July 18, 1939. D. J. LITTLE 2,166,911

FUEL GAS APPARATUS

Filed Nov. 17, 1934

Fig. 2.

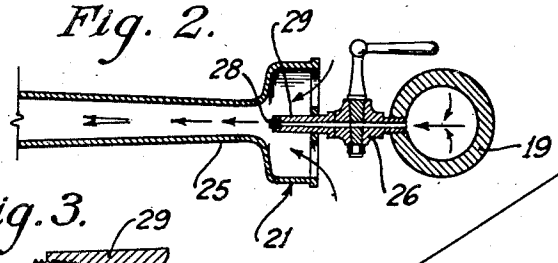


Fig. 3.

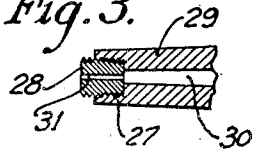


Fig. 1.

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FUEL GAS APPARATUS

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15 Claims. (Cl. 62—1)

This invention relates to fuel gas apparatus and aims to provide an improved system for storing and dispensing liquefied hydrocarbon gas which is relatively safe to operate, simple in construction and efficient in use.

Another important object of the invention is to provide means for manufacturing hydrocarbon gas, particularly butane gas, wherein provision is made to insure a continuous supply of gas and to prevent the vaporized gas from condensing in the service pipe and passing through the burners. Another important object is to provide a fully automatic system of this type which insures safe, efficient and continuous operation.

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

Fig. 1 is a longitudinal sectional view showing one embodiment of the invention;

Fig. 2 is an enlarged longitudinal sectional detail view of a burner and mixing device shown in Fig. 1; and

Fig. 3 is an enlarged, fragmentary sectional view taken through the tip of the burner feed cock.

Considerable quantities of highly volatile gas commonly called "butane" are produced as a by-product of natural gas and in the process of refining petroleum and this gas has, heretofore, been largely wasted, partially because of the lack of efficient and economical means for storing and using it, certain difficulties and hazards being involved on account of its high volatility and inflammability. Its boiling point is between ten to thirty-two degrees F., at atmospheric pressure. Because of this fact, if piping carrying the gas is exposed to lower temperatures it readily condenses back into the liquid state and is apt to cause the collection of a hazardous amount of liquid butane fuel in the service pipe between the generator and the household appliances or burners. A number of hazards result from the accumulation of condensed gas in the system, the most dangerous being the liability of the accumulated liquid passing through the burners and causing a fire.

The present invention provides a new and improved system for utilizing butane as a fuel gas, including means for vaporizing automatically any butane within the system itself, thereby positively preventing the accumulation of condensate in the system between the generator and the burners.

Another difficulty heretofore encountered in using butane as a fuel gas arises from the high B. t. u. value of the gas which ranges from 3000 to 3300 per cubic foot by reason of which a greater supply of oxygen is required for combustion than is supplied to conventional burners at the usual pressures. Various attempts have been made to overcome this difficulty and the most common expedient has been to reduce the supply of gas to the burner and add sufficient "secondary air" to support combustion. This expedient, however, so reduces the size of the flame that the utility of the appliance is greatly impaired. The present invention provides improved means to supply properly carbureted fuel to the burners.

A preferred form of the new apparatus for generating and utilizing butane as a fuel gas is shown in the drawing and is generally designated 10. It comprises a combination storage tank and generator 11 in which a quantity of liquid butane may be stored. The storage tank 11 is installed in the ground 12 below the freezing line in heat absorbing relation with the surrounding earth.

Leading upwardly from the supply tank 11 to a point above the ground level is an inlet pipe 13 by means of which a supply of liquid butane may be introduced. Extending downwardly through a vertical portion of the pipe 13 and concentric therewith is a float-operated shaft 14 for a gauge 22 which indicates the liquid level in the tank.

Leading from the top of the tank 11 is a gas outlet pipe 15 in which is arranged a conventional gas pressure regulator 33, shown as being above the ground level. A manually operable cut-off valve 34 and a T 35 having a removable plug 36 are connected to the pipe below the regulator to provide for venting the displaced gas through a hose when the tank is being filled.

Beyond the pressure regulator 33 the service pipe 15 reenters the earth and connects with one end of a helical coil 17 which is enclosed in a revaporizer 16 located in the earth below the freezing line. The revaporizer casing 16 has an inlet pipe 18, to which the ordinary city water supply is connected. A supply pipe 19 is connected to the other end of the coil 17 and leads to a gas burner 20 for a cook stove, heater, furnace or the like.

Leading from the bottom of the revaporizer 16 to and thermally connecting the generator and the revaporizer is a drain pipe 23 which has an extension 24 passing through the storage tank 11 adjacent the bottom thereof and discharging to a drain. The connection of the generator and the revaporizer is such that as long as there is a

supply of heat in the generator adequate to vaporize the butane, there will always be sufficient heat to revaporize any condensate which may flow back into and collect in the service pipe.

At the burner 20, air is mixed with the gas which issues from the fuel supply pipe 19 by means of a Bunsen mixer 21 having a Venturi throat 25 and gas is delivered to it through a feed cock 62 which includes a tubular extension 29 having a bore or passage 30 formed therein. The bore 30 is shown as having a screw threaded opening 27 for a threaded orifice tip or insert 28 which has an axial bore or passage 31 which is smaller than the bore 30.

In the operation of the apparatus, a supply of liquefied gas is introduced into the tank 11 by way of the intake pipe 13, while the displaced vapor is returned to a service tank through the plug opening in the pipe 15. The liquefied gas is vaporized in the generator by the absorption of heat either from the water passing through the pipe extension 24 or from the surrounding earth, or both, sufficient heat being absorbed to convert the butane from a liquid to a gaseous state at the pressure existing in the tank. The water in the pipe 24 supplements the heat supplied by the surrounding earth during cold weather, or when a large quantity is being consumed. The gas or vapor is thus formed at high pressure in the generator 11 and passes into the outlet pipe 15, thence through the pressure regulator 33 and then, at a lower pressure, through the coil 17 of the revaporizer 16 and into the burner supply pipe 19 from which it passes into the burner 20 by way of the mixer 21 and its throat 25.

In the use of butane as a fuel gas, it has been found that during periods when the temperature of the gas pipe falls to or below that of the boiling point of the liquid, a considerable amount of butane vapor condenses in the burner supply pipe or conduit 19 and runs back to the lowest point in the service line. In the present apparatus, the butane condensate formed in the pipes 15 and 19 is revaporized by the action of the heat exchanger 16—17. As the butane flows back from the fuel supply pipe 19, it passes into the coil 17 wherein it is revaporized by absorbing heat from the water flowing through the closed chamber. By reason of the fact that the water flowing through the coil 17 is at the same temperature as the water flowing through the pipe extension 24 in the generator, and the generator and the revaporizer are closely associated in cooperative relation, approximately the same fuel vaporizing temperature obtains in the revaporizer as exists in the generator. As a result of this arrangement, the condensate, which has a low boiling point, due to the low pressure in the service pipe, is always revaporized, either by the earth or by the heat exchanger, or both.

It has been found that by using higher than ordinary gas burner pressures, preferably in excess of eighteen inches of water, and by reducing the size or diameter of the fuel outlet 31 of the gas cock 26, the velocity of the fuel drawn into the throat 25 of the burner 21 from the outlet 31 of the gas cock 26 is increased to such an extent that a relatively larger volume of air compared to gas, is drawn into the venturi 21, than would otherwise be the case. This provides sufficient air for complete combustion of the gas, thereby eliminating incomplete combustion of butane at the burner and the resulting loss of efficiency, which have heretofore been serious objections to the use of butane as a fuel gas, with conventional gas burning apparatus.

The use of the earth and the city water supply as sources of latent heat for vaporizing the liquid butane in the generator, and for revaporizing the condensate in the burner supply pipe, assures absolute reliability and complete safety, since these sources of heat are not only automatic and uninterrupted, but neither can reach such high temperatures as will dangerously increase the pressure in the tank.

While I have illustrated and described the preferred form of construction for carrying my invention into effect, this is capable of variation and modification, without departing from the spirit of the invention. I, therefore, do not wish to be limited to the precise details of construction set forth, but desire to avail myself of such variations and modifications as come within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to protect by Letters Patent is:

1. Apparatus for generating butane gas from liquid butane and burning said gas, said apparatus comprising a combined generator and storage tank buried in the earth below the freezing line so as to make available to said tank and its contents the heat of the earth, said tank containing a quantity of liquid butane, said heat of the earth then acting to vaporize said liquid butane into gas, a gas outlet pipe leading from the top of said tank and to a point above the ground, said gas outlet pipe having a portion returning into the earth, a gas pressure regulator interposed in said gas outlet pipe above the earth and in advance of said portion, a vaporizer buried in the earth below the freezing line, said revaporizer comprising a closed casing and a helical coil disposed therein, a gas line, a burner above the ground to which one end of said gas line is connected, the remaining end of said gas line being connected to one end of said helical coil and said portion being connected to the opposite end of said helical coil, a water supply line connected to said closed casing, a heat communication pipe leading from said closed casing and entering said combined generator and storage tank, said heat communication pipe passing entirely through said tank, said heat communication pipe and the water therein acting to establish heat exchange between said revaporizer and said combined generator and storage tank whereby a butane vaporizing temperature is maintained in said revaporizer whenever a butane vaporizing temperature is present in said tank.

2. Apparatus for generating butane gas from liquid butane and burning said gas, said apparatus comprising a generator adapted to contain a quantity of liquid butane and the gas resulting therefrom, means continually supplying heat to said generator and acting to vaporize the butane liquid, a gas outlet conduit on said generator, a gas pressure regulator interposed in said outlet conduit, a gas burner to which said outlet conduit is connected, a revaporizer interposed in said conduit between said burner and said pressure regulator, and heat communication means connecting said revaporizer and said generator, whereby condensate formed in the outlet conduit will be revaporized.

3. In a liquefied gas storage and dispensing plant of the class described, a storage tank; dispensing devices, including a pressure reducing regulator connected to said tank; a service pipe

connected to said regulator; and heat exchanging means associated with said service pipe to revaporize any condensed gas therein.

4. In a liquefied gas storage and dispensing system of the class described, a storage tank for holding liquefied gas under pressure; dispensing means, including a pressure reducing valve connected to said tank; and a heat exchanger connected to the dispensing means to revaporize any condensate in the dispensing conduit after the gas passes through said pressure reducing valve.

5. A liquefied gas storage and dispensing system comprising a storage tank buried in the ground to absorb heat of vaporization from the surrounding earth; a dispensing conduit for the gas connected to the tank; a pressure reducing valve connected to the dispensing conduit; and external heating means associated with the lowest portion of the conduit beyond the pressure reducing valve to revaporize any condensate formed in the conduit betwen the reducing valve and the gas-consuming appliances.

6. A liquefied gas dispensing system comprising, in combination, a storage and gas generating tank buried in the ground below the freezing line in heat exchanging relation with the surrounding earth; a gas dispensing conduit connected to the tank; a pressure reducing regulator connected to said dispensing conduit; a gas service pipe connected to said pressure reducing regulator and having its lowest portion also buried under ground below the freezing line, and means to revaporize any condensate formed in said service pipe.

7. A liquefied gas dispensing system comprising, in combination, a storage tank buried in the ground below the freezing line in heat exchanging relation with the surrounding earth; a dispensing conduit connected to the tank; a pressure reducing valve in the dispensing conduit; a service pipe connected to the pressure reducing valve and also having its lowest portion buried in the ground adjacent to said tank, and means to revaporize any condensate formed in said service pipe.

8. In a liquefied gas dispensing system having a pressure storage tank buried in the ground to absorb heat from the surrounding earth, a gas dispensing pipe connected to the tank having a portion buried in the ground; and an external heater for said pipe connected to be supplied with relatively warm water to prevent gas from condensing in said pipe.

9. In a liquefied gas dispensing system having a pressure storage tank buried in the ground to absorb heat from the surrounding earth, a dispensing pipe connected to the tank; heat exchanging means connected to the tank; and means to supply a heating medium to said heat exchanging means.

10. A liquefied gas dispensing system comprising, in combination, a storage tank buried in the ground below the freezing line in heat exchanging relation with the surrounding earth; a dispensing conduit connected to the tank; a pressure reducing valve in the dispensing conduit; a service pipe connected to the pressure reducing valve and also having its lowest portion buried in the ground adjacent to said tank; and heating means supplied with an external source of heat associated with said service pipe and said tank to maintain a constant supply of generated gas and to revaporize any condensate in said service pipe.

11. A liquefied gas dispensing system comprising, in combination, a storage tank buried in the ground below the freezing line in heat exchanging relation with the surrounding earth; a dispensing conduit connected to the tank; a pressure reducing valve in the dispensing conduit; a service pipe connected to the pressure reducing valve and also having its lowest portion buried in the ground adjacent to said tank; and external heating means supplied with flowing water associated in heat exchanging relation with both the service pipe and the tank.

12. A liquefied gas dispensing system comprising, in combination; a storage tank for holding liquefied gas under pressure; a gas dispensing conduit connected to the tank; a pressure reducing regulator in the dispensing conduit; heat exchanging means connected to supply heat to the contents of the tank; means to supply a heating medium to said heat exchanging means and a service pipe leading from the pressure reducing regulator also connected and arranged to absorb some heat supplied by said heating medium and thereby revaporize condensate formed in said service pipe.

13. In a liquefied gas dispensing system of the class described, a pressure storage tank buried in the ground to absorb vaporizing heat from the surrounding earth and adapted to be partially filled with liquefied gas; a gas delivering pipe leading from the tank and having a pressure reducing valve connected thereto; and a water conduit connected to said tank acting as a supplemental heat exchanger for the liquid gas to insure a continuous supply of gas in relatively cold climates.

14. In a liquefied gas dispensing system of the class described, a pressure storage tank buried in the ground to absorb vaporizing heat from the surrounding earth and adapted to be partially filled with liquefied gas; a gas delivering pipe leading from the tank and having a pressure reducing valve connected thereto; and a water pipe connected to and extending through the tank below the liquid level to supplement the vaporizing heat from the earth and insure a continuous supply of gas.

15. In a liquefied gas dispensing system of the class described, a pressure storage tank buried in the ground to absorb vaporizing heat from the surrounding earth and adapted to be partially filled with liquefied gas; a gas delivering pipe leading from the tank and having a pressure reducing valve connected thereto; a service pipe leading underground from said pressure reducing valve; and a relatively warm liquid heat exchanger associated with the service pipe to revaporize any condensate formed therein.

DAVID J. LITTLE.