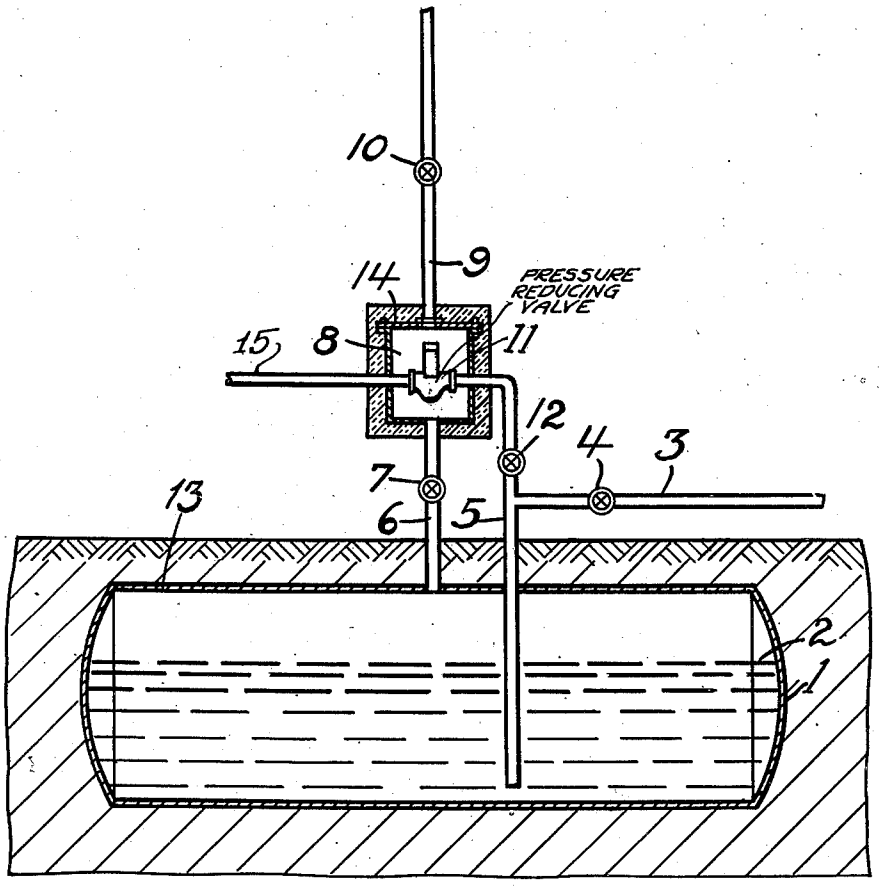
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PRESSURE REDUCTION VALVE FOR BOTTLED GAS SYSTEMS

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PRESSURE REDUCTION VALVE FOR BOTTLED GAS SYSTEMS

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This invention relates to a method and apparatus for storage and dispensing of highly volatile liquefied gases and relates more particularly to a method and apparatus for storage and dispensing of mixtures of highly volatile liquefied gases.

In gas systems (such as home butane installations), which are supplied by the evaporation of liquefied hydrocarbons from pressure containers, the gas is usually withdrawn from the top of the container and expanded through a suitable pressure reducing valve. When a mixture of hydrocarbons such as butane and propane is used, this method of withdrawing the gas causes the mixture within the container to become progressively richer in the less volatile components and consequently lowers the vapor pressure of the remaining liquid mixture. One method of overcoming this difficulty is to withdraw liquid from the bottom of the container and to vaporize it in a pressure reducing valve. Due to the fact that such hydrocarbon stocks usually contain traces of moisture, the low temperature brought about by the vaporization of the hydrocarbon may cause the pressure reducing valve to "freeze up." This is particularly true when the pressure reducing valve is insulated, coated with ice or any other non-conducting material, so that an adequate amount of heat for vaporization cannot be conducted into the expanding liquid as rapidly as required.

An object of this invention is to provide means for withdrawing substantially uniform mixtures of volatile gases from the container even though the container be partially or wholly filled.

Another object of this invention is to provide an arrangement of apparatus so that the pressure reducing valve is not subjected to extreme low temperatures.

A further object of this invention is to provide a method for vaporizing liquefied gases so that the main source of heat for vaporization is the latent heat of condensation of gases similar to those being vaporized.

These and other objects of the invention may be understood by reading the specification with reference to the accompanying drawing wherein is a vertically sectional view of an installation embodying the invention.

For purpose of description with reference to the drawing, it is assumed that a mixture of liquefied normally gaseous hydrocarbons is stored in a cylindrical tank 1 of any suitable capacity to the level 2. The tank may be arranged vertically or horizontally and it is preferred to be insulated by burying underneath the surface of the ground below the frost level; however, it may be covered with a suitable insulating material, such as asbestos, magnesia, etc., provided that an external source of heat is employed when the tank is so insulated other than by burying in the ground. This tank may be filled with liquefied gas under pressure by means of pipe 3 provided with valve 4 and pipe 5. A vapor-tight chamber 8 is arranged above tank 1 and is connected thereto by line 6 which is provided with valve 7. Pipe 9, provided with valve 10, serves as an outlet for chamber 8.

The means for withdrawing the charge from tank 1 for consumption includes pipe 5, which is provided with a hand operated valve 12, a service pipe 15, which may be connected to suitable means not shown requiring a supply of vapors from tank 1, and an automatic pressure reducing valve 11 connecting pipe 5 with service pipe 15. Valves suitable for use as the automatic regulator valve 11 are well known to the art and commercially available; such valves are conventionally constructed either as spring operated pressure reducing valves or weighted lever pressure regulator valve and are shown, for example, in the Chemical Engineer's Handbook, McGraw-Hill Company, 1934, pages 1659 and 1660. The dimensions of pipes 5 and 15 are not critical but, for best operation, these pipes should not be excessively long and should preferably be of a diameter only sufficiently large to transfer the amount of liquefied gas from tank 1 required to meet the load on the system with a minimum of pressure drop. Pipe 6 should be of such size that vapors may easily pass from tank 1 to chamber 8 without interfering with the return of liquid from chamber 8 to tank 1.

In operation, it is preferred to charge the tank with liquefied gas as indicated in the drawing with the liquid level 2 of the charge somewhat below the top of the tank; the vapor space 13 in the upper part of the tank is usually maintained as it is required for safe operation. With the tank charged as shown, when fuel is to be withdrawn therefrom to supply a demand, valves 4 and 10 should be closed and valves 7 and 12 should be open. It will be understood that means, not shown, for consuming the fuel, is attached to the end of service pipe 15 and the fuel is withdrawn from tank 1 through line 5, valves 12 and 11 and pipe 15 to such means.

As the liquefied mixture of volatile gas withdrawn from the bottom of tank 1 is expanded through reducing valve 11, a cooling effect is

produced and the vapors in chamber 8 are condensed on valve 11 and drop back into the container 1 through pipe 6. The latent heat of condensation of the vapors around the valve 11 thus supplies the heat for vaporization of the fuel inside the valve. Accordingly, for every pound of fuel vaporized in the valve 11, approximately one pound of vapors condenses on the outside of the valve in chamber 8. The heat balance of this system is thus substantially the same as that of the usual type of system in which the vapors are withdrawn from the top of the container. If the reducing valve were installed outside the vapor space of the storage tank and directly exposed to the surrounding air, substantially no latent heat of condensation would be available to warm the valve since, under customary operating conditions, the temperature of the air is far removed from its condensation temperature. Furthermore, the latent heat of condensation (and solidification) in the small amount of water vapor generally present in atmospheric air is usually insufficient to supply the required heat of vaporization.

In the preferred embodiment of my invention, where the storage tank 1 is buried in the ground and the reducing valve 11 is within the vapor chamber of the storage tank, it will be apparent that heat from the ground is conducted through the walls of the tank and causes vaporization of the liquid contained therein; the vapors, thus formed, continuously rise around valve 11 and condense thereon to furnish heat for vaporization of the expanding liquid. To facilitate heat transfer, vanes may be provided on pressure reducing valve 11.

If chamber 8 is exposed to the atmosphere, and is not buried beneath the ground, it is desirable that it be covered with a suitable insulating material, such as asbestos, magnesia, and the like. Chamber 8 is preferably also supplied with a suitable vapor-tight flanged head 14 so that ready access is provided to reducing valve 11 without releasing the contents of tank 1. Thus, when it is desired to open chamber 8 for any reason such as inspection, repairing or cleaning of regulator valve 11, valve 7 in line 6 is closed off from tank 1 and valve 12 in line 5 is likewise shut off. Valve 10 in line 9 is opened to release residual hydrocarbon vapors remaining in chamber 8. Flanged head 14 is then opened providing ready access to regulator valve 11.

It is readily apparent to one skilled in the art that regulator valve 11 may be disposed in the vapor space 13 or the liquid space of tank 1. Though some of the same desirable effects may be obtained as by placing it in chamber 8, it would not be possible to periodically inspect the regulator valve or to clean or adjust it without releasing the contents of tank 1 which is a very desirable feature.

It will be understood, that as liquefied gas is withdrawn from line 5, vaporized on passing through valve 11 and discharged into line 15 to meet the demand imposed on the system, the liquid level 2 within tank 1 will gradually lower leaving space into which a fresh supply of liquefied gas may be charged. When it is desired to add additional liquefied gas to tank 1 the pressure within the tank should first be reduced to atmospheric or lower. The pressure within the tank may conveniently be reduced by opening valve 10 to allow equalization between tank 1 and the atmosphere. If desired, the pressure within tank 1 may be reduced to less than atmospheric by connecting a vacuum pump, not shown, or other means for producing a vacuum, to outlet 9. After the pressure within tank 1 has been reduced, valve 4 may be opened and the desired amount of liquefied gas charged into the tank through lines 3 and 5. After the tank has been charged, valves 4 and 10 may be closed and with valve 12 remaining open the device is in condition to supply the load, not shown, attached to line 15 as previously described.

Immediately after the tank has been installed in position, as shown in the drawing, and contains air, it may initially be charged by filling the tank with water in order to displace air from the tank and lines and the water then displaced by the liquefied gas in order to avoid the dilution of the gas with air. Where water is used in filling the tank, a pipe, not shown, with valves connected to a water supply and also to a sewer is provided at the lower part of the tank in order to fill the tank before charging and to allow the water to drain during the charging of the tank with the liquefied gas.

By operating a storage and dispensing apparatus for liquefied gases in the manner set forth herein, numerous advantages over the conventional type of dispensing and storage apparatus may be obtained. By operating in accordance with this invention, it is possible to vaporize liquefied gases containing traces of moisture without freezing the regulator valve. Another advantage accruing to this invention is that mixtures of liquefied gases may be employed which on vaporization will give a vapor mixture of substantially the same composition as the liquid mixtures; thus, when a major portion of the contents of a drum such as disclosed in the drawing has been vaporized, the remaining portion is substantially of the same composition and vapor pressure as that of the original drum contents. When the apparatus which has been described herein is located out doors and below the ground, the method of operating the same will overcome cold weather difficulties which are inherent in conventional types of apparatus.

In many conventional storage and dispensing systems for liquefied gases, it is necessary that external sources of heat be provided; in the system which is the subject matter of this invention, an extraneous source of heat supply is not needed if the storage drum is buried beneath the surface of the ground and is otherwise uninsulated. Besides having available the sensible heat of the vaporized hydrocarbons in tank 1 and chamber 8 surrounding pressure regulator valve 11, there is also available the latent heat of vaporization which, when compared to the sensible heat of air in the atmosphere, is considerable. Under usual conditions of operation when the apparatus is buried below the frost line of the earth, sufficient heat to vaporize the hydrocarbon is made available. A constant supply of gas will thus be assured under conditions which would otherwise prevent the efficient operation of a reducing valve located externally from the drum.

I claim:

1. In a liquefied gas storage and dispensing system, a service pipe, a pressure storage tank arranged with an eduction conduit communicating at one end with a point adjacent to the bottom of the tank, a pressure reducing valve arranged in a separate chamber adjacent to the top of the tank and connecting the opposite end of the induction conduit with the service pipe, a tube extending from the separate chamber to the

upper part of the said storage tank and providing direct communication between the separate chamber and the upper part of the said storage tank.

2. A method of dispensing gas stored as a liquid under pressure which comprises withdrawing from a body of liquefied gas maintained under pressure in a container, a part of the liquefied gas, passing the withdrawn part of the liquefied gas through a reducing valve maintained in direct heat exchange relationship with vapors given off from the liquefied gas maintained under pressure in the container whereby the vapors are condensed and the withdrawn liquefied gas is vaporized and returning the condensed vapors to the main body of the liquefied gas maintained under pressure in the container.

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