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GAS DISPENSING APPARATUS

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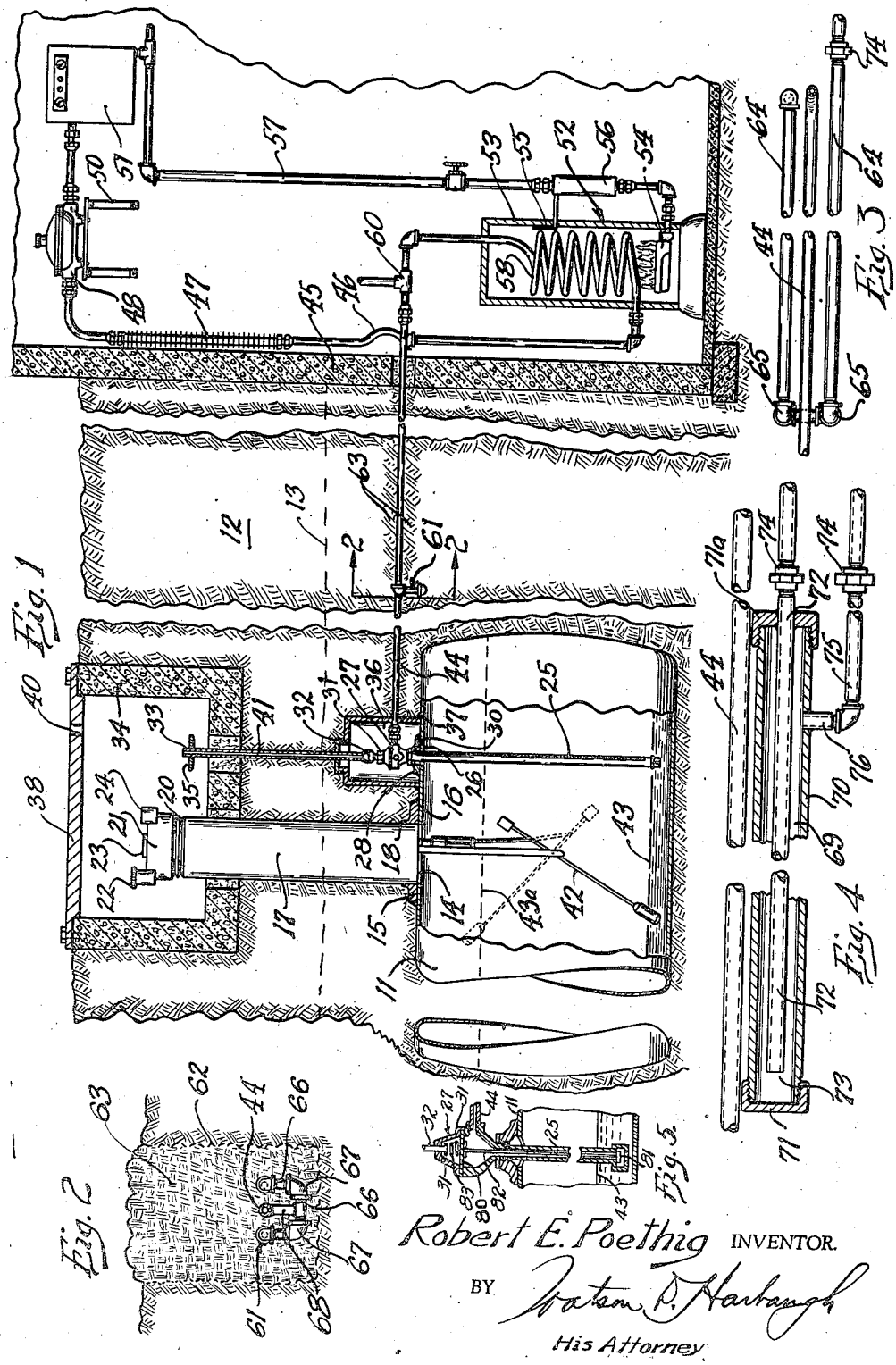


Fig. 1

Fig. 2

Fig. 5

Fig. 3

Fig. 4

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GAS DISPENSING APPARATUS

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11 Claims. (Cl. 62—1)

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The present invention relates to a system for dispensing liquefied petroleum gas in which the liquefied petroleum gas is stored in its liquid phase and vaporized for use at a reduced pressure in its vapor phase.

The petroleum product employed in the system with which the present invention is concerned, is preferably a hydro-carbon of the paraffin series, such as butane or propane or a mixture of both. The fuel is preferably stored where the temperatures are generally above the freezing point of water as in an underground tank and is stored in its liquid phase so that with the assistance of heat of the earth a substantial vapor pressure is provided to serve as a working pressure. Then with a reduction in pressure and absorption of heat, the liquefied gas is vaporized for use in a dwelling as a substitute for a natural gas.

In vaporizing and dispensing the gas, the gas may be withdrawn from the tank under its vapor pressure or other suitable pressure in either its vapor phase and conveyed to a place of use with a reduction of pressure to the service pressure, or, it can be withdrawn in its liquid phase reduced in pressure and vaporized with the assistance either of the heat units present in the tank, or, heat units present in any one of a number of elements including the earth through which the service conduit runs, or both.

Wherever vaporization takes place, whether it be in the tank or at a place spaced from the tank, heat units are absorbed from surrounding elements, thereby developing a refrigerating action, and, although the present invention functions to improve conditions of vaporization either inside or outside of the tank, it is primarily concerned with the dispensing of gas wherein the liquefied gas is withdrawn in its liquid phase and is warmed at a place removed from the tank after the pressure upon the liquid is reduced below its vapor pressure, a so-called "liquid eduction" system.

Wherever the refrigerating action takes place with a liquid eduction system the refrigerating action is sufficient to freeze any water subjected to the action. In other words, wherever water is relied upon as a source of heat or a conveyor of heat to supply thermal units at a place where vaporization is taking place, the danger is ever present that the water will be frozen and the container in which it is held, bursted by the resulting ice.

One of the objects of the present invention is to provide an improved system in which water

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can be employed with or without heat other than the source of heat to which the tank is exposed, such as the heat of the earth below the frost line, with minimum danger of the water being frozen.

Furthermore, it has heretofore been the practice in vaporizing liquefied petroleum gas to bring water and vaporizing gas into heat exchange relationship through a single and common wall of metal, whereby a freezing of the water and bursting of the common wall will either place water in the service line of the dispensing system or will permit the liquefied petroleum gas to enter the water supply and create a hazardous condition wherever the water is used such as at a faucet in the house.

It is another object of the present invention to employ water as a source or conveyor of heat to supply latent heat of vaporization to the liquefied petroleum gas in a manner which obviates the danger of a mixture of water and gas in the event a freezeup of the water occurs sufficient to burst the container holding the water.

A further object of the invention is to provide an improved method of vaporizing liquefied petroleum gas and dispensing it in its vapor phase.

Another object of the invention is to provide an improved method for vaporizing liquefied petroleum gas at the time or immediately after the pressure upon the gas in its liquid phase is reduced below the vapor pressure of the gas as it exists at the temperature of the gas as stored in its liquid phase.

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

Referring now to the drawing:

Fig. 1 is a fragmentary vertical section taken longitudinally through a tank, the earth surrounding the tank, and the cellar wall of a dwelling, to illustrate the construction and arrangement of elements according to a preferred embodiment of the invention.

Fig. 2 is a section transversely of the service conduit, taken upon the line 2—2 in Fig. 1.

Fig. 3 is a fragmentary plan view of a portion of the construction shown in Fig. 1 which is related to that portion shown in Fig. 2.

Fig. 4 is a plan view similar to Fig. 3 illustrating another embodiment of the invention.

Fig. 5 is a sectional view of the regulator shown in Fig. 1 as mounted on the tank.

As already mentioned, the invention is illustrated in connection with a liquid eduction system where the liquefied gas is forced from a stor-

age tank by the vapor pressure of the stored gas. The liquefied gas passes through a first stage regulator which reduces the pressure below the initial vapor pressure and with the addition of the thermal units, the liquefied gas vaporizes. After vaporization the gas in its vapor phase is conducted to a second regulator where it is reduced to the service pressure of 6 ounces per square inch.

In the drawing, the 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. The tank 11 is of a conventional construction as used in the liquefied petroleum gas industry and is provided with an opening 14 surrounded by a collar 15 that is secured to the tank by a weld 16. The collar in turn supports the riser pipe 17 which is welded thereto as at 18.

The riser pipe 17 is threaded at its top as at 20 to receive a unit 21 upon which are mounted a filler connection 22, a liquid level gauge 23, a safety relief valve 24, and other fittings (not shown) such as a vapor return, if desired, and a pressure gauge.

Gas is removed from the tank and conducted to a place of use by a service conduit which includes an eduction pipe 25 extending through an opening 26 in the tank as supported upon the bottom of a first stage regulator 27 threaded to a collar 28 which is welded to the tank as at 30.

As more particularly shown in application Serial No. 399,715 filed by William C. Buttner, or the application Serial No. 395,443 filed by Harold L. Norway, the regulator 27 has its expansion valve at the lower end of the eduction pipe 25 in heat exchange relationship with the contents of the tank and embodies a diaphragm 80 upon one side of which it is held in place by a bonnet 31 that carries a bonnet spring 83 and adjusting nut 32 adjusted as a combined regulator and shut-off valve by a hollow shaft 33 that extends up into a curb box 34 where it receives a hand wheel 35 for the adjustment and operation of the nut 32. The expansion valve is indicated at 81 and is connected to the diaphragm by a rod 82 which closes the valve 81 under rising pressures present below the diaphragm 80 and is opened by downward pressure exerted by the spring 83.

The regulator 27 is protected by a secondary housing 36 welded to the tank as at 37 to remove the regulator from contact with the surrounding earth. The hand wheel 35 is exposed to the outside atmosphere through a curb box cover 38 having an opening 40 therein of sufficient size to permit the escape to the atmosphere of gas that escapes through the safety valve. The passage 41 through the hollow shaft 33 is in open communication at one end with a box 36 and at the other end with the curb box 34 whereby it serves to provide a means for equalizing pressure in the box 36 with the outside atmospheric pressure so that the diaphragm in the regulator 27 on its upper face is subject to atmospheric pressure.

The diaphragm operates a suitable valve preferably of the positive type, wherein liquid supplied from the tank passes through the valve port into the valve compartment below the diaphragm. This valve may be located at the top of the eduction pipe 25 or at the bottom thereof, depending upon whether or not some heat present in the stored liquefied gas is to be used for purposes of vaporization. If the valve is located at the bottom of the pipe 25, the construction of the regulator 27 and pipe 25 is somewhat similar in features and results to that disclosed in application Serial No. 395,443 filed by Harold L. Norway, reference to which is hereby made.

A liquid level float gauge construction is indicated at 42 which, insofar as this application is concerned, is of conventional construction. The float is disposed where it indicates the level of the liquid in the tank as shown by the dotted line 43.

From the regulator 27, liquefied gas is conveyed to the house through a section of service conduit 44 buried in the ground preferably throughout its length below the frost line 13. The service conduit 44 enters the house through the basement wall 45 and turns upwardly as at 46 to lead to a heat exchange element 47 and a second stage pressure reducer 48 mounted upon a bracket 50 next to, and connected with, a meter 51.

In the cellar, a water heater 52 is preferably disposed adjacent the incoming service conduit 44 and it includes an outer shell 53, a burner 54, a thermostat control 55 and an automatic control 56 whereby the burner 54 is supplied by gas from the meter 51 through a pipe 57. A coil 58 inside of the heater is disposed in the water service line 60 to supply hot water for household purposes.

A loop 61 is either supplied with hot water or directly from the water main, or both. In event it is supplied from the heater it may be connected at one end with the top of a heater and at the other end with the bottom of the coil 58, or if supplied with water from the water main, it can be connected in circuit therewith ahead or behind the heater.

It is with the loop 61 and its construction and arrangement that the present invention is primarily concerned, whether same is supplied with water either convectively from the heater or by forced circulation from the water main with or without the benefit of a heater.

Referring now to Fig. 2, when the tank 11 is installed, a trench is dug from the tank to the wall of the dwelling of a width and depth such as illustrated in Fig. 2 by the broken line 62. The loop 61 and service conduit 44 are placed in the trench beyond the cellar wall and covered with the earth fill 63.

In the particular embodiment shown in Figs. 1 and 2 the loop is made of two substantially horizontal pipes 64 (Fig. 3) extending outwardly in the trench 62 beyond the wall to receive elbows 65 connected thereto to receive nipples 66 and elbows 67 forming a U-shaped loop with a support 68 carried by the elbows 67 to support the service pipe 44 in spaced relationship with respect to the horizontal pipes 64.

The spacing of the service pipe 44 and the horizontal pipe is determined in relationship to the heat conductivity of the earth fill 63 and can be varied as conditions warrant.

Then, when the earth fill 63 is tamped in place the service conduit 44 and pipe 64 are primarily in heat exchange relationship with the earth. In event the water supplied to the loop 61 is higher in temperature than the temperature of the earth in which the loop is buried, the loop warms the surrounding earth to store therein heat units which are not readily dissipated beyond certain limits determined by the heat conductivity of the earth.

However, in warming the earth around the pipe 64, the earth around the service conduit 44 is warmer appreciably over a period of time. Thereafter, whenever gas is vaporized in the serv-

ice conduit 44, the earth has a supply of heat units available to supply the latent heat of vaporization necessary for vaporization of the educted liquefied gas. In event that the refrigerating action developed in the strvice line 44 is particularly heavy the low conductivity of the earth, as regards heat, prevents this refrigerating action freezing the water in the loop 61, the water being given sufficient time to supply heat to the earth and replace itself so that at no time is the water in the loop reduced in temperature to a point of freezing.

In event a heater such as that shown at 53 is employed the water may replace itself continuously in the loop 61 by convective circulation without danger of the refrigerating action that takes place in the service conduit 44 causing the freezing of the water while the water is slowly circulating in the loop and heater coil 58.

In this way the conduit 44 is subjected solely to the heat of the earth throughout its length notwithstanding the fact that the heat present in the earth over a portion or all of the length of the conduit may be higher or supplemented by the heat units present in the water line where it flows through the earth. Furthermore, supplementation of the heat in the ground can be had with the present invention with water or a freezable solution without danger of freezeups that would cause hazardous conditions.

In Fig. 4 another form of loop is shown wherein a main pipe is closed at both ends by caps 71, one of which 71*a* receives axially therethrough a smaller pipe 72 which telescopes with and extends to a point 73 adjacent the far end, of the pipe 70. Unions 74 are provided to connect the interior of the pipe 70 with a suitable source of water in a manner such as that already described in connection with the loop 61, a second pipe line 75 being connected to the interior of the pipe 70 through a nipple 76 welded in the side wall of the pipe 70.

With this construction water may be supplied to the compartment 69 through the pipe 72 and withdrawn through the nipple 76 or vice-versa, it depending upon the connections made by the unions 74 whether or not the heater coil 58 will supply the compartment 69 with warmed water or whether the city main will be conducted to the compartment 69 without addition of heat.

Having thus described the invention and several embodiments thereof, other and further embodiments and constructions will be apparent to those skilled in the art without departing from the spirit of the invention, the scope of which is commensurate with the appended claims.

What is claimed is:

1. A liquefied gas dispensing system comprising a storage tank for liquefied petroleum gas buried underground below the frost line, a service conduit comprising a liquid eduction conduit leading from the bottom of the tank, a first stage pressure reducer, a length of service pipe terminating in a pressure regulator, a body of water adjacent a portion of said length of pipe, an earth fill supporting said pipe and body of water in spaced relation with respect to each other with a portion of said fill being disposed therebetween by which heat is transferred between the body of water and pipe.

2. A liquefied gas dispensing system comprising a storage tank for liquefied petroleum gas buried underground below the frost line, a service conduit comprising means for educting fuel from the tank in its liquid phase, means for expanding the fuel in the conduit, and means for reducing the pressure of the expanded fuel to service pressure, closed conduit means adjacent the portion of said conduit in which the fuel is expanded and having a body of water therein, earth fill supporting said service conduit and said conduit means in spaced relation with respect to each other with a portion of said fill being disposed therebetween.

3. A liquefied gas dispensing system comprising a service conduit comprising a source of gas under pressure, service means for educting fuel from the source and expanding same to vaporize fuel present in its liquid phase, closed conduit means adjacent said service means where the expanded fuel is present, said conduit means including a body of water or the like, and earth fill or the like disposed between said service means and said conduit means at said body of water.

4. A liquefied gas dispensing system comprising a storage tank for liquefied petroleum gas buried to absorb heat from the earth below the frost line, service conduit comprising service means for educting fuel from the tank and expanding it in heat exchange relationship with the contents of the tank, conduit means adjacent said service conduit including a body of water or the like, and earth fill supporting said service means and said conduit means in spaced relation with respect to each other with a portion of said fill disposed between them.

5. In a liquefied gas dispensing system having a service conduit leading underground from a storage tank to a point of gas consumption, the combination of a plurality of pipes adjacent said conduit in communication with one another at one end, means for circulating water or the like through the pipes, and means of predetermined thickness disposed between the conduit and pipes for retarding the interchange of heat therebetween in relationship to the rate of flow of said water to prevent a chilling of the water below its freezing point while the water is passing through said pipes.

6. In combination with a service conduit having liquefied petroleum gas therein in its liquid phase, means circulating a body of water or the like disposed adjacent said conduit, and means disposed between said conduit and body of water restricting the interchange of heat therebetween to an inert material having a comparatively low heat conductivity.

7. In combination with a service conduit for conducting liquefied petroleum gas fuel therein in its liquid phase, means confining a body of water to circulate in fuel vaporizing relation with the conduit in adjacency therewith, and means disposed between said conduit and body of water throughout their adjacency and restricting the interchange of heat therebetween.

8. In combination with a service conduit for conducting liquefied petroleum gas fuel therein in its liquid phase, means confining a body of water to circulate in fuel vaporizing relation with the conduit, and earth material disposed between said conduit and body of water restricting the interchange of heat therebetween wherever the body of water and conduit are close enough for interchange of heat.

9. The method of dispensing liquefied petroleum gas fuel comprising conducting the fuel in its liquid state at a pressure below its normal vapor pressure through and in heat exchange relationship with the earth below the frost line, confining a body of water to circulate in the earth in close proximity with said fuel and in heat ex-

change relation therewith, and restricting the interchange of heat between the fuel and the body of water throughout their proximity by earth present between them.

10. A liquefied gas dispensing system comprising a storage tank for liquefied petroleum gas fuel buried below the frost line and absorbing heat from the earth; a service conduit means extending from the tank to a point of use and including a fuel eduction and pressure control device for educting fuel from the tank and conducting the educted fuel at a reduced pressure in heat exchange relationship with the fuel remaining in the tank, said service conduit means including a conduit connected to said device extending underground below the frost line to said point of use; means for confining a body of water to circulate adjacent to the conduit in fuel vaporizing relation therewith, said conduit and water circulating means being arranged to receive earth between them throughout their adjacency to restrict the interchange of heat between them.

11. A liquefied gas dispensing system comprising a storage tank for liquefied petroleum gas fuel buried below the frost line and absorbing heat from the earth, a service conduit means extending from the tank to a point of use and including a conduit section opening at a point near the bottom of the tank to educt fuel in its liquid phase from the tank and a device for reducing the pressure upon said educted fuel, said conduit means including a second conduit section connected to the first section and disposed underground, and means for warming said second section including an element for confining a body of water to flow along a path adjacent to said second section in fuel vaporizing heat exchange relation with the second section, said second section and said element being separated by an inert material of low heat conductivity throughout their adjacenecy whereby the interchange of heat between them is restricted enough to prevent freezing of the water in said element.

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