

March 19, 1940.

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SAFETY APPARATUS

Filed June 20, 1938

2 Sheets-Sheet 1

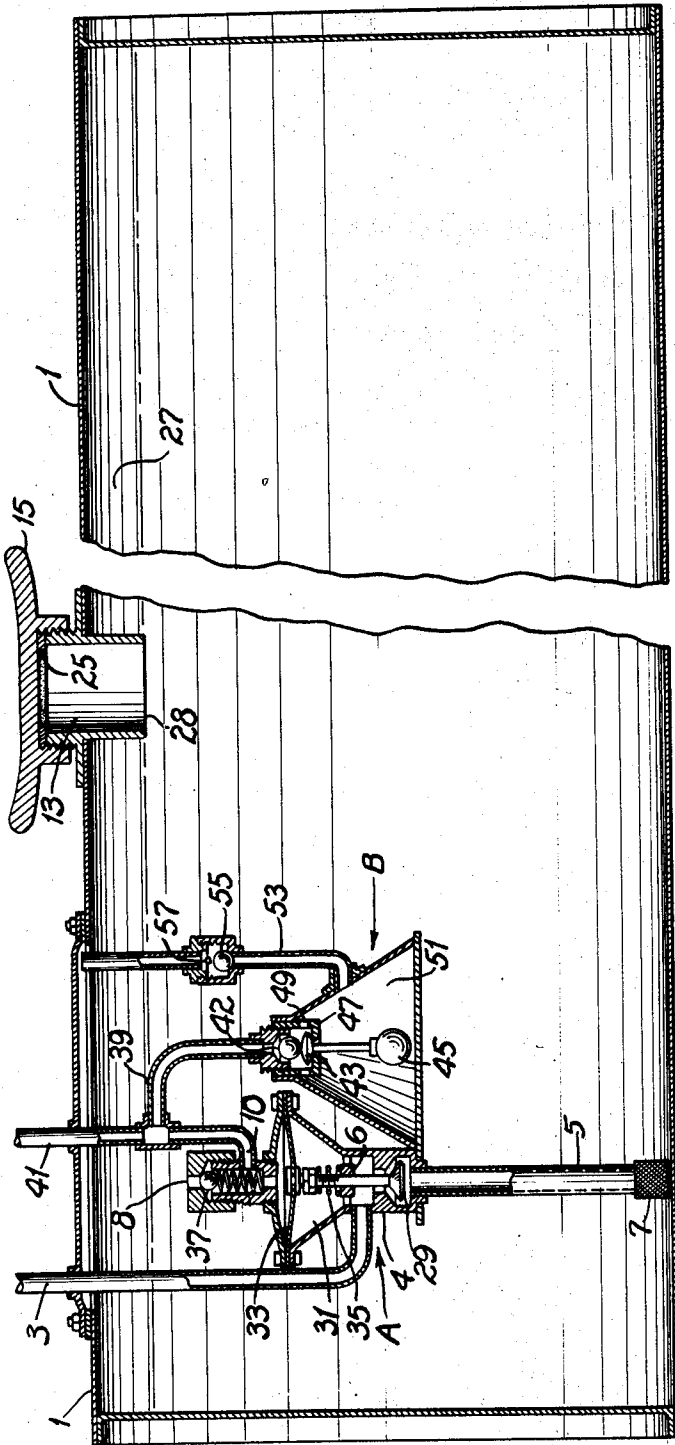


FIG. 2

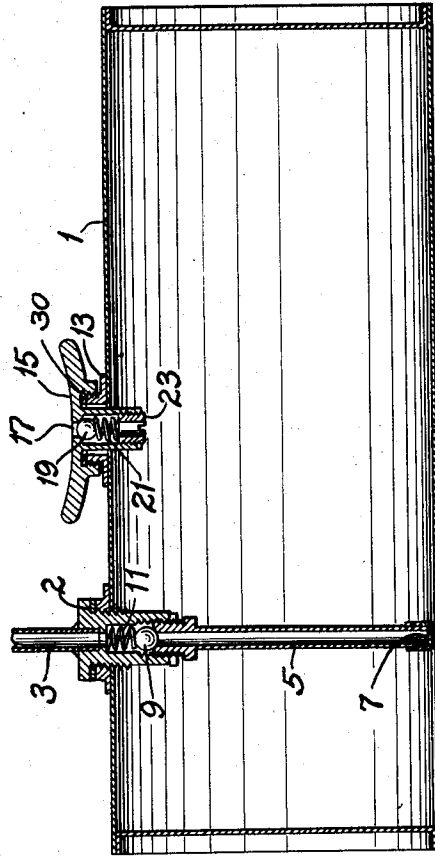


FIG. 1.

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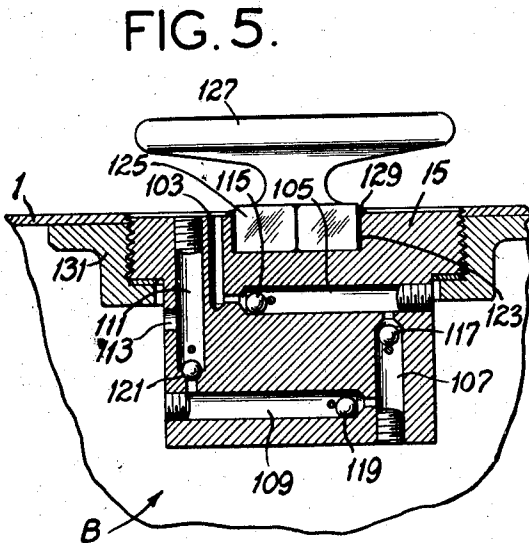
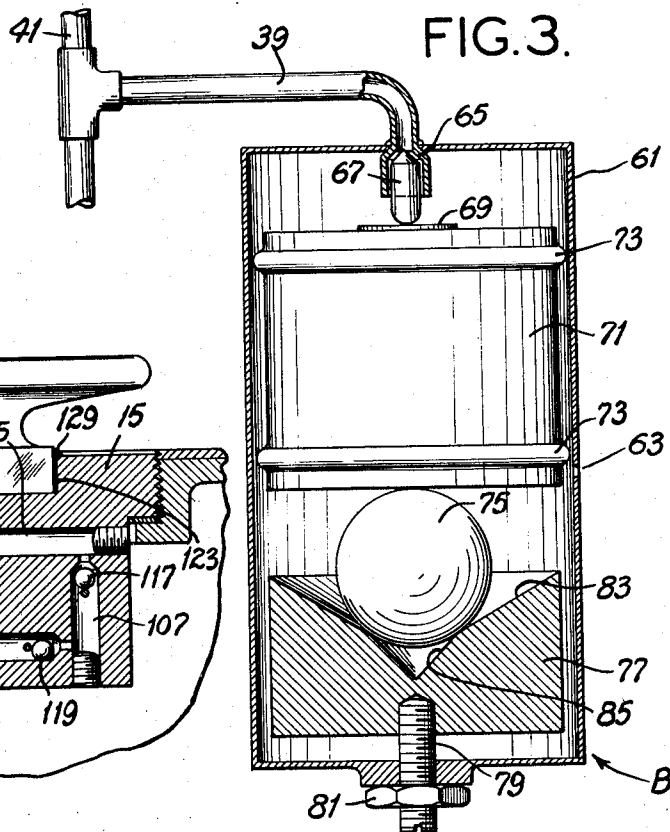
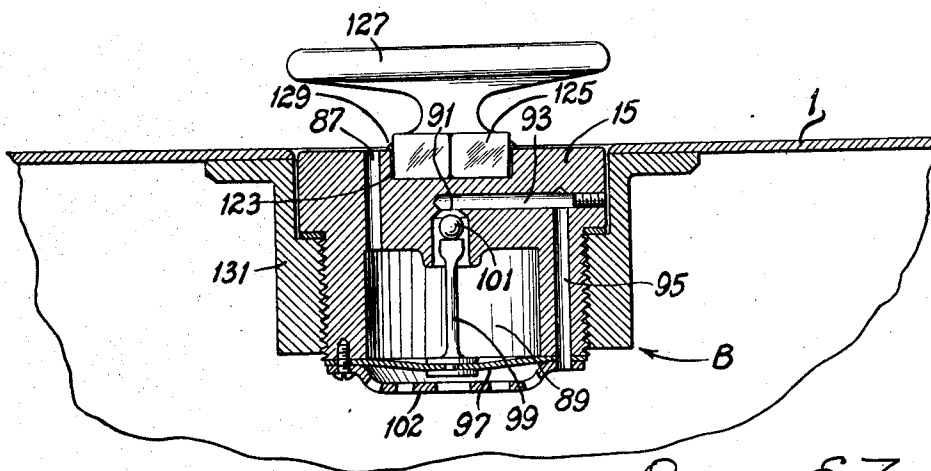


FIG. 4.



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UNITED STATES PATENT OFFICE

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SAFETY APPARATUS

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17 Claims. (Cl. 137—21)

This invention relates to safety apparatus, and with regard to certain more specific features, to safety apparatus for tanks which carry dangerous fluids such as inflammables or the like.

Among the several objects of the invention may be noted the provision of safety apparatus for automobile gasoline tanks which, when an overturning occurs (as in an accident), will prevent spilling of gasoline and thus reduce fire hazards; the provision of apparatus of the class described which prevents emptying of the tank even though the gasoline feed line be broken; the provision of apparatus of the class described which is effective for any angle that the tank may assume; the provision of apparatus of this class which if fire does occur will not permit the tank to explode; and the provision of apparatus of the class described which does not interfere with the operation of providing atmospheric pressure upon the surface of the gasoline as its level lowers in the tank. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which are illustrated several of various possible embodiments of the invention,

Fig. 1 is a diagrammatic section of a simplified form of the invention;

Fig. 2 is a diagrammatic section showing another improved form of the invention; and,

Figs. 3, 4 and 5 are vertical, enlarged and fragmentary sections showing alternative constructions.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Most automobile gasoline tanks today require an atmospheric vent in order that atmospheric pressure may be maintained upon the fluid in the tank as its level lowers during use. This fact, and the fact that the gasoline line from the tank to the carburetor system often breaks in an accident, is responsible for much loss of life and property due to spilling and firing of substantial quantities of gasoline. A further hazard at the scene of an accident occurs when fire breaks out around an otherwise safe gasoline tank. Such a tank bursts or explodes under its internal pressure due to the heat from the fire, thus project-

ing flaming fuel to great distances. The present invention avoids these and other hazards.

Referring now more particularly to Fig. 1, there is shown diagrammatically at numeral 1 an automotive gasoline tank. The feed line 3 from the tank leads to a carburetor pump, a vacuum tank, or the equivalent, for drawing out fuel and forcing it to the carburetor.

The line 3 (Fig. 1) is connected through body 2 to a pipe 5 which reaches to a point near the bottom of the tank 1, where the pipe is provided with an inlet strainer 7. At the upper end of the pipe 5 is a ball-check valve 9 which is pressed to its seat by a spring 11. The check valve 9 opens with flow toward the line 3 from the tank 1 under action of suction in the line 3. The pipe 5 is threaded into body 2 to provide adjustment of the force of spring 11.

Should the line 3 break, as in an accident, and the tank turn over, the maximum pressure of the liquid in the tube 5 is not enough to open the check valve 9, the spring 11 being adjusted to prevent this.

At numeral 13 is shown a filling opening threaded to receive a closure cap 15 having a gasket 30. The cap is provided with a vent hole 17 which is normally closed by a ball-check valve 19 which closes outwardly under action of the spring 21. A threaded member 23 permits of adjusting the force of the spring to a small value which is just great enough to seat the ball 19.

Under conditions of recession of the liquid level in the tank 1, the ball-check 19 will open to admit air, as required. However, the ball-check 19 prevents outward flow of liquid under accidental overturning conditions. If the line 3 breaks or the engine stops, the valve 9 also closes.

In view of the above, it will be seen from Fig. 1 that all danger of leakage is avoided. At the same time, should the tank overheat, as in a fire, the danger of explosion is avoided, because the excessive internal pressure forces liquid out past the check valve 9. It will be understood that the liquid is forced through the line 3, if the line 3 is intact, to the carburetor where it leaks out. It will be understood that such leakage to a relatively safe point is preferable to an explosion, and even where the leakage adds fuel to the fire, as in the case of a broken line, this is preferable to an explosion.

In Fig. 2 is shown another form of the invention, like numerals designating like parts. In this form, the cap 15 carries no vent, and is provided with a sealing gasket 25.

The filling tube 13 is carried down to a point below the top of the tank 1, for example, a distance of an inch and a half. The purpose of this is to provide means for preventing the complete filling of the tank and the provision of an air pocket above and around the tube 25. Thus, under excessively warm conditions, a gas cushion is obtained which prevents the large expansive forces encountered when a liquid alone is contained in an enclosed space. This feature is desirable, though not necessary to the invention, as indicated by its absence from Fig. 1.

The suction tube 3 leads to a valve 29 in a body 4 and the body 4 leads to a pipe 5, the latter ending near the bottom of the tank 1 and being covered by screen 7. In this case, the valve 29 closes outwardly and is slidably supported in an open spider 6. The body 4 (and hence also pipe 3) is in communication with a compartment 31 below a flexible diaphragm 33. The valve 29 is normally pressed to its seat by a spring 35, and is moved from its seat to operate under reduced pressure from the suction line 3 operating upon the diaphragm 33 to pull the diaphragm down. The upper side of the diaphragm receives pressure of atmospheric degree through a pipe 10 connected to vent pipe 41 which preferably leads to what will be hereinafter referred to as a safe point. An outlet 8 covered by a check valve 37 communicates the space above diaphragm 33 with the interior of tank 1. The valve 37 is normally held to its seat by a spring. The valve 29 is fastened to the diaphragm 33.

The operation of the parts thus far described in connection with what will be called device A of Fig. 2 is as follows:

As soon as the engine operates, a reduced pressure is effected in the line 3. This causes the diaphragm to be drawn down against the spring 35. Atmospheric pressure enters over the pipe 41. Thus the valve 29 opens and fluid may be drawn through the strainer 7, pipe 5, valve 29 and over the line 3 to feed the carburetor.

Should an accident occur, the engine ceases to operate, or the line 3 may break, in either of which events the tendency to a vacuum is broken under the diaphragm 31 and the spring 35 returns the diaphragm so that the valve 29 closes and escape of liquid from the tank over line 3 becomes impossible.

If pressure builds up in the tank due to fire from other sources around the tank 1, then the ball-check 37 may open under the internal pressure, and gasoline will be delivered over pipe 41 to a point which is considered normally to be safe. The choice of a relatively safe point is optional. The valve 37 is designed not to open until a relatively high pressure has been reached which is below the bursting point of the tank 1. Ordinarily, in an accident where no fire starts from other causes, this pressure-relieving action will not occur.

The above construction A takes care of the control of leakage of the contents of the tank over the line 3. To provide for venting the tank without possibility of spilling, there is provided the device B which includes a vent 39 to atmosphere via the line 41. It is to be understood that the line 39 may vent directly to the atmosphere without connection to the line 41 and that device B may be used independently of device A.

Associated with the line 39 is an outwardly seating ball-check valve 42 which rests upon a cam 43 of lenticular form. The cam 43 has

associated therewith a depending weight 45. The cam 43 rests upon the lower surface of a pocket 47 in which are inlet openings 49. These openings are in communication with a compartment 51 in which swings the pendulum weight 45. The compartment 51 communicates with the interior of the tank by means of a pipe 53 in which is a ball-check valve 55. The check valve 55 seats by gravity normally to prevent flow from the tank to the valve 42. A pin 57 prevents the valve 55, when lifted, from closing upwardly.

Operation of the device B is as follows:

As the level of the liquid in the tank 1 sinks, under evacuation of liquid over the line 3, the pressure is reduced, which ultimately necessitates drawing air in over the lines 41, 39, valve 42, chamber 51, and line 53 past the valve 55 which automatically opens. Thus atmospheric pressure is normally maintained upon the liquid in the tank. As long as air is flowing in, as described, gasoline liquid or vapor will not flow out. On the other hand, under warm conditions, as on a warm day, when the interior vapor pressure is above atmospheric, then no atmospheric pressure is necessary on the surface of the gasoline in the tank 1. Under these conditions, the valve 55 seats and prevents the escape of vapor through line 53, compartment 51, line 39 to the vent 41. Thus the octane rating of the gasoline is conserved.

Should an accident occur wherein the tank is overturned, the ball-check valve 55 prevents flow of gasoline outwardly from the vent 41 up to about a 90° tilt of the tank. Thereafter, the ball 55 may fall open and pass fluid.

However, under the last-named conditions, the pendulum weight 45 has swung so that the cam 43, at about a 45° position of the tank, presses the ball valve 42 to its upward seat to prevent outward flow of fluid. Thus it will be seen that the ball-check valve 55 is effective over a tilt which is great enough to include a portion of the tilting range of closure of valve 42.

The pendulum 45 is not capable of instantaneously closing the valve 41 during the early 45° period of tilting of the tank. This is in order to take care of the normal tilting activities of the vehicle during which inspiration of air into the tank is necessary. For degrees of tilt about 45, inspiration of air into the tank is neither possible nor needed, because this ordinarily is associated with an accidental condition. It will thus be seen that the valve 55 prevents outflow over a tilt of the order of 90° or so, but always permits inspiration of air. The valve 42 permits inspiration of air over a 45° tilt and prevents loss of fluid throughout all greater angles of tilt.

Thus the tank when rolled is positively proof against all leakage through the necessary air vent. In the case of the ordinary accident, the line 3 remains intact and no fire will occur if gasoline does not leak. This tank therefore is proof against fire due to leakage therefrom. If the line 3 breaks and there is no other fire, it is proof against leakage of tank contents from that line, because the valve 29 automatically closes. The slight amount of gasoline that exudes from the broken line is negligible and seldom starts a dangerous fire.

It is clear that the devices A and B may operate independently. For example, the line 39 may pass to the outlet independently of line 41.

It is also clear that the valve 37 may be eliminated entirely, if the feature of the pressure

ejection of fluid under hot conditions is not desired.

Adjustment for opening pressure of the valve 37 may be effected by the threaded cap which carries the opening 8. The opening pressure of valve 29 may also be adjusted by a suitable adjusting nut threaded on valve 29, against which the spring 35 reacts.

The advantage of the Fig. 2 construction over the Fig. 1 construction is that smaller pressure in the line 3 is necessary for withdrawing fluid from the tank. This is because of the relatively large ratio of the effective areas of the diaphragm 33 and valve 29. In the case of Fig. 1, suction pressure must be used in the line 3 which is at least equal to the liquid head which must be held by the valve 9 when the tank overturns.

In Figs. 3 to 5 are shown alternative constructions which may be substituted for the apparatus B.

Referring to Fig. 3, the vent pipe 39 is shown as leading to a float tank 61 having a restricted opening 63 which communicates with the interior of the gasoline tank. The connection between the pipe 39 and the enclosure 61 is through a valve seat 65 with which cooperates a movable valve 67, the latter resting upon an anvil 69 attached to the top of a hollow float 71. The float 71 is provided with peripheral beads 73 which act as guides and reduce the binding tendency of float 71 in the tank 61.

When not buoyed up, the float 71 rests upon a solid, relatively heavy ball 75. The ball 75 in turn rests upon a cam member 77, the latter being supported by an adjusting screw 79 which may be locked in predetermined position by a lock nut 81. The cam 77 is formed with a conical portion 83 and a steeper conical portion 85. The ball 75 rests upon the corner of intersection between the conical portions 83 and 85. Operation of the device of Fig. 3 is as follows:

If the gasoline tank is too full, the float 71 rises to force the valve 67 to its seat 65. Therefore gasoline cannot, under conditions such as occur on a warm day or the like, be lost. However, air may be drawn in over the line 39, because suction in the line 39 results in forcing down the valve 67 against the downwardly movable float 71, which when floating is free of the ball 75. Or, if the liquid level in the tank is such as not to float the member 71, then air may freely enter the then open valve 67. In either event air may enter.

Should the car overturn, the relatively heavy ball 75 will roll on the conical shape 83 and wedge the float 71 against the valve 67 to close the latter. Should the car turn throughout 180°, any tendency for the float 71 to lift from the valve 67 (being then immersed in liquid) is resisted by the sinking action of the weight of the ball 75 thereon. It is to be understood that the ball 75 is of a size and density to sink the float 71 without the aid of the wedging action of the cone 83 when the tank is overturned.

In Fig. 4 is shown a form of the device B which may be associated with the filler cap 15 and consists in a vent 87 located in the body of the cap 15. The vent leads into a compartment 89. Compartment 89 in turn communicates with the interior of the tank 1 through an upwardly directed valve seat 91 and passages 93 and 95.

The lower open end of the compartment 89 is covered by a fluid-tight, flexible diaphragm 97 made of a flexible substance which is not at-

tacked by oil or gasoline. Such substances are known under various trade names.

Over the diaphragm 97 is formed a protective grill 102.

The center of the diaphragm 97 carries a pillar 99 for supporting a ball-check valve 101 which by gravity normally is forced away from its seat 91, but which, when the diaphragm 97 raises, is pressed to its seat by pillar 99.

Under conditions of a sinking liquid level in the tank 1 (when upright), air is drawn through port 87, compartment 89, normally open valve seat 91, and passages 93 and 95. The valve 101 is heavy enough not to be drawn shut by the incoming air. Should the liquid level in the tank rise too much (as sometimes it does), or should the tank overturn, the pressure of liquid on the diaphragm 97 causes the valve 101 to close on its seat 91, and thus prevents the outflow of fluid.

Fig. 5 shows another form of the device B which may be used in the cap 15 per se. This comprises an inlet 103 which connects with passages 105, 107, 109 and 111, the latter connecting with the inside of the tank by way of passage 113. Passages 105, 107, 109 and 111 are arranged in a circuit, each being preferably at right angles to the other. Each passage 105, 107, 109 and 111 has therein a ball-check valve 115, 117, 119 and 121, respectively, each valve tending to close outwardly with flow to the atmosphere and opening inwardly with the flow from the atmosphere to the inside of the tank. Thus, any excess outside pressure, due to the decrease in the pressure inside of the tank caused by lowering liquid level, results in the valves 115, 117, 119 and 121 opening to permit entry of air to the tank 1. Only one of these valves is normally gravitationally held to its seat, for example, valve 121 in Fig. 5, as shown. Thus, the incoming air needs to open only one valve against gravity. On the other hand, four valves are available against the leakage of gasoline outwardly under the interior pressure. One of these is positively shut under the force of gravity, so that even a slow exudation is impossible.

Should the automobile turn over, as in an accident, at least one of the valves is closed at all times against outward leakage.

It will be noted that, although four passages 105, 107, 109 and 111 are used, more or less may be used in a circuitous arrangement, provided they are related so that the plurality of valves therein always has at least one valve forced shut by gravity.

It is to be understood that if desired the arrangements of Figs. 4 and 5 need not be used on the filler caps per se, and the inlets 87 and 103 respectively may be connected to pipe 41 (Fig. 2). Thus these devices may be used in association with device A of Fig. 2.

Figs. 4 and 5 also show the provision of a socket of polygonal form in the cap 15. A square form is shown in Figs. 4 and 5. The socket 123 loosely contains the square head 125 of a handle or grip 127. Then the portion 125 is spot welded in the socket 123 by light spot welding 129 at spaced locations. The spot welding is just enough to hold the head 125 in the socket 123, but not enough to prevent the handle 127 from being knocked out of the socket 123 if during an accident or the like the handle is bumped with a force which would normally be great enough to tear out the plug 15 with the surrounding bushing 131. Thus the handle is connected with the plug by a frangible connection which breaks

before the plug and/or its bushing could be torn out.

The socket 123 need not be polygonal but may be of other non-circular shape, such as for example oval, the portion 125 being given a similar but slightly smaller shape. The criterion is that any twisting force necessary for tightly applying the cap or removing it under unusual conditions is available, but the spot welding 129 is not depended upon for applying such necessary twisting force. On the other hand any other forces on the handle are adapted to break the spot welding 129 to release the handle. Any equivalent of spot welding may be used for the frangible fastening means 129.

An advantage of the invention is the prevention of spilling and waste of gasoline under normal changes in atmospheric temperature. For example, if a truck comes in from a run on a very cold day and enters a warm garage, the tank and its contents are cold. If the tank then be immediately filled by make-up gasoline, it becomes filled in a relatively cool condition. Herebefore, upon standing, such tanks have had the cold gasoline therein expand and spill through the vent. The present invention entirely overcomes this difficulty. Thus, under normal atmospheric temperature changes, there is effected a large saving of gasoline for truck lines etc. At the same time, under conditions of abnormal temperature changes, as in a fire and the like, relief of pressure and avoidance of explosions are effected.

It will be understood that the spring 35 which normally biases shut the valve 29 may have its function carried out by spring action in the diaphragm 33 itself, or by arranging the parts so that gravity effects closure of the valve. Other mechanical equivalents may also be thought of. Such equivalents of the action of the spring are intended to come within the scope of the appended claims.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. Safety apparatus for tanks and the like comprising a vent line constituting communicating means between the outside and the inside of the tank, a normally open valve in said communicating means, means responsive to a substantial degree of tilt of said tank for automatically closing said valve, and a check valve serially arranged in said communication and closing outwardly with respect to the vent line, said check valve being arranged to prevent outward flow during all periods of tilt during which the first-named valve is open.

2. Safety apparatus comprising a tank, communicating means between the exterior and the interior of the tank, serially arranged check valves in said communicating means, each of said valves closing outwardly, one of said valves being adapted to be automatically closed by gravity over a substantial degree of tilt of said tank, means for closing the other valve in response to a tilt of said tank which is different from the tilt for which the other valve is closed but before

said one valve opens, the apparatus being arranged so that all liquid which might escape from the tank through the communicating means would necessarily need to pass through both valves.

3. Safety apparatus comprising a tank, communicating means between the exterior and the interior of a tank, serially arranged check valves in said communicating means and adapted to close outwardly, one of said valves being arranged to remain closed throughout tank positions up to substantially 90° of tilt, and means for closing the other valve throughout greater degrees of tilt but before said one valve opens, the apparatus being arranged so that all liquid which might escape from the tank through the communicating means would necessarily need to pass through both valves.

4. Safety apparatus comprising a tank, communicating means between the exterior and the interior of a tank, serially arranged check valves in said communicating means each being adapted to close outwardly, one of said valves being arranged normally to remain closed by gravity throughout tank positions up to a substantial degree of tilt, the other valve being normally opened by gravity, and means for automatically closing the last-named valve against gravity throughout greater degrees of tilt but before said one valve opens, the apparatus being arranged so that all liquid which might escape from the tank through the communicating means would necessarily need to pass through both valves.

5. Safety apparatus comprising a tank, a communicating means between the exterior and the interior of a tank, a check valve closing downwardly and outwardly in said communicating means and arranged substantially vertically for normal closure, and a second check valve in said communicating means seating upwardly and outwardly, but normally gravitationally held open and means for closing the second check valve over periods of tilt of the tank before and during which the first-named check valve is open, the apparatus being arranged so that all liquid which might escape from the tank through the communicating means would necessarily need to pass through both valves.

6. Safety apparatus comprising a tank, a suction line and a vent line communicating with said tank, a valve in said suction line, biasing means normally to close the valve, a housing, a diaphragm dividing said housing into two compartments, said vent line communicating with one compartment and said suction line with the other, said valve and diaphragm being connected so that upon suction occurring in the suction line, atmospheric pressure in the vent line will force said diaphragm to open the valve.

7. Safety apparatus comprising a tank, a suction line and a vent line communicating with the tank, a valve in said suction line, biasing means normally to close the valve, a housing, a diaphragm dividing said housing into two compartments, said vent line communicating with one compartment and said suction line with the other, said valve and diaphragm being connected so that upon suction occurring in the suction line, atmospheric pressure in the vent line will force said diaphragm to open the valve, a branch from said vent communicating with the interior of the tank and having a second valve therein permitting flow inward, means responsive to a substantial degree of tilt of the tank for automatically closing said valve, a third valve serially

arranged in said branch and closing outwardly, said third valve being arranged to prevent outward flow during the period of tilt during which the second valve is normally open.

8. Safety apparatus comprising a tank, a communicating means between the exterior and the interior of a tank, a check valve in said communicating means and normally closed by gravity throughout tank positions substantially up to 90° of tilt, a second normally open valve in said communicating means, and means responsive to gravity to close said second valve at a tilt of said tank which is less than substantially 90° and for tilts of the tank of more than 90°, the apparatus being so arranged that all liquid which might escape from said tank through the communicating means would necessarily need to pass through both of said valves.

9. Safety apparatus for tanks and the like having a vent, an upwardly closing valve associated with said vent, a float below said valve adapted upon rising to close the valve, cam means below the float responsive to tilting of the tank to force the float to close the valve upon a substantial tilt of the tank, said last-named means being adapted to sink the float to close the valve when the tank is substantially upside down.

10. Safety apparatus for a tank or the like having an outward vent, comprising means forming a single circuitous passage between the vent and the interior of the tank, and a plurality of valves in said vent, said valves being arranged so that at least one is closed in any position of the tank.

11. Vent means for tanks and the like comprising a single circuitous passage, a plurality of check valves therein, said passage and valves being arranged so that under any tilted condition of the vent means, at least one of said valves is gravitationally closed, each valve being arranged to permit reverse flow therethrough.

12. In apparatus of the class described, a liquid-containing tank, a suction line communicating between the outside and the inside of the tank to a point below the liquid level therein, said tank having a vent communicating between the outside of the tank and the inside thereof, a valve in the suction line, a movable member, a container for the movable member arranged to receive atmospheric pressure from the vent and apply it to the member on the one side, said member on its other side being exposed to suction-line pressure, said member being normally biased to close said valve, atmospheric pressure moving the diaphragm from its vent side to open the valve when suction-like pressure occurs on said other side.

13. Safety apparatus comprising a tank, a suction line and a vent communicating therewith, a valve closing outwardly in said suction line, biasing means normally to close the valve, a housing, a diaphragm dividing said housing into two compartments, said vent communicating with one compartment and said suction line with the other, the valve and diaphragm being articulated so that upon suction occurring in the suction line atmospheric pressure through the vent will force said diaphragm to open the valve, said housing on the vent side of the diaphragm having

a communication with the interior of the tank, a check valve normally biased to close said communication from its diaphragm side, excessive pressure in the tank being enough to force fluid through said check valve against the vent side of the diaphragm to cause venting through said line and opening of the valve to effect further venting through the suction line.

14. Safety apparatus comprising a tank, a liquid suction line communicating with the interior of said tank, a liquid control valve in said suction line, means for normally biasing shut said valve, a housing, a movable member dividing said housing into two compartments, said suction line being connected with one compartment, said valve and movable member being so connected that merely upon substantial suction occurring in the suction line, pressure on the other side of the movable member will always force said movable member to open the valve.

15. Safety apparatus comprising a tank, a liquid suction line communicating with the interior of said tank, a liquid control valve in said suction line, means for normally biasing shut said valve, a housing, a movable member dividing said housing into two compartments, said suction line being connected with one compartment, said valve and movable member being connected so that upon suction occurring in the suction line, pressure on the other side of the movable member will force said movable member to open the valve, and a check valve having an opening from the other of said two compartments into the tank and biased to close against predetermined pressure in the tank but to open above such pressure.

16. Safety apparatus comprising a tank, a suction line communicating with said tank from the exterior, a valve in said suction line, biasing means normally to close the valve, a housing, a movable member dividing said housing into two compartments, said suction line being connected with one compartment, said valve and movable member being connected so that upon suction occurring in the suction line, pressure on the other side of the diaphragm will force said diaphragm to open the valve, a vent line leading from the outside of the tank to said other side of the movable member, there being also an opening between the inside of the tank and said other side, a check valve in said opening normally checking against entry of fluid to the diaphragm but under abnormal pressure conditions in the tank permitting such entry.

17. Apparatus of the class described comprising a tank, a suction line leading into the tank, a diaphragm having one side exposed to the suction pressure in said line and adapted to be deflected thereby, a valve adapted to open in response to diaphragm deflection, means normally to close the valve when the diaphragm is not deflected, a vent line connecting the other side of the diaphragm with the atmosphere, branch means communicating between said vent line and the interior of the tank, a valve in said branch means, and means to hold said valve to its seat in response to vapor pressure in the tank and thus to resist escape of vapor under pressure in the tank.

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