Dec. 14, 1954 T. D. WHIDDEN 2,696,931

SAFETY EQUIPMENT FOR FUEL TANKS

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Fig. 1

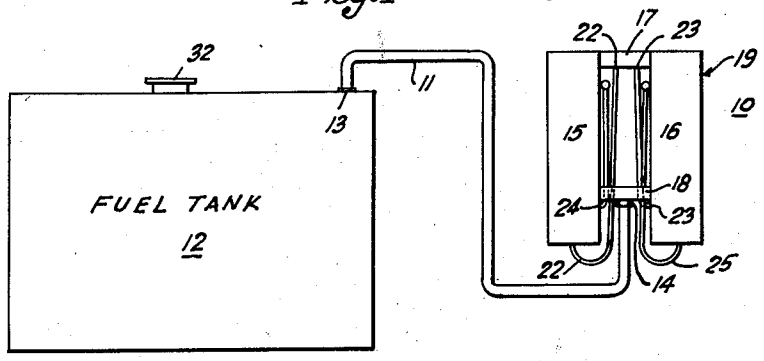


Fig. 2

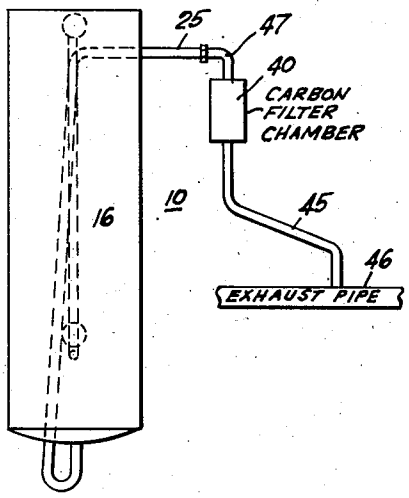
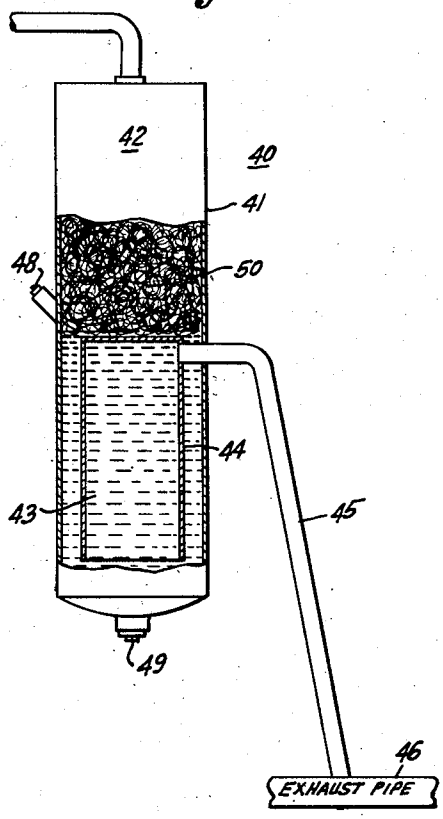


Fig. 3



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Fig. 4

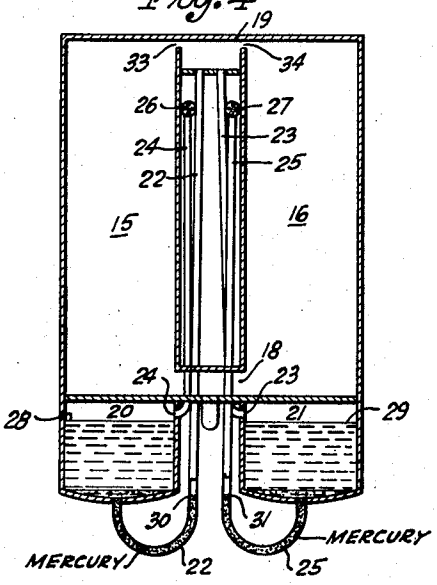


Fig. 5

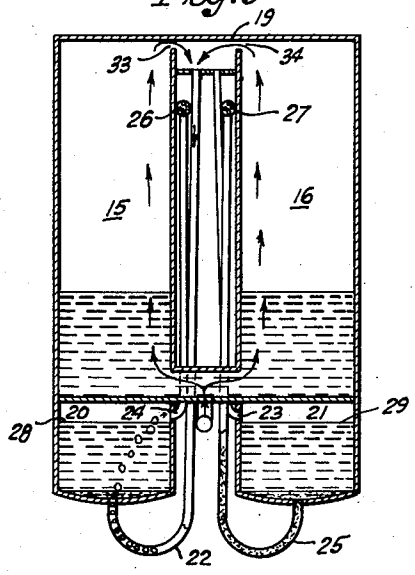


Fig. 6

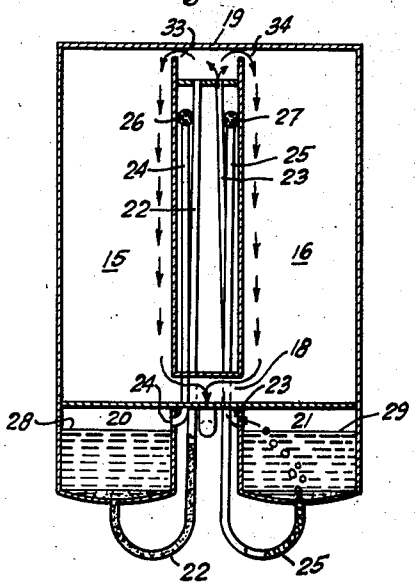
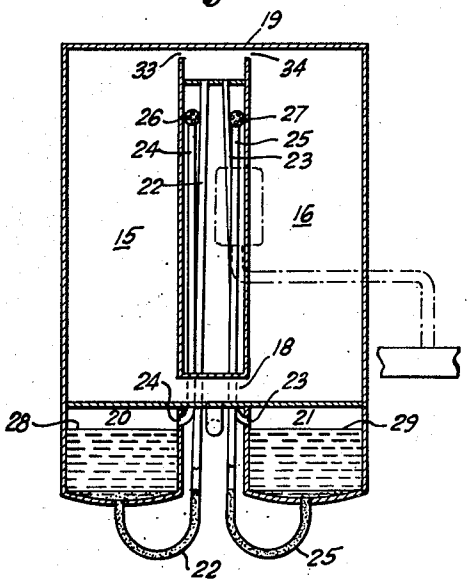


Fig. 7



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SAFETY EQUIPMENT FOR FUEL TANKS

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Application November 2, 1949, Serial No. 125,140

8 Claims. (Cl. 220—88)

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

A copending application of the present inventor, Serial No. 646,921, filed February 11, 1946, now Patent No. 2,552,472, discloses various fuel tank safety arrangements which have many advantages. The present invention also relates to such safety arrangements and employs features which produce even greater safety in certain circumstances and which have other advantages as well.

It is an object of the present invention to improve the safety of tanks containing inflammable gas or liquid, particularly fuel tanks for trucks and the like.

One of the most common causes of fires on automotive equipment is fuel line breakage between tank and fuel pump. This often allows the fuel to be siphoned out of a broken line and, if this fuel becomes ignited, serious damage is caused. Moreover, in the case of wrecks or tipping over of the equipment, many fires are caused by fuel leakage from the present vents of the inverted tanks. This danger is so well recognized that certain fire underwriters require that vents be fitted with a ball-type check valve which is supposed to seat or close when the tank is inverted. In many cases, these valves fail to function because of their infrequent use and because they are more often than not seriously corroded. Furthermore, there is an additional hazard—that of the danger of the tank exploding—if they do succeed in closing, because the tank has no means of relieving its internal pressure (caused by the expansion of the gases therein due to increase in temperature) if fire does come in contact with the tank. While this danger is recognized, a very poor arrangement has been offered to overcome this hazard, that is, an alloy metal of low melting point is employed in the head of the ball check and this alloy is supposed to melt and relieve the pressure. Unfortunately, however, all too often the fire menacing the tank is sufficiently remote from the valve so that the heat will not melt the seal quickly enough to prevent tank explosion resulting from the tremendously increased internal pressure.

It is, accordingly, another object of this invention to prevent, more efficiently than it has been accomplished in the past, leakage of fuel from the vent in the event of the equipment tipping over, or leakage of fuel from broken fuel lines between the tank and fuel pump.

The above and related objects are attained in accordance with the invention by providing a novel expansion chamber arrangement employing liquid type check valves and, in particular, using mercury as a valve seal. Moreover, there is provided in combination with the expansion chamber and liquid type check valves a liquid carbon filter chamber as an improved means for conducting engine exhaust gases into the fuel tank for replacement of fuel when the latter is being used for engine consumption. The arrangement of the invention is of great importance because it is completely automatic in operation and requires no manual or mechanical valves, no pumps that require starting or servicing, or manual drains to open to discharge condensed water vapor while in transit.

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 shows in elevation a fuel tank and connected thereto a self-contained safety vent unit in accordance with the invention;

Fig. 2 shows the manner in which the self-contained

safety vent unit of this invention is connected to an exhaust pipe through a carbon filter chamber forming part of the unit;

Fig. 3 is an elevation view, to a somewhat larger scale, of the carbon filter chamber shown in the arrangement of Fig. 2; and

Figs. 4 to 7, inclusive, are elevational sectional views of the safety vent unit of this invention at various stages in its operation.

Referring more specifically to the drawings, Fig. 1 shows, by way of example for purposes of illustration, a self-contained safety vent unit **10** in accordance with the invention connected by means of a pipe or tube **11** to a fuel tank **12** for automotive equipment and the like. Obviously, the invention is not limited to the type of tank **12** to which the unit **10** is connected. The safety unit **10**, which will be described in detail below, is mounted in the upright position (shown in Fig. 1) and fastened securely to a frame, bulkhead or wall. The pipe **11** is connected between the vent opening **13** in the top of the fuel tank **12** and to the fitting **14** on the safety device **10**. The unit **10** can be mounted anywhere just so long as no portion of the device **10** is lower than the bottom of the tank **12**.

The device **10** comprises (see Fig. 4 as well as Fig 1) a pair of cylindrical tanks **15** and **16** which are joined together at top and bottom to form a top passage **17** and a bottom passage **18**. In effect, tanks **15** and **16** form a single chamber **19** into which the fuel in the tank **12** can expand if the temperature rises, the fuel passing through opening **14** into the expansion chamber **19**. Also forming a part of the device **10** are the flame guard or arrestor chambers **20** and **21** which can be cylindrical in shape and positioned below the tanks **15** and **16**. The bottom of chamber **20** is connected to the top passage **17** of expansion chamber **19** by pipe **22** while the top of chamber **21** is connected to the passage **17** by pipe **23**. The upper part of chamber **20** is connected to an outlet pipe **24** while the lower portion of chamber **21** is connected to an inlet pipe **25**. Plugs **26** and **27**, respectively, can be used to cap the open ends of pipes **24** and **25**. These plugs or caps **26** and **27** are not intended to close outlet pipe **24** and inlet pipe **25** completely. These caps have small openings in their heads to act as screens to prevent insects from entering the pipes and causing stoppage. The chambers **20** and **21** are filled to substantially the levels **28** and **29** shown in Fig. 4 with a suitable non-inflammable liquid, such as glycerine, which will mix readily with water but not with gasoline. It also has the viscosity and specific gravity required. A predetermined amount of mercury, such as one fourth pound of mercury for each one half pound of glycerine, for example, is placed in each chamber **20** and **21** and this mercury sinks into the pipes **22** and **25** and rises therein as far as the levels **30** and **31**, respectively. The chambers **20** and **21** are then sealed (as by replacing plugs (not shown) closing openings through which the glycerine and the mercury are poured), the fuel tank **12** is filled and the fill cap **32** is screwed on tight. In order to detect any leaks, the operator can blow into line **25** with the mouth or a small hand pump while soap suds are spread around all fittings. Air bubbles around the fittings indicate leaks.

Before describing the operation of the chambers **15**, **16**, **20** and **21** and their associated connections, reference will first be made to Fig. 3 which discloses a carbon filter chamber **40** in accordance with the invention and to Fig. 2 which shows such a filter chamber used with and forming a part of the safety equipment **10**. The device **40** comprises a tank **41** having an upper portion **42** filled with steel wool or similar material **50** and a lower portion **43**. In the lower portion **43** is a bell chamber **44** to which is connected pipe **45** from the exhaust pipe **46** of the vehicle carrying the fuel tank **12**. The upper part of the tank **41** is connected by pipe **47** to the pipe **25**. A filler plug **48** is provided in the side of the device **40** and a drain plug **49** in the bottom thereof. The chamber **41** is filled to the level of the filler plug **48** with glycerine or similar liquid. The carbon filter chamber **40** and the pipe line **45** become a condenser causing the water vapor in the exhaust pipe to condense and become water. This water and carbon

particles from the exhaust become trapped in the lower part 43 of the filter, the gases rising to the surface of the device 40 and then through the line 25 when the mercury or liquid column becomes unbalanced (as will be pointed out more fully below in connection with Figs. 5 and 6) or when the liquid valve opens.

Reference will now be made to Figs. 4 to 7, inclusive, which show various stages of operation of the device 10.

Fig. 4 shows the safety device 10 immediately after the attached gas tank 12 has been filled. The safety device is neutral, mercury and glycerine seals in chambers 20 and 21 and lines 22 and 25 are balanced. The tank is neither at a vacuum nor a pressure stage.

Fig. 5 shows the safety device 10 in a pressure or expansion state. Fuel in the tank 12 has changed temperature and is expanding. The liquid fuel passes through opening 14 into expansion chamber 19 which holds for example, approximately 11 pints of the expanded fuel. This expansion causes the air in the chamber 19 to be forced through openings 33 and 34 into passage 17 and overbalance the seal in chamber 20, allowing air to pass through the line 22 in small bubbles through the mercury and glycerine, going out through line 24 into the atmosphere.

Fig. 6 shows the safety device 10 in a vacuum or contraction stage which occurs when the fuel contracts or is drawn from the fuel tank 12, thus causing the seal in chamber 21 to become overbalanced allowing the air or inert gases to be drawn into line 25 and pass through the mercury and glycerine in small bubbles into line 23, through the openings 33 and 34 into chamber 19 and down through opening 14 into the fuel tank 12.

Fig. 7 shows the safety device with the carbon filter chamber 40 attached and using inert gases from the engine exhaust 46 as shown in Figs. 2 and 3. Chamber 19 becomes a reservoir for inert gases to supply the fuel tank 12 whenever there is a decrease of temperature and the engine is not in operation. The filter chamber 40 automatically expels any excess water out the lines 45 and 46. Since the flow of gas is periodic due to opening and closing of the liquid valves, any excess water will rise higher in chamber 42 during inhaling and this height or weight of liquid will force itself into bell chamber 44 and out line 45 to the exhaust pipe 46 as soon as inlet flow is interrupted. The bell chamber 44 is arranged to prevent the natural expansion of gases from forcing all of the liquid out line 45 as, when expansion forces all of the liquid out of chamber 42, the bell chamber 44 is still full and air or gas will pass through this liquid and escape out line 45. Now in the reverse operation, the inlet flow of exhaust gas forces all of the liquid out of the bell chamber 44 into chamber 42 allowing the passage of air or gas upward through the liquid, thus washing the gas and depositing carbon, which settles below bell chamber 44. This chamber also is a flame and spark arrestor, thus assisting the chambers 22 and 25. The metal or fiber wool 50 in chamber 42 serves to collect the splash of liquid and allow it to drain off below and also to condense water vapor in gases and for further collection of fine carbon compounds in the gases.

It will be evident that there has been described above an expansion chamber 19 which offers a space for expansion of fuel and splash of fuel from the tank 12, that retains this splash and expansion and that cannot be filled by human carelessness; furthermore, it offers both inhaling and exhaling means and also affords means for returning the splash, expansion and condensation of vapors to the fuel tank 12, assists in the entrapment of fuel in case the vehicle tips over and offers a reservoir for non-combustible gases. A multiplicity of other advantages will be apparent to those skilled in the art.

While the present invention has been described in terms of a preferred illustrative embodiment, it will be realized that the invention and its several features are susceptible of embodiment in a wide variety of other forms and hence the invention is to be understood as comprehending such other forms as may fairly come within the spirit and letter of the claims.

What is claimed is:

1. A safety vent unit for a fuel tank comprising an expansion chamber separated from the tank and adapted to be connected to the upper part thereof, said expansion chamber comprising a pair of vertically-disposed cylindrical tanks having passageways therebetween at the top and bottom thereof, means for connecting the bottom passageway to said fuel tank, a pair of flame arrestor chambers located under said cylindrical tanks, respectively, a pair of tubes for connecting said top passageway respectively to the under portion of one of said flame arrestor chambers and to the upper portion of the other, and respective connections from said two flame arrestor chambers to the atmosphere for pressure and vacuum relief.

2. The combination of elements as in claim 1 with a layer of mercury in each of said flame arrestor chambers.

3. The combination of elements as in claim 1 with layers of mercury and of another liquid in each of said flame arrestor chambers.

4. The combination of elements as in claim 1 with layers of mercury and of glycerine in each of said flame arrestor chambers.

5. The combination of elements as in claim 1 with a carbon filter chamber connected between one of said respective connections and a source of inert gas containing carbon particles to be removed.

6. A safety vent unit for a fuel tank comprising an expansion chamber separated from the tank, said chamber being normally free of liquid and adapted to have its lower portion connected to the upper portion of said tank, liquid pressure relief and vacuum relief chambers adjacent said expansion chamber and each relief chamber having a mercury column therein, means connecting the top of said expansion chamber through the mercury column in the liquid pressure relief chamber to the atmosphere, and means connecting the top of said expansion chamber through the mercury column in the liquid vacuum relief chamber for entrance of air or other gases.

7. The combination of elements as in claim 6 in further combination with a layer of a liquid other than mercury in each relief chamber to prevent mercury splatter.

8. The combination of elements as in claim 6 in further combination with a layer of glycerine in each relief chamber to prevent mercury splatter.

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