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METHOD AND APPARATUS FOR DISPENSING LIQUID FUEL

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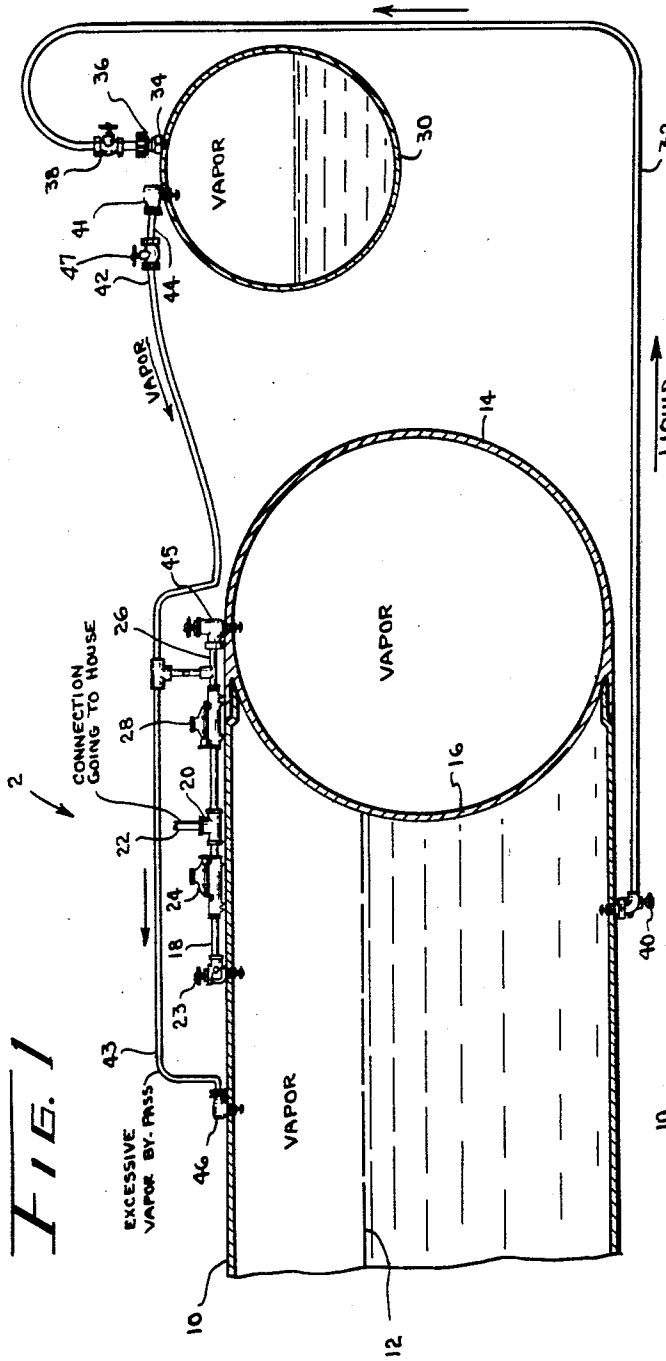


FIG. 1

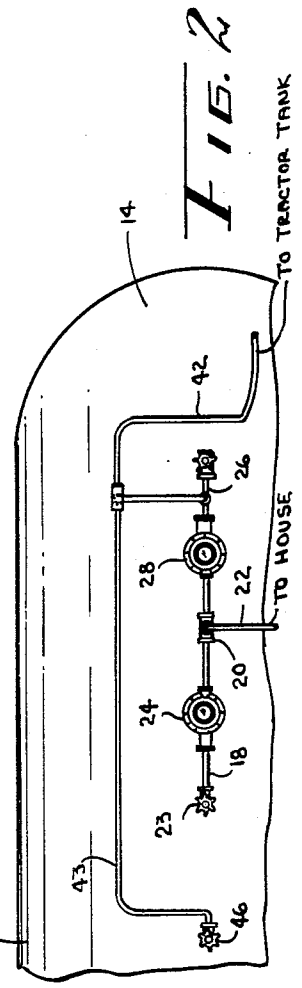


FIG. 2

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METHOD AND APPARATUS FOR DISPENSING LIQUID FUEL

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This invention relates to the dispensing of liquified petroleum gases of low boiling points, especially butane and propane in their liquid phase and in their gas phase in a closed system, by creating differential pressure in the closed system.

The dispensing from one container to another of liquified gas in its liquid and gas phases has been accomplished by several means and methods. One of the systems utilizes a valve to bleed off gas from portions of the system. This bleed off method is both dangerous and wasteful. In other systems, liquid pumps are employed for the dispensing of the liquified gas in its liquified phase. These pumps are either operated manually or by some type of power such as fuel or electricity. The manually operated liquid pumps are both extremely fatiguing to operate and inadequate in that the liquid flowed is quite slow from a storage tank to a tank to be filled. The power operated liquid pumps flow the liquid at a fair rate of speed, but entail considerable initial investment and maintenance cost.

Vapor pumps have also been used in these systems and they operate in the vapor line. The vapor is flowed from the tank to be filled into the supply tank which creates a differential pressure in these two tanks, thus the higher pressure in the supply tank forces liquid therefrom through a line into the tank to be filled. Vapor pumps are expensive and are subject to maintenance costs.

This invention comprises a primary supply tank for holding liquified gas which is connected through a vapor line which is in turn controlled by a valve and a pressure responsive means to a consumer's vapor line. An auxiliary container which may be integral with or separate from the primary supply tank is connected by a vapor line to the consumer vapor line. In the vapor line from the auxiliary container there may or may not be interposed a vapor pressure responsive device. If, however, a pressure responsive device is used in the auxiliary container vapor line, it is always set to release a pressure not lower and preferably slightly higher than the regulator in the vapor line connecting the primary supply container with the consumer line. If greater pressure is present in the auxiliary container than the pressure released by the regulator in the primary vapor line, vapors will be flowed to the consumer's supply line entirely from the auxiliary container rather than from the primary supply container.

A liquid line connects the liquid in the primary tank to a portable tank which may be associated with a tractor or other type vehicle or equipment. A vapor line connects the top of the portable tank with the auxiliary tank. When the portable tank is to be filled with liquid from the primary tank, valves are opened in the liquid line and in the vapor line connected between the portable tank and the auxiliary tank. Now, vapor gas flows from the high pressure portable tank to the low pressure auxiliary tank creating less pressure in the portable tank than in the primary supply tank so that the relatively greater

pressure in the primary supply tank forces liquid from the primary supply tank to the portable tank.

It is an object of this invention to provide a system for dispensing liquified gas in its liquid phase by differential pressure without the use of pumps or other similar means.

It is another object of this invention to provide a system for dispensing liquid gas in its liquid phase and for dispensing liquified gas in its gas phase by means of creating differential pressure in different portions of the system.

It is still a further object of this invention to provide a closed system for dispensing liquified gas in its liquid phase, by means of differential pressures within the system, to a portable container which is quickly connectable to the system.

It is yet another object of this invention to provide a closed system for dispensing liquified gas in its liquid state from a primary supply zone in the system to a portable consuming zone in the system by means of differential pressures in the system and to provide pressure regulating means in the system whereby liquified gas in its gas phase is supplied to a stationary consuming zone in the system from the primary supply zone at one given pressure value and to supply liquified gas in its gas phase from an auxiliary supply zone in the system to the stationary consuming zone at a pressure which is of a higher value than the one given pressure value.

It is another object to provide a closed system for dispensing liquified gas in the liquid phase from a primary supply tank in the system to a portable tank in the system and the dispensing of liquified gas in its gas phase from the portable tank to an auxiliary tank in the closed system by means of differential pressure in the system, without the loss of any of the liquid gas or vapor gas.

Figure 1 is a schematic plan of the system, parts in section, and parts broken away.

Figure 2 is a plan view of the supply and auxiliary tanks employed in the system, parts broken away.

Referring in detail to the drawing, **10** is a primary supply tank or container for holding a supply of liquid petroleum gas. The level of the liquid is shown in the tank **10** as at **12**. An auxiliary tank or container **14** is formed integral with tank **10** and a seal proofed metal wall **16** separates the container **14** from the container **10**.

A primary gas line **18** connects the upper portion of the container **10** to a connection **20** which is in communication with a gas supply line **22** which leads to a final stage regulation device, not shown, thence to an appliance or the like. A shut-off valve **23** may be or may not be interposed in the gas line **18** adjacent the top of container **10** and a pressure regulator **24** is also interposed in the gas line **18** for regulating the pressure at which gas flows from tank **10** through line **18** to the gas supply line **22**. A gas line **26** connects the auxiliary tank **14** with the connection **20** which flows gas from the auxiliary container **14** to the gas supply line **22**. A pressure regulator **28** may or may not be interposed in the gas line **26**.

A portable tank **30** which may be the tank for a tractor or the like is detachably connected by lines from the primary supply tank **10** and from the auxiliary tank **14**. One end of a liquid hose line **32** is connected to the liquid portion of the primary supply tank **10** and its opposite end is detachably connected to a liquid fill valve **34** of the portable tank **30** by means of a hose coupling **36**. A shut-off valve **38** is interposed in the liquid line **32** adjacent the hose coupling **36**. A liquid service valve **40** is interposed in the liquid line **32** adjacent the supply tank **10**. One end of a vapor gas line **42** is connected by a section of line **26** to a shut-off valve **45** which in turn communicates with the interior of auxiliary tank **14**

while the opposite end of line 42 is detachably connected to a vapor return valve 41 on the portable tank 30 by means of a vapor return hose coupling 44. A shut-off valve 47 is interposed in the gas line 42. A pressure equalizing by-pass line 43 is connected at one end to a vapor check valve 46 in the primary tank 10 and is connected at the other end to line 42.

In operation of the system when the tank 30 of a tractor or other portable container is to be filled with liquid petroleum from the primary supply tank 10, the liquid hose 32 is connected to the liquid fill valve 34 of tank 30 and the vapor line 42 of the auxiliary tank 14 is connected to the vapor return valve 41 of the tank 30. Now the shut-off valves 38 and 47 in the liquid and vapor lines respectively are opened. Gas vapors in the upper portion of the tank 30 flow through line 42 to the auxiliary tank 14 which is at a much lower pressure value than the pressure in tank 30. As the gas vapors in tank 30 flow into the auxiliary tank 14, the gas pressure in the tank 30 drops to less than the pressure in the primary supply tank 10 so that the gas pressure in the primary supply tank 10 forces liquid from tank 10 through line 32 until the portable tank 30 is filled with liquid petroleum gas.

The pressure regulating means 24 in the gas line 18 which is pressure responsive is set to release a pressure value as low or lower than does the optional pressure regulating means 28, if used, in the gas line 26 which is pressure responsive. As long as the fixed gas pressure released by pressure regulator 24 is as great as the varying gas pressure in the auxiliary tank 14 gas flows from the primary supply tank 10 through gas line 18 to the supply line 22 thence to the appliance (not shown), but as soon as the gas pressure in the auxiliary tank 14 becomes greater than the fixed pressure released by regulator device 24 then the pressure regulating means 24 in line 18 is closed and the optional pressure regulating means 28, if used, in the gas line 26 controls the flow of all gas vapors into the consumer's line 22. Of course if there is no pressure regulator in the line 26 between the auxiliary tank 14 and the connection 20, the effect will be exactly the same except the pressure within the entire consumer line down to the final stage regulator will vary as does the pressure in the auxiliary tank 14. This will continue until the pressure in the auxiliary tank 14 drops below that required to keep closed the primary regulator 24. After the gas pressure in tank 14 drops below the gas pressure released by the regulator 24, then all gas flow will again automatically come from the primary supply tank 10.

It is evident that the amount of liquid gas that can be transferred at any one time is dependent upon and limited by the existence of a pressure differential between the auxiliary tank and the portable tank. This differential pressure is dependent upon the amount of gas consumed through line 22. Experience shows that portable tank 30 may have a greater internal pressure than the primary tank 10 due to heat. It would be imprudent to transfer these excessive vapors to the auxiliary tank because unless the amount of gas consumed through line 22 is sufficient to maintain a differential pressure between the portable tank 30 and the auxiliary tank 14 the amount of liquid gas that can be transferred from the primary tank 10 to the portable tank 30 will be further limited.

Opening of the shut-off valve 47 in the vapor line 42 connecting the portable tank 30 with the auxiliary tank 14 and closing shut-off valve 45 will cause any excessive vapors in the portable tank 30, should they exist, to by-pass through line 43 through the vapor check valve 46 into the primary supply tank 10 until the pressures of the primary supply tank 10 and the portable tank 30 are equal.

The closed system as illustrated shows the consumer line 22 being supplied alternately by the primary supply tank 10 through line 18 and by the auxiliary supply tank 14 through line 26. However, the consumer line 22 could be supplied exclusively from the auxiliary tank 14. This, then, would entail vapors from the primary supply tank 10 passing through line 18 and the pressure regulator 24 into the auxiliary tank 14.

Another alternative to the diagram as shown would place the pressure regulator 28, if used, in line 22 instead of line 26, and if used its setting could be without regard to the setting of pressure regulator 24 in line 18.

It can be seen that the portable tank 30 connected in the system is filled by creating differential pressure in the system and no pumps are required. Also, the auxiliary tank 14 is adapted to receive the gas formed in the portable tank both before and during its filling of liquid so that none of the fuel is lost by being bled off to atmosphere which is both wasteful and dangerous. One manufacturer of vapor pumps claims that conclusive tests have shown that the use of the bleed off method results in a waste of from ten to fifteen percent of the liquid fuel transferred to the tank being filled.

A pressure regulating means is to be interposed in the supply line 22 to reduce the value of the pressure to a useable value for an appliance.

The auxiliary tank 14 may be spaced entirely inside the primary supply tank 10 or may be outside and separate from the primary supply tank 10.

The present invention is primarily designed to transfer liquid petroleum gases of low boiling points from a primary source to a more portable container without attendant loss of gas.

Since certain changes in carrying out the above process and in the construction set forth, which embody the invention may be made without departing from its scope, 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.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. An apparatus for dispensing liquified gas in its liquid phase and in its gas phase comprising in combination a primary container for liquified gas, a primary line, a consumer's line, the primary line connecting the upper portion of the primary container with the consumer's line for supplying liquified gas in its gas phase thereto; a means for regulating the gas pressure flowing in the said primary line, an auxiliary container, an auxiliary line connecting the auxiliary container with the consumer line, a portable container means, a liquid line connecting the liquid in the primary container with the liquid fill valve of the portable container, valve means in the liquid line, a vapor line connected between the vapor valve of the portable container and the auxiliary container, valve means in the vapor line, the valve means in the liquid line for controlling the flow of liquified gas in the liquid phase from the primary container to the portable container, the value means in the vapor line for controlling the flow of liquified gas in the gas phase from the portable container to the auxiliary container, the regulator means in the primary line being set to release vapor pressure at a predetermined value so that when the said predetermined value is as great or greater than the value of the vapor pressure in the auxiliary container, gas vapors flow from the primary container to the consumer line, but when the gas vapor pressure becomes greater in the auxiliary container than the vapor pressure released by the regulator in the primary line then vapors flow from the auxiliary container through the auxiliary line to the consumer line.

2. An apparatus as set forth in claim 1 wherein an auxiliary regulator means is interposed in the auxiliary line which is set to release a pressure as great or greater than the regulator in the primary line.

3. An apparatus as set forth in claim 1 wherein the primary container is stationary.

4. An apparatus as set forth in claim 1 wherein the portable container is portable and easily connectable to the liquid and vapor lines.

5. An apparatus as set forth in claim 1 wherein the auxiliary container is independent and separate of the primary container.

6. An apparatus as set forth in claim 1 wherein the auxiliary container is integral with the primary container.

7. An apparatus as set forth in claim 1 wherein the vapor line is connected respectively adjacent to the upper portion of the portable container and to the auxiliary container.

8. An apparatus as set forth in claim 1 wherein a shut-off valve is interposed in the vapor line connecting the portable container with the auxiliary container, and wherein a by-pass line flows gas from the portable container to the primary container when the said vapor line valve is closed.

9. In an apparatus for dispensing liquified gas in its liquid phase and in its gas phase comprising in combination a primary container for holding liquified gas of a closed system, including a consumer line connected to said container for supplying liquified gas in the gas phase to the consumer line, an auxiliary container connected to said system, means in the system connecting the primary container and the auxiliary container to the consumer line, a primary and auxiliary pressure responsive means interposed in the connecting means in the system, a portable container connected in the system for receiving liquified gas in the liquid phase from the primary container, the portable container connected in the system with the auxiliary container, valve means in the system for controlling the flow of liquified gas in the liquid phase from the primary container to the portable container and for controlling the flow of liquified gas in the gas phase from the portable container to the auxiliary container, the primary pressure regulating means for controlling the flow of gas from the primary container to the consumer line being set to operate at a lower value than the auxiliary pressure regulating means which regulates the flow of gas from the auxiliary container to the consumer's line.

10. An apparatus as set forth in claim 9 wherein the primary container is stationary.

11. An apparatus as set forth in claim 9 wherein the portable container is easily connectable into the closed system.

12. An apparatus as set forth in claim 9 wherein the auxiliary container is formed as an integral part of the primary container.

13. The method of dispensing a liquified gas in its liquid phase and in its gas phase by differential pressures in a closed system, including three zones and a consumer's line, flowing liquified gas in its gas phase from the first zone to the second zone in the system thereby creating a lower gas pressure in the first zone than in the third zone whereby the gas pressure in the third zone flows liquified gas in its liquid phase to the first zone, controlling the flow of liquified gas in its gas phase from the third zone and the second zone to the consumer line whereby when the gas pressure released from the third zone to the consumer line is of a greater value than the gas pressure released by the second zone to the consumer line, then all gas flow will be from the third zone to the consumer line and when the gas pressure released from the second zone to the consumer line is of a greater value than the gas pressure released from the third zone to the consumer line then all gas flow will be from the second zone to the said consumer line.

14. In an apparatus for dispensing liquified gas in its liquid phase and in its gas phase comprising in combination a closed system including a primary container for holding liquified gas, a consumer line, a first means connecting the primary container to the consumer line, an auxiliary container, a second means in the system connecting the auxiliary container to the consumer line, a pressure responsive means interposed in the first connecting means of the system, a portable container

connected in the system for receiving liquified gas in the liquid phase from the primary container, the portable container connected in the system with the auxiliary container, valve means in the system for controlling the flow of liquified gas in the liquid phase from the primary container to the portable container and for controlling the flow of liquified gas in the gas phase from the portable container to the auxiliary container, the regulator means for controlling the flow of vapor gas from the primary container to the consumer line being set to operate at a predetermined value so that when the gas pressure released from the said regulator is greater than the pressure in the auxiliary container, gas flows from the primary container to the consumer line, but when the gas pressure becomes greater in the auxiliary container than the pressure released by the regulator for the primary container, then gas flows from the auxiliary container to the consumer line.

15. An apparatus as set forth in claim 14 wherein a shut-off valve is interposed in the system for controlling the flow of gas from the portable container to the auxiliary container, and wherein a by-pass line flows gas from the portable container to the primary container when the said shut-off valve is closed.

16. An apparatus as set forth in claim 14 wherein an auxiliary pressure responsive means is interposed in the second connecting means of the system, said auxiliary pressure responsive means being set to release a higher pressure value than the pressure responsive means in the first connecting means of the system.

17. The method of dispensing a liquified gas in its liquid phase and in its gas phase in a closed system having a primary liquified gas container, an auxiliary container, a portable container, and a consumer line, flowing liquified gas in its gas phase from the portable container, normally having a greater pressure value than the auxiliary container to the auxiliary container thus creating less pressure in the portable container than in the primary container whereby the gas pressure in the primary container flows liquid from the primary container to the portable container, controlling the flow of liquified gas in its gas phase at a predetermined pressure value from the primary container to the consumer line, controlling the flow of liquified gas in its gas phase, at a pressure value as high or higher than the said predetermined pressure value, from the auxiliary container to the consumer line whereby when the pressure of the gas released from the primary container is of a greater value than the pressure of the gas released from the auxiliary container, gas vapor flows from the primary container to the consumer line, and when the pressure of the gas released from the auxiliary container is of a greater value than the pressure of gas released from the primary container, gas flows from the auxiliary container to the consumer line.

18. The method of dispensing liquified gas in its gas phase to a consumer line, and in its liquified phase to a mobile tank means, a primary supply tank containing liquid gas in its liquified phase and in its gas phase, an auxiliary tank, flowing gas from the mobile tank means to the auxiliary tank normally having a gas pressure less than the mobile tank means, said flowing causing pressure to be lowered in the mobile tank means, and then flowing liquid from the primary supply tank to the mobile tank means which now has a lower pressure than the primary supply tank, controlling the flow of liquified gas in its gas phase at a predetermined pressure value from the primary container to the consumer line, controlling the flow of liquified gas in its gas phase at a pressure value higher than the said predetermined pressure value, from the auxiliary container to the consumer line, whereby when the pressure of gas released from the primary container into the consumer line is of a greater value than the pressure of the gas released from the auxiliary container into the consumer line, gas flows from the primary con-

tainer into the consumer line, and when the pressure of the gas released from the auxiliary container into the consumer line is of a greater value than the pressure of gas released from the primary container into the consumer line, gas flows from the auxiliary container into the consumer line.

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