May 8, 1951 T. D. WHIDDEN 2,552,472

SAFETY SYSTEM FOR TANKS CONTAINING INFLAMMABLE FLUIDS

Filed Feb. 11, 1946 3 Sheets-Sheet 1

Fig. 1.

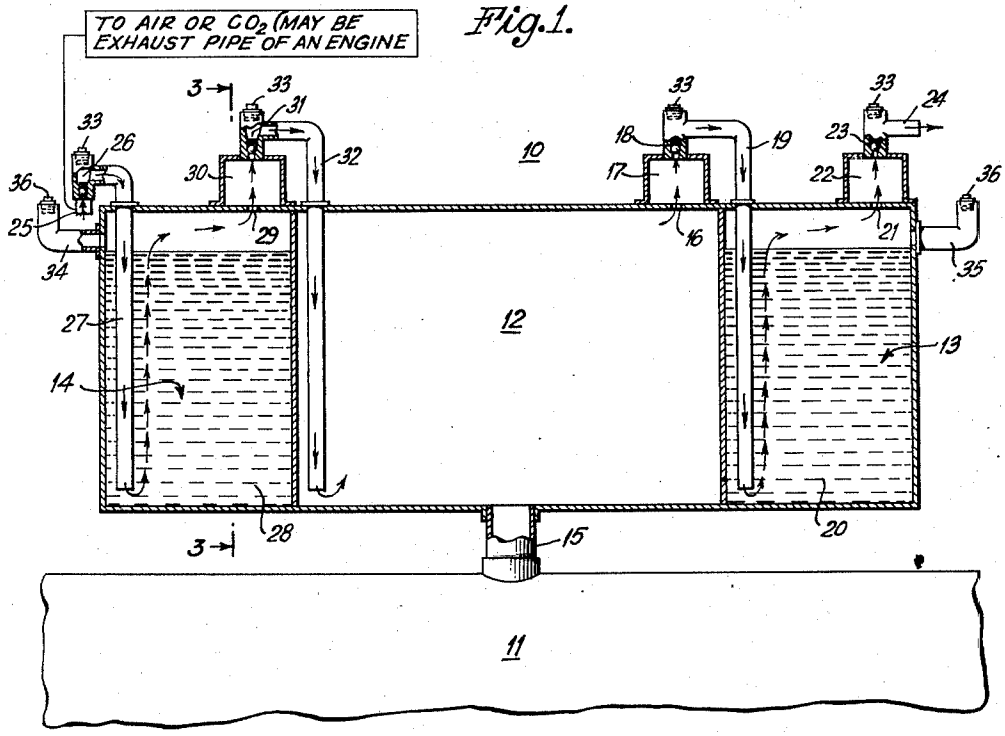


Fig. 2.

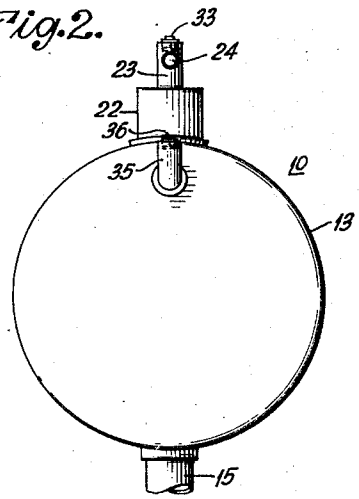
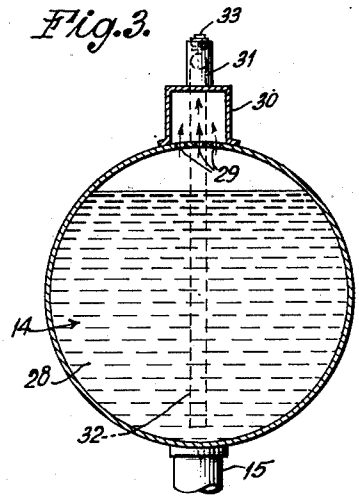


Fig. 3.



INVENTOR.
T. D. WHIDDEN
BY Hugh S. Wertz
ATTORNEY

May 8, 1951 T. D. WHIDDEN 2,552,472

SAFETY SYSTEM FOR TANKS CONTAINING INFLAMMABLE FLUIDS

Filed Feb. 11, 1946 3 Sheets-Sheet 2

Fig. 4.

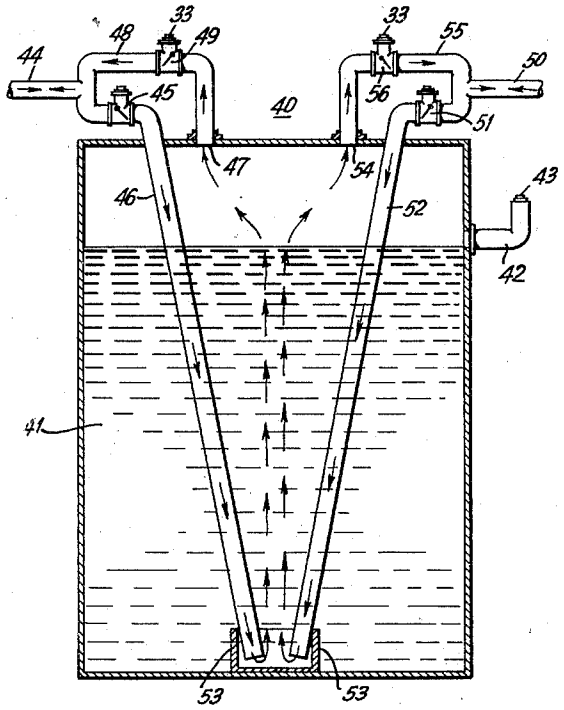
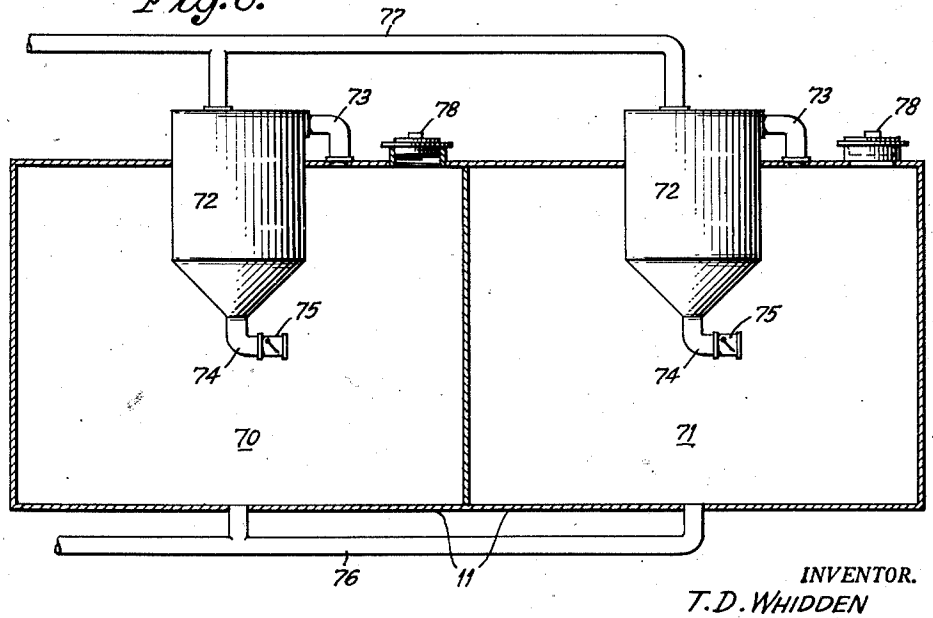


Fig. 6.



INVENTOR.
T. D. WHIDDEN
BY Hugh S. Wertz
ATTORNEY

May 8, 1951 T. D. WHIDDEN 2,552,472

SAFETY SYSTEM FOR TANKS CONTAINING INFLAMMABLE FLUIDS

Filed Feb. 11, 1946 3 Sheets-Sheet 3

Fig. 7.

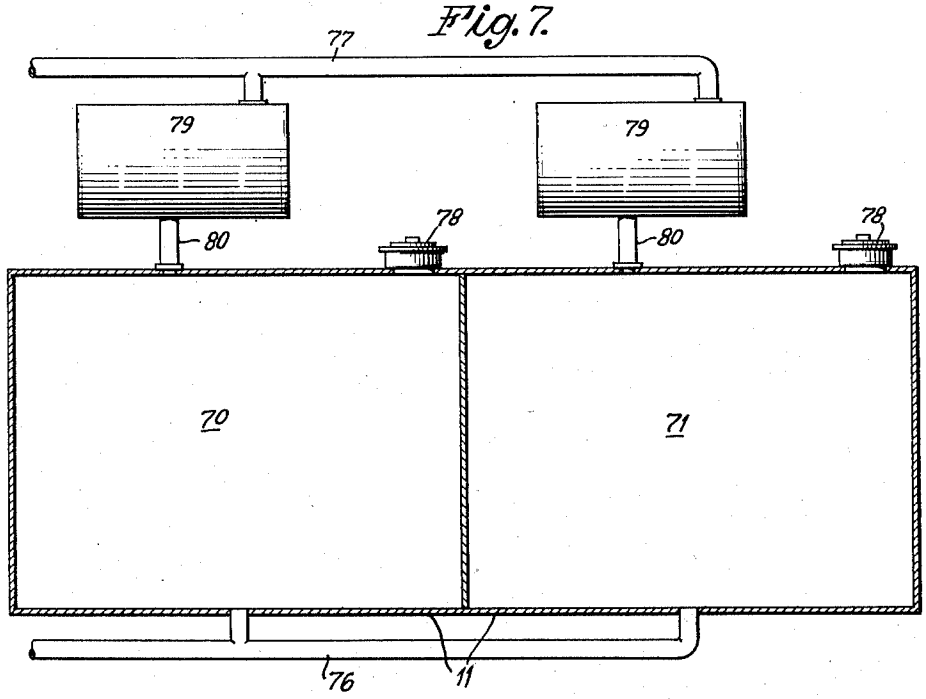
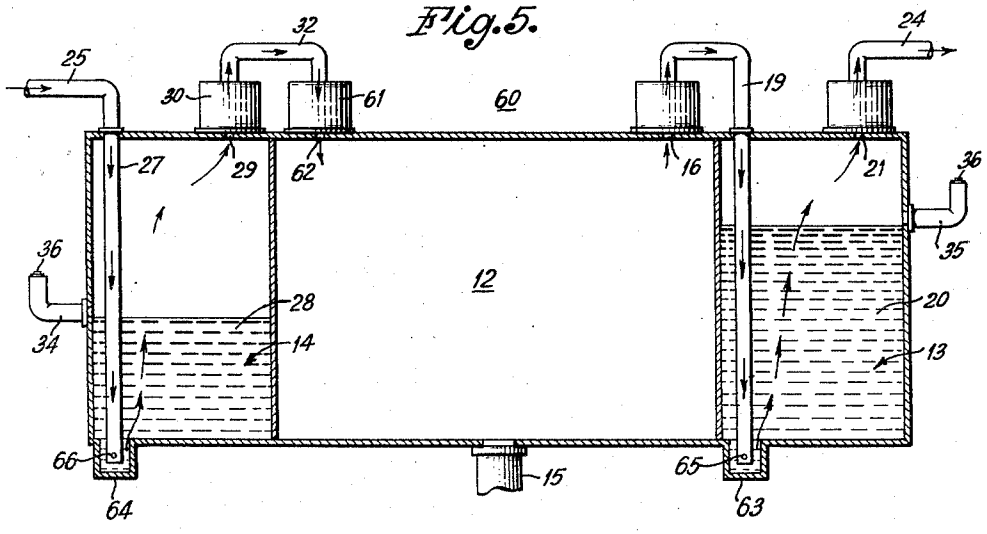


Fig. 5.



INVENTOR.
T. D. WHIDDEN
BY Hugh S. Wertz
ATTORNEY

Patented May 8, 1951 2,552,472

UNITED STATES PATENT OFFICE

2,552,472

SAFETY SYSTEM FOR TANKS CONTAINING INFLAMMABLE FLUIDS

Theron D. Whidden, Jacksonville, Fla.

Application February 11, 1946, Serial No. 646,921

11 Claims. (Cl. 220—88)

1

This invention relates to safety devices and more specifically to apparatus for protecting a tank containing an inflammable liquid or gas from fire or explosion.

It is an object of this invention to provide improved safety means for tanks containing inflammable fluids.

Tanks designed to carry gasoline or other inflammable fluids are subject to fire hazards and danger of explosion. For example, with increase in temperature, the fluid expands, increasing the pressure within the tank and making an explosion possible if proper venting means are not provided. Moreover, the expanded fluid may leak out of the tiny vent hole sometimes provided in the cover, causing fumes external of the tank which are liable to become ignited. Still another hazard is that of causing an ignition within the tank by a spark or flame sucked into the tank. The present invention relates primarily to the alleviation or removal of these hazards. While the invention will be described by way of example as applied to a tank for gasoline it will be readily apparent that it has other applications as well.

It is another object of this invention to provide novel means for preventing fire from entering a tank of inflammable fluid.

It is still another object of this invention to provide an improved fluid fuel tank arrangement which allows the inflammable fluid to expand with increase in temperature without danger of it leaking out.

It is a further object of this invention to provide novel and improved arrangements employing flame guard chambers and expansion chambers in connection with gasoline tanks and other tanks containing inflammable materials.

These and related objects are attained in accordance with the invention by providing as an illustrative embodiment thereof a novel arrangement of an expansion chamber and flame guard chambers for a gasoline tank of the saddle type. The expansion chamber is mounted on top of the fuel tank and connected to it by a short pipe through which excess fuel can reach the expansion chamber. Air or gas in the expansion chamber is expelled through a pipe line leading into a flame guard chamber which is partially filled with a non-inflammable liquid, the pipe line from the expansion chamber reaching under the surface of the liquid in the flame guard chamber. The air or gas bubbles up through the liquid and out through an exit line or pipe. By means of one or more check valves in the exit line, no air from the outside can enter this flame guard chamber. A second flame guard chamber is also provided, preferably placed on the side of the expansion chamber remote from the first flame guard chamber. This second flame guard chamber is provided with an inlet pipe or line leading beneath the surface of a non-inflammable liquid partially filling this chamber. As the fuel in the expansion chamber shrinks or is drawn off, it will drain back into the fuel tank and air will enter through the inlet pipe and be conducted to the bottom of the second flame guard chamber from whence it rises to the surface of the non-inflammable liquid and is conducted to the bottom of the expansion chamber. Check valves will prevent air from the expansion chamber being expelled through the second flame guard chamber. Instead of air, a gas which does not promote combustion, such as, for example, carbon dioxide, can be aplied to the inlet pipe.

2

Instead of two flame guard chambers, a single chamber combining the functions of the two chambers can be provided. This chamber is nearly filled with a non-inflammable liquid. It can be connected either to an expansion chamber or to the top of the main fuel tank to be vented.

While check valves are in some cases desirable, they are not always required. An arrangement in accordance with the invention employing no check valves combines simplicity of construction and operation (in that no moving parts are required) with reduced cost.

Instead of the expansion chamber being mounted outside the fuel tank, it can be placed at least partially inside it. If desired, the fuel tank can have a divided construction and two or more expansion chambers provided, one for each division of the fuel tank. These expansion chambers can be placed outside or at least partially inside the fuel tank.

While complete protection can be assured by using all three elements of the novel safety arrangement of this invention, namely (1) an expansion chamber or chambers preventing loss or waste of fuel and eliminating fire hazard outside the tank from overflow, (2) one or more flame guard chambers which positively prevent fire entering the tank of inflammable liquid or gas as long as the fill caps or drains are closed and the liquid seals are intact or partially filled, and (3) carbon dioxide or other non-inflammable gas to replace the air space in the tank above the level of inflammable fluid, great advantages

are produced even though one or two of these are omitted.

While several embodiments of the invention are described in detail below, it will be readily apparent that the invention is capable of a number of other embodiments as will be apparent from the description which follows.

The invention will be more readily understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which:

Fig. 1 is a vertical cross-sectional view of an arrangement in accordance with the invention suitable for mounting on a gasoline tank, the arrangement comprising an expansion chamber and two flame guard chambers;

Fig. 2 is an end view of the arrangement of Fig. 1;

Fig. 3 is a vertical cross-sectional side view of the arrangement of Fig. 1 taken in a plane through the line 3—3 of Fig. 1 looking in the direction of the arrows;

Fig. 4 is a vertical cross-sectional view of a single flame guard chamber which can replace both flame guard chambers of the arrangement of Fig. 1;

Fig. 5 is a vertical cross-sectional view of an arrangement in accordance with the invention which does not require check valves;

Fig. 6 shows another arrangement in accordance with the invention in which two expansion chambers are used with a divided gasoline tank; and

Fig. 7 illustrates a modification of the arrangement of Fig. 6.

Referring more specifically to the drawings, Figs. 1, 2 and 3 show, by way of example for purposes of illustration, a safety system 10, in accordance with the invention, for a tank 11 adapted to carry inflammable fluids such as gasoline, for example. The tank 11 can be of the saddle type used on motor trucks or it can be of the stationary type. While it will be described as holding fuel it will be understood that it could hold any type of inflammable fluid—either liquid or gaseous. The system 10 includes an expansion chamber 12, a first flame guard chamber 13, and a second flame guard chamber 14. These units can be of steel or any other suitable material.

The expansion chamber 12 is located above the tank 11 and connected to it by a short pipe 15. The purposes of the expansion chamber are (1) to protect the tank by preventing a rise in internal pressure caused by a rise in temperature, (2) to produce a saving of fluid from the main tank, and (3) to eliminate the fire hazard created outside the tank by overflow of fuel caused by expansion. When the fuel in tank 11 expands due to an increase in temperature, the fuel will rise into the chamber 12. Air or gas in this chamber will be expelled through the small openings 16 in the top of the chamber 12, through the small hollow chamber 17, check valve 18, and pipe 19 into the bottom of the first flame guard chamber 13 which is almost filled with a suitable non-inflammable liquid 20, such as water. The air or gas will bubble up through the liquid 20, as indicated by the arrows in the drawing, and pass through the opening 21 which leads to the small chamber 22 which is similar to the chamber 17. The chamber 22 is connected through a check valve 23 to an exit pipe 24. No air can enter the chamber 12 through pipes 24 and 19 as check valves 23 and 18 will close.

As the fuel or other inflammable liquid shrinks or is drawn off, that in the chamber 12 will drain back into the tank 11 through the pipe 15, or be otherwise retrieved, and air will enter through the inlet pipe 25 to the check valve 26 and the pipe 27 which extends nearly to the bottom of the chamber 14 which is nearly filled with a suitable non-inflammable liquid 28, such as water. The air will rise to the surface of the liquid 28 and enter the expansion chamber 12 through the openings 29 in the top of flame guard chamber 14, small chamber 30 (which can be similar to the chambers 17 and 22), check valve 31, and pipe 32 which extends almost to the bottom of the expansion chamber 12. The check valves 31 and 26 prevent air or gas from being expelled through the chamber 14 in the direction against the arrows shown in the drawing. The members 33 are screw plugs which are provided so that the check valves 18, 23, 26 and 31 can be inspected. Pipes 34 and 35 are for filling chambers 13 and 14 with water or other suitable liquid to a proper level, such as that just below the pipes 34 and 35. These latter pipes can be provided with screw plugs 36 similar to the plugs 33. The small chambers 17, 22 and 30 are provided so as to allow any splash of water or fuel to drain back instead of entering other chambers.

The inlet pipe 25 can be connected, if desired, to a copper or other pipe which leads to a suitable source of a gas which will not support combustion. Such a gas is carbon dioxide. It can be obtained, for example, by connecting the pipe 25 to the exhaust line or muffler of a gas engine. By this means the fuel tank is further protected from explosion in case of crash or rupture of the tank as the air space above the level of the fuel (either in the tank 11 or in the expansion chamber 12, depending on the height of the fuel) would then be filled with carbon dioxide instead of oxygen and gas fumes. If the flame guard chambers are inspected regularly and kept at least half full of a non-inflammable liquid, preferably one with a low evaporation point, and the fill caps of the fuel tank (and of the pipes 34 and 35) are kept tightened, it is practically impossible to set the fuel tank afire.

While the flame guard chambers and expansion chamber have been shown contiguous to one another in a single unit, it is, of course, possible to build them in separate units with longer connection lines, it being only necessary that the lower portion of the expansion chamber be high enough so that contracting fuel can drain back into the fuel tank.

Although two check valves have been provided for each vent line (valves 26 and 31 in the air or non-inflammable gas input line and valves 18 and 23 in the air and inflammable vapor output line) as a double precaution, only one in each vent line will frequently be found sufficient and in some cases (as will be pointed out below) no check valves at all are required. If spring loaded check valves are provided, a pressure of gas higher than nearly atmospheric pressure can be used.

One or more flame guard chambers can be used without the expansion chamber and still serve the purpose of fireproofing the tank. For example, assume the chamber 13 is connected directly to the pipe 15. If the tank 11 becomes filled with fuel or the fuel expanded, the fuel passes into the chamber 13 but as it does not mix with the water in this chamber it rises to the surface and is expelled through the pipe 24

(where it can be retrieved by any suitable means). Thus a fire hazard is created only at the expelling point as fire cannot pass through the flame guard chamber 13 to the tank 11. Similarly, the expansion chamber 12 can be used without the flame guard chambers, examples of such use being given below. The various chambers can be manufactured separately or integral with one another and/or with the fuel tank 11.

Fig. 4 shows a flame guard chamber 40 which combines the features of the two flame guard chambers 13 and 14. The chamber is partially filled with a non-inflammable liquid 41 through a pipe 42 having a plug 43 therein. A first terminal pipe 44 is connected to the atmosphere or to a suitable source of carbon dioxide or other gas which discourages combustions and this pipe is connected through check valve 45 to a pipe 46 leading almost to the bottom of the chamber 40. An opening 47 in the top of the chamber permits air or gases to flow back to the pipe 44 through pipe 48 having a check valve 49 therein. A second terminal pipe 50 is connected either to an expansion chamber, like the chamber 12, or directly to the fuel tank 11. The terminal 50 is connected through a check valve 51 to the pipe 52 (similar to the pipe 46). The two pipes 46 and 52 are supported in the chamber 40 by means of brackets 53. A second opening 54 in the top of the chamber is connected by means of pipe 55 having a check valve 56 therein to the terminal pipe 50. The operation of the chamber 40 is as follows:

When the fuel is expanding, the fumes will pass through pipe 50, check valve 51, pipe 52, the liquid 41, opening 47, pipe 48 and valve 49 and be ejected from pipe 44. When the fuel is contracting, air or carbon dioxide will be drawn in pipe 44 and pass through check valve 45, pipe 46, the liquid 41, opening 54, pipe 55 and check valve 56 and be conducted through pipe 50 into the expansion chamber 12 or fuel tank 11. In this arrangement, there are separate openings allowing passage of air or gas only one way through the system. Explained another way, there are four separate openings into the flame guard system allowing a complete passage of air or gas one way only. An advantage of this basic principle is that there is thereby maintained in the flame guard chamber 13 or 40 the highest possible level of water which is important as this reduces the vapor space near the exit where it can burn.

Fig. 5 shows an arrangement 60 like that of Fig. 1 except that it is much more simple since all check valves have been removed. Elements in Fig. 5 which are similar to those in Fig. 1 are given the same reference characters. Water pockets 63 and 64 are provided so that the smallest amount of water can seal the tubes or pipes 27 and 19. Also holes 65 and 66 can be provided near the bottom of the pipes 19 and 27, respectively, to allow smaller bubbles to rise causing less agitation on the surface of the water. By making the level of the liquid 28 in the flame guard chamber 14 lower than of the liquid 20 in the chamber 13, the flow of air and gases will be only in the direction indicated by the arrows, thus doing away with the necessity of having check valves. Instead of the pipe 32 extending down into the chamber 12 as in Fig. 1 it may terminate in a chamber 61 which has an opening 62 at the bottom thereof. The operation of the arrangement of Fig. 5 is as follows: If suction were applied at pipe 15 (as would be the case when replacing liquid with air in the main tank) the same amount of suction would be applied on pipes 27 and 19. This would lift the water up in pipe 19 and would pull the water down in pipe 27 the same amount as the distance from the surface of the water to the bottom of pipe 27 is less than the distance from the surface of the water to the top of pipe 19. Air would enter the flame guard chamber 14 before water is sucked out of flame guard chamber 13.

If pressure were applied at pipe 15 it would lift the water in pipe 27 and force the water down in pipe 19 as the distance from the surface of water to bottom of pipe 19 is less than the distance from the surface of the water to the top of the pipe 27. Therefore air would pass out into chamber 13 before water is expelled from pipe 27. Thus the heights of the water in the tubes act as check valves to some extent. If the same water level were used in both chambers they would be in perfect balance. This would not destroy the purpose of the system as expansion in the tank would push water out of line 27 providing line 19 were higher until the balance were broken or overcome. The only disadvantage would be in the opposite operation as suction because of removing fuel from main tank would lift water in pipe 19 causing some to flow over into the expansion tank and into the main fuel tank until the balance were broken.

Figs. 6 and 7 show modifications suitable for divided tanks but it will be obvious that some features are applicable to single chamber tanks as well. In Fig. 6 the tank 11 comprises two divisions 70 and 71. Partially within each of the divisions is an expansion chamber 72. Each of these chambers has an inlet pipe 73 opening into the top of the fuel tank 11 and a drain pipe 74 having a check valve 75 therein. A drain 76 is provided for the tank 11 and the expansion chambers 72 have their upper portions connected to the pipe 77 which is a vent line to a flame guard chamber or to the atmosphere or to a source of carbon dioxide. Caps 78 are provided to fill the divisions 70 and 71. The expanded fuel flows into the chambers 72 and when it contracts it flows back into the tank 11 through the check valves 75. In Fig. 7, the expansion chambers 79 are placed above the divisions 70 and 71 and the pipes 80 serve as passageways between the chambers and the divisions of the fuel tank. With this construction, no check valves are required. A continuation-in-part of the present application, Ser. No. 125,139, filed November 2, 1949, contains subject-matter related to Figs. 6 and 7.

Various other modifications are possible without departing from the spirit of the invention, the scope of which is indicated in the appended claims. In the claims, the term "gas" is intended to include a mixture of gases, such as air.

What is claimed is:

1. An expansion chamber for a tank containing an inflammable fluid comprising a hollow container provided with means independent of the tank filler opening for connecting the container to said tank in such a way that when fluid in said tank expands or overflows it flows into said container and when the fluid later contracts in volume that which flowed into the container is retrieved, means for admitting a non-inflammable gas into said container through one opening therein when the fluid is being reduced in volume, and means for directing the flow of said gas from said container through a second open-

ing therein when the fluid is being increased in volume, each of said admitting and directing means having a check valve therein.

2. An expansion chamber for a tank containing an inflammable fluid comprising a hollow container provided with means independent of the tank filler opening for connecting the container to said tank in such a way that when fluid in said tank expands or overflows it flows into said container and when the fluid later contracts in volume that which flowed into the container is retrieved, means for admitting a non-inflammable gas into said container through one opening therein when the fluid is being reduced in volume, and means for directing the flow of said gas from said container through a second opening therein when the fluid is being increased in volume, said admitting means comprising a pipe extending from an entrance terminal outside said container to an open-ended exit terminal near the bottom thereof.

3. An expansion chamber for a tank containing an inflammable fluid comprising a hollow container provided with means independent of the tank filler opening for connecting the container to said tank in such a way that when fluid in said tank expands or overflows it flows into said container and when the fluid later contracts in volume that which flowed into the container is retrieved, means for admitting a non-inflammable gas into said container through one opening therein when the fluid is being reduced in volume, and means for directing the flow of said gas from said container through a second opening therein when the fluid is being increased in volume, said admitting means comprising a pipe extending from an entrance terminal outside said container to an open-ended exit terminal near the bottom thereof, and said directing means comprising a smaller container at the top of said hollow container with an opening between the two containers and an exit pipe connected to the smaller container, the pipe in said admitting means and said exit pipe each having a check valve therein.

4. A flame guard system for a tank containing an inflammable fluid comprising a hollow chamber adjacent the tank and having connecting means thereto, a non-inflammable liquid in said chamber, means for bubbling a non-inflammable gas through said liquid and into the connecting means, and means separate from said bubbling means for expelling inflammable gases from said tank, said connecting means and said bubbling means each having a check valve therein.

5. A flame guard system for a tank containing an inflammable fluid comprising a hollow chamber adjacent the tank and having connecting means thereto, a non-inflammable liquid in said chamber, a first pipe extending from outside said chamber to a point near the bottom thereof, a second pipe also extending from outside said chamber to a point near the bottom thereof, means for directing through a check valve a non-inflammable gas to the first of said pipes, means for directing through a second check valve inflammable fumes from said tank to the second of said pipes, and two pipes for respectively connecting each of said directing means to an opening in the top of said tank, each of said pipes having a check valve therein.

6. A safety system for a tank containing an inflammable fluid, comprising a hollow closed container adapted to be positioned so that its lower portion is at a higher level than at least

the lower portion of said tank, an inlet pipe in the bottom of said container adapted to communicate with the upper portion of said tank in such a manner that when fluid in said tank expands or overflows it flows into said container and, upon the contraction of said fluid, it returns by gravity to said tank, means for admitting non-inflammable gas into said container, a flame guard chamber adjacent said hollow container adapted to contain non-inflammable liquid, a pipe between the upper portion of said container and the lower portion of said chamber below the liquid level, and a gas outlet from said chamber positioned above said liquid level.

7. The combination of elements as in claim 6 in which said means for admitting non-inflammable gas into said container includes a second flame guard chamber adjacent said hollow container and communicating therewith, said second flame guard chamber having an inlet opening for non-inflammable gas.

8. The combination of elements as in claim 6 in which said means for admitting non-inflammable gas into said container includes a second flame guard chamber adjacent said hollow container and communicating therewith, said second flame guard chamber being adapted to contain non-inflammable liquid and including an inlet pipe for non-inflammable gas extending below the liquid level.

9. A safety system for a tank containing an inflammable fluid comprising an expansion chamber adapted to communicate with the upper portion of said tank through a pipe positioned to permit gravity feed from said expansion chamber to said tank, means for creating a circulation of gas through said expansion chamber, said means including inlet and outlet openings for said chamber, both of which openings are separated from said pipe and from each other, a flame guard chamber adjacent said expansion chamber adapted to contain non-inflammable liquid, a pipe between the upper portion of said expansion chamber and the lower portion of the flame guard chamber below the liquid level, and a gas outlet from said flame guard chamber above the liquid level.

10. A safety system for a tank containing an inflammable liquid comprising an expansion chamber adapted to be normally free of liquid but which is provided with means independent of the tank filler opening for conducting overflow and expanded liquid from said tank into said chamber and for returning by direct gravity feed said liquid to said tank when there is room therefor in the tank, and two flame guard chambers respectively placed on opposite sides of said expansion chamber, said expansion chamber having two openings communicating respectively with openings in said flame guard chambers, each of said flame guard chambers having non-inflammable liquid therein and each having an individual opening therein other than the opening communicating with said expansion chamber.

11. A safety system for a tank containing an inflammable liquid comprising an expansion chamber adapted to be normally free of liquid but which is provided with means independent of the tank filler opening for conducting overflow and expanded liquid from said tank into said chamber and for returning by direct gravity feed said liquid to said tank when there is room therefor in the tank, and two flame guard chambers respectively placed on opposite sides of said expansion chamber, said expansion

chamber having two openings communicating respectively with openings in said flame guard chambers, each of said flame guard chambers having non-inflammable liquid therein and each having an individual opening therein other than the opening communicating with said expansion chamber, the level of liquid in one of said flame guard chambers being lower than the level in the other.

THERON D. WHIDDEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
57,479	Church	Aug. 28, 1866
1,901,576	Atwell	Apr. 25, 1927
1,974,034	Pelleriti	Sept. 18, 1934
2,375,834	Walker	May 15, 1945

FOREIGN PATENTS

Number	Country	Date
467,334	Great Britain	June 14, 1937