention.

FIG. 2 a schematic diagram of one form of electric circuit that may be used to control the operation of the system of FIG. 1.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Referring to FIG. 1, there is illustrated a fire detector and explosion suppression system, which comprises generally one or more optical detection units **10** for supplying a signal to an amplifier **12** to energize the solenoid **14** of a solenoid actuated valve **16**, to release extinguishant from a container **18** and distribute it through suitable piping **20** to discharge nozzles **22** to the space viewed by the optical detection units. A pressure switch **24** is provided in the discharge piping near the outlet of the valve **16** for a purpose to appear hereinafter.

Referring to FIG. 2 of the drawing, there is illustrated a schematic diagram of one form of electric circuit for use in controlling the operation of the system of FIG. 1, in installations where it is desired that the entire contents of the extinguishant container be discharged when the valve is actuated either automatically by the optical detector or manually in the manner described in the above identified Tufts application.

The optical detectors **10** are of the discriminating type, such as is disclosed in U.S. Pat. No. 3,188,593 issued June 8, 1965, and each comprises two photo-responsive cells **26** and **28** connected in series across a voltage source V. As described in the above identified patent, the cells respond to different light frequencies in such a manner that the voltage at the junction of the cells rises to a predetermined alarm voltage only when infra-red radiation from a flame is received.

The voltage appearing at the junction of the cells is fed to the input of a transistor amplifier **12** through diodes **29.** When the junction voltage reaches a predetermined value, the amplifier energizes a relay R1 to close relay contacts R1X1 to light a fire indicating light B1 and to energize the solenoid **14** of the valve **16** to open the valve and discharge the contents of the container **18** through the nozzles **22.**

Provision is made for either automatic or manual modes of operation by means of switch **S1.** When switch S1 is in the automatic position, with contacts S1X1 and S1X2 closed, the energization of relay **30,** in addition to energizing the solenoid **14,** also creates, through the switch S1 a feedback circuit through line L1 into the amplifier to maintain the amplifier in the energized condition. To further insure that the discharge of the container, once started, continues until the container is empty, and to provide means for indicating, on a master control panel, the fact that the discharge of the extinguishant is taking place, the pressure switch **24** is provided in the discharge line.

The pressure switch is placed in the discharge line just downstream from the solenoid valve, and is normally open, but is closed by the pressure that builds up in the discharge when the extinguishant discharges into the line from the valve **16.** The switch **24** is connected between the power source V and the solenoid valve coil **14,** so that when the switch **24** is closed a circuit to the solenoid is created through the switch **24** independently of the circuit created by the amplifier **12.** The switch **24** also completes a circuit to a light B2 to provide a visual indication that the extinguishant is being discharged.

To operate effectively as a system capable of stopping the explosion-like burning of gasoline vapor, all of the components of the system must be able to operate

rapidly enough to cause discharge of the extinguishant into the compartment within about 200 milliseconds after ignition. Most of the time between appearance of infra-red radiation and the discharge of the extinguishant from the system is taken up by the operation of the valve. Therefore, to have valve actuation to occur as rapidly as possible, it has been found desirable to energize the valve solenoid with a voltage greater than that for which the solenoid coil was designed. For example, if the solenoid is intended to be operated by a six volt power source, it has been found that much greater speed of valve operation can be achieved by energizing the solenoid from a **12** volt source. To prevent damage to the solenoid coil by the use of such excessive voltage, a timer **30** having normally closed contacts is inserted in series with the solenoid coil. In one embodiment of the invention the timer is set to open its contacts and thereby break all circuits to the solenoid coil after the container of extinguishant has been completely discharged.

Manual means may also be provided for opening the valve. Such means is described in the above mentioned Tufts application, and comprises means such as cable **32** attached to lever **34** for upsetting the pilot valve to cause opening of the main valve piston, without energizing of the solenoid to accomplish such valve opening. However, when extinguishant is released in this manner, the pressure on the downstream side of the valve closes the pressure switch **24** to energize the solenoid. Hence once the valve has been operated manually and the extinguishant has started to flow, flow thereof will continue until the container is exhausted. Hence the person operating the valve manually in an emergency need not continue to hold the valve cable to insure complete discharge. The circuit to the solenoid may then be broken by either the opening of the pressure switch when the container is empty or by the timer switch **30.**

In the illustrated embodiment, the closing of the pressure switch **24** also completes a circuit to a feedback line **L1** to the amplifier so that the relay **R1** is energized to light the fire indicator light **B1** and to complete the same circuit to the solenoid that is created when a fire is detected with the switch **S1** in the automatic position. Hence if, for any reason, the switch **S1** is shifted to automatic from manual when the extinguishant is discharging, the automatic circuit to the solenoid is maintained. Although the extinguishant would continue to flow even without the automatic circuit because of the circuit through the pressure switch, the automatic circuit may in some cases be used to power other devices, such as external horns, bells or other fire signal devices.

Since certain modifications may be made in the illustrated system without departing from the scope of the invention, it is intended that all matter contained herein be interpreted in an illustrative and not a limiting sense.

I claim:

1. A fire extinguishing system comprising fire detecting means which produces a signal on detecting a fire supply of extinguishment, extinguishant from said supply releasing means responsive to said signal to release extinguishant, and means detecting the released extinguishant to maintain the extinguishant releasing means in the extinguishant releasing condition.

2. A fire extinguishing system, comprising fire detecting means and fire extinguishing means, said extinguishing means comprising a supply of pressurized extinguishant and a solenoid actuated valve for releasing the extinguishant, amplifier means responsive to the detection of a fire by the detecting means to energize the solenoid to open the valve and release the extinguishant, and means responsive to the release of the extinguishant to maintain said valve in the open position.

3. A fire extinguishing system, comprising fire detecting means, and fire extinguishing means, said extinguishing means comprising a supply of pressurized extinguishant and a solenoid actuated valve for releasing the extinguishant to a discharge nozzle, means responsive to the detection of a fire by the detecting means to energize the solenoid of the valve to open the valve to release the extinguishant to the discharge nozzle, and means responsive to the increase in pressure downstream of the valve to complete a second circuit to the solenoid, whereby said circuit remains energized so long as the extinguishant is flowing.

4. A system as set out in claim **3** in which means is provided for opening the valve manually, whereby said pressure switch is operated to energize the solenoid to hold the valve open so long as extinguishant is flowing.

5. A fire detection and extinguishing system comprising a supply of pressurized extinguishant, valve means to release extinguishant to a discharge nozzle, solenoid means for opening said valve, means responsive to radiation from a fire to produce a signal, means responsive to said signal to energize said solenoid to open the valve and release the extinguishant, means detecting the release of the extinguishant, and means responsive to the detection of the released extinguishant to create another circuit path to said solenoid to maintain said solenoid energized so long as extinguishant is flowing.

6. A fire detection and extinguishing system comprising a supply of pressurized extinguishant, valve means to release said extinguishant to a discharge nozzle, solenoid means for opening said valve, means responsive to radiation from a fire to produce a signal, means responsive to said signal to energize said solenoid to open the valve and release the extinguishant, said solenoid being energized from a power source that applies a voltage to the solenoid that is substantially greater than the voltage for which the solenoid was designed for use, and timing means connected to break all energizing circuits to the solenoid after said solenoid has been energized for a predetermined period of time.

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