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FUEL GAS DISPENSING SYSTEM

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2 Sheets-Sheet 1

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2 Sheets-Sheet 2

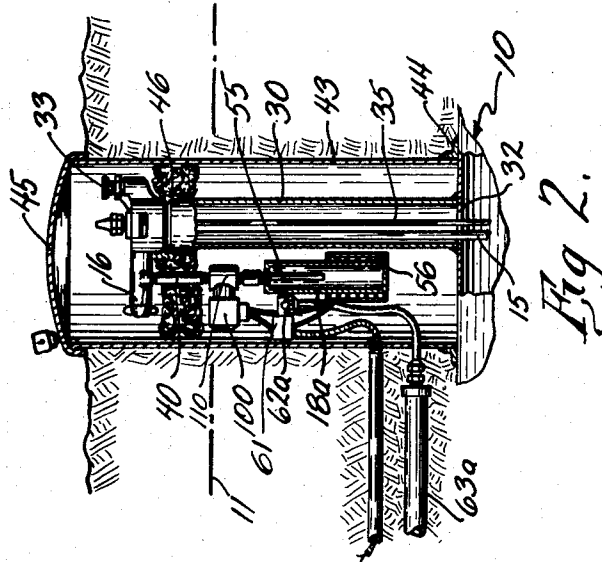


Fig 2.

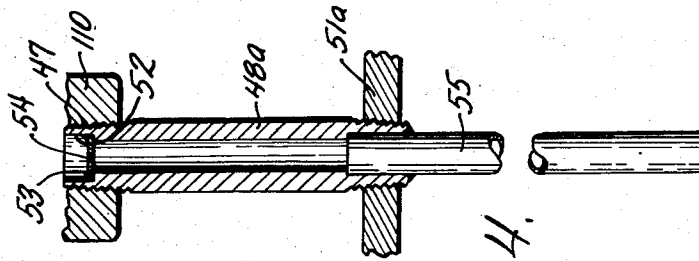


Fig 4.

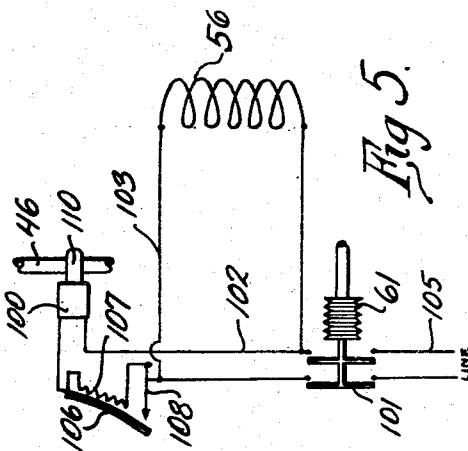


Fig 5.

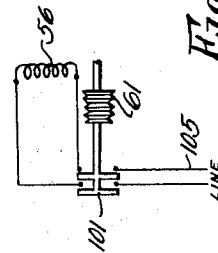


Fig. 6.

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FUEL GAS DISPENSING SYSTEM

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12 Claims. (Cl. 62-1)

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The present invention relates to the dispensing of liquefied petroleum gases such as butane and propane having a boiling point below the normally expected temperature of the ground below the frost line.

Liquefied petroleum gases are used when a natural gas is not available, as in rural communities, and as a general rule is supplied in households by individual systems, one or more for each household, although in some instances with a large storage tank and small loads, several closely built houses can be served through meters from a single tank.

Liquefied petroleum gases generally employed as a fuel for these purposes include butane and propane and various mixtures thereof in which the mixtures are either blended or are present in the original product commercially. The boiling point of the fuel is below 32° F. so that it can be stored some place where the temperature is above the freezing point of water, such as below the frost line of the ground, where the warmth of its environment develops a vapor pressure above atmospheric pressure that will serve as a working pressure to force fuel from the tank in either its liquid or vapor phases.

Although this working pressure may be augmented by the presence of air, it is preferred that a mixture of fuel be provided sufficiently rich in propane, which has a boiling point at minus 40° F., that the resulting working pressure will be maintained at a substantial and acceptable high pressure so that heavy withdrawals even in extreme winter conditions will not cause the system to shut down. Propane, however, has a lower B. t. u. content than butane, per cubic foot, and if the fuel is educted from the tank in its vapor phase, the propane will tend to vaporize first and leave the remaining mixture with a much lower working pressure.

On the other hand, if the fuel is educted in its liquid phase, it has to be vaporized, a step which requires a localized input of substantial amounts of heat for the latent heat required for vaporization. In the last instance, however, the fuel gas produced for consumption has a substantially uniform B. t. u. content throughout the discharge of the system with sufficient other advantages to warrant the solving of the problem regarding vaporization, in systems already installed, and systems to be installed, having in mind the difficulties incurred by the requirements of the National Board of Fire Underwriters', the laws of the many States, the dangers of handling a highly flammable gas and the requirements of good engineering practice.

In the present invention it is proposed to employ advantages of liquid eduction to provide a constant B. t. u. content and to supply sufficient heat to accomplish vaporization of the

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educted liquid fuel in a safe, new and improved manner.

It is one of the objects of the present invention to accomplish this vaporization by supplying the necessary latent heat of vaporization to the fuel along with a primary reduction in the pressure upon the fuel, and in doing this supply the heat only when it is necessary and then to so time the supplying of the heat and the movement of the fuel to coincide with each other in point of time for heat exchange at a particular point in the service conduit.

It is also an object of the invention to provide a second or service stage pressure regulator in combination with the first stage pressure reduction to maintain a back pressure upon the vaporized fuel between them sufficient, in combination with the volume of the service line, to provide sufficient reserve there that the control of the heat can be made economically and to the best advantage without in any way endangering the continuous operation of the system.

A further object of the invention is to supply heat in a new and improved manner whereby fuel in its liquid phase will not pass beyond a predetermined point in the service conduit.

Another object of the invention is to prevent fuel in its liquid phase from moving beyond a certain point in the service conduit.

A further object of the invention is to prevent a rapid excess flow of liquid into the service line when the load conditions are high.

Other and further objects of the invention will appear from the drawings, the description relating thereto and the appended claims, including the provision of a device which is simple, easily installed and serviced.

Referring now to the drawings—

Fig. 1 is a section taken in a vertical plane in a gas dispensing system embodying the preferred form of the invention.

Fig. 2 is a view similar to Fig. 1 showing a particular portion of a gas dispensing system embodying another form of the invention.

Fig. 3 is a section taken longitudinally through the outlet of the first stage pressure reduction shown in Fig. 1.

Fig. 4 is a section similar to Fig. 3 showing the construction of the outlet of the solenoid valve disclosed in Fig. 2.

Fig. 5 is a wiring diagram illustrating the manner in which the embodiment shown in Fig. 2 is preferably connected.

Fig. 6 is a wiring diagram illustrating the manner in which the embodiment shown in Fig. 1 is connected.

In accomplishing the objects of the invention a pressure tank 10 is preferably located below the frost line 11 in the ground 12 where it is subjected to temperatures above 32° F. It is

filled to a predetermined level in a conventional manner with a liquefied petroleum gas present therein in both its liquid phase 13 and its vapor phase 14, and although this system is well adapted to handle butane alone, it is preferred to provide a liquefied petroleum gas which is a mixture of butane and propane having a boiling point of approximately 0° F. or a little higher, such as that generally experienced with so-called commercial butane, a commercial product which contains approximately 20% propane as produced at the refineries.

The fuel is preferably withdrawn in its liquid phase 13 through an eduction conduit 15 having its opening adjacent the bottom of the tank. From the eduction conduit, the fuel passes through a shutoff valve 16, a first stage pressure reducer 17, a well or trap 18, which will be described a little later. From there, the fuel passes in its vapor phase through an underground service conduit 20 extending through the foundation wall 21 into a cellar 22, through a service stage pressure reducer 23 located in the cellar and a meter 24 to a gas appliance such as a stove 25.

Although the tank 10 may be made spherical or of any other shape which may be economical, it is shown for purposes of illustration as made of a cylindrical central portion 26 having heads 27 welded thereto along weld lines 28. A riser pipe 30 is welded to the tank as at 31 in communication therewith through an opening 32 to form and be considered as a part of the tank. At the top of the riser member 30 a unitary fitting 33 is mounted in any suitable manner as by threading 34 and includes a slip tube gauge 35 for determining the level of the liquid 13 in the tank, a filler connection 36, a pressure gauge 37, and, among other things such as a safety valve, and vapor return connection (not shown), it includes the liquid eduction conduit, an outlet connection 38, the hand shutoff valve 16, a nipple 40 and the first stage regulator 17 supporting the well 18. In event it is desirable that the regulator and well be handled as a separate unit a universal coupling of suitable nature may be substituted for the nipple 40.

The regulator 17 is of the construction shown in the Buttner application, Serial No. 399,715, reference to which is hereby made for further details of its construction and operation, it being indicated at this time that the reducer 17 constitutes a pressure regulator whose valve is adjusted by the bonnet screw 41 to close at any predetermined point within the range of 5 to 20 pounds pressure at the outlet 42 thereof.

The well 18 is preferably mounted as shown upon the regulator 17 as supported by the fitting 33 and although the well 18 with its accompanying elements may be located in the basement 22 or some other point remote from the tank 10 it should be located as near the regulator 17 as possible and preferably at the tank 10 where it may be protected by a housing 43 secured to the tank as at 44 and protected from contact with atmosphere by a cover 45 and a layer of insulation 46.

In supporting the well 18, the regulator outlet 42 is internally threaded as at 47 (Fig. 3) to receive a nipple 48 that is externally threaded as at 50 to be secured in the top wall 51 of the well 18. At the upper end of the nipple 48 a cavity is provided in which is received a washer 53 having a restricted opening 54 therethrough, calibrated to permit a flow of liquid fuel slightly in excess of the maximum expected rate of con-

sumption of gas in a particular household. At the lower end of the fitting 48 the discharge tube 55 is provided to direct the incoming liquefied gas against the bottom of the well 18.

The well 18 is made preferably of an elongated cylindrical container made preferably of a metal, such as brass, having high heat conductivity with a low factor of corrosion when used with liquefied petroleum gas having an odorant and possible water moisture therein. A heating coil 56 is placed around the lower end of the well 18 as protected by a waterproof jacket 57 which protects the heating element from any moisture reaching it which might run down from the regulator 17 due to frosting and defrosting of the body thereof in operation or due to water trapped in the housing 43.

The heating coil is supplied with electrical power through a plug-in extension 58 extending underground through an explosion proof conduit 60 as controlled by an explosion proof pressurestat 61 which is mounted upon the upper end of the well 18 where it is subject to the pressure existing inside of the well 18. The pressurestat 61 is connected to operate in a manner closing the circuit to energize the electrical coil when the pressure in the container 18 drops below a predetermined pressure that has a definite relationship to the outlet pressure of the regulator 17, as will be hereinafter described.

The fuel outlet from the well 18 is made at a point near the upper portion thereof as indicated at 62 to assure the withdrawal of vapor fuel from the well 18 and from this point the fuel is carried to an enlarged pipe 63 which provides a substantial volume which when filled with vapor under pressure affords a reserve supply of fuel for use in the house. The service stage regulator 23, which reduces the pressure of the gas to eleven inches of water column, and the meter 24 are connected to the outlet of the pipe 63 by means of pigtails or other forms of conduits 64, and the stove 25 is connected to the meter 24 by means of the house pipe 65.

On operation, once the tank is charged with a quantity of fuel of the nature discussed and the extension cord 58 is plugged into an electrical outlet socket, liquid will begin to flow through the eduction conduit 15 and the pressure regulator 17 when the hand valve 16 is opened. As the liquid passes through the regulator 17 there will be a reduction of pressure thereon which will be momentary until the valve compartment is filled. During this and, to the extent that heat is present in the regulator 17, to that extent vaporization of the fuel in the valve compartment will take place and the fuel will flow through the orifice 54 in its vapor state. When the available body heat of the valve is exhausted, the regulator valve compartment will be full with liquid.

Thereafter, liquid will flow through the orifice 54 to the extent controlled thereby and beyond this orifice the liquid will vaporize at the reduced pressure to the extent that latent heat of vaporization is present in the surrounding parts and usable at the reduced pressure. Liquid which is not vaporized but which is greatly chilled will drop to the bottom of the well 18 where it will begin to collect in a pool. What fuel has been vaporized will pass out into the pipe 63 and on into the house to the stove 25 until such time as the pressure of the fuel present beyond the regulator 17 rises to the outlet pressure determined for the regulator by the bonnet screw 41.

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For the purposes of discussion here it will be assumed that the outlet pressure of the regulator 17 is set for 10 pounds. Therefore, until the 10 pound pressure is reached in the well 18 the pressure in the well 18 will range some place between zero gauge and the 10 pound limit. In this range, the pressurestat 61 is adjusted to operate preferably at a pressure of a couple pounds per square inch, gauge pressure below the 10 pound per square inch limit, such as 8 pounds per square inch gauge pressure. Thereafter, while the liquid is flowing into the well 18 and up until the time that the pressure therein reaches 8 pounds the heating coil will be turned on to warm the walls of the well 18. This heat will supply sufficient heat for the latent heat of vaporization and will tend to keep the bottom of the well 18 dry during operation, even for a short period of time after the pressure exceeds 8 pounds and the pressurestat has turned off the control switch. Once the air is purged from the system which is present after initial installation, the system is ready for operation to supply any stove, furnace or water heater or a heat operated absorption refrigerator, or all of them at once since the orifice 54 is calibrated so that the highest expected load for carrying these appliances will be that which is supplied by the liquid fuel passing through the orifice 54.

Thereafter, as long as pressure is present in the well 18 in excess of 8 pounds, that is, in excess of the setting of the pressurestat 61, no electricity will be consumed, and as long as the load upon the system does not exceed the capability of the associated parts to supply the latent heat of vaporization, no electricity will be supplied. In event, however, a withdrawal is made in sufficient quantities that the associated parts are unable to apply the latent heat of vaporization, chilled liquid will begin to collect in the bottom of the well 18 as a low point and continued withdrawal of vapor from the pipe 63 will substantially lower the pressure therein by depleting the amount of fuel present in its vapor phase faster, volume for volume, than the orifice 54 can supply liquid volume for volume. Once the pressure begins to go down, it is only a short time until the pressurestat 61 will close the heater circuit and heat will be added to the well to vaporize the liquid collecting therein. Thereafter, the liquid present in the well 18 will be vaporized to increase the pressure to actuate the pressurestat 61 to open the electrical switch with sufficient residual heat remaining in the coil to dry the well 18 once the load is shut down after the heater has been warmed.

Certain relationship exist which may be mentioned, namely, that there should be enough volume of gas in the pipe 63 that the expected load in the house will not deplete that supply before the heater has begun to vaporize liquid fuel present in the well 18. For any particular installation or expected load, this can be computed quite easily once the lag time of the heater is known. Furthermore, the size of the well 18 should be such that it will accommodate the potential maximum liquid fuel volume which would be passed by the orifice 54 during the warm-up period of the heater coil. This computation is also made upon the potential peak expected load in the household. Speaking roughly with a safety factor added thereto the volume of the well below the outlet 62 should be equal to the volume of

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the fuel present in the pipe 63 if that fuel were in its liquid form.

Referring to Fig. 2 the same general principles are carried forward in a further embodiment of the invention in which an explosion proof solenoid valve 110 is substituted for the regulator valve 17. The connections are identical to the extent that the same numbers refer to like parts but in this embodiment the time delay element, more particularly shown diagrammatically in Fig. 5, is provided to control the energizing of the solenoid 100. The control is a delaying one and the time of this delayed action of the solenoid valve 110 is determined in relation to the lag or warm-up period of the heater. In this particular embodiment the heater is operated to come on and go off as the gas is used in relationship to the volume of reserve, as in the service conduit 63a.

More particularly, the pressurestat is a double acting one which closes the electrical circuit at a minimum pressure, preferably of approximately 3 pounds, and opens the circuit at a maximum pressure of 10 pounds or higher, but preferably not to exceed 20 pounds. Sufficient volume is provided in the pipe 63a that the system is not cycling itself repeatedly upon light loads.

As shown diagrammatically in Fig. 5, the pressurestat 61 operates a single throw, double pole switch 101 which closes a circuit 102 beyond it that includes leads 103 connecting the heater coil 56 directly in circuit with the power line indicated at 105, and a bi-metal switch 106 which closes after a small heater coil 107 thereon flexes the bi-metal 106 to close the main circuit by engaging the contact 108. The resistance of the heater 107 is sufficiently high that it will not energize the solenoid 100 and open the valve 110 mounted upon the outlet nipple 40 on the fitting 33.

The operation of this embodiment is such that when the pressure upon the vapor fuel present in the conduit 63a drops to a predetermined point as the fuel is being used the pressurestat is actuated to close the switch 101 to start the heater coil so that the well 18a is being supplied by heat by the time the solenoid valve 110 is opened by the closing of the thermostatically controlled delay switch 106. When this valve 110 is open liquid flows from the tank 10 through the eduction means and into the well 18a where vaporization occurs. The flow of liquid through the valve 110 is limited by a washer 54 as in the previously described embodiment. The delay is timed in relationship to the warm-up period of the heater 107. Thereafter, liquid passing through the orifice 54 will be projected downwardly into a warm region to which is being supplied all the heat that is required for latent heat of vaporization. With this construction fuel will not be permitted to be present in this system in its liquid form at or beyond the well 18a. Consequently, in this embodiment the well 18a may be much smaller than represented in the figure, or the size of the well 18 in the other embodiment, even to the point that it may be nothing more than a depression in a line that is otherwise continuous as long as the heat is supplied at that point where liquid would otherwise collect. Although it is not shown in the embodiment illustrated, it is desirable, when cold weather temperatures and fuels having a high boiling temperature are likely to be encountered, to arrange the conduit 63a so that its entire length is above the outlet of the valve 18a. The conduit 63a should also slope upwardly from the

well 18a to the second stage pressure regulator 23. With this arrangement any liquid condensing in the conduit 63a will drain back into the well 18a. Thereafter, liquid present at the bottom of the well 18a would be reheated upon the next cycle when the pressure of the fuel present in its vapor form in the conduit 63a falls below the criterion determined by the setting of the pressurestat 61.

Having thus described the invention and certain principles of operation and relationships of size, position and cooperation of the respective elements, it will be readily apparent to those skilled in the art that various and further modifications can be made without departing from the spirit of the invention, the scope of which is commensurate with the appended claims.

What is claimed is:

1. In a liquefied petroleum gas dispensing system having a storage tank in which gas is stored in both its liquid and vapor phases, conduit means for educting gas from the tank in its liquid phase including a section opening adjacent to the bottom of the tank, a well, and a service line; and means for controlling the flow of gas through said conduit means including a pressure responsive valve means between said section and well, means for restricting the flow of gas into the well, pressure controlled means for supplying heat to the well when gas is present there in its liquid phase.

2. In a gas dispensing system having means for storing liquefied gas in both its liquid and vapor phases, conduit means for educting gas from the storage means in its liquid phase including a section opening adjacent to the bottom of the tank, a service line and a low point in the line; and means for controlling the flow of gas through said conduit means including a pressure controlled valve means between said section and low point, means for retarding the flow of gas into the low point, and pressure controlled means cooperating with the valve means for supplying heat to the low point.

3. In a gas dispensing system having means for storing liquefied petroleum fuel in both its liquid and vapor phases, conduit means for educting liquid fuel from the storage means including a section opening adjacent to the bottom of the tank, a service line and a low point in the line; and means for controlling the flow of gas through said conduit means including a pressure controlled valve means between said section and low point, means for retarding the flow of gas into the low point, and pressure controlled means for supplying heat to the low point when gas is present at the low point in its liquid phase under a pressure below a predetermined pressure, said retarding means being so constructed and arranged as to supply in liquid volume an amount of fuel in excess of that which in its vapor phase would carry the expected peak load upon the system.

4. In a liquefied petroleum gas dispensing system having a tank for storing the gas in its liquid and vapor phases, the combination of conduit means for conveying gas from the tank to a place of use, and control means for controlling the flow of gas through the conduit means; said conduit means including an eduction section opening adjacent to the bottom of the tank, a second section having a well therein and an outlet near the top thereof, and a third section connected to the outlet; and said control means including a pressure reducer between the eduction and second sections, and a service pressure regulator in said

third section; and means for supplying heat to the contents of said well including a device responsive to a predetermined drop in pressure in the well.

5. A liquefied petroleum gas dispensing system including a tank for storing the gas in its liquid and vapor phases, a protective casing secured to the tank, conduit means for conveying gas from the tank to a place of use and control means for controlling the flow of gas through the conduit means; said conduit means including an eduction section opening adjacent to the bottom of the tank, a second section having a well therein disposed in said casing and having an outlet near the top thereof, and a third section connected to the outlet; and said control means including a pressure actuated valve between the eduction and second sections, and means for connecting a service pressure regulator at the outlet of said third section; and means for supplying heat to the contents of said well including a device responsive to a predetermined drop in pressure in the well, said second and third sections having volume enough to sustain expected peak withdrawal on the system during the warmup period of said heat supplying means.

6. In a liquefied gas dispensing system having a tank receiving a fitting thereon, means for educting liquefied petroleum gas in its liquid phase from the bottom of the tank through the fitting, a pressure reducer supported upon the fitting and connected to receive the educted gas from said eduction means, a vaporizing chamber supported by the regulator at the outlet thereof, and means for warming said chamber with an outside source of heat.

7. In a liquefied gas dispensing system having a tank receiving a fitting thereon, means for educting liquefied petroleum gas in its liquid phase from the bottom of the tank through the fitting, a pressure actuated means supported upon the fitting and connected to receive the educted gas from said eduction means, a vaporizing chamber carried by the pressure actuated means at the outlet thereof, means for retarding the flow of gas from the pressure actuated means, and means for warming said chamber with an outside source of heat.

8. In a liquefied gas dispensing system having a storage member receiving a fitting thereon, means for educting liquefied petroleum gas in its liquid phase from the bottom of the tank through the fitting, a pressure controlled valve means supported upon the fitting and connected to receive the educted gas from said eduction means, a vaporizing chamber carried by the valve means, and means for warming said chamber with an outside source of heat, and an orifice for retarding the flow of gas passing through the valve means.

9. In a liquefied petroleum gas dispensing system having a service conduit section, a well member in said section, a heat exchange device for supplying heat to the well member, and means controlled by the pressure in said well for actuating said heat exchange device.

10. In a liquefied petroleum fuel dispensing system, a fitting adapted to be received upon a tank and carrying an eduction conduit element opening at the bottom of the tank when the fitting is in place, a pressure controlled valve supported on the fitting to receive educted fuel from the conduit element, a well member carried by the valve, flow restricting means between the valve and well member, means for warming the

well, and means for actuating the warming means when the pressure in the well falls to a predetermined pressure.

11. In a liquefied petroleum fuel dispensing system, a fitting adapted to be received upon a tank and carrying an eduction conduit element opening at the bottom of the tank when the fitting is in place, a pressure controlled valve supported on the fitting to receive educted fuel from the conduit element, a well member carried by the valve, flow restricting means between the valve and well member, means for warming the well, and means for actuating the warming means when the pressure in the well falls to a predetermined pressure including a time delay control for the opening of the pressure controlled valve.

12. In a liquefied gas dispensing system having a storage member adapted to be buried below the frost line in the ground and receiving a fitting thereon, means for educting liquefied petroleum gas in its liquid phase from the bottom of the tank through the fitting, valve means supported upon

the fitting and connected to receive the educted gas from said eduction means, said valve means being controlled by variations in pressure, a vaporizer carried by the valve means including an element for warming said vaporizer from an outside source of heat, and means for energizing said warming element operated by variations in pressure.

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