RE 26020

Feb. 6, 1962 D. POWELL 3,019,843

FIRE INHIBITOR AND EXTINGUISHER

Filed July 27, 1956 2 Sheets-Sheet 1

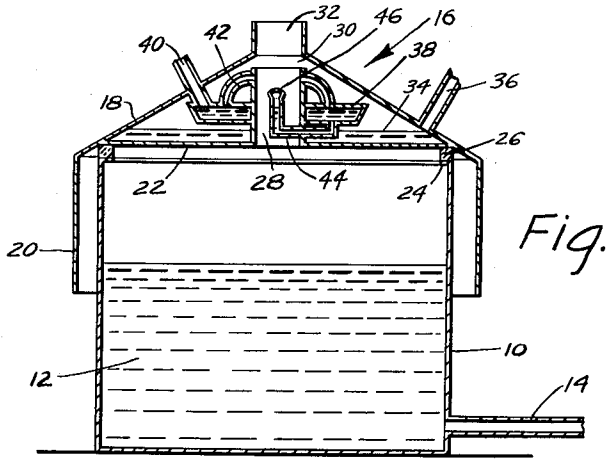

Fig. 1

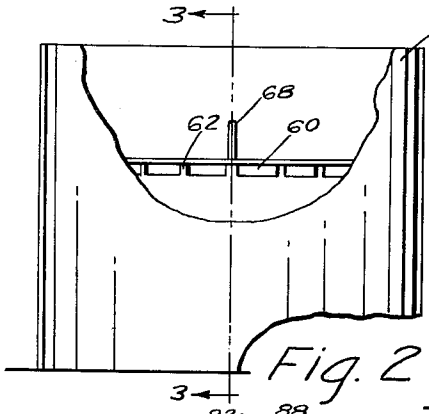

Fig. 2

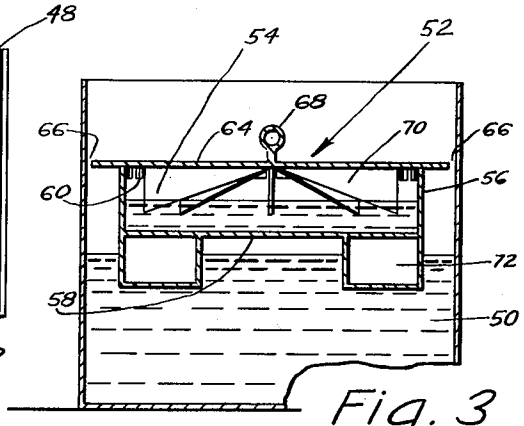

Fig. 3

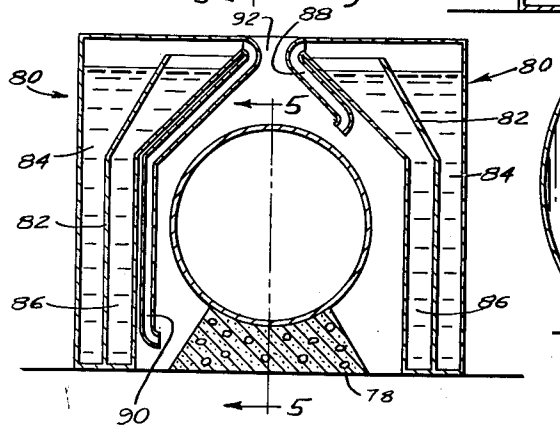

Fig. 4

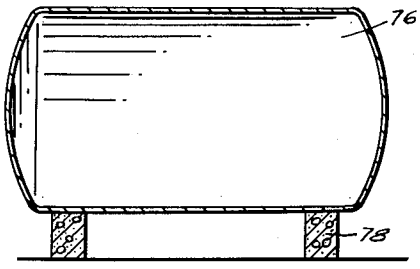

Fig. 5

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FIRE INHIBITOR AND EXTINGUISHER

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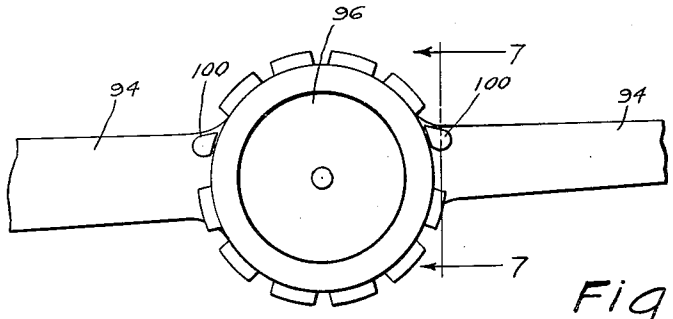

Fig. 6

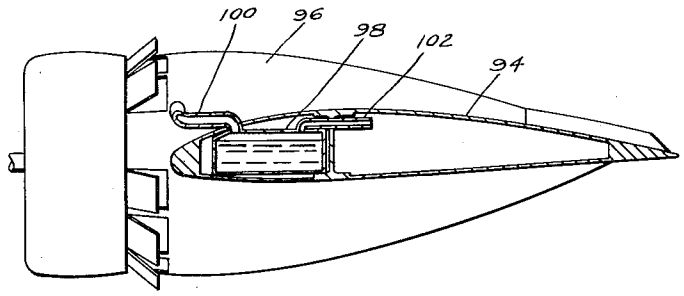

Fig. 7

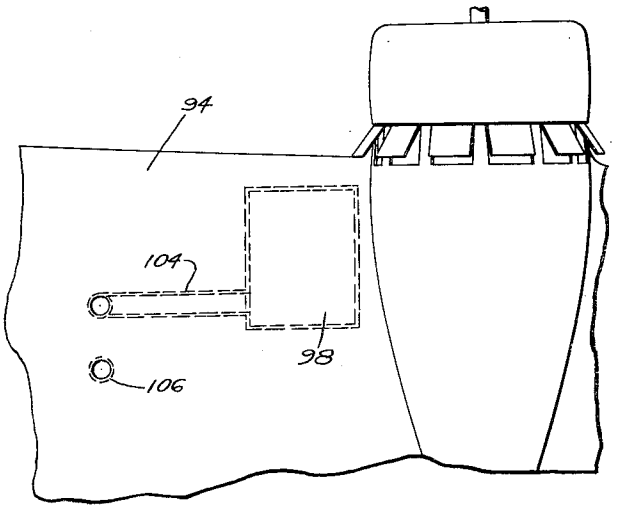

Fig. 8

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3,019,843

FIRE INHIBITOR AND EXTINGUISHER

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6 Claims. (Cl. 169—2)

The present invention relates generally to fire prevention and extinguishment, and has particular reference to fire control in connection with tank storage of flammable liquids and compressed flammable gases which are stored as liquids.

A primary object of my invention is the provision of means for preventing and/or extinguishing fires, such as are likely to be fed by vapors escaping from storage tanks for volatile petroleum liquids, oils, and LPG (liquefied petroleum gas) maintained in the liquid state by conditions of pressure and temperature.

Another object of the instant invention is the provision of means of the above described character which will be equally as effective with both horizontal- and vertical-type storage tanks, and which, in connection with the latter, may be utilized whether the tank has a closed or open top.

Another object of my invention is the provision of fire prevention and extinguishing means which may effectively be used wherever flammable liquids or gases are stored, some illustrative applications being household-size LPG storage tanks, small and large industrial-size LPG storage tanks, including so-called portable tanks, railroad LPG tank cars and other flammable liquid railroad tank cars, truck delivery tanks for animal, vegetable and mineral oils and LPG, oil-filled transformers, quench and dip tanks, and fuel tanks in airplane wings.

Another object of my invention is the prevention of flaming of the vapors of fuel dumped from airplanes while in flight.

A further object is the provision of fire prevention and extinguishing means wherein the very input heat which is necessary to initiate and sustain the fire is the actuating or triggering means for rendering operative the prevention and extinguishing means.

Still another object of the instant invention is the provision of fire prevention and extinguishing means which are practical and economically feasible to utilize in connection with a wide variety of applications, but which, nevertheless, are highly efficient in operation.

Other objects, features and advantages of the invention will become apparent as the description thereof proceeds when considered in connection with the accompanying illustrative drawings.

In the drawings which illustrate the best mode presently contemplated by me for carrying out my invention:

FIG.1 is a sectional view of a vertical, closed top, storage tank embodying my invention;

FIG. 2 is an elevational view of an open top, vertical storage tank embodying a slightly modified form of my invention, portions broken away for purposes of illustration;

FIG. 3 is a section taken on line 3—3 of FIG. 2;

FIG. 4 is a sectional view of a horizontal storage tank embodying the instant invention;

FIG. 5 is a section taken on line 5—5 of FIG. 4;

FIG. 6 is a fragmentary front elevation of an airplane wing and engine embodying my invention;

FIG. 7 is a section taken on line 7—7 of FIG. 6; and

FIG. 8 is a fragmentary bottom view of an airplane wing showing schematically an additional feature of the instant invention.

Heretofore it has generally been taught that three factors are involved in the initiation and continuation of

fire whenever a solid or liquid is the source of the flammable gas or vapor. Basically, these factors are heat, fuel, and oxygen. It is well known that fire can be prevented by the elimination of one of these factors, and that once started, fire can likewise be extinguished by the elimination of one of these factors. In accordance with the instant invention, however, it is contended that there are actually six observable or measurable factors involved in the life cycle of a fire and that elimination of any one of these six factors will serve to effectively prevent initiation and/or continuation of the fire. These six factors are:

(1) Input-heat;
(2) Fuel (a vapor or gas);
(3) Oxygen (from air);
(4) Proportioning;
(5) Mixing (for near-burning or remote-burning); and
(6) Ignition continuity

With the above factors in mind, it has been found desirable to control the initiation, spread and termination of fire by providing means for intercepting the input-heat before it reaches the flammable vapor or gas source whereby to prevent vaporization of the latter, without which flame is incapable of initiation. Furthermore, it is the basic concept of my invention to cause non-flammable vapor to mix with any flammable vapor that may result from only partial interception of the input heat, said mixture taking place before said vapors come in contact with the surrounding atmosphere or before the occurrence of ignition and to provide, where desirable, intercepting means which in itself is triggered by the input heat it absorbs to convert a non-flammable vaporizing liquid into its non-flammable vapors to to cause the release of non-flammable liquids, vapors or gases stored under pressure. As will be obvious, combustion will be prevented when the proportions of the resulting mixture contain a sufficiently high percentage of non-flammable components. While I prefer to dilute the flammable vapors, it will be understood that flame can be just as well prevented by diluting the oxygen supply with non-flammable gas or vapor before mixture thereof with the flammable vapors.

Referring now to the drawings, and more particularly to FIG. 1 thereof, there is shown a conventional metallic storage tank 10 having therein a supply of flammable liquid 12 such as gasoline, kerosene, or the like. Any desirable means, such as duct 14, may be provided for replenishing or removing the supply 12 from the tank 10. At the open upper end of tank 10 there is provided a combination cover and interceptor, constructed in accordance with the instant invention, and generally designated at 16.

The cover 16 is preferably constructed of any highly heat conductive metallic material and comprises a substantially conical roof 18 having a downwardly depending peripheral skirt 20 in spaced relation to the wall of tank 10. Cover 16 further comprises a bottom partition or wall 22 which seats on the upper edge of tank 10, it being understood that the latter may be provided with a marginal flange 24 in order to provide a sufficient base surface for receiving said cover 16. Preferably, a heat insulating layer 26 is interposed between partition 22 and flange 24.

Centrally disposed in partition 22 and communicating with the interior of tank 10 is a passageway or channel 28 which extends upwardly toward roof 16 but terminates in spaced relation thereto whereby to define an open area 30 which functions as a mixing chamber. As will be noted, the passageway 28 is in alignment with an outlet 32 carried by roof 16 and centrally disposed with respect thereto. Surrounding passageway 28 is a lower

reservoir 34 defined by partition 22 and roof 16, said reservoir having an inlet 36 extending through roof 16 in order to facilitate replenishment thereof. Located above reservoir 34 is a second reservoir or compartment 38, said compartment being enclosed and having an inlet 40, ducts 42 communicating with passageway 28, and a conduit 44 leading to a spray nozzle 46 located within said passageway. Preferably, a cover 16 is painted black whereby to establish maximum radiant heat absorption characteristics.

In operation and use, the reservoirs 34 and 38 are each filled with a vaporizing, non-flammable liquid, and preferably, reservoir 34 is filled with water, while compartment 38 is filled with carbon tetrachloride or the like. Actually, the specific liquids utilized are not critical so long as they are vaporizing and non-flammable, and accordingly, such liquids as monobromomonochlorodifluoromethane, methyl bromide, dibromodifluoromethane, dibromotrafluoroethane, bromochloromethane, as well as liquids of the "Freon" class, can be used, if desired. At any rate, no matter what liquids be utilized, it will be understood that as radiant input heat is directed toward tank 10, it will be intercepted by cover 16 and its depending skirt 20. Since the cover 16 is highly heat absorbent, as heretofore described, and since said cover makes contact with tank 10 only through the medium of heat insulating layer 26, it becomes apparent that the transfer of the input heat to the tank 10 proper is substantially minimized. In the meantime, the application of heat to the cover 16 causes vaporization of the non-flammable liquids contained in the reservoirs 34 and 38. As will be obvious, the non-flammable vapors from reservoir 34 will pass upwardly to mixing chamber 30 and thence outwardly through outlet 32, while the vapors from compartment 38 will pass through ducts 42 to passageway 28 and then upwardly and outwardly through said outlet 32. Since the only outlet for whatever vaporization that does take place of the flammable liquid in tank 10 is through passageway 28, it becomes obvious that said flammable vapors are thoroughly mixed in the mixing chamber 30 with a sufficient proportion of non-flammable vapors to render the effluent mixture non-flammable before said mixture comes in contact with the surrounding atmosphere and oxygen and a source of ignition. Thus it will be seen that I have provided an entirely self-contained unit which intercepts the radiant heat energy before it comes in contact with the flammable liquid and which further employs said heat for vaporizing a non-flammable liquid. The non-flammable vapors in turn are caused to mix with whatever flammable vapors do occur, before said mixture comes in contact with the surrounding atmosphere.

When a liquid such as "Freon" is used in compartment 38 wherein temperature rise causes rapid pressurization of same, I prefer to take advantage of this fact by wetting down, so to speak, the flammable vapors as they pass through passageway 28. Thus I have provided a conduit 44 for connecting compartment 38 with spray nozzle 46, the latter being located within the passageway 28, whereby as the temperature rises and the "Freon" in substantially enclosed compartment 38 becomes highly pressurized, non-flammable liquid spray will be forced into said nozzle and will spray therefrom, mixing with the effluent flammable liquid, vapors or gases. At the same time, the non-flammable vapors from the "Freon" will pass through ducts 42 into passageway 28, as aforedescribed.

Referring now to FIGS. 2 and 3, a slightly different application and construction of the instant invention is illustrated. More specifically, there is shown an open-top storage tank 48 having therein a supply of flammable liquid 50. A floating inhibitor generally designated at 52 is positioned on the upper surface of the liquid 50 and comprises a reservoir 54 having a continuous side wall 56 and a bottom wall 58. As will be seen most clearly in FIG. 2, the uppermost portion of side wall 56 is provided with a plurality of spaced openings 60 defining therebetween upwardly extending struts 62 on which is mounted a top wall 64 of slightly smaller peripheral dimension than tank 48 whereby to define an open area or mixing chamber 66 therebetween. The upper surface of top wall 64 is preferably black whereby to impart thereto maximum heat absorbing characteristics, and centrally secured thereto is a lifting ring 68. The under surface of wall 64 is provided with a plurality of radial, downwardly depending heat conductive fins 70. A plurality of flotation chambers 72 are secured to the lower surface of bottom wall 58 whereby the inhibitor 52 may be crane lifted into place within the tank 48 and will be floatingly received therein.

In operation, this form of my invention is quite similar to that described in connection with FIG. 1. More specifically, any desirable vaporizing non-flammable liquid is placed within the reservoir 54, whereby upon application of input heat to the unit, non-flammable vapors will flow outwardly through openings 60 and upwardly through mixing chamber 66. Since the flammable vapors from the liquid 50 also must pass through the space 66, said flammable vapors will be diluted by the non-flammable vapors before coming in contact with the surrounding atmosphere and oxygen. The dilution of the flammable vapors is such that the mixture is no longer flammable even when it is further mixed with air in the presence of a source of ignition.

Here again, the construction is such that much of the input radiant energy will be intercepted and absorbed by the inhibitor. Hence, the exposed top of the latter is preferably black, and the heat conductive fins 70 will function to cause quick transfer of the heat to the vaporizing, non-flammable liquid whereby to insure rapid vaporization of the latter. As will be obvious, my inhibitor 52 is, in effect, portable and may rapidly be positioned within any open tank should a fire develop. In addition to its fire extinguishing function, it will be understood that, if desired, the inhibitor 52 could also be permanently positioned within a tank in order to function as fire preventative means.

FIGS. 4 and 5 illustrate my invention as applied to horizontal storage tanks, and in this embodiment the basic principle is to automatically envelope the tank with a non-flammable vapor responsive to a sufficient application of input heat. Thus, the tank 76 is mounted on a pair of spaced concrete pedestals 78 and is positioned between a pair of substantially identical, longitudinally extending enclosures generally designated at 80. Each of the enclosures 80 is provided with a longitudinally extending partition 82 defining a pair of separate, open-top compartments 84 and 86. A plurality of ducts 88 extend from one of the enclosures and terminate adjacent the upper portion of tank 76, while a plurality of somewhat longer ducts 90 extend from the opposite enclosure and terminate adjacent the lower portion of said tank.

Briefly summarizing the operation of this form of my invention, the compartments 84 and 86 are filled with any vaporizing, non-flammable liquids, although I prefer to use water in the outer compartments 84. As will be obvious, the enclosures 80 will serve to intercept input heat directed toward the tank 76, and at the same time the application of heat to the enclosures will vaporize the liquids in the compartments 84 and 86, causing non-flammable vapor to flow through ducts 88 and 90 and substantially envelope the tank 76 whereupon any flammable vapor that may emanate from the latter will be rendered non-flammable before coming into contact with the surrounding air. In this respect, it will be noted that the enclosures 80 are designed to provide a relatively restricted passage 92 above the tank 76 whereby to better insure proper mixing of the non-flammable and flammable vapors or gases before they come in contact with the oxygen of the surrounding air.

While each of the aforedescribed illustrations of my invention works on the principle of diluting the hydro-

carbon before it comes in contact with the air, whereby the mixture will be non-flammable, it will be understood that the opposite approach can be utilized, if desired, with substantially the same results. More specifically, if the air or oxygen is sufficiently diluted before mixing with the hydrocarbon, flaming will be prevented. This specific approach is particularly adaptable in connection with aircraft fire prevention and extinguishment and may be readily applied to fuel-tank sections of airplane wings, engine sections, jet power pod sections, etc. Since the necessary radiant-heat absorbing areas can be built of very thin, light metal, the inclusion of my invention will add very little weight to an airplane wing structure, and, if desired, the web structures of the wings can be used to simultaneously serve the double function of providing strength for the wings and at the same time acting as containers for the non-flammable vaporizing liquid. Reservoirs, with connecting piping of small tubing, can be located in the main fuselage of the plane for replenishment of the non-flammable vaporizing liquid either by gravity or pressure feed.

Referring now to FIGS. 6 through 8, an illustrative embodiment of this form of my invention, as applied to aircraft usage, is shown. An airplane wing **94** having an engine **96** has provided within its web structure a lightweight metal container or reservoir **98**. Preferably, a pair of these containers or reservoirs are provided for each engine, and are located adjacent to and on opposite sides thereof. Conduit or tube **100** extends from each reservoir **98** and is directed toward the space surrounding the engine whereby when the reservoirs are filled with a vaporizing, non-flammable liquid, radiant heat from hostile fire around the engine **96** will cause vaporization of said liquid, and the non-flammable vapors will flow through conduit **100** and mix with the oxygen in the atmosphere surrounding the engine. This dilution of the oxygen renders the surrounding atmosphere non-flammable whereby hostile fire is prevented from spreading within the power pod or wing structure.

In order to further inert the atmosphere within the wing structure, a second conduit **102** discharges non-flammable vapors from reservoir **98** to the interior of the wing space. This is important since the engine fuel tanks are usually located within the wing structure and are normally subject to input heat from a hostile engine fire capable of vaporizing the contents of said fuel tank and thereby creating a serious fire hazard. By inerting the area surrounding these fuel tanks, near exposure to the radiant heat from flame is prevented.

In connection with this form of my invention just described, an additional tube or conduit **104** may be provided to carry vaporizing, non-flammable liquid from the container or reservoir **98** to a point adjacent the outlet **106**, through which fuel is dumped while the aircraft is in flight. More specifically, for any one of a number of reasons, it may become necessary or desirable to jettison the fuel supply of an aircraft in flight, and it will be understood that the high-speed air stream into which the fuel is dumped will cause atomization of the liquid, resulting in the formation of flammable vapors. Should the aircraft engine exhaust ever inadvertently come into contact with these flammable vapors, an explosion could conceivably occur with disastrous results. Accordingly, I prefer to render the jettisoned fuel non-flammable by causing it to mix with a proportion of vaporizing, non-flammable liquid prior to being introduced into the air stream. This can be most simply accomplished by causing vaporizing non-flammable liquid to flow from reservoir **98** through conduit **104** by gravity or pressure means (not shown) to a point adjacent and preferably ahead of fuel outlet **106**. The fuel opening and the opening from the proportioning conduit or tube may be closed by a remote control common cover (not shown) which closes and opens both of them simultaneously, or the closure of the tube may be opened thermostatically by the interception and absorption of radiant heat energy or by other means. When both ports are open, the effect will be to cause the non-flammable vaporizing liquid flowing from reservoir **98** to mingle with and flow confluently with the fuel from the aircraft's fuel tanks, resulting in both being atomized simultaneously in the high-speed air stream passing the outlets. The effect of such simultaneous atomization and vaporization of non-flammable vaporizing liquid and flammable vaporizing liquid will be the formation of a mixture of non-flammable and flammable components in proportions which are non-flammable in total when further mixed with the surrounding air, even in the presence of a source of ignition.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the underlying inventive concept and that the same is not limited to the particular forms herein shown and described except insofar as indicated by the scope of the appended claims.

I claim:

1. Apparatus for preventing and extinguishing combustion in open-top storage tanks for flammable liquids, said apparatus comprising a floatable compartment of slightly less peripheral dimension than the tank interior, said compartment being substantially enclosed with the exception of a plurality of outlet openings located adjacent the upper portion thereof, said compartment being adapted to receive therein a supply of vaporizing non-flammable liquid whereupon application of radiant heat to said tank will simultaneously cause vaporization of the flammable liquid therein and the non-flammable liquid in said compartment, said vapors mixing to produce a non-flammable mixture before contacting the surrounding air.

2. In the apparatus of claim 1, said compartment having an upstanding side wall and a top wall, said outlet openings being positioned at the upper end of said side wall and said top wall having a plurality of heat conductive fins extending into the compartment interior.

3. A non-combustible storage tank for flammable liquids and the like having a cover portion, an enclosed reservoir within said cover portion, a mixing area associated with said cover portion through which vapors and the like emanating from said tank must pass before reaching the surrounding atmosphere, and a passageway interconnecting said reservoir and said mixing area whereby vapors and the like emanating from said reservoir must also pass through said mixing area before reaching the surrounding atmosphere, said cover portion being insulated from said tank and having a skirt depending in spaced relation thereto.

4. Apparatus for preventing and extinguishing combustion in a storage container containing flammable material, said apparatus comprising a compartment located adjacent to said storage container, a supply of vaporizing, non-flammable material in said compartment, means associated with said compartment for intercepting a sufficient proportion of input heat directed toward said storage container from points outside said container to cause said non-flammable material to vaporize at least as soon as any vaporization of said flammable material takes place, and means causing said non-flammable vapors to mix with all said flammable vapors prior to mixing with the surrounding air whereby to cause a mixture which is non-ignitable by the temperature attained by the said input heat, said last mentioned means comprising a restricted mixing space through which said flammable and non-flammable vapors must pass before reaching the surrounding atmosphere.

5. A non-combustible storage container for flammable material and the like, a cover portion for said container defining a restricted mixing space through which flammable vapors from said container are free to pass to mingle with the surrounding air, said cover portion other-

wise blocking said flammable vapors whereby it is essential that they pass through said mixing space before reaching the surrounding air, an enclosed reservoir associated with said container, and means interconnecting said reservoir with said mixing space whereby vapors and the like emanating from said reservoir will be forced into said mixing space, said reservoir being associated with said cover portion so that heat absorbed by the latter will be directed to the former to cause vaporization and pressurization of its contents at least as quickly as vaporization of the stored flammable material takes place.

6. A method for preventing and extinguishing flaming combustion fed by fuel vapors or gases from flammable material within an enclosure and resulting from the application of input heat from an ignition source located externally of the enclosure, said method comprising the steps of intercepting and absorbing controlled proportions of the input heat from said ignition source, utilizing said intercepted and absorbed heat to cause the emission of non-flammable vapors or gases from non-flammable material held adjacent said enclosure, and mixing said non-flammable vapors or gases with all of the flammable vapors flowing out from the enclosure or with all the air flowing into the enclosure, prior to the mixing of said flammable vapors and air with each other, with the proportion of non-flammable gases or vapors being such that the resultant mixture of non-flammable and flammable gases or vapors and air is non-ignitable by the temperature attained from the said input heat, thus preventing ignition of the mixture whereby to inhibit spread of the fire to the flammable material within the enclosure.

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