March 7, 1950 H. L. NORWAY **2,499,409**

LIQUEFIED PETROLEUM GAS DISPENSING SYSTEM

Filed Sept. 3, 1943 2 Sheets-Sheet 1

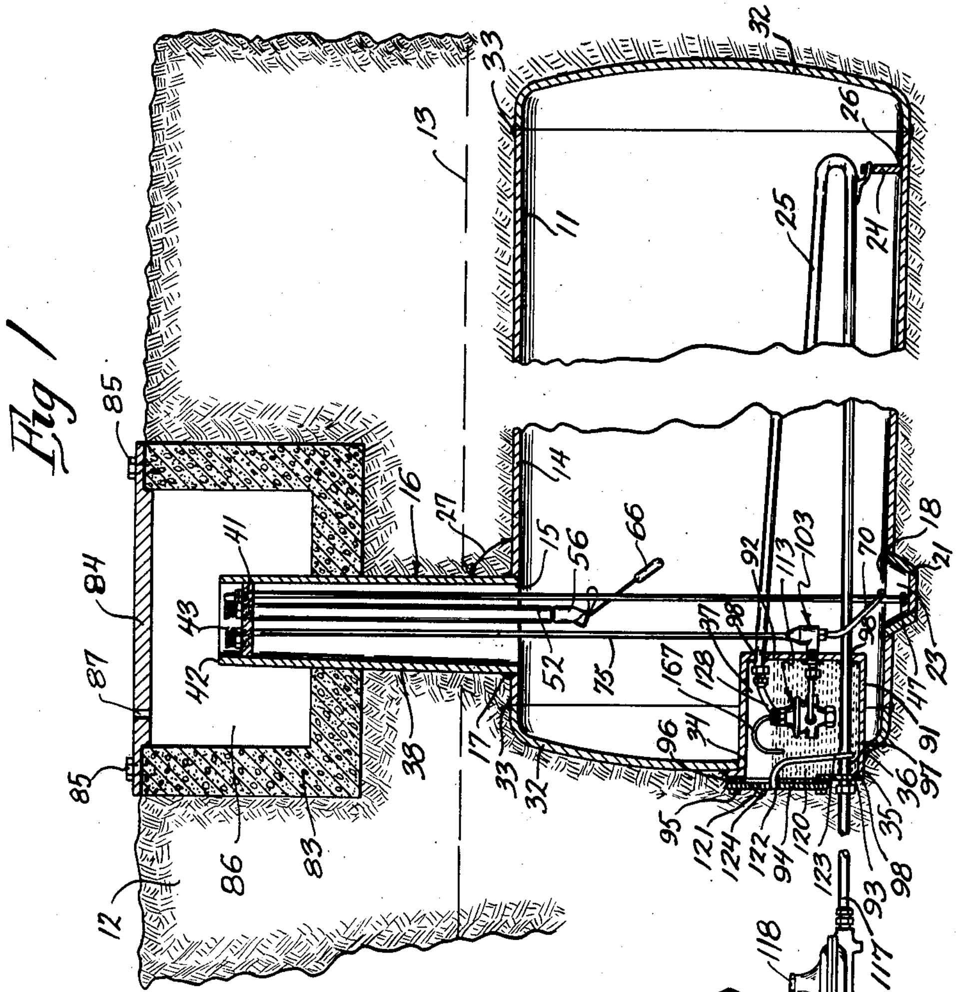

Fig 1

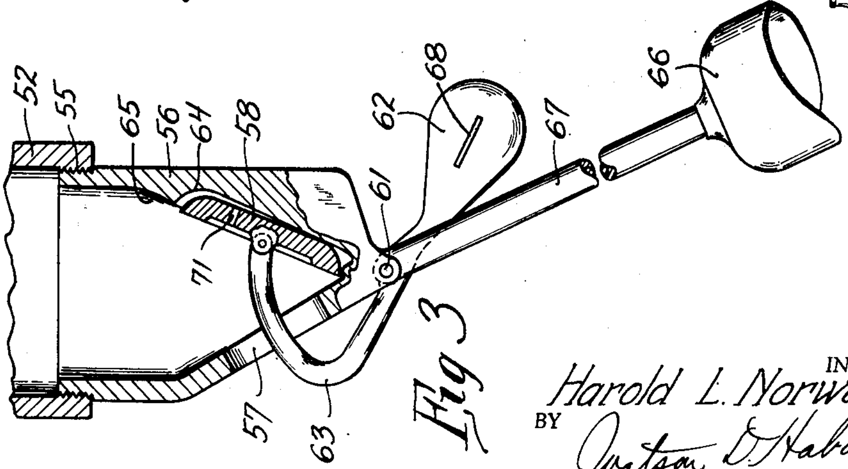

Fig 3

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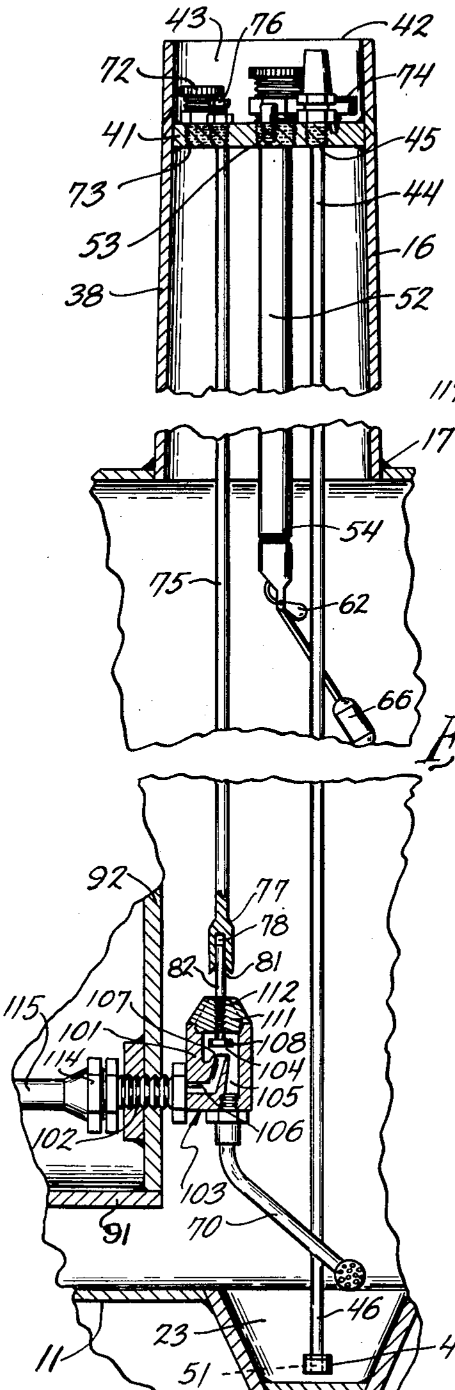


Fig 4

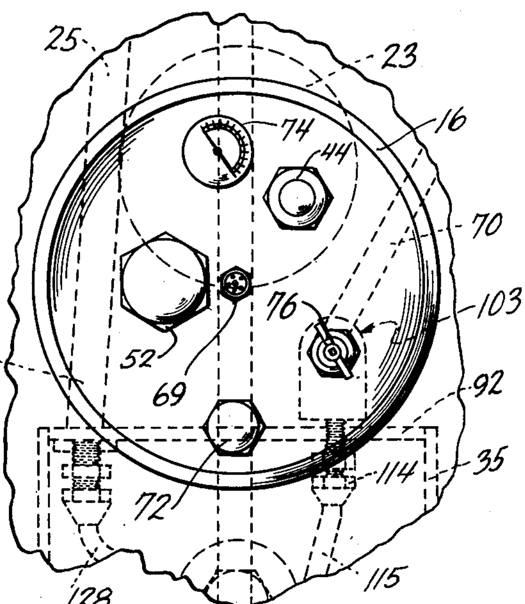
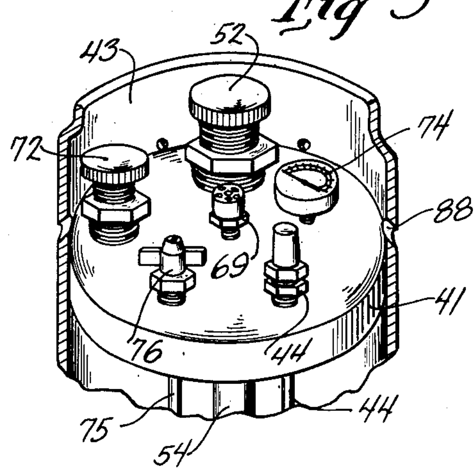


Fig 2

Fig 5



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LIQUEFIED PETROLEUM GAS DISPENSING SYSTEM

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10 Claims. (Cl. 62—1)

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The present invention relates to liquefied petroleum gas dispensing systems and is a continuation in part of my application which matured into Patent No. 2,400,570 on May 21, 1946, to cover divisible subject matter therein.

The petroleum product employed in the system with which the present invention is concerned, is preferably a hydrocarbon of the paraffin series, such as butane or propane, or a mixture of both, and the fuel is preferably stored in an underground tank in the form of a liquefied gas which, with the assistance of the heat of the earth and reduction in pressure is vaporized for use in a dwelling as a substitute for natural gas.

One way of vaporizing the liquefied gas is the so-called "batch" system in which the vaporization is carried on in the storage tank and vapor is withdrawn in the form of gas from the tank. The other way of vaporizing the liquefied gas is the so-called "flash" system in which the liquefied gas is withdrawn as a liquid from the tank and passed through a pressure reducing regulator which causes the liquid to flash into vapor.

Wherever the vaporization takes place, heat units are absorbed from surrounding parts, and, in the batch system, this refrigerating action is largely expended in the tank, whereas with the flash system, the heat absorption is concentrated in a comparatively small space, namely around the pressure reducing device and adjacent parts.

Although the present invention will improve vaporization and operating conditions for both systems, it is primarily of interest with the flash systems having for one of its objects the adaptation of the flash process to take advantage of the benefits derived with batch systems in that latent heat of vaporization is supplied from the warmth of the liquid contents in the tank as in the case of batch vaporization.

A further object of the invention is to prevent frosting of the body of the regulator in which the flash vaporization takes place. In this connection, another object of the invention is to submerge in an anti-freeze solution, those parts of the regulator which are subject to the refrigerating effect which follows the absorption of the latent heat of vaporization that accompanies pressure reduction.

Another object of the invention is to circulate an anti-freeze liquid convectively in heat exchange contact with the first stage regulator and a source of heat, in this instance the source of heat preferably being the heat of the earth.

A further purpose of the invention is to vent the regulator to the same anti-freeze liquid which conveys heat to the regulator.

Another object of the invention is to place a flash regulator in contact with a liquid exposed to a source of heat such as the earth over an area greatly in excess of the area of the regulator.

Another object of the invention is to provide

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an improved means for determining the level of liquid in the tank and for evacuating from the tank such foreign fluids as water.

A further object of the invention is to provide an improved means for preventing the filling of the tank above a predetermined level.

A further object of the invention is to provide an improved shutoff control for the gas supply leading from the tank which is not exposed to atmospheric temperatures.

Another purpose of the invention is to provide a dispensing system of the class described where, under normally expected conditions of heavy withdrawal, a revaporizer is not needed, yet without changing the general organization of standardized parts a revaporizer may be used where extra heavy withdrawals of gas are anticipated and condensation is likely to be incurred.

A further purpose of the invention is to provide a rugged, unitary tank assembly which is simple in construction, easy to make, readily placed in operation and serviced.

These being among the objects of the invention, other and further objects will become apparent from the drawings, the description relating thereto and the appended claims.

Referring now to the drawings:

Fig. 1 is a fragmentary vertical section taken longitudinally through the tank, standpipe and eduction cavity illustrating one of the improved embodiments of the invention.

Fig. 2 is a plan view of the standpipe illustrated in Fig. 1 showing the arrangement of the various elements thereon as projected upon the associated parts in the tank which are indicated in broken lines.

Fig. 3 is an elevational view partly in section of an improved form of a means for preventing the filling of a tank above a predetermined level.

Fig. 4 is an enlarged vertical section showing the relative location of the elements associated with the standpipe.

Fig. 5 is a perspective view of the top of the standpipe.

As already mentioned, the invention is illustrated in connection with a flash system of vaporization where a liquefied gas is forced from a storage tank by the vapor pressure of the stored gas and is passed through a first stage regulator which reduces the pressure whereby the liquefied gas is vaporized along with absorption of latent heat of vaporization and the resulting vapor is then conducted through and to a second regulator where it is reduced to a service pressure of 6 ounces per square inch. In the drawing, a storage tank is indicated at 11 as buried in the earth 12, below the frost line 13 normally expected to exist in the region where the installation is made.

Tank construction

The tank comprises a cylindrical central shell

14 apertured on the top at 15 to receive the standpipe which is welded therein as by a weld line 17. On its bottom, the shell 14 is provided with an opening 18 that partially overlaps a vertical projection of the opening 15, and the opening 18 is closed by a cup 21 welded thereto as at 22 to provide a sump 23. A support 24 for the revaporization coil 25 is welded upon the inside of the shell 14 as at 26 and for purposes of installing the tank properly in place so that the sump 23 works most effectively, the standpipe 16 is so positioned as to provide an angle at 27 which is slightly in excess of a right angle. When the tank is buried, the plumbing of the standpipe 16 will assure that any water collecting in the tank will lie to the right of the sump 23 until such time as the amount of water will exceed a depth of 1" or 1½" after which it will flow into the sump 23, the excess collecting there over and above that expected to be present after the tank has been tested hydraulically in its pressure test.

Both ends of the cylindrical shell are closed by caps 31 and 32 secured by welds 33. The cap is apertured as at 34 to receive the well member 35 welded therein as at 36 to provide a cavity 37 in the tank, and the tank is preferably constructed and assembled in this order.

Standpipe construction

The standpipe 16 comprises a cylindrical casing 38 closed at the top by a wall 41 spaced from the top 42 a sufficient distance to provide a recess 43 therein.

Referring to Figs. 2, 4 and 5, a slip tube gauge 44 is threaded into an opening 45 in the wall 41. The gauge 44 extends downwardly and its lower end 46 enters the sump 23 at the bottom of the tank 11. The lower end 46 is provided with a stop 47 which prevents complete removal of the slip tube gauge and in addition to the slip tube gauge functioning in the conventional manner to determine the level of the liquid in the tank, the stop 47 has an opening 51 therein with the mouth of the opening close to the bottom of the sump 23 so that water present in the sump will be evacuated through the slip tube gauge whenever the slip tube gauge is all the way down and the top is vented in the same manner in which the slip tube is employed as a gauge. The slip tube gauge would be left open as long as it was discharging water and could be closed again whenever liquefied gas began to flow.

The tank is filled through a fill pipe indicated at 52 as secured in the threaded opening 53. The fill pipe is so constructed and arranged that it can be completely assembled outside the tank and inserted into place in the standpipe 16 through the opening 53. The top of the fill pipe 52 is provided with a back pressure check valve which is opened by the pressure forcing liquid into the tank and the bottom 54 thereof is threaded at 55, as more particularly shown in Fig. 3, to receive a fitting 56 having a discharge opening 57 in the side thereof and a flap shutoff valve 58 pivoted as at 61 on the bottom and outside thereof where it is easily assembled.

The flap valve 58 is held normally opened by a weight 62 upon the other end of a curved arm 63 which extends through the opening 57 to control the movement of the valve 58. A recess 64 protected by a shielding lip 65 receives the flap valve 58 in one side of the fitting 56 where it is protected against a closing action of the flow of liquid passing down the pipe, through the opening 57. The valve 58 and the weight 62 are so related that an appreciable upward pressure upon the weight 62 will cause the flap valve 58 to leave the recess 64 and enter the path of the incoming fluid. The flowing fluid then enters the cavity 64 and forces or causes the valve to close under the pressure of the incoming fluid. When closed the valve positively stops the flow of liquid into the tank in a manner preventing the filling of the tank above a predetermined level. A valve actuating means that is responsive to the level of the liquid in the tank, such as a float 66 is employed to actuate the valve at the proper time in the filling operation.

In order to actuate the valve 58 the float 66 is mounted upon an arm 67 which is pivotally mounted upon the same axis 61 as the arm 63 and in the preferred embodiment of the invention the float arm 67 engages a stop 68 upon the weight 62 as the liquid and float 66 approaches the predetermined safe filling level.

Although in less expensive installation, the float 66 might serve as a weight, it is preferred that the weight 62 be provided and be movable separate from the float away from the arm 67 when the flap valve 58 is closed. In this way there is no straining of parts when the valve 58 is closed quickly by the incoming liquid and once the liquid supply line is turned off at the service tank, a vent-hole 71 will permit the liquid to drain through the flap valve and permit the weight 62 to reopen the valve 58.

It is preferred that the opening 57 be directed towards the left end of the tank as shown in Fig. 1 whereby the eddy current developed by the incoming liquid will tend to keep any water resulting from condensation in the tank away from the liquid eduction tube 70.

In this way a positive shutoff is provided to prevent an overfilling of the tank, thereby avoiding the deficiencies of conventional practice in which vapor return gauges are inadequate due to the peculiar nature of the liquefied petroleum gas. With certain conventional devices the continuance of filling pressures in the tank causes a liquefication of the gases already there and the level continues to rise regardless of a dip tube vent.

Although a vapor return connection is not entirely necessary, one is shown at 72 as threaded into an opening 73 in the wall 41. A safety check valve (not shown) is provided in the vapor return 72 which is opened when the nozzle of the vapor return base is connected thereto.

A pressure gauge 74 and a safety relief valve 69 are mounted upon the wall 41 and also a shaft 75 which can be manually turned by the winged handle 76 to control the passage of liquid through the eduction pipe 70, more specifically described hereinafter.

The lower end of the shaft 75 is provided with a wrench socket 78 having a flared mouth 81 which serves as a guide to engage with the valve shaft 82 which controls the operation of the eduction tube 70.

When the tank is buried in the ground, the upper part of the standpipe 16 is located in a concrete box or vault 83 having a cover plate 84 secured thereto by bolts 85. The cover 84 seals the space 86 and a vent 87 is provided for free venting of the vault to atmosphere in the event the safety relief valve is called upon to function. In order to prevent water from collecting in the recess 43 at the top of the standpipe the walls of the standpipe are drilled as at 88 just above the wall 41 to drain water collecting in the recess 43.

Eduction cavity—general construction

Referring now to the eduction cavity 37 the well member 35 is a fabricated construction comprising a cylindrical shell 91 which is about 6" to 8" in diameter and the same in length. The shell 91 is closed at its inner end by a plate 92 welded marginally thereto and the outer end has a wall 93 which is 2" or 3" high. The opening above the wall 93 is sealed by a head 94 and gasket 96 held in place by bolts 95.

A.—Eduction cavity shown in figure No. 1

Referring to Fig 1 the plate 92 is perforated to receive the two ends of a revaporization coil 25 at preferably vertical spaced points in which the outlet end 97 of the coil is low enough to pass through the wall 93. In this construction when the coil is welded in place as by welds 98 the coil is rigidly supported and held in place at three spaced points.

Referring to Fig. 4 a shutoff valve fitting 101 is threaded into the plate 92 through the opening 102 and comprises a main body portion 103 having a valve compartment 104 therein to which liquefied gas is conducted by the liquid eduction pipe 70 through an inlet passageway 105 and from which an outlet passage 106 leads from the valve opening 107 controlled by a valve member 108.

It is preferred that the valve member be negative, opening against the flow of the liquid, so that the valve compartment 104 can be located upon the pressure side of the valve. Then there is no need for packing where the valve stem 82 is threaded through the valve cap 111 as at 112.

Thus, as already mentioned, the flow of liquefied gas from the tank into the eduction cavity is controlled by the handle 76 at the top of the standpipe 16.

The outlet passage 106 of the valve body 103 is connected to a first stage regulator 113 by means of couplings 114 and a short elbow 115, one of the couplings comprising a union so that the regulator may be removed and attached at will. The outlet side of the regulator is connected to the upper end 117 of the coil 25 by a pig-tail 128 so that liquid withdrawn through the eduction tube 70 passes through the valve 101, the regulator 113, the coil 25 and out to a second stage regulator 118 which reduces the ultimate gas pressure to 11" of water column for use in a dwelling.

The head 94 as shown in Fig. 1 has an outwardly and downwardly inclined vent 121 therein to equalize the pressures between the atmosphere and the eduction cavity 37. The head 94 is also provided with a venting means 124 and a liquid level drain 122 which prevents the cavity 37 from being filled above a predetermined point.

The cavity 37 is filled preferably by a water-immiscible anti-freeze 120 and in order to prevent any water seeping into the cavity 37 and forcing the anti-freeze out, the drain opening 122 is connected to a sump pipe 123 extending to the bottom of the cavity 37 so that any liquid head developed in the cavity 37 will force the water collecting at the bottom thereof, out through the opening 122. The vent opening 121 is provided with a tube 124 to trap air above the liquid level and prevent a flooding of the cavity 37 in event an excessive amount of water is present at any one time around the tank.

First stage regulator

The regulator comprises a unitary body arranged to absorb heat from the liquid in which the regulator is disposed to supply that heat to the liquefied gas as it is vaporized. The operation of the regulator is controlled by a diaphragm (not shown) and the space in the bonnet above the diaphragm is vented to atmospheric pressure through a vent pipe 167.

The tube 167 opens into the interior of the cavity 37 and into the anti-freeze liquid 120 to prevent water condensation therein.

Second stage reduction

The outlet of the pipe 25 is connected to the second stage regulator by a service conduit 117 which may be made of any suitable length to locate the regulator 118 inside or outside the dwelling or in the basement or upon the first floor of a dwelling wherever it is found desirable to locate the regulator.

The regulator 118 receives the gas under 5# to 20# pressure from the first stage regulator 113, and reduces it to a working pressure of 11" of water column, the pressure conventionally used with gas burning appliances.

Assembly

In assembling the eduction cavity all the parts are assembled thereto and the unit is then inserted into the opening 34 and welded in place by the weld line 36 after which the valve control shaft 75 is inserted and lowered to engage the socket 78 over the valve shaft 82 and is guided by the engagement of the latter with the flared mouth 81. The mechanic can see to do this by looking through the relatively large opening 53. Thereafter the fill pipe 52 is mounted in the opening 53, the slip tube gauge is inserted and the fittings mounted upon the plate 41. The tank is then ready for shipment and in its assembled form it is evident that all the important parts are protected from damage in transit.

Installation

As already mentioned the tank is buried below the frost line. Before the earth is filled into the trench around the tank the cavity 37 is attended to. The liquid level drain 122 is removed and the cavity 37 filled with the water-immiscible liquid to a level at which it begins to run out of the drain vent 122.

After the tank is covered with earth, the standpipe 16 being free of side obstructions, the concrete box 83 may be received and lowered in place with a snug fit around the standpipe. Thereafter the filling of the trench in which the tank is placed is completed.

The cover 84 for the box 83 may be removed at any time during the operation and the fill pipe connected with the source of liquefied petroleum gas under pressure. In event a vapor return connection is provided, this also is connected with a supply tank to equalize the pressures between the supply tank and the storage tank. The weight of the float 66 or weight 62 will maintain the check valve open to permit the liquefied gas to enter the tank, the level of which gradually rises until it comes in contact with the float 66. Thereafter the float moves from a position inclined to the vertical to a position inclined to the horizontal and thereby increases its effective leverage during the lost motion between the float arm and the valve arm. Thereafter the float moves the valve outwardly gradually into the path of the incoming liquid far enough for the liquid to pick up the valve and close it, thereby obstructing the further flow of liquid gas to the tank and assuring that the tank will not be filled above a predetermined level.

During or after the filling operation the valve 103 may be opened to place the tank in operation. Thereafter liquefied gas will flow to the first stage regulator and be there reduced in pressure and simultaneously supplied with heat from the liquid body in which the regulator body is submerged.

The heat absorbed from the liquid body is replaced convectively through the walls of the cavity 37 (Fig. 1). As heat is absorbed in this relationship the body of liquid in the tank replaces it with heat absorbed from the earth.

Thus, it will be seen with the present construction that heat units are supplied directly in a new and improved manner to that part of the system, namely the first stage regulator, where the greatest refrigerating effect is experienced.

It will be apparent to those skilled in the art that various changes, modifications and alterations may be made without departing from the spirit of the invention, the scope of which is commensurate with the claims.

What is claimed is:

1. In a liquefied petroleum gas system a storage tank having an opening therein, means for filling the tank including an inlet passageway, means for controlling the flow of fluid through the passageway comprising a normally open cut-off valve, a float in the tank having all cross-sectional dimensions slightly less than the diameter of said opening and means operated by the float to close the valve when a predetermined level is reached in the tank, said controlling means, float and float operated means comprising an assembly insertable into the tank through said opening, and means for mounting the assembly in sealed relationship with respect to said opening.

2. In a liquefied petroleum gas system, a storage tank, means for filling the tank including a conduit, means for controlling the flow of fluid through the conduit comprising a valve seat facing upstream, a valve member closing with the flow of fluid, a recess means in the conduit to receive the valve member laterally of the path of fluid flow, and means responsive to the level of the liquid for moving the valve member from the recess means to a position where it will close with the flow of liquid.

3. In a liquefied petroleum gas system, a storage tank, means for filling the tank including a conduit, means for controlling the flow of fluid through the conduit comprising a valve seat facing upstream, a valve member closing with the flow of fluid, a recess means in the conduit to receive the valve member laterally in the conduit and means responsive to the level of the liquid for moving the valve member into position where it will close with the flow of liquid.

4. In a liquefied petroleum gas system, a storage tank adapted to be buried in the ground below the frost line, a standpipe in communication with the tank and adapted to extend upward to a point readily accessible from above the ground when the tank is buried, means for filling the tank including an inlet passageway, means for controlling the flow of fluid through the passageway comprising a valve body insertable through the standpipe and having a valve seat facing upstream, a valve member closing with the flow of fluid, and means responsive to the level of the liquid in the tank for actuating the valve member.

5. In a liquefied petroleum gas system, a storage tank having a riser pipe and an element closing said riser pipe at the top thereof, said element having an opening therein smaller than the inside diameter of the riser pipe, a filling assembly removably extending into the riser pipe through the opening in said element closing the top of said riser pipe, said assembly including a discharge fitting, a positive shutoff valve in said fitting, and means received in the tank and responsive to the level of the liquid in the tank for closing the valve at a predetermined level.

6. In a liquefied petroleum gas system, a storage tank having an opening therein, a filling assembly removably extending through said opening into said tank, said assembly including a discharge fitting, a positive shutoff valve in said fitting, and means carried by said fitting responsive to the level of the liquid in the tank for closing the valve at a predetermined level, said assembly and associated responsive means having an overall cross-sectional dimension capable of being received in an opening restricted substantially to a size sufficient to receive said responsive means.

7. In a liquefied petroleum gas system, a storage tank buried in the ground and having a riser thereon, said riser having an opening in the upper end thereof accessible from above ground, filling means removably extending through said opening, said means including a conduit and said filling means also including an assembly mounted upon said conduit, said assembly comprising a positive shutoff valve for closing said conduit, and means responsive to the level of liquid in the tank for closing said valve when the liquid in the tank reaches a predetermined level.

8. In a liquefied petroleum gas system a storage tank having a riser pipe, means for filling the tank through the riser pipe including an element having a passageway, means for controlling the flow of fluid through the passage comprising a cutoff valve, a float in the tank carried by said element, and means actuated by the float to close the valve when a predetermined level is reached in the tank.

9. In a liquefied petroleum gas system a storage tank having an opening through a wall thereof, a filling conduit removably extending through said opening, an assembly mounted on said conduit, said assembly comprising a shutoff valve for closing said conduit, and means responsive to the level of liquid in said tank for closing said valve when the liquid in the tank reaches a predetermined level, said assembly being of a size adapted to be received through an opening of a minimum size capable of receiving said means.

10. In a liquefied petroleum gas dispensing system a storage tank having an opening therein, an element closing said opening, said element having another opening therein, a filling assembly removably extending into said tank through said other opening in said element, said assembly including a discharge fitting, a positive shutoff valve in said fitting, and means received in the tank through said other opening and responsive to the level of liquid in the tank for actuating the valve at a predetermined level.

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