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METHOD OF AND APPARATUS FOR DISPENSING LIQUEFIED GAS MIXTURES

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Fig. 1

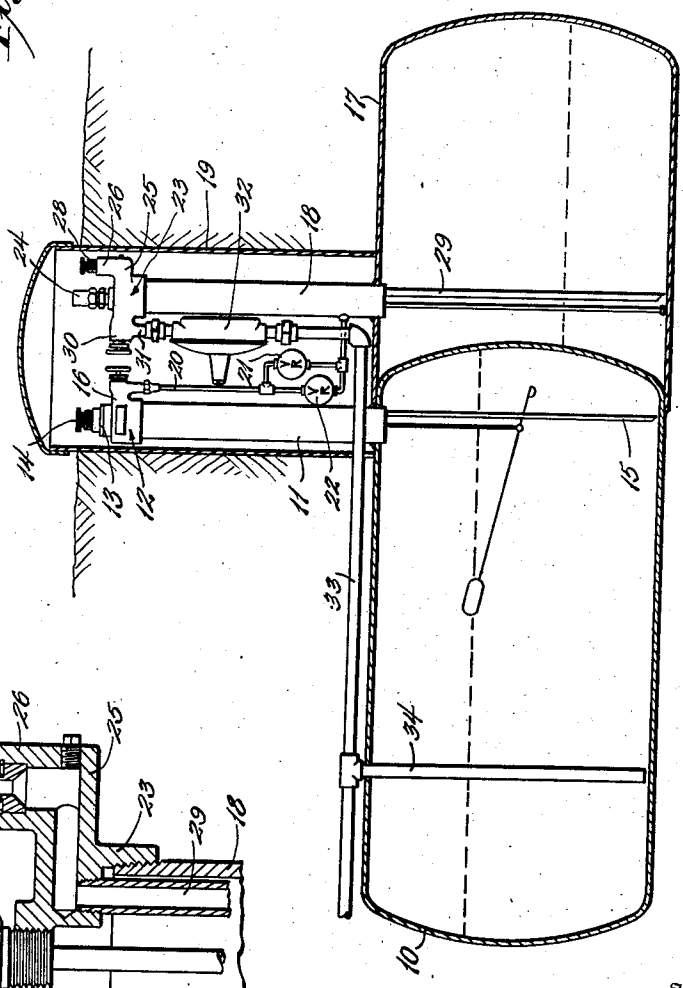
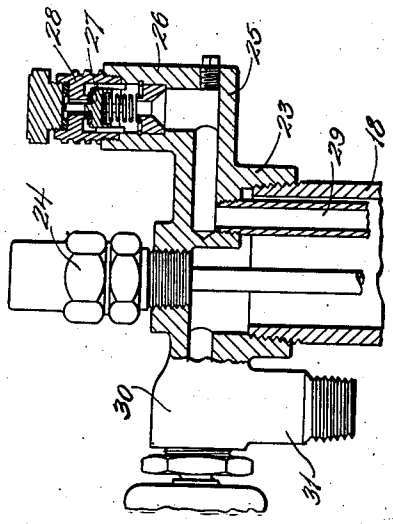


Fig. 2



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METHOD OF AND APPARATUS FOR DISPENSING LIQUEFIED GAS MIXTURES

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11 Claims. (Cl. 62—1)

This invention relates to a method of and apparatus for vaporizing and dispensing liquefied gas and, among other objects, aims to provide a greatly improved system to dispense propane, ethane or other highly volatile liquefied gases or mixtures thereof combined with normally liquid petroleum distillates or blends thereof, such as commercial gasoline, so that the vapor pressure at normal temperatures is reduced and the necessity to use extra heavy bulk storage tanks, truck tanks, dispensing containers and other appurtenances is avoided. One of the main objects is to provide an economical and commercially practicable method of using propane as the base fuel in domestic and commercial gas dispensing installations without requiring heavy and expensive storage, transporting and dispensing equipment due to the normal high vapor pressure of propane when used alone.

It is contemplated that, due to war conditions and the present National Defense Program, there will be a shortage of butane which is employed in underground gas systems of the general type shown in Patent 2,176,829, because butane and other less volatile hydrocarbons are now used more extensively in the manufacture of high octane aviation fuel. However, some of the more volatile hydrocarbons, such as propane, derived from petroleum and natural gases, are not so readily adapted to the making of high octane aviation fuel and are therefore readily available for use in domestic dispensing systems. Propane is now in general use for household systems, but one of its main drawbacks is the requirement that the containers therefor shall be capable of withstanding very much higher pressures than those designed for pressures such as for butane mixtures. Further, the cost of transportation of propane is much higher, due to the heavy equipment required to withstand the high pressures. Also, it is well known that propane is not as rich in BTU content as the less volatile mixtures of butane. Due to the shortage of steel available at this time for ordinary civilian use and of other equipment used in such systems, it is highly desirable to reduce the quantity of metals required to be used in systems for dispensing propane mixtures. Therefore, it is one of the main objects of this invention to provide an improved method of and apparatus for dispensing propane and the like which involves mixing it with a normally liquid hydrocarbon fuel, such as ordinary gasoline, to raise its boiling point and reduce its vapor pressure, thereby making it possible to use such mixtures in existing butane systems, with slight modifications and in improved systems wherein provision is made for removing the gasoline after it has served its purpose.

Other aims and advantages of the invention will appear in the specification, when considered in connection with the accompanying drawings, wherein:

Fig. 1 is a longitudinal sectional view of a typical system designed to carry out the method; and

Fig. 2 is an enlarged sectional view of a valved fitting for dispensing vapor and discharging separated gasoline.

Referring particularly to the illustrative apparatus, the system is shown as embodying a main storage tank 10 which is buried in the ground to absorb vaporizing heat from the surrounding earth; but it is to be understood that the invention is applicable to both underground and aboveground installations. In this instance, the main tank 10 has an ordinary standpipe 11, to the upper end of which is connected the usual multiple valved fitting 12 like that shown in the aforesaid patent. It embodies a liquid level gauge 13 which may be of the float operated type as shown or of the slip tube type. It also has the usual filling valve 14 and a liquid eduction tube 15 leading through a valved outlet branch 16. It is to be understood that such systems may be either gravity filled or pressure filled.

Liquid from the main tank 10 is adapted to be delivered by its vapor pressure to a second container, here shown as being an auxiliary tank or extension 17 connected to the main tank; although it will be understood that the second vaporizing container can be entirely separate from the main tank. It is also shown as being arranged to absorb vaporizing heat from the surrounding earth. In this instance, the vaporizing tank 17 carries a standpipe 18 arranged in the same protecting casing 19 with the main standpipe 11 and a liquid eduction pipe 20 is connected to the branch 16 to discharge into the standpipe 18 through either of two pressure reducing regulators 21 and 22 connected in parallel to the eduction pipe. When the liquid passes through a pressure reducing regulator and some of it flashes into vapor due to the reduction in pressure, ice is likely to form in the regulator when the mixtures carries a moisture content and, in some cases, will obstruct the valve orifice and prevent the regulator from functioning properly. The separate regulators are set to close at different back pressures so that, when one of the regulators is frozen and ceases to function, the other regulator will function until the first is thawed

out. One of the regulators may be set at, say 8 pounds and the other at 6 pounds, so that the liquid will normally flow through the regulator set to close at 8 pounds until it ceases to function. Then, the other regulator will come into action and operate until the first regulator thaws out and resumes operation. It will be understood that more than two regulators may be desirable in extremely cold climates, while in very warm climates one regulator will perform satisfactorily. If the mixture is moisture-free one regulator is all that is required in any climate.

The second standpipe is shown as having a fitting in the form of a cross **23** screwed on its upper end and shown in detail in Fig. 2. The upper branch of the cross carries a slip tube gauge **24**, or a float operated gauge similar to the gauge **13** may be employed. One of the lateral branches **25** has an upstanding extension **26** in which is mounted a liquid evacuating valve **27** preferably similar to that shown in my application Ser. No. 299,211, filed October 12, 1939. The branch **26** also has a hose fitting **28**, so arranged that, when an evacuating hose is connected to it, the valve is automatically opened. It is designed to evacuate liquid or spent gasoline from the bottom of the vaporizing tank **17** through an eduction tube **29**. When a hose is connected to the fitting **28**, the gasoline will be discharged under the pressure existing in the vaporizing tank. Another branch **30** of the cross fitting is shown as having a valve controlled outlet leading through a depending nipple **31** to dispense vapor from the vaporizing tank **17** through an ordinary second stage pressure reducing regulator **32** connected to a service pipe **33** preferably extending downwardly to a point adjacent to the tank and laterally underground toward the point of use. In this example, the lowest point of the service pipe carries a revaporizing spur pipe **34** extending downwardly into the tank **10** so that any condensate formed in the service pipe will drain into the pipe and be revaporized. However, the vaporizer may be like that shown in my Patent 2,105,383.

From the foregoing description, it is believed that the method of operation will be apparent. It is contemplated that propane will be mixed at the refinery with less volatile hydrocarbon fuels or blends, such as gasoline. The mixture ratio will be determined by the desired vapor pressure at normal or atmospheric temperatures and the safe working pressures prescribed for truck tanks and the systems in which the mixture is to be employed. An ordinary mixture of, say 50% propane and 50% gasoline by volume, has been found to be satisfactory because its pressure does not exceed the safe working pressure of containers designed for ordinary butane mixtures. The gasoline is readily miscible with propane and not only serves to reduce its vapor pressure during transit and in the storage containers, but a small quantity of it vaporizes with the propane component and remains mixed with it, thus enriching the propane vapor. The mixture is charged into the main storage tank **10** and the liquid passes from it to the vaporizing chamber or tank **17**, as gas is consumed. Incidentally, the storage capacity of the vaporizing tank or chamber **17** is preferably such as to hold all of the gasoline used in the mixture which fills the main storage tank. In the case of a 50–50 mixture, the vaporizing tank should be at least half the size of the main tank.

As the mixture passes through one of the first stage pressure reducing regulators, some of it immediately flashes into vapor and, due to the lower pressure existing in the vaporizing chamber and the absorption of heat by it, practically all of the propane components of the mixture will be vaporized and some gasoline vapor is retained in it which increases the B. t. u. content of the vapor. It will be understood that the gasoline constituents will not readily vaporize at any ordinary atmospheric or earth's temperatures. Therefore, the gasoline separates and settles to the bottom of the vaporizing chamber. The used gasoline will rise in the chamber and eventually fill it if it is not evacuated. It is contemplated that the used gasoline may be removed automatically by means of a float operated valve (not shown) or it may be evacuated periodically, preferably when the main tank is filled, by connecting a hose to the fitting **28**. The evacuated gasoline may be used in automobiles, gas engines, tractors and the like. The vaporizing tank will be fully evacuated to the lower end of dip pipe due to the vapor pressure existing in it.

The vapor passes from the vaporizing tank through the usual low pressure regulator at the prescribed pressure for the consuming appliances. Any condensate will collect in the condensate trap or spur pipe **34** and be revaporized, due to absorption of heat from the liquid in tank **10** which, in turn, absorbs heat from the earth below the frost line.

From the foregoing description, it will be seen that the method and apparatus provide for the use of propane and its mixtures with less volatile hydrocarbons and avoid the necessity for using high pressure equipment for handling it, thereby effecting great economy in the use of indispensable defense materials. Furthermore, such systems may be buried in the ground in extremely cold climates and the mixture of propane and gasoline may be varied to suit any given range of temperatures. Moreover, a sufficient quantity of gasoline may be employed in warm climates where the systems are sometimes placed above ground to avoid the possibility of generating high or dangerous vapor pressures or pressures exceeding the safe limits of the storage tanks and other equipment.

Obviously, the invention is not restricted to the particular embodiment thereof herein shown and described. Moreover, the method can be practiced by employing other types of apparatus.

What is claimed is:

1. In a liquefied gas dispensing system of the character described, a storage container adapted to be filled with liquefied gas; a liquid eduction pipe connected to deliver liquid from the storage container; a separate vaporizing chamber into which the liquid is discharge and vaporized; at least two pressure reducing valves connected in parallel to the liquid eduction pipe and adjusted to operate at different back pressures, so that when one reducing valve ceases to function, due to freezing, the other will function until the first one is thawed out; a vapor discharge conduit connected to the vaporizing tank; and a second stage pressure reducing regulator connected to the vapor delivery conduit.

2. In a liquefied gas system of the character described, a storage tank adapted to be charged with a mixture of liquefied gas and a normally liquid hydrocarbon fuel to reduce the vapor pressure; a standpipe connected to the tank; valved filling and dispensing appurtenances connected to the standpipe, including a liquid eduction con-

duit; a vaporizing tank adjacent to the storage tank and connected to receive educted liquid therefrom; a pressure regulator in the liquid eduction conduit for reducing the pressure of the liquid and causing partial vaporization thereof; a standpipe on the vaporizing chamber; a fitting carried by the standpipe through which vapor is discharged to a point of use; and a valved liquid eduction pipe connected to the fitting and extending into the vaporizing chamber to evacuate separated, normally liquid fuel therefrom for subsequent use.

3. In a liquefied gas system of the character described, a storage tank adapted to be charged with a mixture of liquefied gas and a normally liquid hydrocarbon fuel to reduce the vapor pressure; a standpipe connected to the tank; valved filling and dispensing appurtenances connected to the standpipe, including a liquid eduction conduit; a vaporizing tank adjacent to the storage tank and connected to receive educted liquid therefrom; a pressure regulator in the liquid eduction conduit for reducing the pressure of the liquid and causing partial vaporization thereof; a standpipe on the vaporizing chamber; a fitting carried by the standpipe through which vapor is discharged to a point of use; a valved liquid eduction pipe connected to the fitting and extending into the vaporizing chamber to evacuate separated, normally liquid fuel therefrom for subsequent use; and a single protecting casing surrounding both standpipes and the appurtenances thereon.

4. In a liquefied gas system of the character described, a storage tank adapted to be charged with a mixture of liquefied gas and a normally liquid hydrocarbon fuel to reduce the vapor pressure; a standpipe connected to the tank; valved filling and dispensing appurtenances connected to the standpipe, including a liquid eduction conduit; a vaporizing tank adjacent to the storage tank and connected to receive educted liquid therefrom; a pressure regulator in the liquid eduction conduit for reducing the pressure of the liquid and causing partial vaporization thereof; a standpipe on the vaporizing chamber; a fitting carried by the standpipe through which vapor is discharged to a point of use; a valved liquid eduction pipe connected to the fitting and extending into the vaporizing chamber to evacuate separated, normally liquid fuel therefrom for subsequent use; a single protecting casing surrounding both standpipes and the appurtenances thereon; and a liquid level gauge also carried by said last named fitting to determine the level of the separated liquid in the vaporizing chamber.

5. In a liquefied gas dispensing system of the character described, an underground pressure storage tank adapted to be charged with a mixture of liquefied gas and a normally liquid hydrocarbon fuel to reduce the vapor pressure; a standpipe connected to the pressure storage tank having a combination valved fitting carrying filling and dispensing appurtenances; a liquid eduction tube connected to the storage tank through said fitting; a vaporizing tank adjacent to the pressure storage tank connected to receive liquid discharged therefrom; at least two pressure reducing regulators in the liquid eduction tube set to operate at different back pressures to operate in succession and thereby avoid cutting off the supply of liquid due to freezing of one of the regulators; a standpipe on the vaporizing chamber carrying a fitting through which vapor is delivered to a point of use; a valved liquid eduction pipe connected to said fitting to evacuate separated liquid fuel accumulated in the vaporizing chamber; a liquid level gauge also carried by said last named fitting to determine the level of the separated fuel therein; a gas service pipe connected to said fitting carrying a second stage pressure reducing regulator; and a single protecting casing surrounding both of said standpipes and the appurtenances thereon affording access thereto from above the ground.

6. That method of using propane in a gas dispensing system designed to withstand lower pressures than the normal vapor pressure of propane, which comprises charging the system with propane, mixed with commercial gasoline, so that the mixture has a vapor pressure less than the designed working pressure of the system; reducing the pressure of the mixture; generating propane vapor by evaporation and simultaneously separating gasoline therefrom at reduced pressure; reducing the pressure of the vapor and delivering it to a point of use; and periodically removing the separated gasoline.

7. That method of using propane in a system designed to withstand lower pressures than the normal vapor pressure of propane, which consists in mixing the propane with a readily miscible, normally liquid hydrocarbon fuel and thereby reducing the vapor pressure of the mixture to within the designed working pressure of the system; withdrawing the mixture at a reduced pressure and vaporizing the propane component thereof to separate the normally liquid hydrocarbon component; delivering the vapor to a point of use at a further reduced pressure; and reclaiming the separated liquid fuel for subsequent use.

8. In a domestic liquefied gas dispensing system of the character described, an underground pressure storage tank charged with a mixture of liquefied gas and a readily miscible, normally liquid hydrocarbon fuel, said mixture having a vapor pressure about the same as that of ordinary butane; a liquid eduction pipe connected to the tank and delivering the mixture therefrom by virtue of the vapor pressure of the mixture in the tank; a separate vaporizing chamber buried in the ground with and connected to receive the educted liquid from the tank; an automatic pressure reducing regulator in the liquid eduction pipe to reduce the pressure of the mixture and permit vaporization of the liquefied gas component of the mixture in the vaporizing chamber; a vapor delivering conduit leading from the vaporizing chamber to a point of use; a pressure reducing regulator in the vapor delivering conduit; and a liquid eduction pipe connected to the vaporizing chamber to evacuate separated normally liquid fuel therefrom for subsequent use.

9. In a liquefied gas dispensing system of the character described, a pressure storage tank adapted to be filled with a mixture of propane and readily miscible normally liquid hydrocarbon fuel; a liquid eduction pipe connected to the tank and delivering the mixture therefrom by virtue of the vapor pressure of the mixture in the tank; a separate vaporizing chamber connected to receive the educted liquid from the tank; an automatic pressure reducing regulator in the liquid eduction pipe; a vapor delivering conduit leading from the vaporizing chamber to a point of use; a pressure reducing regulator in the vapor delivering conduit; a fitting connected to communicate with

the vaporizing chamber; a liquid evacuating pipe in the vaporizing chamber connected to the fitting; and a valve in the fitting to control the discharge of separated liquid fuel accumulated in the vaporizing chamber through said evacuating pipe.

10. In a liquefied gas system of the character described, wherein a mixture of liquefied gas and gasoline is taken from a storage tank in the liquid phase by virtue of its own vapor pressure, a vaporizing chamber connected to receive the discharged liquid and arranged to absorb vaporizing heat for the volatile component of the mixture; automatic pressure reducing means connected to reduce the pressure of the mixture between the tank and the vaporizing chamber; a liquid evacuating tube in the vaporizing chamber to discharge the separated gasoline accumulated therein; a fitting carrying a valve connected to the liquid evacuating tube; and a hose connection on said fitting.

11. That method of using propane in a liquefied gas dispensing system designed for a lower vapor pressure than that developed by propane, which is characterized by charging the pressure tank of the system with propane mixed with a readily miscible normally liquid fuel so that the vapor pressure of the mixture is less than the designed working pressure of the system; delivering the mixture under its own vapor pressure to a vaporizing chamber and reducing its pressure in transit; vaporizing the propane by absorption of heat in the vaporizing chamber; delivering the propane vapor to a point of use and at a further reduced pressure; and periodically removing the normally liquid fuel component separated from the mixture in the vaporizing tank for subsequent use.

LOYD J. WHITE.