

July 18, 1939.

D. J. LITTLE

2,166,915

METHOD OF AND APPARATUS FOR STORING AND DISPENSING LIQUEFIED GAS

Filed May 28, 1937

2 Sheets-Sheet 1

Fig. 1

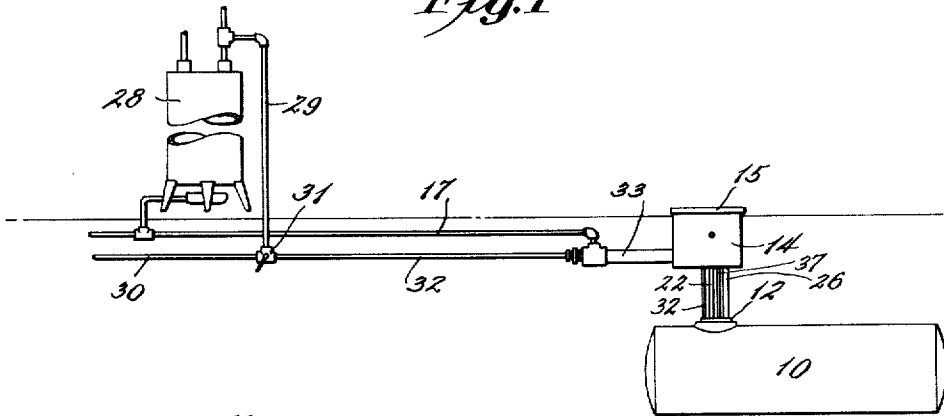
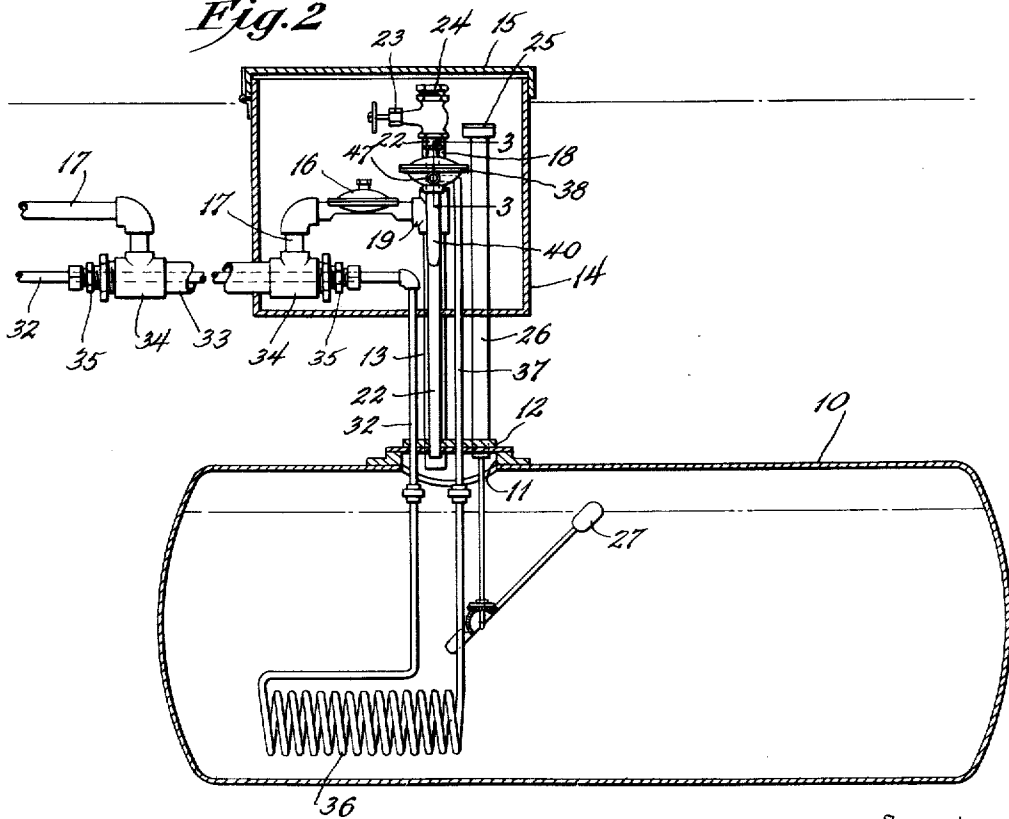


Fig. 2



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2 Sheets-Sheet 2

Fig. 3

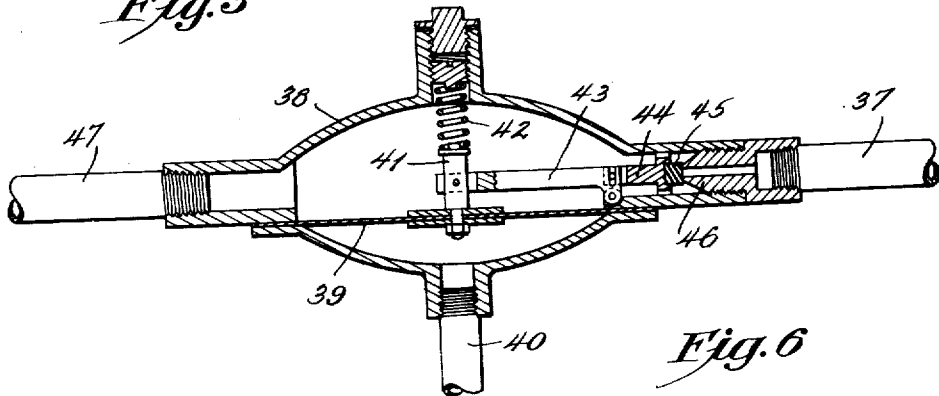


Fig. 6

Fig. 4

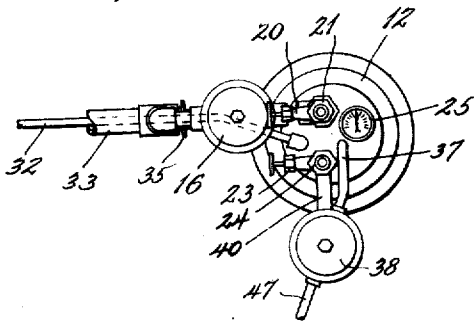
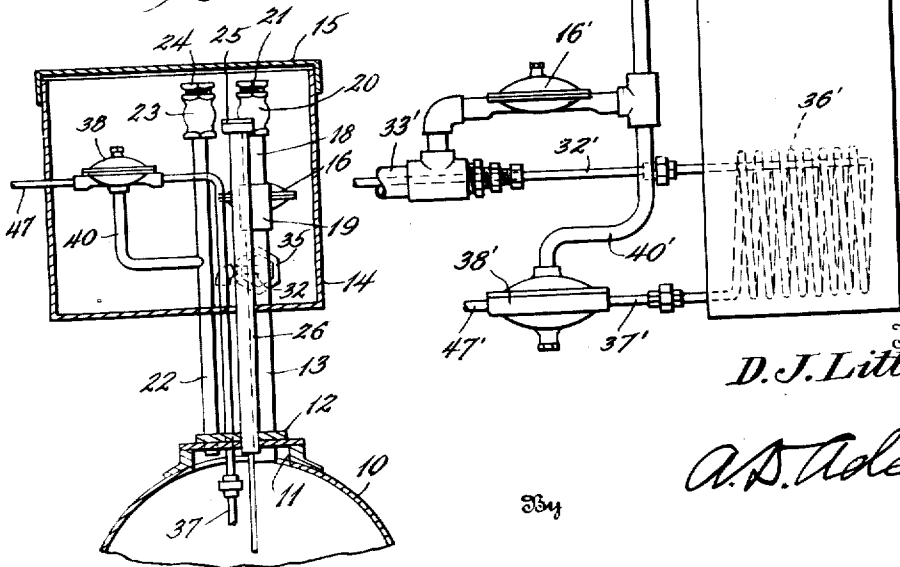


Fig. 5



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UNITED STATES PATENT OFFICE

2,166,915

METHOD OF AND APPARATUS FOR STOR-
ING AND DISPENSING LIQUEFIED GASDavid J. Little, San Antonio, Tex., assignor to
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Application May 28, 1937, Serial No. 145,391

10 Claims. (Cl. 62—1)

This invention relates to a method of and apparatus for storing and dispensing liquefied gas, such as butane, isobutane, propane or volatile mixtures of hydrocarbon constituents and, among other objects, aims to provide an improved system wherein the liquefied gas is stored in and dispensed from a container or storage tank. The main idea is to provide a novel method and means to vaporize the gas and maintain a substantially constant pressure in the tank so that an ample supply of gas is generated for domestic or commercial purposes. Another aim of the invention is to provide a simplified plant of this type in which the stored gas is vaporized by a heat exchanger which is controlled automatically in response to variations in pressure in the storage tank or container. Also, the invention aims to provide improved means for revaporizing any condensate formed in the gas service pipe, using the same heating medium employed for vaporizing the liquefied gas in the storage tank. This application involves gas dispensing systems of the general type disclosed in my copending application Ser. No. 753,501, filed November 17, 1934.

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

Fig. 1 is a diagrammatic illustration of an underground system embodying the invention;

Fig. 2 is a vertical sectional view of the storage tank and dispensing appliances shown in Fig. 1, shown on an enlarged scale;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2, also shown on an enlarged scale;

Fig. 4 is a top plan view of the dispensing appliances shown in Fig. 2, the casing being omitted;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 2; and

Fig. 6 is a side elevation of a bottled gas plant embodying the invention.

Referring particularly to the drawings and to the underground system illustrated in Figs. 1 to 4, the apparatus there shown is especially designed for use in dispensing liquefied hydrocarbon such as mixtures of butane, propane, etc., having a vaporization temperature of less than 50° F. at atmospheric pressure. In this example, the system includes the usual storage tank 10 adapted to be buried in the ground just below the frost line in heat exchanging relation with the surrounding earth fill. The tank is shown as having a flanged opening 11 provided with a cover plate 12 to which the dispensing appliances are connected. It will be understood that the tank is

adapted to be partially filled with the liquefied gas to be dispensed and the gas is delivered through a gas outlet or dispensing pipe 13 extending upwardly into a protecting casing 14 which is partially buried in the ground and has a lid 15. This outlet pipe carries an ordinary pressure regulator or reducing valve 16 to which is connected a service pipe 17 buried under ground after it leaves the casing. The outlet pipe 13 is also shown as having a vertical extension 18 connected to a pipe T 19 on the upper end of the pipe 13. The extension is shown as having a hand valve 20 and an ordinary automatic vent valve 21 adapted to be connected to a venting hose, not shown, when the tank is being filled. A filling pipe 22, also having a hand valve 23 and an automatic filling valve 24, is connected to the tank through the cover plate 12. The arrangement is such that the tank may be filled by connecting the filling hose to the filling pipe and the vent hose to the vent pipe so that the displaced gas therein may be returned to the service truck tank. In this instance, the level of the liquefied gas in the tank may be observed on a gage 25 carried by a gage pipe 26 and operated by an ordinary float 27.

In accordance with the present invention, the necessary heat to generate the vapor or gas in the storage tank and maintain it at a substantially uniform pressure and temperature is supplied by a suitable fluid heating medium which is circulated through a heat exchanger associated with the lowest portion of the service pipe 17 and a heat exchanging coil within the tank. Water is preferably used as the heating medium and, in some instances, may be supplied by an ordinary water service pipe. However, in systems wherein the absorption of heat from the earth fill around the tank is insufficient to maintain the vaporizing temperature at the pressure existing in the tank, it is desirable to supply heated water for that purpose. In the present example, a hot water heater or tank 28, preferably heated by the generated gas, is connected to deliver a small amount of heated water through the heat exchanger. It will be understood that this hot water heater may be the usual hot water tank used in a house and the temperature of the water may be controlled by an ordinary thermostat, not shown. In this example, a small hot water supply pipe 29 is connected to the tank 28 and is shown as extending underground to a cold water service pipe 30, being connected to said pipe by a three-way valve 31, the arrangement being such that either cold water, during relatively warm weather, or hot

water, during cold weather, may be delivered through a common pipe 32 to the heat exchanger.

Referring to Figs. 1 and 2, the gas service pipe 17 is shown as having an enlarged pipe section 33 at its lowest point where it leaves the casing 14 and is provided with T fittings 34 at its opposite ends through which the pipe 32 passes, suitable stuffing glands or boxes 35 being employed to prevent gas from escaping around the pipe. The gas from the low pressure side of the pressure regulator 16 passes through the enlarged pipe section 33 in heat exchanging relation with the pipe 32 and any condensate in the service pipe which drains into this heat exchanger will be re-vaporized.

The pipe 32 is also shown as extending downwardly through the cover plate 12 on the tank 10 and is connected to a heat exchanging coil 36 below the level of the liquefied gas in the tank. A return pipe 37 is also connected to the coil and extends back through the cover plate into the casing 14, from which it may pass to a sewer or dry well. It will be understood that only a small amount of heat exchanging water is necessary to supplement the heat supplied by the earth to the tank in order to maintain the desired pressure and vaporizing temperature of the gas within the tank.

To maintain the pressure of the gas generated in the tank substantially constant and to economize with the heating medium, the supply of water is controlled automatically in response to variations in the pressure of the gas in the tank. Herein, the water outlet pipe 37 is shown as having a pressure operated valve in a casing 38. The casing 38 is shown as having a diaphragm 39 and one side of the casing is connected by a branch pipe 40 to the filling pipe 22. A stem 41 is connected to the opposite side of the diaphragm and the pressure at which the diaphragm will respond is regulated by means of an adjustable compression spring 42. A valve operating arm 43 pivoted at its outer end is connected to the stem 41 and operates a valve stem 44 which carries a valve 45 seated on the end of a nozzle fitting 46. When the pressure exceeds a predetermined minimum within the tank, the diaphragm will operate to close the valve 45 and stop the flow of water through the heating coil. When the pressure drops within the tank, the spring 42 will open the valve and permit the water to circulate through the heating coil. It passes through the valve casing into an ordinary drain pipe 47 to the outside of the casing 14.

In the modified form of the invention shown in Fig. 6, the heat exchanger is applied to a bottled gas tank or container 10' within which is arranged the heating coil 36'. The circulation of water through the heating coil is controlled by the pressure responsive valve 38' which is connected to the gas dispensing pipe 13' from the tank by means of a branch 40'. The water also passes through a heat exchanger pipe section 33' as explained in connection with Figs. 1 and 2. The heat exchangers used in bottled gas systems of this type make it possible to use gas mixtures having low vaporization temperatures and high heat content without exposing any gas pipe or other part of the system to a heating flame.

From the foregoing description, it will be understood that the method and apparatus are reliable and dependable in operation. The pressure controlled heat exchanger makes it possible to maintain a substantially uniform pressure and temperature within the storage tank or container,

thereby insuring a uniform quality of gas to be consumed. Furthermore, the heat exchanger also supplies ample heat to revaporize any condensate that may be formed in the service pipe and it is not essential that the service pipe be buried in the ground below the frost line because the temperature of vaporization of the low pressure gas is much lower than that of the high pressure gas within the tank.

Obviously, the present invention is not restricted to the particular embodiment thereof herein shown and described. Moreover, it is not indispensable that all the features of the invention be used conjointly, since they may be employed advantageously in various combinations and sub-combinations.

What is claimed is:

1. In a liquefied gas storage and dispensing system of the class described, a storage tank adapted to be partially filled with volatile liquefied gas; a gas service pipe connected to the tank; heat exchanging means arranged to supply heat to both the service pipe and the contents of the tank; and automatic control means for the heat exchanging means connected to maintain the temperature and pressure of the gas within the tank substantially constant.

2. In a liquefied gas storage and dispensing system of the class described, a storage tank adapted to be partially filled with volatile liquefied gas; a gas service pipe connected to the tank; a heat exchanger associated with the service pipe; a heat exchanger in the tank; a water pipe connected to both of said exchangers; and an automatic valve in the water pipe operable in response to changes in pressure of the gas to control the pressure and temperature of the gas.

3. In a liquefied gas storage and dispensing system of the class described, a storage tank adapted to be partially filled with volatile liquefied gas; a gas delivery pipe connected to the tank; a pressure reducing valve connected to the delivery pipe; a service pipe leading from the pressure reducing valve; a source of heating medium connected to supply heat to a low portion of the service pipe and to the contents of the tank; and automatic means connected to control the supply of heat to the tank and maintain the gas at a substantially constant pressure and temperature.

4. In a liquefied gas storage and dispensing system of the class described, a storage tank adapted to be partially filled with volatile liquefied gas; a gas delivery pipe connected to the tank; a pressure reducing valve connected to the delivery pipe; a service pipe leading from the pressure reducing valve; a water coil heat exchanger within the tank; a source of warm water connected to the coil; means to control the supply of water to the coil to maintain the pressure and temperature of the gas substantially constant; and means to supply some of the heat to a portion of said service pipe to prevent condensate from forming therein.

5. In a liquefied gas storage and dispensing system, a storage tank adapted to be partially filled with liquefied gas and buried in the ground below the frost line; a gas dispensing pipe; a pressure reducing valve connected to the dispensing pipe; a gas service pipe connected to the pressure reducing valve and extending below the ground level; a water pipe arranged in heat exchanging relation with a low portion of the service pipe; a heat exchanging coil in the tank connected to the water pipe; and automatic means to control the delivery of water through the coil

to supply sufficient heat to vaporize the liquefied gas.

6. In a liquefied gas storage and dispensing system, a storage tank adapted to be partially filled with liquefied gas and buried in the ground below the frost line; a gas dispensing pipe; a pressure reducing valve connected to the dispensing pipe; a gas service pipe connected to the pressure reducing valve and extending below the ground level; a water pipe extending through a low portion of the service pipe; a heat exchanger within the tank connected to the water pipe; a source of heated water adapted to be connected at will to said water pipe; and means to control the delivery of water through said heat exchanger to supply sufficient heat to vaporize the liquefied gas.

7. In a liquefied gas storage and dispensing system, a storage tank adapted to be partially filled with liquefied gas and buried in the ground below the frost line; a gas dispensing pipe; a pressure reducing valve connected to the dispensing pipe; a gas service pipe connected to the pressure reducing valve and extending below the ground level; a water pipe connected in heat exchanging relation to a portion of the service pipe and the tank; means to deliver either heated water or ordinary cold water through the pipe; and an automatic valve in the pipe operable in response to the pressure of the gas in the tank to control the delivery of water through the pipe.

8. In a liquefied gas storage and dispensing system of the class described, an underground storage tank adapted to be partially filled with liquid and having a manhole opening; a cover plate for the opening; a gas dispensing pipe carried by the

cover plate; a pressure reducing valve connected to the dispensing pipe; a gas service pipe connected to the pressure reducing valve; a water coil within the tank having inlet and outlet pipes extending through said cover plate; an automatic valve controlled by the pressure of the gas within the tank to regulate the supply of water to heat the liquefied gas; and heat exchanging means connected to supply some of the heat to a portion of said service pipe.

9. That method of generating and dispensing a volatile liquefied gas which comprises storing the liquefied gas under pressure in a dispensing container; artificially heating the contents of the container to vaporize the gas; delivering the generated gas at a reduced pressure to a service pipe; supplying some of the artificial heat to revaporize any condensate in the service pipe; and automatically controlling the supply of heat to the container to maintain a substantially constant pressure and temperature of the gas in the container.

10. That method of generating and dispensing a volatile liquefied gas which comprises storing the liquefied gas under pressure in an underground tank in heat exchanging relation with the surrounding earth; delivering the generated gas at a reduced pressure to a service pipe; using circulating water as a supplemental heating medium to vaporize the liquefied gas in the tank and also to revaporize any condensate in the service pipe; and automatically controlling the delivery of circulating water in response to changes in the pressure of the gas in the tank.

DAVID J. LITTLE.

CERTIFICATE OF CORRECTION.

Patent No. 2,166,915.

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DAVID J. LITTLE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 17, claim 9, for "artificial" read artificial; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of October, A. D. 1939.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

to supply sufficient heat to vaporize the liquefied gas.

6. In a liquefied gas storage and dispensing system, a storage tank adapted to be partially filled with liquefied gas and buried in the ground below the frost line; a gas dispensing pipe; a pressure reducing valve connected to the dispensing pipe; a gas service pipe connected to the pressure reducing valve and extending below the ground level; a water pipe extending through a low portion of the service pipe; a heat exchanger within the tank connected to the water pipe; a source of heated water adapted to be connected at will to said water pipe; and means to control the delivery of water through said heat exchanger to supply sufficient heat to vaporize the liquefied gas.

7. In a liquefied gas storage and dispensing system, a storage tank adapted to be partially filled with liquefied gas and buried in the ground below the frost line; a gas dispensing pipe; a pressure reducing valve connected to the dispensing pipe; a gas service pipe connected to the pressure reducing valve and extending below the ground level; a water pipe connected in heat exchanging relation to a portion of the service pipe and the tank; means to deliver either heated water or ordinary cold water through the pipe; and an automatic valve in the pipe operable in response to the pressure of the gas in the tank to control the delivery of water through the pipe.

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9. That method of generating and dispensing a volatile liquefied gas which comprises storing the liquefied gas under pressure in a dispensing container; artificially heating the contents of the container to vaporize the gas; delivering the generated gas at a reduced pressure to a service pipe; supplying some of the artificial heat to revaporize any condensate in the service pipe; and automatically controlling the supply of heat to the container to maintain a substantially constant pressure and temperature of the gas in the container.

10. That method of generating and dispensing a volatile liquefied gas which comprises storing the liquefied gas under pressure in an underground tank in heat exchanging relation with the surrounding earth; delivering the generated gas at a reduced pressure to a service pipe; using circulating water as a supplemental heating medium to vaporize the liquefied gas in the tank and also to revaporize any condensate in the service pipe; and automatically controlling the delivery of circulating water in response to changes in the pressure of the gas in the tank.

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