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AUTOMATIC CUTOFF VALVE ASSEMBLY

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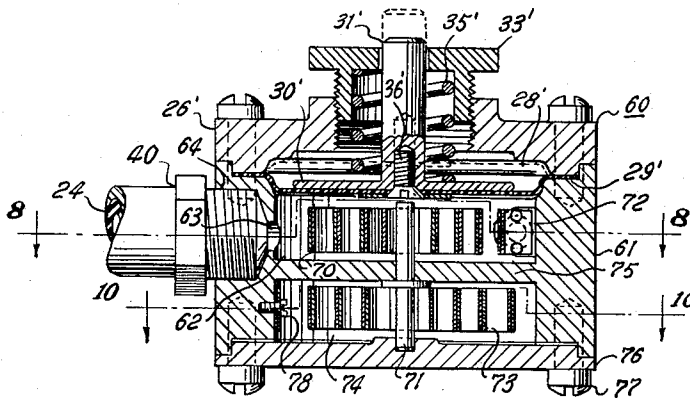


Fig. 7

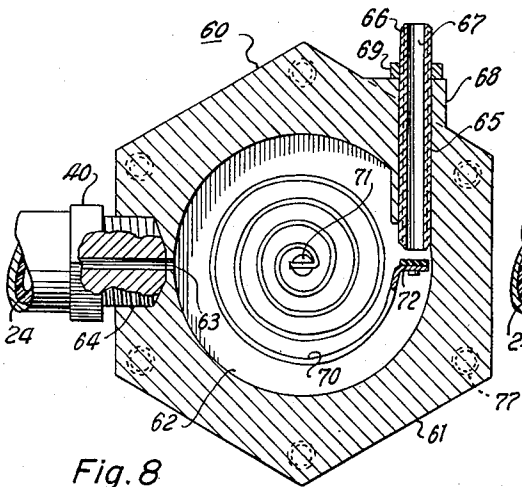


Fig. 8

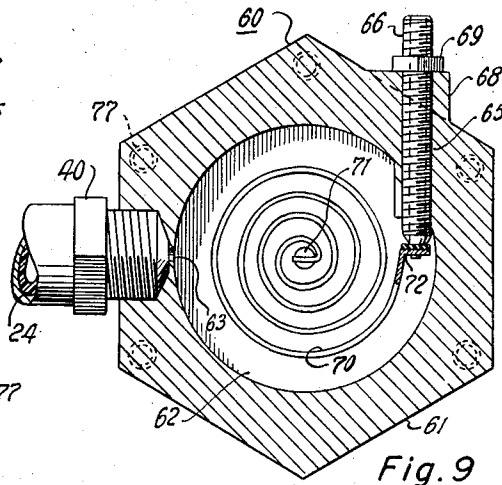


Fig. 9

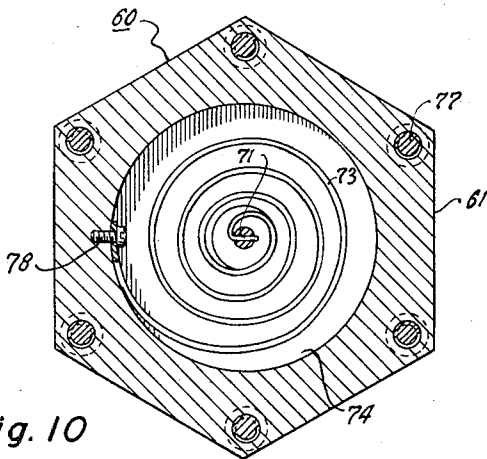


Fig. 10

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AUTOMATIC CUTOFF VALVE ASSEMBLY

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2 Claims. (Cl. 62—55)

This invention relates to new and useful improvements in automatic cutoff valve assemblies.

One object of the invention is to provide improved means for automatically closing a valve of the type used in a line for filling a container with a volatile liquid, such as liquefied petroleum gas, anhydrous ammonia or other liquefied gas, wherein the liquid vented from the container upon filling thereof to a predetermined level is utilized to close the valve and said liquid is prevented from being vented to the atmosphere.

An important object of the invention is to provide an improved automatic cutoff valve assembly having a chamber communicating with the vapor space of the container for receiving and venting gas during the filling of said container and pressure-responsive means exposed to the pressure of the fluid within the container for closing the valve, the vented liquid vaporizing in said chamber so as to create an increased pressure for actuating the pressure responsive means.

A particular object of the invention is to provide an improved automatic cutoff valve assembly, of the character described, wherein the chamber has an opening for venting gas during the filling of the container and associated with means arranged to be actuated in response to the increased pressure due to vaporization of the liquid for closing the vent opening to prevent escape of said liquid as well as the escape of vapor after closing of said opening, whereby the pressure of the fluid within the container is exerted upon the pressure-responsive means.

Another object of the invention is to provide an improved automatic cutoff valve assembly, of the character described, wherein the vent closing means may be actuated either by the increase in pressure or by the decrease in temperature of the vaporized liquid which is vented from the tank upon filling thereof to a predetermined level.

A further object of the invention is to provide an improved automatic cutoff valve assembly, of the character described, wherein the vent closing means is actuated by temperature responsive means which has connection with compensating means so as to prevent interference with its actuation by the ambient temperature.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, wherein examples of the invention are shown, and wherein:

Fig. 1 is a side elevational view of an automatic cutoff valve assembly constructed in accordance with the invention with the valve being closed,

Fig. 2 is a side elevational view, partly in section, showing the valve assembly connected to a tank,

Fig. 3 is a perspective view of a portion of the valve assembly with its latch holding the valve open,

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Fig. 4 is a top plan view of the cutoff device with its diaphragm removed,

Fig. 5 is a transverse, vertical, sectional view, taken on the line 5—5 of Fig. 4, with the diaphragm seated and the vent opened,

Fig. 6 is a view, similar to Fig. 5, showing the vent closed and the diaphragm unseated,

Fig. 7 is a transverse, vertical, sectional view of a modified cutoff device for the valve assembly,

Fig. 8 is a horizontal, cross-sectional view, taken on the line 8—8 of Fig. 7, with the vent opened,

Fig. 9 is a view, similar to Fig. 8, showing the vent closed, and

Fig. 10 is a horizontal, cross-sectional view, taken on the line 10—10 of Fig. 7.

In the drawings, the numeral 10 designates a valve of the self-closing type and having a spring-loaded plunger 11 and an actuating lever 12. A suitable angular bracket 13 is mounted on the upper portion of the valve for pivotally supporting the lever 12, as shown at 14, in coacting relation to the plunger 11 whereby the inner portion of said lever overlies the outer end of said plunger. Due to this arrangement, the valve 10 is opened by inward or downward swinging movement of the lever and depressing of the plunger (Fig. 3) and is closed when said plunger projects from said valve as shown in Figs. 1 and 2. An upright latch 15 is pivotally mounted on the bracket 13, as shown at 16, opposite the pivotal mounting 14 of the lever for holding said lever in its inward, plunger-depressing position. The latch 15 extends through an opening 17 formed in the lever 12 outwardly of its engagement with the plunger 11 and has a lateral projection or keeper 18 for coacting with the opening to hold said lever in its latching position. A suitable spring 19 is provided for urging the latch outwardly to maintain its keeper 18 in engagement with the lever. For coacting with an automatic cutoff device 20, embodying the principles of the invention, the latch is angular or substantially T-shaped and has a laterally projecting arm or member 21 below its keeper 18.

As shown in Fig. 2, the valve 10 is mounted in a conductor or hose 22 of the type used in filling a container or tank T with a volatile liquid, such as liquefied petroleum gas, anhydrous ammonia or other liquefied gas and having a union 23 for connection with the filler valve F of the tank. A dip or vent tube D, of any suitable construction, communicates with the vapor space of the tank for venting gas therefrom during the filling of said tank. The dip tube D includes a vent valve A and extends into the tank to the desired level of filling whereby liquid is vented when said tank is sufficiently filled. Usually, it is desirable to fill the tank to 85% of its capacity so that the vapor space occupies approximately 15% of the volume of the filled tank. The vent valve A has a minute or restricted orifice (not shown) to restrict the flow therethrough in the usual manner. For connecting the automatic cutoff device to the dip tube, a vent hose or line 24 is provided and includes a union or other fitting 24'.

The automatic cutoff device 20 includes a relatively flat body or case 25 having a complementary cap 26 fastened thereto by suitable screws 27. A circular, shallow chamber 28 is formed by recessing the adjacent surfaces of the body 25 and its cap 26 and has a suitable pressure-responsive member or diaphragm 29 extending thereacross and separating the case recess from the cap recess in the usual manner. The diaphragm 29, which is of conventional construction, has its margin clamped between the body and cap and includes an overlying circular disk 30 having an axial plunger or stem 31 projecting externally through said cap. A relatively large,

screw-threaded opening 32 is formed axially in the cap for engagement by a hollow, screw-threaded plug or gland 33 which has an axial opening 34 for accommodating the stem 31. The plug 33 is of greater diameter than the stem and is adapted to confine a concentric, helical spring 35 in engagement with the disk 30 for holding the diaphragm 29 against the body recess of the chamber 28 (Fig. 5). As shown by the numeral 36, an axial screw and washer are provided for connecting and centering the disk with respect to the diaphragm.

As shown most clearly in Fig. 5, the stem 31 is retracted when the diaphragm 29 is held in engagement with the body recess of the chamber 28. Upon outward or upward flexing of the diaphragm into the cap recess of the chamber, the projection of the stem is increased as shown in Fig. 6. The body 25 of the cutoff device 20 is mounted adjacent the pivotal mounting 16 of the latch 15 by a suitable bracket 37 so that the stem underlies the lateral arm 21 of said latch. When the lever 12 is engaged with the keeper 18 of the latch, the latch arm is spaced a slight distance from the stem 31 as shown in Fig. 3. Upon outward or upward projection, the stem strikes the latch arm and counter-clockwise movement is imparted to the latch for disengaging its keeper from the lever. As a result, the spring-loaded plunger 11 of the valve 10 is permitted to move outwardly or upwardly for closing the valve 10 whereby said valve is closing by outward or upward flexing of the diaphragm 29.

For admitting fluid to the chamber 28 below the diaphragm, the cutoff body 25 includes a lateral, inlet port 38 having a screw-threaded counterbore portion 39 at its outer end which receives a suitable fitting or nipple 40 mounted on one end of the vent line 24. An axially-extending, inlet opening 41, of restricted diameter, connects the port 38 to the chamber adjacent its periphery, whereby fluid vented from the tank T flows through the line 24 into said chamber below the diaphragm 29. Since the orifice of the vent valve A may not be restricted in some installations, it is preferable to restrict the inlet opening. For elongating or prolonging the flow of fluid through the chamber from the inlet opening 41 to an axial outlet opening 42, a labyrinth passage 43 is formed in the recessed surface of the body by a plurality of substantially annular, upstanding baffles or ribs 44. As shown most clearly in Fig. 4, the baffles 44 are disposed in concentric, spaced relation with the interrupted portions or openings of adjacent baffles in opposed relation to each other whereby the fluid is forced to flow around at least one-half of each baffle. The diaphragm 29 rests upon the baffles and forms the wall of the labyrinth passage 43 opposite the recessed surface of the body. Of course, the inlet opening 41 is opposed diametrically of the interrupted portion of the outermost baffle.

An enlarged axial bore 45 is formed in the body in communication with the outlet opening 42 and has its outer portion screw-threaded for engagement by a hollow, screw-threaded plug or gland 46 in which a cylindrical valve element 47 is slidably mounted. The valve element has an axial, reduced pin 48 on its inner end projecting through the outlet opening into engagement with the diaphragm 29 or the head of its screw 36 and a bevelled or tapered surface 55 for seating in said opening. A helical spring 49 is confined within the plug 46 and engages in a socket 50 formed in the outer end of the valve element for constantly urging its surface 55 into seating engagement with the opening as shown in Fig. 6. Since the spring 35 holds the diaphragm 29 in engagement with the baffles 44 and pin 48, the valve element is held out of engagement with the opening 42 and said opening communicates with the labyrinth passage 43 as shown in Fig. 5.

A lateral passage or port 51 extends from the inner portion of the bore 45 to the exterior of the body and has its outer end enlarged to provide a screw-threaded counterbore 52 in which a suitable orifice fitting or plug 53

is engaged. As shown in Fig. 5, the plug 53 has an aperture 54 for controlling the rate of flow therethrough. It is noted that the aperture 54 is of greater diameter than the inlet opening 41 and/or the restricted orifice of the valve A of the dip tube D so that there is no restriction of flow through the chamber 28 so long as the valve element 47 remains unseated. For the same reason, all of the flow spaces of the cutoff device 20 are of greater area than the diameter of the restricted orifice and/or the restricted inlet opening. It is noted that the port 38 and opening 41 coact to provide an inlet for the cutoff device and that its outlet or vent is provided by the opening 42, bore 45, passage 51 and aperture 54 of the orifice fitting 53.

When it is desired to fill the tank T, the lever 12 is swung inwardly or downwardly and engaged with the keeper 18 of the latch 15 whereby the spring-loaded plunger 11 is depressed to open the valve 10. The valve element 47 is unseated to permit flow of vented fluid through the cutoff device 20 due to the force of the spring 35 being exerted upon said element through the diaphragm 29 and being greater than the force of the spring 49 which tends to seat said element. As a result, the vapor vented from the tank flows through the line 24, port 38, inlet opening 41, chamber 28, outlet opening 42, passage 51 and aperture 54. Although the labyrinth passage 43 formed by the baffles 44 elongates or prolongs the flow of the vapor through the chamber by forcing the same through circuitous paths, the rate of flow is not restricted and there is insufficient pressure to actuate the diaphragm.

Upon filling of the tank to the desired predetermined level, the liquid enters the vent line 24 and flows there-through into the chamber 28. Since the temperature of the body 25, its recessed surface and baffles 44 is above the boiling point of the liquid, said liquid vaporizes during its extended travel through the circuitous paths of the labyrinth passage 43. This vaporization of the liquid causes expansion and a pressure increase within the chamber for actuating the diaphragm 29. Due to the relatively large area of the diaphragm exposed to the vaporized liquid within the chamber, little pressure increase is required to overcome the force of the spring 35. The valve element 47 follows the outward or upward flexing movement of the diaphragm and its tapered surface 55 is seated in the opening 42 by the force of the spring 49 which exceeds the effective opposing force of the pressure exerted upon the valve pin 48. In fact, due to the small area of the valve pin exposed to the pressure within the chamber, the spring 49 is strong enough to prevent opening of the valve element by the pressure within the tank T.

As has been explained, the stem 31 is projected by the outward flexing of the diaphragm so as to trip the latch 15 and permit outward swinging of the lever 12 and closing of the valve 10 by its spring-loaded plunger 11. It is noted that the spacing between the latch arm 21 and stem 31 is greater than the travel of the valve element 47, whereby initial outward flexing of the diaphragm permits seating of said valve element prior to engagement of the stem with said latch arm. This spacing allows pressure from the tank to build up under the diaphragm to assist, if needed, the pressure increase due to vaporization of the liquid. The force of the spring 35 returns the diaphragm 29 to its unseated position and overcomes the force of the spring 49 to unseat the valve 47 as shown in Fig. 5 when the valve assembly and its vent line are disconnected from the tank fittings.

A modified cutoff device 60 is shown in Figs. 7 through 10 and includes a body or case 61 similar to the body 25 and having a similar cap 26', screws 27', cap recess 28', diaphragm 29', disk 30', stem 31', plug 33', spring 35' and screw 36'. The body 61 is of greater depth than the body 25 and has a circular chamber 62 below the diaphragm 29' and in full communication with the cap

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recess 28' so as to form a continuation thereof. A restricted inlet opening 63 extends from the chamber 62 and has a screw-threaded counterbore 64 at its outer end for connection with the nipple or fitting 40 of the vent line 24. As shown most clearly in Figs. 8 and 9, an outlet or vent opening 65 extends laterally through the wall of the body and is screw-threaded for receiving an orifice fitting or screw 66. The latter serves the same purpose as the orifice fitting 53 and has a similar aperture 67 of greater diameter than the restricted orifice of the valve A of the dip tube D and/or restricted inlet opening 63. For holding the fitting 66 in adjusted positions, a boss 68 surrounds the outer end of the outlet opening 65 and is adapted to be engaged by a jam nut 69 carried by said fitting. This arrangement permits variation of the inward projection of the fitting into the chamber 62.

In order to control the flow of fluid through the outlet or vent opening and the aperture 67 of its fitting, a concentric, coiled strip 70 of bimetallic or other temperature-responsive material is suspended within the chamber upon an axial, rotatable pin or spindle 71. A flat valve element or plate 72 is carried by the radially-extending, outer end of the bimetallic strip 70 for seating against the inner end of the fitting 66 which projects tangentially into the chamber. It is noted that the bimetallic strip 70 is adapted to support the valve plate 72 in spaced relation to the inner end of the orifice fitting 66. Counter-clockwise rotation of the spindle 71 is resisted by a bimetallic strip 73, similar to the strip 70 and having reverse convolutions, fixed on said spindle and suspended within a chamber 74 below the chamber 62 (Fig. 10). The chambers are similar and are separated by a transverse partition 75, while a cap 76 is fastened by screws 77 to the body for closing the lower or outer end of the chamber 74. The spindle extends through the chambers and is rotatably supported by being journaled in the partition 75 and cap 76. A suitable fastener or screw 78 attaches the outer end of the bimetallic strip 72 to the peripheral wall of the chamber 74 whereby said strip resists counter-clockwise rotation of the spindle 71 by the strip 70 to compensate for external temperature variation.

The diaphragm 29' of the modified cutoff device 60 is actuated by increased pressure within the chamber 62 in the same manner as the diaphragm 29. So long as vapor flows through the chamber, the outlet or vent 66 remains open and the vapor is vented (Fig. 8). Upon filling of the tank 23 and the venting of liquid through the line 24, the liquid enters the chamber through the inlet opening 63 and expands therein due to the large area of said chamber. This expansion results in vaporization and consequent cooling whereby the bimetallic strip 70 contracts and moves the valve plate 72 into seating engagement with the inner end of the orifice fitting 66 (Fig. 9). Since the aperture 67 is closed by the seating of the valve plate, the expanded and vaporized liquid cannot escape from the chamber and the pressure increases due to the continued admission of the liquid from the tank through the vent line.

As has been explained, this pressure acts upon the diaphragm 29' and flexes said diaphragm outwardly or upwardly by overcoming the force of the spring 35'. The stem 31' is projected by this movement of the diaphragm for tripping the latch 15 and releasing the lever 12 to permit closing of the filler valve 10 by outward movement of its spring-loaded plunger 11. When the pressure within the chamber 62 is relieved, such as by disconnection of the valve assembly, the diaphragm relaxes and returns to its original position. Of course, the bimetallic strip 70 expands to its original position and unseats the valve plate 72 as soon as the temperature within the chamber 62 rises to approximately ambient temperature. Due to the provision of the bimetallic strip 73 and its reverse convolutions, the ambient temperature does not interfere with the actuation of the strip 70 because both strips are subjected to such temperature.

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It is noted that in both embodiments of the invention, the liquid is prevented from being vented to the atmosphere. This is a highly desirable feature because the same opening will vent a much greater volume of liquid or liquefied gas than gas or gaseous vapors in a given time. Since a small quantity of liquid expands to a large quantity of vapor, it is dangerous to vent the liquid. The valve elements 47 and 72 positively close the outlets or vents of the chambers 28 and 62 so as to trap the liquid and provide pressure for actuating the diaphragms 29 and 29'. Although one valve element is actuated by pressure-responsive means and the other by temperature-responsive means, in both instances the vaporization of the liquid is utilized. Also, the liquid vented from the tank is employed by both embodiments to close the valve.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What we claim and desire to secure by Letters Patent is:

1. An automatic cutoff valve assembly for filling a liquefied gas container having means for venting gas during filling thereof and for venting liquid upon being filled to a predetermined level, including a filling valve, a body, a chamber in the body having an outlet to atmosphere and an inlet communicating with the vent means whereby the chamber receives and vents vapor during filling of the container, said chamber being of enlarged area to permit vaporization of liquid vented from the container, pressure-responsive means in said chamber for actuation by the pressure of the vaporized liquid, operating means extending between the pressure-responsive means and filling valve for closing the valve upon actuation of said pressure-responsive means, and a spring-pressed valve in said body for closing the outlet to prevent the escape of the liquid and engaged by and held open by the pressure-responsive means until said pressure-responsive means is actuated by the pressure of the vaporized liquid in said chamber.

2. In combination with a valve for filling a liquefied gas container having means for venting gas during filling thereof and for venting liquid upon filling to a predetermined level, the valve being of the self-closing type and having means for latching the valve in open position, an automatic cutoff device including a body, a chamber in the body having an outlet to atmosphere and an inlet communicating with the vent means for receiving and venting vapor during filling of the container, the chamber being of enlarged area to permit vaporization of liquid vented from the container, a diaphragm in said chamber for actuation by the pressure of the vaporized liquid, means operable by the actuation of the diaphragm for engaging and releasing the latch means to permit closing of the filling valve, and vent valve means in said body for closing the outlet to prevent the escape of the liquid, said diaphragm being engageable with the vent valve means for holding the latter unseated until said diaphragm is actuated by the pressure of the vaporized liquid in said chamber.

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