March 21, 1950 G. W. DICK 2,500,936

GAS GENERATING APPARATUS

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Fig. 1.

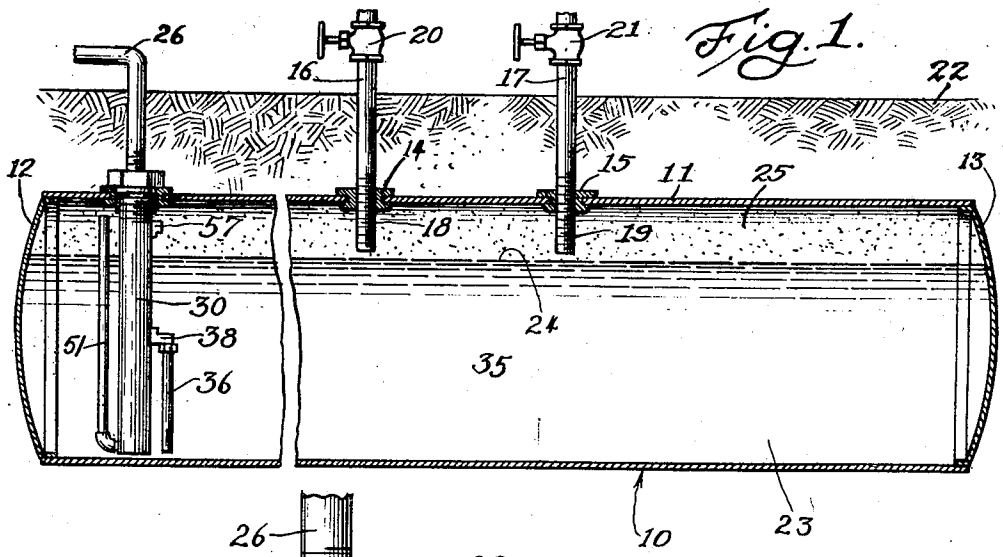


Fig. 2.

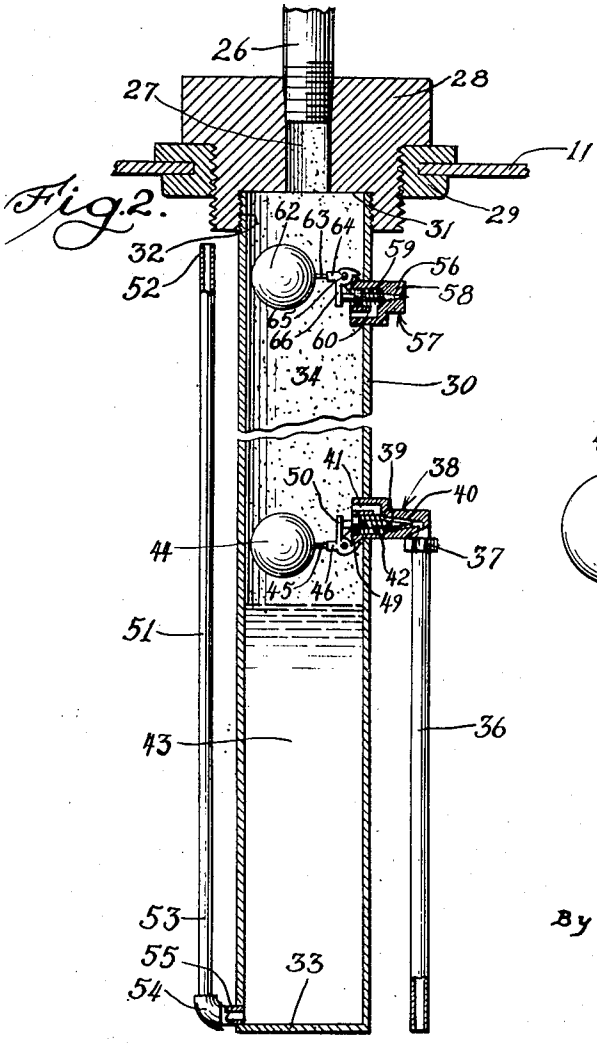
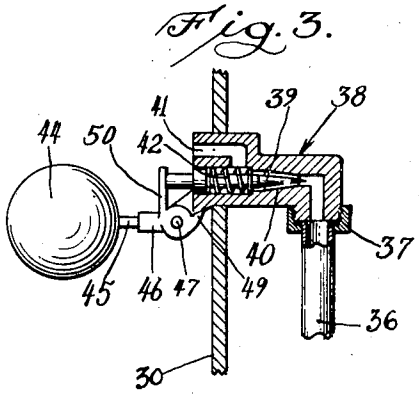


Fig. 3.



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GAS GENERATING APPARATUS

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32 Claims. (Cl. 62—1)

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This invention relates to gas generating apparatus and more particularly to improved means for progressively converting a highly volatile fuel such as butane from its liquid to its vapor state for consumption, although certain features thereof may be employed with equal advantage for other purposes.

Numerous types of devices have heretofore been proposed for vaporizing fuel, but these are inefficient, expensive, and embody intricate instrumentalities. Highly volatile fuel such as butane is most efficiently consumed in its vapor state, and the simplified vaporization thereof warrants its adoption as a fuel for both domestic and commercial purposes.

Obviously, most fuels can be vaporized by the application of extraneous heat which substantially enhances the cost of such fuel treatment and otherwise complicates the instrumentalities that are necessary for effecting the conversion. With the teachings of the instant invention, it is proposed to utilize the heat inherent in a storage tank that is preferably positioned in the ground below the frost line so that the heat from the surrounding earth may be utilized for conversion of liquid butane to its gaseous or vapor state. This conversion of the liquid to its vapor state, is accomplished by the transfer of ground heat to the liquid butane stored in the tank to develop a vapor pressure therein. The stored liquid is forced by this vapor pressure into a compartment disposed inside the storage tank through a valve which controls the amount of liquid present in the compartment. The vapor is withdrawn from the compartment for use in a house appliance and as the vapor is withdrawn from the compartment the liquid remaining in the compartment absorbs heat from the walls of the compartment, which heat is convectively conveyed thereto from the earth by the liquid stored in the storage tank.

Butane is made from petroleum and in its commercial form is contemplated in the present invention has a boiling point of 33° F. It is the most suitable gas utilizable with the teachings of the instant invention for the purpose set forth, since pentane or commercial gasoline has a boiling point of 94° F. while propane has a boiling point of minus 40° F. Consequently, of these three related fuels, butane is most suitable for conversion into a vapor or gaseous state for efficient consumption to fulfill commercial requirements.

One of the objects of the invention is to effect vaporization of liquefied petroleum gas in an improved manner as by utilizing the heat present

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in a surrounding liquid body exposed to the heat of the earth as a source of supply for the sensible heat of vaporization, so as to effect such vaporization, and maintaining said fuel under reduced pressure during vaporization thereof. A further object is to provide a method of withdrawing vapor from a small body of liquid fuel which is located within but segregated from a larger or main body of such fuel, whereby the sensible heat of the larger body effects vaporization, and to maintain the liquid level of the segregated body of liquid at a predetermined height. A further object is to provide for supplementing the volume of vapor withdrawn from said segregated body with vapor derived from a vapor space located above said body.

Other objects and advantages will appear from the following description of an illustrative embodiment of the present invention.

In the drawing:

Figure 1 is a sectional view in elevation of a storage tank embodying features of the present invention.

Figure 2 is an enlarged longitudinal sectional view of the vaporizing chamber.

Figure 3 is an enlarged sectional view in elevation of a float valve shown in Figure 2.

The structure selected for illustration comprises a tank 10 which is of standard design and may vary within a wide range to provide different capacities depending upon the dictates of commercial practice and the requirements of any particular installation. The tank 10 is usually constructed to provide a cylindrical body 11 having circular end enclosures 12 and 13 which are welded or otherwise attached to the cylindrical body 11 to hermetically seal the ends thereof for confinment of liquid, gas or other substances without any possible escape therefrom other than through its discharge orifice provided for that purpose.

In the present embodiment, the body 11 of the tank 10 is provided with threaded flanges 14 and 15 fixed along a top longitudinal median line thereof to enable the attachment of pipes 16 and 17, respectively, which are in threaded engagement therewith. As shown, the pipes 16 and 17 have extensions 18 and 19 confined within the tank 10 so as to define the filling level to which the tank 10 is charged with any liquid. Hand valves 20 and 21 are provided in the intake pipes 16 and 17 which extend upwardly so that the tank 10 may be submerged in the confining earth or ground 22 below the frost line thereof so that the

walls will be in direct contact therewith to absorb the heat therefrom.

Obviously, the frost line varies in different localities depending upon climatic conditions so that the depth to which the tank 10 is submerged depends entirely upon local conditions which are easily determined for any particular installation. It is worthy of note that the hand valves 20 and 21 are disposed above the ground 22 so as to be exteriorly accessible for manual control so that the tank 10 may be charged with the liquid fuel such as butane through the pipes 16 and 17 in the customary and well known manner. Further elaboration on the precise method of supplying butane to the tank is thought unnecessary in that this is effected in a manner well known in the art to supply a highly combustible liquid 23 to a maximum level such as defined by the line 24 coincident with the lower extremities of the intake pipe extensions 18 and 19 so as to provide sufficient space 25 above the maximum initial liquid line 24 within the tank 10.

Another pipe 26 is in threaded engagement with a port 27 provided axially within a coupler 28 which is in threaded hermetic engagement with a flange 29 welded or otherwise fixed to the body 11 preferably though not essentially in longitudinal alignment with the flanges 14 and 15 described supra. The pipe 26 serves to convey gaseous fuel to any suitable burner or other apparatus for consumption or use depending upon the purpose of any particular installation.

The tank 10 is provided with a chambered member 30 that extends vertically downward from the coupler 28, it having a threaded peripheral edge 31 for engagement with the correspondingly threaded bore 32 provided in the coupler 28 coaxialy of the port 27 for communication with the pipe 26 in engagement therewith. As shown, the chambered member 30 extends downwardly to a position proximate to the bottom of the tank 10, and is provided with a closed bottom end 33 to define a chamber 34 distinct from the interior 35 of the tank 10 so as to provide an exchange of fuel from one to the other. This is effective in converting the liquid fuel 23 to a gaseous or vapor state for passage through the pipe 26 that leads to the consumer.

The chamber 30 is provided with a tubular member such as a pipe 36 that extends to a level coincident with the chambered bottom 33 for connection through a coupler 37 to a valve body 38. The valve body 38 is fixed to the side wall of the chamber 30 at any desirable level between the maximum liquid level 24 and the bottom 33 of the chamber 30. The valve body 38 communicates with the interior 34 of the chamber 30 so as to provide a path for fuel passage therefrom to the interior 35 of the tank 10 through the pipe 36. The valve body 38 is provided with a valve pin 39 that is reciprocatingly mounted therein to confront a correspondingly shaped seat 40 in communication with the interior of the tubular pipe 36, there being a port 41 provided in the valve body 38 to extend from the interior 34 of the chamber 30 to the interior of the pipe 36 with the valve pin 39 disposed therebetween to control the passage of fuel therethrough.

To this end, the valve pin 39 is provided with a coil spring 42 in enveloping relation therewith so as to normally urge the valve pin 39 away from its seat 40 to provide communication between the interior of the tubular pipe 36 and the port 41 of the valve body 38. So that the liquid 23 will be maintained at a maximum level within the chamber 30 coincident with the vertical position or level of the valve body 38, a float 44 is fixed to a rod 45 anchored to a bell crank lever 46. The bell crank lever 46 is pivoted to the valve body 38 by means of a pintle 47 so that its arms 49 and 50 will cooperate with the valve body 38 and valve pin 39, respectively.

The lever arm 49 cooperates with the valve body 38 so as to limit the counterclockwise displacement of the float 44 (viewed from Figure 2) while the lever arm 50 is disposed in the path of the valve pin 39 so as to effect the displacement of the latter in the direction of its seat 40 against the urge of the spring 42 when the liquid fuel 43 rises to a level above the pintle 47. The liquid 43 enters the chamber 30 through the pipe 36 that communicates with the port 41 provided in the valve body 38 so as to fill that portion of the chamber 30 beneath the pintle 47 with the liquid fuel 43 from the comparatively larger chamber 35 comprising the interior of the tank 10.

A pipe 51 extends vertically downward within the tank 10 and parallel to the chamber 30 so that its upper extremity 52 is preferably within the vapor space 25 above the maximum fuel line 24, its lower extremity 53 being connected to an elbow 54 that engages a nipple 55 in communication with the interior 34 of the chamber 30.

As shown, the nipple 55 is fixed to the chamber 30 proximate to the bottom 33 thereof so that the gas or vapor fuel 25 will be forced downwardly through the pipe 51 responsive to its own vapor pressure above the liquid fuel line 24 for passage and circulation through the liquid 43 confined in the chamber 30.

No particular control is necessary therefore except to insure that the liquid fuel 43 within the chamber 30 will not rise to the pipe 26, this being precluded by the float operated valve 39. Should the float valve 39 become inoperative or ineffective through any mechanical failure or defect, another emergency relief valve 56 is provided in a valve body 57 fixed to the wall of the chamber 30 at a position above the valve body 38 and below the port 27 that reaches to the pipe 26 connected to the consumer. A valve pin 56 is reciprocatingly mounted in the valve body 57 to cooperate with the correspondingly shaped valve seat 58.

A coil spring 59 envelops the valve pin 56 to normally urge the valve 56 from its seat 58 and provide communication between the interior 34 of the chamber 30 in the vapor space 25 through a port 60 provided in the valve body 57. The valve pin 56 is, however, normally maintained in contact with its seat 58 by means of a float 62 fixed to a rod 63 anchored to a lever 64. The lever 64 is pivoted to the valve body 57 by means of a pintle 65 so as to normally gravitate the float 62 in a counterclockwise direction (viewed from Figure 2) so that the valve pin 56 will be maintained in contact with its seat 58 to close the port 61.

This is accomplished by means of an arm 66 formed on the lever 64 and disposed in the path of the valve pin 56 to normally close the port 60 against the urge of the spring 59. Should the float operated valve 39 stick or otherwise become ineffective for limiting the level of the liquid fuel 43 and the latter rise to the float 62, its connecting rod 63 will be displaced in a clockwise direction responsive to the continued rise of the liquid fuel 43 and thus remove the lever arm 64 from the valve pin 56 so that the spring 59 will be free to effect its displacement to the left

(viewed from Figure 2) and open the valve seat 58 for communication with the port 60 so that the liquid fuel 43 will pass into the chamber 35 constituting the interior of the tank 10.

It is worthy of note, however, that the valve body 57 with its float operated valve 56 is attached to the chamber 30 at a level normally above the maximum liquid fuel level 24 so that the excess liquid within the chamber 30 will be discharged into the tank 10 without any particular interruption to the conversion of the liquid fuel to its gaseous state and insuring against the withdrawal of liquid fuel 43 through the delivery pipe 26 connected to the consumer.

In practice, after the tank 11 is placed in the ground, it is partially filled with vaporizable liquid fuel as indicated at 35. Good practice dictates that the original volume of gas 35 in liquid phase should be approximately 90% of the capacity of the tank, leaving a space 25 corresponding to approximately 10% of its capacity, above the liquid level 24, in which gas in vapor phase may accumulate. The top level 24 of the liquid will be above the plane of the float valve 38. The chamber 30 being empty at this stage, and the valve 38 being open, the liquid will flow through the eduction conduit 36 and through the valve 38 into the container, as indicated at 33, until the level of said liquid 43 raises the float 44 sufficiently to close the valve 38. While the container is being filled, the liquid level in the pipe 51 will also rise to correspond with the liquid level existing in the container 30.

In operation, when vapor is withdrawn from the container 30 through the service pipe 26, the pressure will be reduced within container 30. This reduction of pressure, however, will be relieved to some extent by the head of liquid that exists within the pipe 51, since the vapor pressure in the space 25 of the storage tank 10 is effective in the pipe 51, because the latter is open to such pressure. Accordingly, as the level of the liquid is lowered in pipe 51, the level of the liquid 43 in chamber 30 rises to exert an increased force against the float 44 in the direction tending to close the valve 39.

At this time, a pressure differential exists between the inside of the container 30 and the pressure effective at the inlet of the valve as represented by the displacement of the liquid level in the pipe 51. It will be observed that this pressure differential on both sides of the valve 38 is controlled and maintained by said valve. As long as the withdrawal of vapor from the container 30 does not exceed the heat transfer capacity of the system to supply the latent heat of vaporization required in the container 30 to support that load, there will be no flow of vapor through the pipe 51. However, when the requirements of the appliance to which the service pipe 26 is normally connected exceeds this stated capacity, supplemental fuel in vapor phase will be conducted from the space 25 through the pipe 51, and into the lower portion of the chamber 30 below the level of the liquid 43, in such manner as to bubble upwardly through and to agitate said liquid 43.

As the volume of liquid 43 is diminished due to vaporization, its level will drop until the float valve 38 will open under the tension of its spring 42. The effect of the pressure differential existing at the valve will operate to refill or replenish the liquid loss in the container 30. When the level therein again reaches a position which will move the float 44 sufficiently, the valve 38 will be closed.

The flow of liquid itself in no way affects the pressure differential. However, due to the fact that liquid will be leaving one side of the valve—where a higher pressure exists than that which exists on the other side of the valve—portions of the liquid passing through the valve will vaporize in the region of lower pressure as the liquid enters the chamber 30, and to the extent that the heat in the liquid so passing through the valve, is capable of supplying the latent heat of vaporization.

To clarify the term "extraneous" heat as referred to herein, it should be borne in mind that such term is applied to heat that is artifically furnished such as by establishing combustion or applying heat. This term is not used to apply to the heat inherent in the ground 22 below the frost line thereof which is conducted to the tank 10, and thus absorbed by the liquid fuel 23 such as butane that is vaporized to an appreciable extent to fill the space provided therefor above the initial liquid line 24.

This is initially accomplished without resort to comingling or the conduction of fuel between the chambers 30 and 35, since the space 25 above the maximum liquid line 24 is measured to accommodate the initial conversion of the liquid butane 23 as the tank 10 is charged therewith. Its conversion will instantaneously take place when the liquid butane 23 strikes the interior walls of the tank 10 which is filled therewith up to the maximum level 24 defined by the lower extremities of the intake pipe extensions 18 and 19.

Various changes may be made in the embodiment of the invention herein specifically described without departing from or sacrificing any of the advantages of the invention or any features thereof, and nothing herein shall be construed as limitations upon the invention, its concept or structural embodiment as to the whole or any part thereof except as defined in the appended claims.

I claim:

1. A method of producing gas from a liquefied fuel comprising storing a normally confined main body of liquid fuel under its vapor pressure, segregating a second smaller body of liquid fuel within said main body in heat exchange relation to the main body, withdrawing vapor from said segregated body to lower the pressure above said segregated body, replenishing from said main body the liquid loss of said segregated body due to vaporization of the segregated liquid and limiting the liquid level of the latter to a predetermined height, and supplying vapor from the vapor space above said main body through said segregated body when the volume of vapor withdrawal therefrom exceeds the vapor producing capacity of the heat exchange-relationship between the two bodies.

2. The method of producing gas from a liquefied petroleum gas comprising storing a main body of liquid fuel below the ground under its vapor pressure and in a position to be warmed by the heat of the earth, segregating a smaller body of said liquid fuel within said main body in heat-exchange relation to the main body, withdrawing vapor from said segregated body to lower the pressure above said segregated body, replenishing from said main body the liquid loss of said segregated body due to vaporization of the segregated liquid and limiting the liquid level of the latter to a predetermined height, and supplying vapor from the vapor space above said main body through said segregated body when the volume of vapor withdrawal therefrom exceeds the volume of vapor producing capacity of the

vapor producing relationship between the two bodies.

3. A method of producing gas from a vaporizable liquid fuel comprising storing a normally confined main body of liquid fuel under its vapor pressure, segregating a smaller segregated body of said liquid fuel within said main body below the liquid level of the latter and in heat-exchange relation therewith, withdrawing vapor from said segregated body to lower the pressure above said segregated body, replenishing from said main body from a point below the liquid level thereof the liquid loss of said segregated body due to vaporization of the segregated liquid, and limiting the liquid level of the segregated liquid to a predetermined height, and supplying vapor from the vapor space above said main body through the segregated body when the volume of vapor withdrawal therefrom exceeds the vapor producing capacity of the heat-exchange relationship between the two bodies.

4. A method of producing vapor from a liquefied petroleum gas comprising storing a normally confined main body of liquid fuel below the ground under its vapor pressure, so as to be warmed by the heat of the earth, segregating a smaller body of said liquid fuel within said main body in such manner as to be warmed by the heat of the main body, withdrawing vapor constituents from said segregated body at a point above the liquid level thereof, controlling the flow of fuel to said segregated body under the pressure differential existing between the two bodies, conducting vapor from said segregated body to a place of use, and supplying vapor from the vapor space above said main body when the volume of vapor withdrawal therefrom exceeds the vapor producing capacity of the heat-exchange relationship between the two bodies.

5. The process of vaporizing liquefied petroleum gas fuel comprising educting said fuel in its liquid phase and disposing the educted fuel in heat exchange relation with a body of liquid warmed with the underground heat of the earth and at a pressure less than the vapor pressure of the liquid fuel at the temperature of said body of liquid.

6. The process of vaporizing liquefied petroleum gas fuel comprising placing the fuel under pressure, and bringing said fuel in its liquid phase at a reduced pressure into heat exchange relation with a liquid warmed with the underground heat of the earth.

7. The process of vaporizing liquefied petroleum gas fuel comprising educting said fuel in its liquid phase and disposing it in heat exchange relation with a body of liquid warmed with the underground heat of the earth and at a pressure less than the vapor pressure of the liquid fuel at the temperature of said body of liquid, and supplying additional vapor to the product from another source.

8. The process of generating gas for use in appliances at service pressure from a liquefied petroleum gas stored in an underground container comprising educting gas from the container in its liquid phase and delivering it at a reduced pressure to a second member in heat exchange relationship with liquid maintained at ground temperature below the frost line, and conducting the gas generated thereby to a service conduit.

9. The process of progressively converting a highly volatile fuel such as butane or the like from its liquid to its vapor state for consumption comprising confining a quantity of said fuel in both its liquid and vapor state in a storage tank positioned in the ground below the frost line to absorb heat from the ground and establish a vapor pressure in the tank, educting fuel from the tank in its liquid state and conveying it along a path to a chamber and supplying the educted fuel at a reduced pressure with heat from the ground by the contents of the tank to vaporize the educted fuel, and delivering said vaporized fuel for service use.

10. In a system of the class described having a container storing a body of liquefied gas stored under pressure in heat exchange relationship with the ground below the frost line, a member mounted in the container with its lowest part in heat exchange relationship with the body of liquid and defining a chamber distinct from the interior of the container, means for withdrawing gas in its liquid phase from the container including a conduit whose inlet is located at a point adjacent the bottom of the container, and means for introducing the withdrawn liquid into the chamber at a reduced pressure including an automatic valve automatically controlling the flow of liquid to the chamber in relation to the amount of vapor present in said chamber, and means for delivering gas vaporized in said chamber to a service pipe for consumption.

11. In the production of fuel gas from a body of stored liquefied petroleum gas, the steps of providing a supply of said liquid, maintaining the liquid confined under gasifying conditions of heat and pressure with the liquid under its own gas pressure, providing a charge of a predetermined smaller quantity of liquid petroleum gas confined under gasifying conditions of heat and pressure and under its own gas pressure, submerging said charge within the body of the supply liquid without intermingling therewith but in heat-exchange relationship thereto, developing a gas pressure differential between the gas pressures upon the two bodies of liquid and progressively vaporizing the liquid charge into fuel gas and thereby reducing the quantity of the charge and also the temperature thereof and causing a heat-exchange from the body to the charge, establishing a communication between the two bodies of liquid and permitting a flow of liquid from the supply body to the charge under the gas pressure differential when a predetermined amount of the liquid charge has been gasified, and closing said communication and stopping the flow of liquid to the charge when the latter has been restored to its predetermined quantity.

12. In the production of fuel gas from a body of stored liquefied petroleum gas, the steps of providing a supply of liquid petroleum gas, providing a charge of a predetermined smaller quantity of liquid petroleum gas confined under gasifying conditions of heat and pressure and under its own gas pressure, controllably releasing fuel gas given off by the charge for consumption and thereby reducing the pressure of said gas and progressively vaporizing the liquid charge into fuel gas and thereby reducing the quantity of the charge and the temperature thereof, restoring the temperature of the charge to a gasifying temperature, establishing a communication between the two bodies of liquid and permitting a flow of liquid from the supply body to the charge when a predetermined amount of the liquid charge has been gasified, and closing said communication and stopping the flow of liquid to the

charge when the latter has been restored to its predetermined quantity.

13. In an apparatus for producing fuel gas from a body of liquid fuel gas stored under gasifying conditions of heat and pressure and for supplying the fuel gas to a place of use, the combination of a storage tank to contain the material in both its liquid and vapor state and adapted to be heated to a gasifying temperature, a vaporizing chamber to contain the material, said chamber being within the tank and disposed so that it will be surrounded by a body of liquid stored in the tank and thereby in heat-exchange relation with the stored liquid, a liquid eduction conduit leading from a bottom portion of the interior of the tank into the chamber at a predetermined elevation above the bottom thereof, there being a gas space in the upper portion of the chamber above the level of the connection of the eduction conduit with the chamber, a service conduit and means controlled by conditions within the chamber for closing and opening communication through the eduction conduit to permit the flow of stored liquid under its own gas pressure from the tank to the chamber to restore the level of liquid in the chamber to a predetermined level.

14. In an apparatus for producing fuel gas from a body of liquid fuel gas stored under gasifying conditions of heat and pressure and for supplying the fuel gas to a place of use, the combination of a storage tank to contain the material in both its liquid and vapor state and adapted to be heated to a gasifying temperature, a vaporizing chamber to contain the material, said chamber being within the tank and disposed so that it will be surrounded by a body of liquid stored in the tank and thereby in heat-exchange relation with the stored liquid, a liquid eduction conduit leading from a bottom portion of the interior of the tank into the chamber at a predetermined elevation above the bottom thereof, there being a gas space in the upper portion of the chamber above the level of the connection of the eduction conduit with the chamber, a gas service conduit leading from said gas space to a place of consumption of the gas, and means controlled by varying levels of segregated liquid in the chamber for closing and opening communication through the eduction conduit to permit the flow of stored liquid under its own gas pressure from the tank to the chamber to restore the level of liquid in the chamber to a predetermined level.

15. An apparatus for supplying fuel of substantially uniform composition and at a low pressure from a mixture of liquefied petroleum gases; said apparatus comprising an underground tank, conduit means extending from said tank to a place where the fuel is consumed, and means for regulating the flow of fuel through said conduit means; said conduit means including a section having its inlet adjacent the bottom of said tank, a second section connected to the first section and having a portion disposed in the tank in position to be submerged by the contents thereof, and a service conduit communicating with the second section; and said control means including a pressure reducer arranged between the first and second sections of said conduit means.

16. The method of handling a liquid petroleum fuel comprising storing a body of such liquid fuel in heat-exchange relationship with the earth, causing such relationship to convert some of said liquid fuel into a progressively increasing body of vapor overlying the vaporizing portion of said body of liquid, utilizing the pressure of said body of vapor in transferring liquid from said body of liquid toward a point of use along a predetermined path having an intermediate portion submerged in the vaporizing portion of said body of liquid, and lowering the pressure of the fuel as it enters said intermediate portion and utilizing heat from the liquid fuel in contact with said intermediate portion in the vaporization of the fuel therein.

17. An apparatus for supplying fuel of substantially uniform composition and at a low pressure from a mixture of liquefied petroleum gases, comprising a tank adapted to be heated for gasifying purposes, conduit means extending along the interior of said tank and including a liquid eduction section having an inlet section adjacent the bottom of the tank and a vaporizing section connected to the eduction section and positioned so as to be submerged in the liquid contents of the tank, a service conduit leading from the vaporizing section, and means for regulating the flow of liquid into the conduit means, said regulating means being included in the said conduit means and located between the eduction section and the vaporizing section of said conduit means.

18. The method of handling a liquid petroleum fuel comprising storing a body of such liquid confined under gasifying conditions of heat and pressure and thereby converting some of said liquid into a progressively increasing body of vapor overlying the vaporizing portion of said body of liquid, utilizing the pressure of said body of vapor for transferring liquid from said body of liquid along a predetermined path having a vaporizing portion submerged in the vaporizing portion of said body of liquid, lowering the pressure of the liquid as it enters the vaporizing portion of said path, and utilizing heat from the stored liquid surrounding the vaporizing portion of the path to vaporize the liquid in said vaporizing portion of the path.

19. A process of discharging vaporizable liquid from a tank comprising keeping it under pressure in said tank, withdrawing the liquid as needed from said tank, reducing the pressure of the withdrawn liquid thereby causing a reduction in temperature and a partial vaporization of said liquid, further vaporizing the liquid through the heating effect of the liquid contained in the tank and then discharging the vapors thus formed.

20. The method of dispensing gas from a storage member which comprises the following steps; withdrawing a quantity of fluid from said storage member, reducing the pressure of the fluid withdrawn and thereby cooling it, causing it to flow to a point of use and causing it in such flow to pass through the interior of said storage member without being mixed with the liquid within the storage member and thereby vaporizing it by transfer of heat from the liquid within the storage member to the withdrawn gas while the latter passes through the storage member.

21. The method of dispensing and vaporizing liquefied gas from a quantity of gas held under pressure in a storage member which includes the following steps: retaining a quantity of said gas under pressure in said storage member, withdrawing a quantity of fluid from said storage member, reducing the pressure of said fluid after withdrawal from the storage member, directing said fluid through said storage member without mixture with the contents of the storage mem-

ber, accomplishing vaporization of said fluid by the transfer of heat from within the storage member to the stream of withdrawn fluid while the latter passes through said storage member.

22. A fuel supply apparatus comprising a tank adapted to contain a liquid under pressure, means to withdraw the liquid from said tank, and means to vaporize said withdrawn liquid comprising means to reduce the pressure thereon and means connected with the withdrawing means to convey the vapors through the liquid under pressure in said tank in heat exchange relationship therewith.

23. An apparatus for supplying a fuel of substantially uniform composition and at a low pressure from a mixture of liquid hydrocarbons, said apparatus comprising an uninsulated tank for containing said liquid, conduit means extending from said tank for conveying fuel therefrom for consumption, said conduit including a means forming a section thereof having an inlet adjacent the bottom of the tank, a second section connected with the first mentioned section, a body of liquid enclosing a substantial portion of said second section in heat exchange relation therewith, a third section communicating with the second section and extending toward the point of fuel consumption, and a pressure reducer arranged in said conduit between the first and second sections thereof.

24. In a liquefied gas dispensing system of the class described having a storage tank buried underground in heat exchange relationship with the surrounding earth and adapted to be filled from above the ground level, conduit means communicating with the tank and extending to a point of use; and a pressure reducer value in said delivery conduit means and disposed to absorb some heat from the contents of the tank, the pressure reducer valve being protected from the chilling effects of atmospheric air.

25. That method of generating and delivering butane fuel gas of a substantially uniform B. t. u. content for use in household appliances which comprises charging a quantity of liquid fuel under pressure into an underground pressure container; deriving and absorbing heat from the surrounding earth and thereby maintaining the stored fuel under a pressure well above atmospheric pressure due to the absorption of heat from the earth; transferring liquid fuel from the bottom portion of the tank to a vaporizing chamber forming a part of the container; boiling the transferred liquid fuel to generate a gaseous fuel under pressure by absorbing heat derived from the adjacent earth; dispensing gaseous fuel from the vaporizing chamber for consumption; and automatically controlling the flow of fuel from the storage container to the vaporizing chamber as the vapor is dispensed.

26. The method of handling a liquid petroleum fuel comprising storing a body of such liquid fuel in heat exchange relationship with the earth, causing such relationship to convert some of said liquid fuel into a progressively increasing body of vapor overlying the vaporizing portion of said body of liquid, utilizing the pressure of said body of vapor in transferring liquid from said body of liquid toward a point of use along a predetermined path having an intermediate portion submerged in the vaporizing portion of said body of liquid, lowering the pressure of the fuel as it enters said intermediate portion and utilizing heat from the liquid fuel in contact with said intermediate portion in the vaporization of the fuel therein, and delivering the vapor thus generated to a point of use.

27. In a liquefied gas dispensing system of the class described, the combination of a storage tank buried underground in heat exchange relationship with the surrounding earth and below the frost line and adapted to be filled from above the ground level, conduit means extending from said tank to a place where the fuel is to be consumed, and means for regulating the flow of fuel through said conduit means, said conduit means including a section having its inlet adjacent the bottom of the tank, a second section connected to the first section and having a portion disposed in the tank in position to be submerged by the contents thereof, and a service conduit communicating with the second section, the said regulating means including a pressure reducer arranged between the first and second sections of said conduit means in position to absorb some heat from the contents of the tank and protected from the chilling effects of atmospheric air.

28. A process of producing and discharging vapor from a body of vaporizable liquid fuel stored in the ground, comprising a directing of a stream of said liquid fuel from said body along a path, reducing the pressure of said stream of fuel at a point along said path and thereby causing a partial vaporization of the liquid in said stream, and vaporizing a portion of the liquid in said stream beyond the location of the reduction of pressure and by heat absorbed from a body of liquid warmed by heat from the ground.

29. A method of producing gas from a liquefied fuel comprising storing a normally confined main body of liquid fuel under its vapor pressure, segregating a smaller body of liquid fuel within the main body in such heat exchange relationship therewith that vaporization of the smaller body is effected by the sensible heat of the larger body, withdrawing vapor from said segregated body whereby the pressure above said segregated body is lowered and the temperature of said segregated body is lowered below the temperature of said main body, and replenishing from said main body the liquid and heat loss of said segregated body due to vaporization of the segregated liquid, and limiting the liquid level of the latter to a predetermind height.

30. A method of producing vapor from a liquefied petroleum gas comprising storing a normally confined main body of liquid fuel under its vapor pressure below the ground so as to be warmed by the heat of the earth, segregating a smaller body of said liquid fuel within said main body in heat exchange relationship therewith, withdrawing vapor from said segregated body whereby the pressure above said segregated body and the temperature of said segregated body are lower than the pressure and temperature respectively of said main body, and replenishing from said main body the liquid and the heat loss of said segregated body due to vaporization of the segregated liquid.

31. A method of producing gas from a liquefied petroleum gas comprising storing a quantity of a liquefied gas in a tank below the ground to be warmed by the heat of the earth, segregating therefrom a quantity of liquefied gas at a point adjacent the bottom of the tank, reducing the pressure upon the segregated quantity and adding latent heat of vaporization thereto from the sensible heat of the remaining liquid in the tank derived from the ground, and conducting the vaporized fuel to a point of use.

32. The method of generating gas comprising storing a quantity of liquefied petroleum gas in a tank in heat exchange with the earth, educting a quantity of the stored gas from the bottom of the tank, reducing the pressure upon the educted gas and disposing the educted gas at the reduced pressure in heat exchange relationship with the liquid contents of the tank to acquire from the sensible heat thereof the latent heat necessary to vaporize the educted gas and conducting the vaporized gas to a place of consumption.

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