

[54] FIRE PREVENTION AND/OR SUPPRESSION SYSTEM

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Related U.S. Application Data

[63] Continuation of Ser. No. 35,994, May 11, 1970,
abandoned, which is a continuation-in-part of Ser.
No. 711,020, March 6, 1968, Pat. No. 3,590,559.

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[58] Field of Search 169/2 R, 5, 9, 11, 30,
169/31

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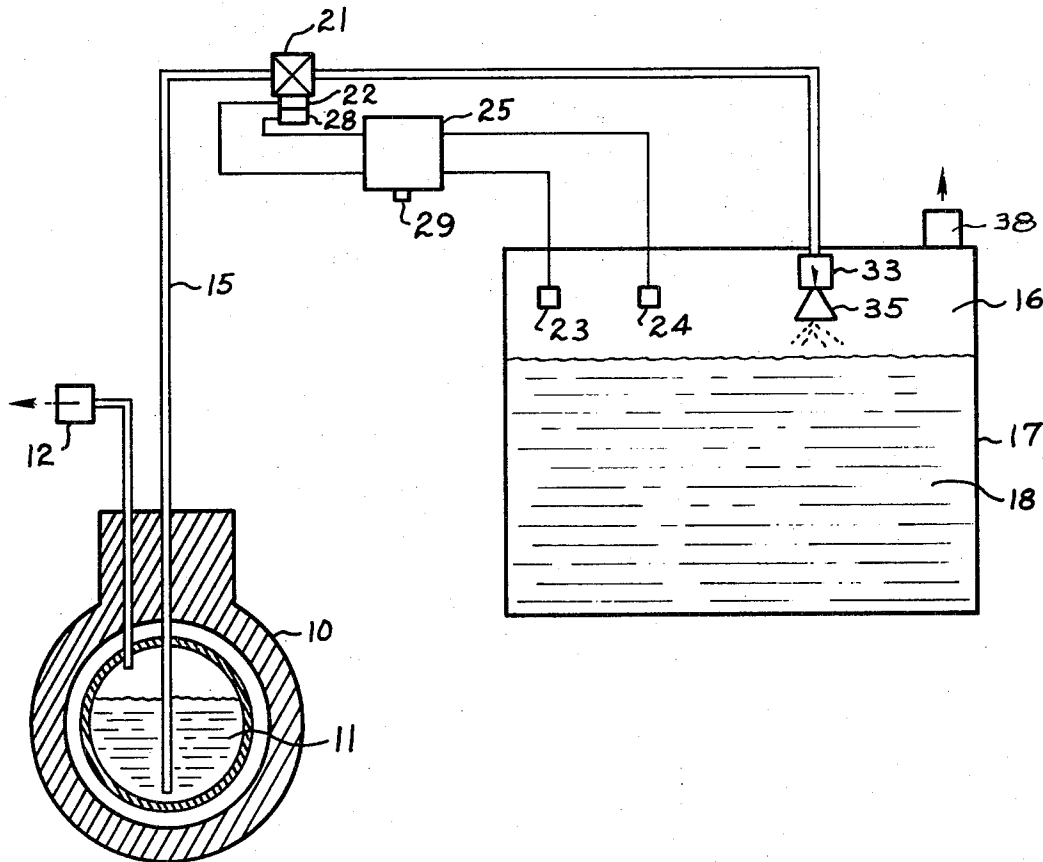
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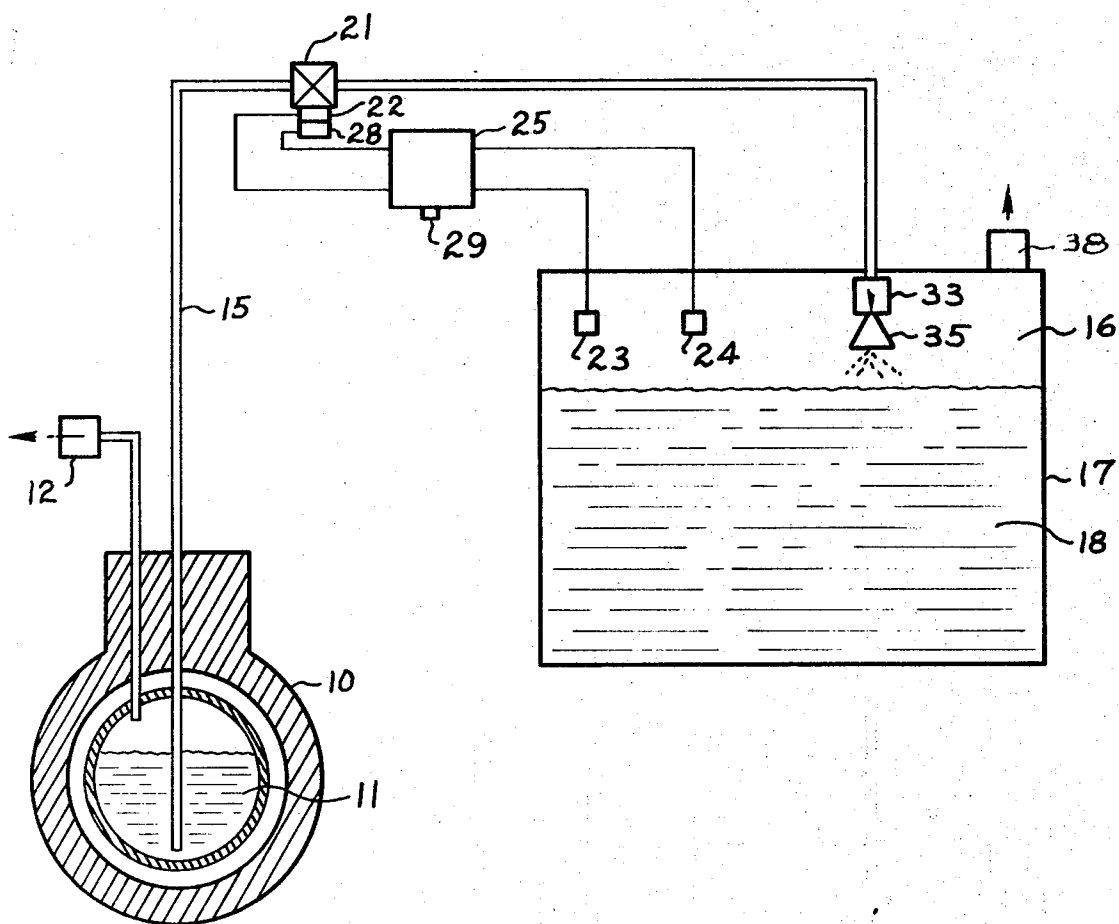
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[57] **ABSTRACT**

A fire prevention and/or suppression system in which liquid nitrogen is injected into a space to be protected against fire and/or explosion. The nitrogen vaporizes in the space and mixes with the combustible gases therein to extinguish flame that may be present and/or render the gases non-flammable to prevent their ignition, and also quickly cools the gases and/or other combustible material that may be present to protect against ignition or re-ignition.

1 Claim, 1 Drawing Figure





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FIRE PREVENTION AND/OR SUPPRESSION SYSTEM

This application is a continuation of Ser. No. 35,994, filed May 11, 1970, now abandoned, which in turn is a continuation in part of Ser. No. 711,020, filed Mar. 6, 1968, now Pat. No. 3,590,559.

SUMMARY OF THE INVENTION

In aircraft and other places where danger of fire or explosion exists in particular locations because of the presence, or possible presence of flammable materials, it is highly desirable to provide means for preventing and/or extinguishing fire and to prevent re-ignition if a fire has occurred and has been extinguished. In the present system nitrogen, or some other cryogenic fluid, is introduced into the space that is to be protected in liquid form, and preferably in the form of fine liquid droplets. The droplets vaporize in the space and mix with the oxygen gas in the space to dilute, cool and or replace the same to the extent that there is insufficient oxygen in the space to support combustion.

In addition, the liquid nitrogen, being very cold, such as in the vicinity of -320° F., exerts a very rapid and considerable cooling effect on the oxygen and other gases in the space, and on nongaseous materials in or adjacent to the space, to eliminate or delay subsequent increase of temperature of the combustible materials present to ignition levels.

DESCRIPTION

The drawing indicates a schematic view of a container having cryogenic inert liquid therein connected by a conduit to a space to be protected against fire or explosion.

The system may, for example, by an installation within an aircraft, and as shown includes a dewar 10 containing liquid nitrogen 11. The liquid nitrogen is under pressure due to vaporization of a portion thereof, such vaporized nitrogen being in the upper portion of the dewar. The pressure may be in the neighborhood of 30 to 70 psi, for example, and is prevented from exceeding this pressure by a pressure relief valve 12. The temperature of the liquid nitrogen will be approximately -310° F. to -290° F.

The dewar is connected by a conduit 15 to the ullage space 16 of a fuel tank 17 containing liquid fuel 18. The ullage space 16 contains fuel vapor and will also contain some oxygen that had entered the tank either from the atmosphere or as dissolved gas in the liquid fuel when the tank was being filled with fuel. The tank ullage may also contain gaseous nitrogen previously introduced for the purpose of rendering the oxygen-fuel vapor content of the ullage non-flammable by keeping the oxygen content to about 11 percent or less of the total gaseous content of the ullage.

Mounted in conduit 15 is a normally closed control valve 21 having associated therewith an operator 22, such as a solenoid, that may be automatically actuated for opening valve 21 by a fire detection means that includes fire detectors 23, 24, and a control unit 25. Valve 21 also has associated therewith an operator 28 that may be actuated by manual operation of a switch button 29 on control unit 25. Control unit 25 preferably includes a timer that operates to shut off valve 21 after a predetermined period of time after being

opened by operator. A check valve 33 is also in the conduit and the latter terminates at a fog nozzle 35 of conventional design for spraying liquid nitrogen from conduit 15 into the tank ullage space in small or finely divided liquid droplets. A one-way vent valve 38 permits venting of excess gas from the tank to prevent overpressurizing of the tank interior.

Space 16 will contain fuel vapor and will also contain some oxygen, as already explained. If the oxygen content becomes greater than about 11 %, the fuel vapor-oxygen mixture will become flammable. If ignition occurs, this will be detected by detectors 23, 24, which may be of the infra-red type, and a signal will be generated for causing control unit 25 to actuate operator 22 for opening valve 21. Liquid nitrogen will then flow from dewar 11 to nozzle 35 and be sprayed therefrom in fine liquid droplet form into the tank ullage where it will vaporize and quickly dilute the oxygen in the ullage to the point where combustion ceases. Snuffing out of the fire is also facilitated by the fact that the nitrogen also cools the combustible gases. Furthermore, the nitrogen causes additional cooling of the ullage contents and material adjacent thereto to prevent or delay re-ignition after valve 21 has been shut off. Such cooling occurs very rapidly with the use of liquid nitrogen as described.

If valve 21 should fail to function when needed, or if it is automatically shut off by the timer in control unit 25 before the fire is extinguished, or if it is desired to introduce nitrogen into the protected space as a precautionary measure, valve 21 may be opened by manually depressing button 29. This manual operation is of special importance if the space to be protected against fire is within an engine nacelle, or surrounds a wheel brake, or is in any other location where a dangerous condition may be anticipated.

To assure that the nitrogen will reach nozzle 35 in liquid form, conduit 15 may be of sufficient flow capacity (diameter) and of short enough length so that the liquid will pass therethrough before ambient temperature causes complete vaporization of the same before it is discharged from nozzle 35. Some of the liquid nitrogen may vaporize within the conduit before it reaches the nozzle because the conduit, prior to initiation of flow therethrough, may be at a temperature higher than that of the liquid nitrogen.

We claim:

1. A system for preventing and/or extinguishing fire in a gaseous space within a closed container, comprising a dewar containing a cryogenic fluid, a portion of said fluid being in liquid form and another portion being in gaseous form that exerts pressure on the liquid, a conduit connecting the liquid containing portion of said dewar to a fog nozzle communicating directly with said space, said gaseous fluid providing the only source of pressure for moving said liquid from the dewar through the conduit and the fog nozzle to said space, said fog nozzle delivering said liquid to said space in finely divided liquid droplets, a valve in said conduit controlling flow of said cryogenic liquid from the dewar through said conduit to said fog nozzle, means for detecting a fire in said space and for opening said valve in response to said detection, and a one-way vent valve for venting excess gas from the container to prevent overpressurization of the container.

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