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GAS STORAGE AND DISPENSING APPARATUS

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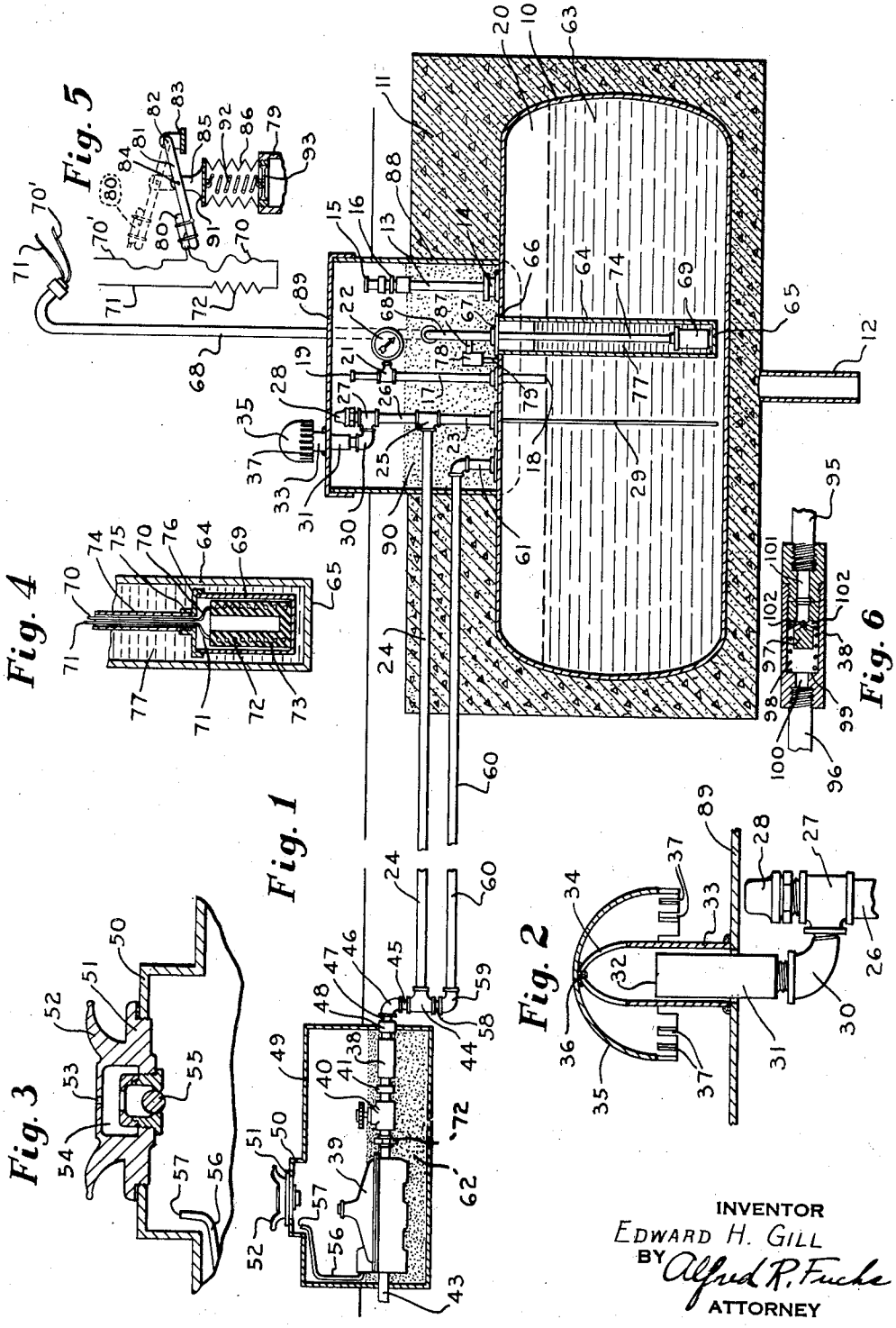


Fig. 1

Fig. 3

Fig. 4

Fig. 5

Fig. 2

Fig. 6

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GAS STORAGE AND DISPENSING APPARATUS

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10 Claims. (Cl. 62—1)

My invention relates to gas storage and dispensing apparatus, and more particularly to means for storing liquefied gases and dispensing the same in vaporous or gaseous form.

Certain petroleum gases, such as Butane and Propane, and similar gases, are adapted to be liquefied under pressure and shipped in such liquefied condition from place to place and stored in a storage tank and will vaporize, or turn into a gas at temperatures that are relatively low, so that frequently the atmospheric temperature is sufficient to cause such vaporization of these liquefied gases, so that the same can be dispensed to apparatus, such as cooking stoves, or other similar devices, where the gas is used in a similar manner to the ordinary manufactured or natural gas. These gases frequently are available in mixtures, or substantially in a pure condition, and it is desirable to provide an apparatus that can be used in conjunction with any of these readily vaporizable gases to provide means for feeding the vaporized gas to the apparatus, at which it is to be used, in a reliable and regular manner and to so construct the apparatus that this is not dependent upon atmospheric temperatures, as frequently atmospheric temperatures are encountered that are too low to properly vaporize the liquefied gas so that it will be fed in a regular and reliable manner to the apparatus that consumes the same.

In many localities, especially in cities, fire ordinances and similar regulations provide that the storage tank for the liquefied gas under pressure must be located at a certain predetermined distance from any building. This makes a relatively long pipe line necessary from the storage tank to the apparatus that consumes the vaporized gas, or the gas in its gaseous state. A serious problem in connection with such pipe lines is the condensation of the gas in the pipe line causing the same to lie in the pipe line and be carried along with the vapor in the pipe line in a liquefied condition. It is obvious that if a small quantity only, or a slug of larger amount of such liquefied gas reaches the consuming apparatus, such as the ordinary gas stove, it will cause a serious flare of flame that might injure the user of the apparatus and cause fire. It is one of the important purposes of my invention to provide a storage and dispensing apparatus for liquefied gases of the above mentioned character, and similar liquefied gases, that will not permit any such liquefied gas to reach the gas consuming apparatus, such as the stove burner, for example. While ordinarily in the ordinary temperatures found within buildings, there is no danger of such condensation, there is considerable probability that such condensation will take place in a long pipe line, particularly in climates that are cold during the winter and other cold months. It has been customary to provide a storage tank for the liquefied gas with a pressure reducing apparatus at or closely adjacent the tank from which a service pipe, or low pressure pipe line, extended to the apparatus at which the gas was burned. This would not present so much of a problem, if the storage tank were closely adjacent the apparatus at which the gas was consumed or burned, but with longer pipe lines the low pressure line of considerable length has considerable condensation in it, and it has been found necessary to provide various apparatus for revaporizing the condensed or liquefied gas. The difficulty with revaporizing the condensed gas in the service pipe line is that when this is revaporized the pressure is altered and no regular pressure, such as intended to be obtained by the pressure reducing means, can be obtained at the apparatus at which the gas is consumed, where such revaporizing means is used, because the revaporization of the liquefied, or condensed, gases causes an increase in pressure whenever such takes place. My improvements have avoided these difficulties. I avoid these difficulties in the dispensing of such liquefied gases in the vapor state by providing means for vaporizing the gases that are stored in a liquid state in the storage tank, which causes the gases to be generated at a certain vapor pressure that is much higher than that at which it is desired to utilize the same. From this tank I provide a high pressure pipe line that extends to pressure regulating means for reducing the pressure near the apparatus that is to consume the gases, such as a stove burner, for example, and provide a return pipe line to the tank for returning any condensed or liquefied gases in the high pressure pipe line to said tank, said return pipe line extending from adjacent the pressure regulating means on the high pressure side thereof back to the tank. Due to the fact that the pressure in the pipe line and the return line is the same as in the tank, no other means need be provided for returning the liquefied gas to the tank than the flow thereof by gravity through the return pipe to said tank.

It is a further purpose of my invention to provide new and improved means for providing a substantially uniform vapor pressure in the high pressure pipe line and in the vapor space in the upper part of the tank, by providing heating means for the liquefied gases in the tank that is pressure controlled, so as to heat the liquefied

gases to cause vaporization thereof only when the vapor pressure in the upper part of the storage tank is below a certain predetermined amount. The heating means, preferably, comprises a tubular chamber that contains a fluid medium, such as oil, in which an electrical heating apparatus is mounted that has a pressure responsive switch in circuit therewith, so that it is energized only to heat said fluid in said chamber when the pressure in the vapor space in the upper part of the tank is below a predetermined volume.

It is another purpose of my invention to provide an apparatus of the above mentioned character that has the apparatus associated with the pressure tank housed within a housing extending upwardly from said tank, including gauges, filling means and a safety valve, and the pressure responsive switching means, and to provide means associated with said safety valve whereby the vapors, or the gas in its gaseous state, passing through the safety valve to relieve the pressure in the apparatus, will be dissipated and scattered so that no pockets thereof will exist near the housing that might cause fire or explosion. This is accomplished by providing a dome-like cover over the outlet from the safety valve, which is provided with a plurality of openings, or slits, therein, through which the gas is adapted to escape in such a manner that any current of air whatsoever striking the same will cause the combustible gas thus escaping to be spread out and dissipated, so that it will not be of sufficient quantity in any part of the atmosphere adjacent the housing and the outlet from the safety valve to ignite under any circumstances.

It is another purpose of my invention to provide pressure reducing and regulating means at a point remote from the storage tank, and to provide a housing for such pressure regulating means including venting means for said housing to permit the escape of any combustible gases, that may accumulate in said housing, through said venting means.

Other objects and advantages of my invention will appear as the description of the drawing proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details shown or described, except as defined in the claims.

In the drawing:

Fig. 1 is a view partly in vertical section and partly in elevation of my improved apparatus, portions of the pipe line being broken away.

Fig. 2 is a fragmentary view partly in vertical section and partly in elevation, on an enlarged scale, of the safety valve and dissipating means for the gases escaping from the safety valve.

Fig. 3 is a fragmentary vertical sectional view on an enlarged scale, of the upper portion of the housing for the pressure regulating means remote from the tank, showing the vented closure means therefor.

Fig. 4 is a fragmentary vertical sectional view through the lower portion of the heating means for the liquefied gas in the storage tank, on an enlarged scale.

Fig. 5 is a diagrammatic view of the pressure responsive controlling means for the heating apparatus, and

Fig. 6 is a longitudinal section through the excess flow check valve.

Referring in detail to the drawing, my liquefied gas storage and dispensing apparatus comprises a tank 10, which is mounted underground in a bed of loose material, such as crushed rock 11, which extends over and around the sides and ends and under the tank, a drain pipe 12 being provided for draining any water that may accumulate in this bed of crushed stone downwardly into the ground an appreciable distance below the tank. Said tank is provided with filling means comprising a filler pipe, or conduit, 13 that extends into the top of the tank through a check valve 14, which closes so as to prevent any back pressure from the tank entering the pipe 13. The filler pipe 13 is provided with any standard coupling means 15 for connecting a filler conduit extending from a portable delivery tank to the pipe, or conduit, 13 and a filler valve 16 of any well known standard construction.

Cooperating with the filler conduit 13 is an equalizing conduit 17, the lower end 18 of said conduit 17 determining the level to which the tank may be filled with the liquefied gas. Said equalizing pipe, or conduit, 17 is provided with a combined vapor valve and coupling 19 of any desired construction for connecting the conduit extending from the portable delivery tank thereto. The method and apparatus for feeding the liquefied gas under pressure from the portable tank to the storage tank 10 is not a part of the invention except insofar as it determines the provision of a vapor space 20 in the top of the tank 10 that will always exist. This is due to the fact that as soon as the liquefied gas that enters through the pipe 13 reaches a level such that the bottom end 18 of the equalizer conduit 17 is reached thereby, the vapor under pressure will be cut off from said pipe and will no longer equalize the pressure in the tank and the back pressure check valve 14 will close, cutting off the feeding of liquefied gas to the storage tank. A T 21 is, preferably, provided on the equalizer pipe 17, to which a pressure gauge 22 is connected. This will, of course, function immediately after any gas has been drawn off from the tank 10, because the liquid level will then be below the entrance 18 to the equalizer conduit 17.

A high pressure vapor outlet pipe 23 extends from the top of the tank 10 and is connected with the high pressure vaporized gas pipe line 24 by means of the T 25. A pipe 26 extends from the T 25 to a gauging coupling 27, which is provided with a slip tube gauge having a closure 28 that is removed to obtain access to the slip tube 29 to read the level of the liquid in the tank 10 in a well known manner. Extending from the member 27 is an elbow 30, to which is connected a safety valve 31, which extends through the cover member 89 of the housing 88 and operates in a well known manner to discharge vapor therethrough when the pressure in the vapor space 20 in the tank reaches a predetermined maximum, the discharge end 32 of the safety valve being mounted in a tubular conduit 33, which is welded to the cover member 89 and extends upwardly therefrom, said conduit 33 terminating at its upper end in a U-shaped member 34, which is welded to the inverted dome-like, or cup-like, member 35 at 36, said dome or cup-like member 35 serving as means for dissipating any combustible vapors that will escape from the outlet 32 of the safety valve. This is accomplished by providing a large number of slits, or slots, 37 in the bottom peripheral edge of the dome-like member 35, through which combustible vapor is adapted to escape, and it will be obvious that it will be scattered by this means, so that if there is any movement of air whatsoever it will be carried away in small amounts in the moving air into the atmos-

phere in such a manner that no pockets thereof will collect that could possibly be ignited.

The high pressure pipe line 24 extends from the storage tank 10, which is located at a predetermined distance, usually determined by some fire regulation, or similar regulation, from a building in which the vaporized gas is to be used, to pressure regulating means adjacent the walls of such building, said pressure regulating means comprising an excess flow check valve 38 of any well known construction, and a pressure regulator, or pressure reducing member, 39, a shut-off valve 40 being provided between the excess flow check valve 38 and the pressure regulator 39, any suitable connecting means, such as the couplings 41 and 42, being provided between the check valve 38 and shut-off valve 40, and between the shut-off valve 40 and the pressure regulating member 39, respectively. The pressure regulating member 39 is of a well known standard construction and serves to prevent the pressure in the low pressure pipe line 43 from exceeding a predetermined maximum. The check valve 38 operates to prevent any excessive amount of gas from passing through the same to the pressure regulator 39, shutting off when the flow therethrough becomes too rapid, and would shut off in case of breakage of any pipe or other apparatus located beyond the outlet end thereof.

The pipe line, or high pressure vapor supply pipe, 24 is provided with a T 44 at the end thereof adjacent the pressure regulating means, from which a pipe 45 extends to an elbow 46, which is connected with a pipe 47 leading to said check valve 38, through a suitable bushing 48 that is mounted in a housing 49 for the pressure regulating means, check valve and shut-off valve. The housing 49 is located closely adjacent the building in which the gas consuming apparatus, such as a stove, for example, is located, to which the vaporized gas from the liquefied gas storage tank 10 is supplied. Said housing 49 is provided with a dome-like member 50 thereon that is provided with a screw-threaded closure member 51, which is provided with suitable means 52 thereon for turning the same, and which has a vent opening 53 therein leading to the chamber 54 within said closure member, into which a ball check valve 55 discharges vapors within the chamber 49 whenever these exceed the atmospheric pressure sufficient to raise the ball check valve 55 from its seat. The pressure regulator 39 is provided with a vent, or vapor discharge pipe, 56, which operates to discharge gas or vapor from the pressure regulator 39 whenever the pressure on the high pressure side thereof becomes so large that the pressure regulator is unable to handle the reduction in pressure to that desired for the low pressure service pipe 43, said vent pipe 56 having its discharge end 57 closely adjacent the vented closure member, or plug, 51.

A pipe 58 extends downwardly from the T 44 and has an elbow 59 connected therewith, which is connected with a return pipe 60 that extends back to the tank 10, entering the same through a downwardly extending pipe 61 leading into the top of the shell portion of said tank into the vapor space 20. It will be obvious that the pressure in the pipes 24 and 60, as well as the pipe 23, pipe 61, T 44 and pipe 58 will be equalized and that if any liquefied gas should accumulate in the pipe 24 due to condensation thereof, or from any other cause, when it reaches the T 24 it will pass downwardly into the pipe 58, through the elbow 59 and through the return pipe 60 and return pipe 61 back to the tank 10.

Heat insulating material 62 is provided in the housing 49 around the check valve 38, the pipe connections, the shut-off valve 40 and the pressure regulating means 39, so that there will be little possibility of any condensation in this portion of the apparatus, and as the service pipe, or low pressure supply pipe, 43 will be relatively short and will enter the building immediately adjacent the housing 49, any possibility of condensation of gas in this portion of the apparatus will be eliminated. Condensation occurs in most instances due to the temperature reaching a critical point, below which the gas, at the pressure existent in the pipe line, will change to the liquid phase. In very warm mild climates this will seldom occur, but in colder climates it is quite liable to occur frequently, and furthermore, inasmuch as such condensation might occur in any such apparatus, no matter where located, under certain conditions, it is highly important as a safety measure, to provide means for preventing any of the liquefied gas from passing in any quantity into the low pressure pipe line 43. This is avoided by means of the arrangement of drip connection 58 and return pipe 60.

While in certain climates it may be unnecessary to heat the liquefied gas 63 in the storage tank 10, in most locations for such apparatus, there are times when it will be necessary to heat the liquefied gas 63 to cause the building up of the proper amount of vapor pressure in the vapor space 20 to transport the vaporized gas through the high pressure pipe line 24 to the pressure regulating and reducing means within the housing 49. I provide electrical heating means for this purpose, which indirectly heats the liquefied gas 63, through a fluid medium that is provided within a housing that is liquid tight and separates the fluid that is used for heating purposes entirely from the liquefied gas 63. Said means comprises a tubular member 64, which is provided with a closed end wall 65 and which is secured in an opening in the shell of the tank at 66 in any desired manner, as by welding. Said tubular housing, or tubular heater member, 64 is closed at its upper end by means of a cap 67, from which a conduit 68 extends for electrical conductors.

Mounted within the tubular member 64 is an electric heater 69, from which the conductors 70 and 71 extend. The electric heater 69 is provided with a housing, which is made of metal and within which is provided a heating coil, or element, 72 that is embedded in a heat conducting electrical insulating composition 73. The conductors 70 and 71 may be mounted in a metal tube 74, which is connected with a suitable internally screw-threaded nipple 75 provided on the cover member 76 for the metallic housing of the heater 69, so that the liquid medium 77, such as oil, provided within the tubular member 64, will not come in contact with said electrical apparatus at all. In order to control the vapor pressure in the vapor space 20, a pressure responsive controlling member 78 is provided, that is connected with the vapor space by means of the conduit 79. Any suitable apparatus of this character may be utilized, preferably, a pressure responsive means being utilized that interrupts the electrical circuit to the electrical heating element 72 by the effect of the pressure on a tiltably mounted tube containing mercury, such as that shown diagrammatically in Fig. 5, in which a member 80 is provided that has a quantity of

mercury therein, and into one end of which extend the wires 70 and 70' leading to spaced contacts adapted to be bridged by the mercury when the tube is in the full line position shown in Fig. 5. The tube 80 is mounted on a lever 81 pivoted at 82 on any suitable support 83 and pivotally connected at 84 to a bracket 85 provided on the head 91 of a diaphragm 86 that is connected with the conduit 79 and open thereto. Within the diaphragm 86 is a spring 92, which is connected with the head 91 and a spider 93 forming part of the mounting of the pressure responsive means on the conduit 79. It will be clear that when the pressure in the vapor space 20 reaches a predetermined maximum the diaphragm 86 will expand to the extent that the lever 81 will move to the dotted position shown in Fig. 5, causing the circuit between conductors 70 and 70' to open because the mercury in the tube 80 moves to the end of the tube remote from the contacts.

It will be obvious that if this pressure responsive switching means, or any other pressure responsive switching means, is mounted between portions 70 and 70' of one of the conductors, leading to the heating element, indicated diagrammatically at 72 in Fig. 5, the circuit will be completed through the terminals in the tube by the mercury whenever the pressure is below a predetermined minimum, such condition being indicated diagrammatically in full lines in Fig. 5, and the heating element 72 will be energized to heat the electrical heater 69 and the liquid, such as the oil 77 in the tubular member 64. However, when the vapor pressure in the space 20 reaches a predetermined maximum, the switch will be actuated as above described, interrupting the circuit to the heating element 72 and thus interrupting the heating of the oil 77 in the tubular member 64, so that the vapor pressure in the vapor space 20 will be prevented from increasing to an excessive amount. If, due to outside temperature conditions, the vapor pressure in the space 20 should become too great it is relieved through the safety valve 31. A suitable metallic conduit 87, preferably, extends from the conduit 68 to the pressure regulating means 78, so that all electrical connections are enclosed within a metallic tubing.

Extending upwardly from the storage tank 10 is a housing 88 that has a top closure member 89 provided thereon, and within said housing heat insulating material 90 is, preferably, provided around the major portion of the various pipes extending from said tank and around certain of the apparatus connected with said pipes that does not have to be readily accessible from externally of the apparatus. It will be obvious that when the cover member 89 is removed, the dome-like member 35 and the tubular member 33 are removed therewith, but the safety valve 31 remains in place within the housing 88.

In Fig. 6 one form of excess flow check valve is shown, which has the inlet connection 95 and the outlet connection 96. A valve member 97 is provided therein, which is urged toward the right in Fig. 6 by means of the coil spring 98. However, should the flow through the outlet 96 be at too rapid a rate, the valve 97 will be unbalanced, due to the pressure applied to one side thereof by the gas entering through the inlet connection 95, causing the valve 97 to move to the left and engaging the seat 99 around the passage 100 leading to the outlet connection 96. Ordinary flow of gas through the excess flow check valve 38 will permit the valve 97 to remain in the position shown in Fig. 6, the gas normally passing through the passage 101 and the passages 102 provided in the valve member 97 and then through the passage 100 to the outlet connection 96. The purpose of this type of valve is to check or control the flow of gas through the same, so that no excessive amounts will pass therethrough. While a well known type of such valve is illustrated in Fig. 6, it is, of course, to be understood that any type of valve having the same function can be used at the place indicated at 38 in Fig. 1, the particular type of valve illustrated being shown merely to clearly define what is meant by an excess flow check valve.

What I claim is:

1. An apparatus of the character described, comprising a storage tank for liquefied gas having a vapor space in the upper portion of the liquid receiving space thereof, pressure reducing means at a point remote from said tank, a high pressure gas supply conduit freely open to and extending from the upper portion of said tank to said pressure reducing means, and a high pressure return conduit extending from said high pressure supply conduit adjacent said pressure reducing means, and at a point between said pressure reducing means and said tank, to the upper portion of said tank, and freely open to the liquid receiving space in said tank.

2. An apparatus of the character described comprising a liquefied gas storage tank having a common liquid and vapor chamber, a short low pressure gas line, a relatively long high pressure gas supply line extending from said chamber in said tank mostly in a generally horizontal direction, pressure reducing means interposed between said high pressure and low pressure lines, said pressure reducing means being located at a point spaced an appreciable horizontal distance from said tank, and a high pressure condensate return line extending mostly in a generally horizontal direction from said high pressure supply line at the end thereof adjacent said pressure reducing means to said tank, and being freely open to said common liquid and vapor chamber.

3. An apparatus of the character described comprising a liquefied gas storage tank having a common liquid and vapor chamber, a low pressure gas line, a high pressure gas supply line extending from and freely open to said common chamber in said tank, pressure reducing means interposed between said high pressure and low pressure lines, said pressure reducing means being located at a point spaced an appreciable distance from said tank, a housing for said pressure reducing means and a high pressure liquid gas return line extending from said high pressure supply line, at a point externally of said housing between said pressure reducing means and said tank and adjacent said pressure reducing means, to said tank, and freely open to said common chamber.

4. An apparatus of the character described comprising a liquefied gas storage tank having a single common liquid and vapor storage chamber, a low pressure gas line, a high pressure gas supply line extending from said tank, vented pressure regulating means interposed between said high pressure and low pressure lines, said pressure regulating means being located at a point spaced an appreciable horizontal distance from said tank, a housing for said pressure regulating means, a vented closure for said housing, and a high pressure return line extending from said high pressure supply line, at a point ex-

ternally of said housing between said pressure reducing means and said tank and adjacent said pressure regulating means, to said tank, said high pressure supply line and said high pressure return line extending in vertically spaced relation to each other through the major portions thereof and both freely open to said common chamber.

5. An apparatus of the character described, comprising a storage tank for liquefied gas having a vapor space in the upper portion of the liquid receiving portion thereof, pressure reducing means at a point remote from said tank, a high pressure gas supply conduit extending from the vapor space in the upper portion of said tank to said pressure reducing means, means for maintaining a predetermined vapor pressure in said vapor space, and a high pressure condensate return conduit extending from said supply conduit adjacent said pressure reducing means at a point between said pressure reducing means and said tank to the vapor space in the upper portion of said tank, said high pressure supply and return conduits being freely open to each other and both freely open to said tank.

6. An apparatus of the character described, comprising a storage tank for liquefied gas having a vapor space in the upper portion of the liquid receiving portion thereof, pressure reducing means at a point horizontally remote from said tank, a high pressure gas supply conduit extending from the vapor space in the upper portion of said tank to said pressure reducing means, means for maintaining a predetermined vapor pressure in said vapor space comprising means for heating the liquefied gas in said tank and pressure responsive means controlling said heating means, and a high pressure condensate return conduit extending from said supply conduit adjacent said pressure reducing means at a point between said pressure reducing means and said tank to the vapor space in the upper portion of said tank, said high pressure supply and return conduits being freely open to each other and both freely open to said tank.

7. An apparatus of the character described comprising a liquefied gas storage tank having a single common liquid and vapor storage chamber, a low pressure gas line, a high pressure gas supply line extending from said common chamber in said tank and freely open thereto, pressure reducing means interposed between said high pressure and low pressure lines, said pressure reducing means being located at a point spaced an appreciable horizontal distance from said tank, means for heating the liquefied gas in said tank, controlling means for said heating means responsive to the vapor pressure in the tank, and a high pressure return line extending from said high pressure supply line adjacent said pressure reducing means at a point between said pressure reducing means and said tank to said tank, and freely open thereto, said high pressure supply line and said high pressure return line extending in vertically spaced relation to each other through the major portions thereof.

8. An apparatus of the character described comprising a storage tank for liquefied gas, having a vapor space in the upper portion thereof, and means for maintaining a predetermined vapor pressure in said vapor space comprising means for heating the liquefied gas, comprising a liquid tight chamber in said tank sealed from the interior of said tank, a liquid medium in said chamber and means within said chamber for heating said liquid medium, and means responsive to the pressure of the vapor in said vapor space for both initiating and halting the operation of said heating means.

9. An apparatus of the character described comprising a storage tank for liquefied gas, having a vapor space in the upper portion thereof, and means for maintaining a predetermined vapor pressure in said vapor space comprising means for heating the liquefied gas, comprising a liquid tight chamber in said tank sealed from the interior of said tank, a liquid medium in said chamber, electrical heating means in said chamber immersed in said liquid medium, and switching means responsive to the pressure of the vapor in said vapor space to both close and open the circuit to said heating means.

10. An apparatus of the character described comprising a liquefied gas storage tank having a liquefied gas storage chamber, a low pressure gas line, a high pressure gas supply line extending from said liquefied gas storage chamber, pressure reducing means interposed between said high pressure and low pressure lines, said pressure reducing means being located at a point spaced an appreciable distance horizontally from said tank, and a line freely open to said chamber and high pressure line for returning condensate from a point in said high pressure line adjacent said pressure reducing means to said tank, said high pressure and return lines comprising a fluid circulating system between the point adjacent said pressure reducing means and said tank.

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