Nov. 30, 1943. A. ABRAMSON 2,335,837

APPARATUS FOR UTILIZATION OF LIQUEFIED PETROLEUM GASES

Filed Feb. 24, 1941 2 Sheets-Sheet 1

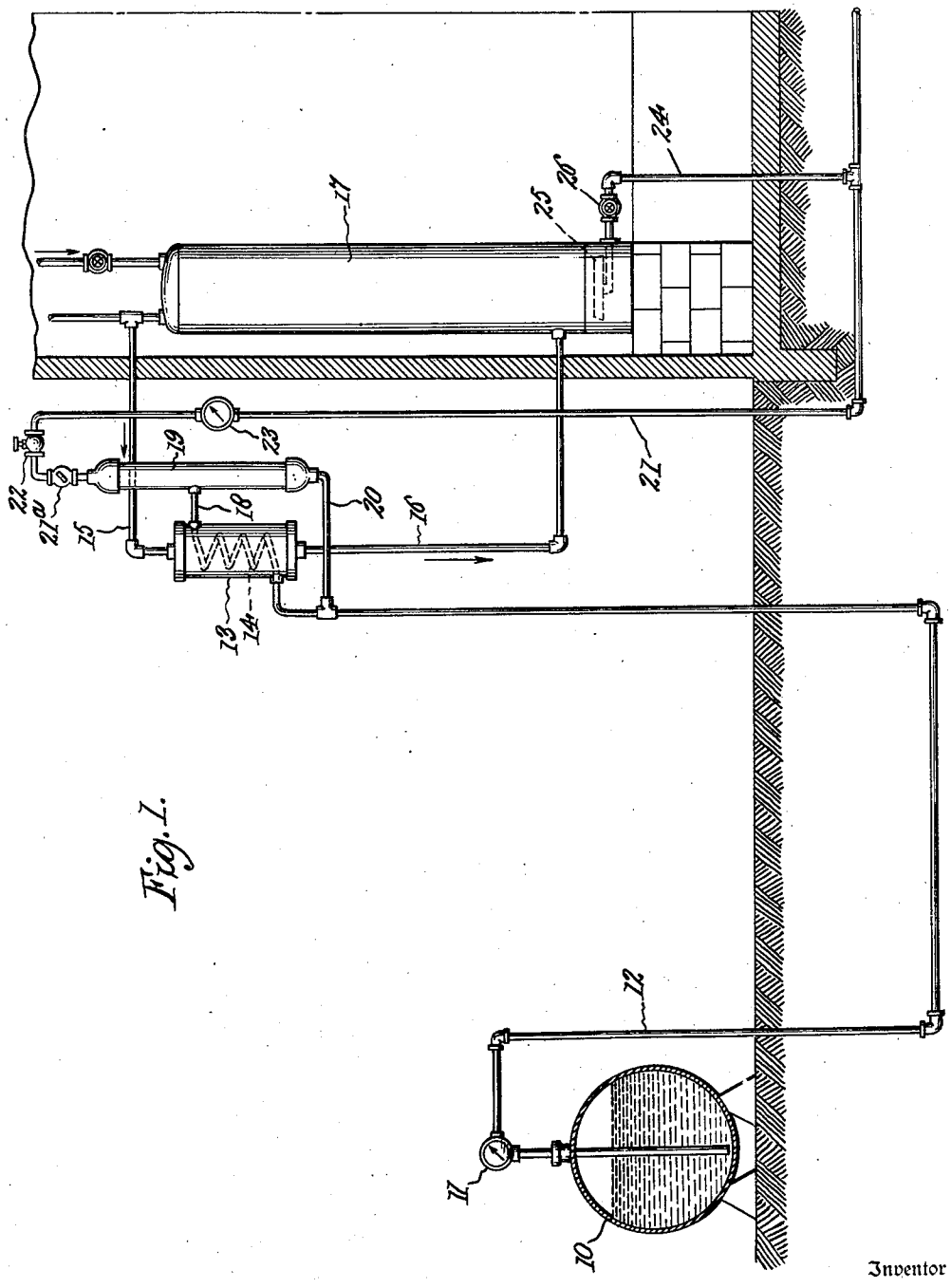

Fig. 1.

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Fig. 2.

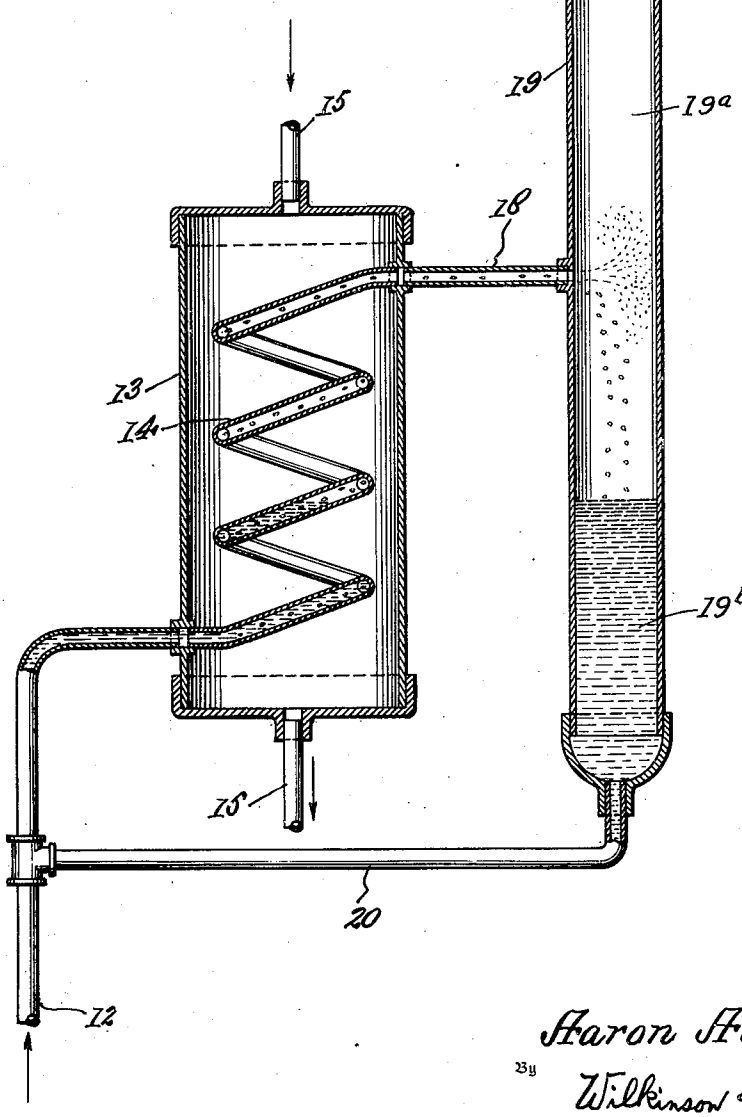
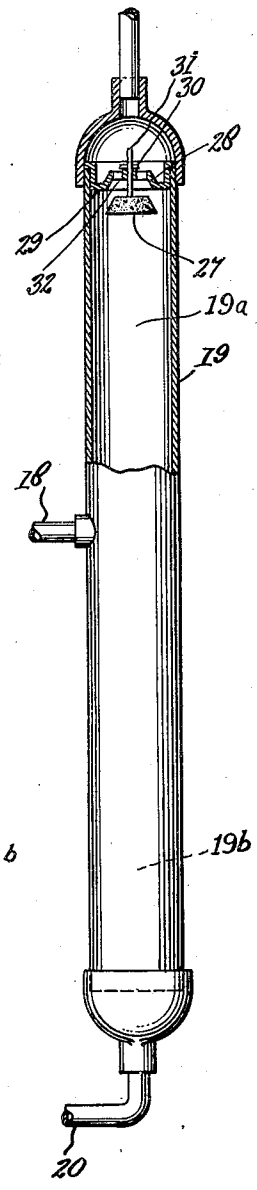


Fig. 3.



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APPARATUS FOR UTILIZATION OF LIQUEFIED PETROLEUM GASES

Aaron Abramson, New Orleans, La.

Application February 24, 1941, Serial No. 380,383

4 Claims. (Cl. 62—1)

The present invention relates to improvements in method and apparatus for the utilization of liquefied petroleum gases and more particularly provides an improved method and apparatus for the more effective use of such products both for commercial and domestic use.

The primary object of the invention is to provide an improved method and means, in which safety is a prime factor of supplying a constant gaseous flow of liquefied petroleum gases, wherein the user will be assured of a continuous supply of gaseous fuel of uniform composition regardless of conditions, such as weather, liquid level in the container, rate of withdrawal of the gas, temperature of heating medium, etc.

The combination of petroleum gases ordinarily in use for certain heating purposes and for refrigeration consists of a combination of propane, iso-butane, and butane. These compounds are ordinarily in gaseous form but are reduced to liquid form for handling purposes by application of pressure. Such compounds have varying boiling points, for example: propane boils at minus 46 degrees; iso-butane boils at plus 12 degrees; and butane boils at plus 32 degrees. The three compounds also have different heat values. Propane is added to the other two compounds primarily to produce sufficient pressure, but it also decreases the heat value of the combination. When the three compounds are placed in a tank, there is a predetermined amount of each compound present. This predetermined amount is for the purpose of securing the best heat value and service from the combination for any given purpose. If the content of the tank is drawn off in liquid form, the uniformity of the mixture will be maintained, but if the content of the tank is drawn off in gaseous form, then the quantity of the three compounds will continually vary. The reason for this variance is that the three compounds have a varying volatility and, as a result thereof, a larger percentage of propane is obtained in the first gas drawn from the tank than from the last gas drawn from the tank.

The purpose of the present invention is to eliminate this varying B. t. u. (British thermal units) content of the gas by enabling users to draw liquid from the tank which has a constant percentage of composition.

Such liquefied petroleum gases are now being distributed and sold by companies who furnish, loan, rent, lease, or sell containers for both above and below ground, which are placed on the customer's premises, and in which the liquefied petroleum gas is stored in the liquid state. These gases are kept liquid by their own vapor pressure in these closed containers, and, as a safety measure and for utilization, a vapor space is always maintained above the liquid in the tank. These containers are refilled by trucks or returned to a bulk storage plant for refilling.

The gases are used in a vapor state, and some means provided for supplying the necessary heat to vaporize the liquid. At present there are two general types of systems in operation:

I. The vapor withdrawal system, in which gases are withdrawn in the vapor state from the vapor space above the liquid, passed through a regulator which reduces the pressure to the desired point, which in most domestic application, is six to eight ounces. As the gas is withdrawn, the pressure in the container drops, and more of the liquid passes into the vapor state. The heat of the evaporation of the liquid is taken from the remaining liquid which absorbs heat from the container, which in turn absorbs heat from the air or ground. This system is used extensively for butane-propane mixtures. The disadvantages of this system are many, and some of them may be outlined as follows:

A. The propane being a more volatile gas forms a larger part of the gas given off in the beginning, and consequently the liquid loses most of the propane content and the subsequent gas from the liquid becomes richer and richer in butane, giving the user a gas of varying B. t. u. content (heat value). This interferes with the adjustments and service calls are frequently necessary.

B. In extreme weather or under heavy gas loads, the liquid does not receive enough heat from the container to provide for its vaporization and a failure of, or diminished gas supply results.

II. The liquid withdrawal system, in which the gases are withdrawn in the liquid state and passed through a high pressure regulator which drops the pressure to 5 to 15 lbs., and the liquid is run underground to the inside of the building where a coil of pipe leads to a low pressure regulator. In this system the liquid draws its heat from the ground around the intermediate pressure pipe and from the air inside of the building. The disadvantages of this system are:

A. The serious fire and explosion hazard of high (5–15#) pressure gas inside of the building.

B. The limited capacity of the system due to a limited heat capacity of the ground and air.

C. The possibility of getting liquid fuel into the system.

In accordance with the present invention, the

liquefied petroleum gases are drawn from the bottom of the container (either above or below the ground) in a liquid state, and run by its own pressure through a coil or heat exchanger where heat for evaporation is applied by direct, or indirect means, and thence to a separator. The vapor drawn off the top of the separator is passed through a regulator, where the pressure is reduced to whatever required, and thence to the consumer. The bottom of the separator is connected by a constantly open return conduit or pipe to the system on the intake side of the heat exchanger so that any liquid which is entrained into the separator drops or settles and is drawn off the bottom of the separator and returned to the inlet of the heat exchanger for constant recirculation with the incoming liquid from the supply tank 10 through the vaporizer in order to insure a constant mixture of the vaporized gases of uniform B. t. u. value at the vapor outlet side of the separator.

With the foregoing and other objects in view, the invention will be more fully described hereinafter and more particularly pointed out in the appended claims.

In the drawings, like or identical parts are represented by the same or similar reference characters throughout the several views.

Figure 1 is a side elevation, with parts broken away and parts shown in section, of an improved installation constructed in accordance with the present invention.

Figure 2 is a vertical section, on an enlarged scale, showing the improved heat exchanger and separator.

Figure 3 is a side view of a modified form of separator.

Referring more particularly to the drawings the storage tank 10 containing liquefied petroleum gas is shown as above the ground. Such tank will be equipped with the usual safety appliances and a high pressure regulator 11 may or may not be used. The liquid is drawn off by its own pressure through the line 12 to the heat exchanger or vaporizer 13 which contains a coil 14. The interior space of the receptacle 13 outside the coil 14 is in circuit with a source of hot water supply through the pipes 15 and 16. In this instance the source shown is a hot water heater 17 located inside the building. The upper end of the coil 14 is connected by an output pipe 18 with an intermediate portion of a vertical elongated separator 19. Such separator is preferably of narrow horizontal dimension but of great vertical height and connects at its lower end by a constantly open return pipe 20 with the liquid supply line 12 near the bottom of coil 14. There is no valve in the outlet pipe 18 or in the return pipe 20 or in the connection 12 between the pipe 20 and the heat exchanger or vaporizer 13—14. The upper end or vapor space 19a of the separator extends for a substantial distance, as shown, above the top of the coil 14 and the connecting pipe 18 and is connected with the consumer's line 21 which may include the excess flow check valve 21A, the line valve 22 and the pressure regulator 23. The consumer's line 21 extends down into the ground and is buried below the frost line to prevent cooling of the gases (in extremely low temperatures) to their condensing temperatures.

In operation, the material in the liquid state is drawn from the supply tank 10 through the supply line 12 through the bottom of coil 14, where a stream of such liquefied petroleum is subjected to the heat of the hot water, flowing in the direction of the arrows (Fig. 2) through the receptacle 13, to raise the temperature of the liquefied petroleum in coil 14 above the boiling point of the highest boiling constituent of the liquefied gases at the prevailing pressure within vaporizing coil 14, coil 14 and its jacketing receptacle 13 being constructed and dimensioned for this purpose, as shown, and in a manner well understood in the art. The liquefied petroleum is converted by the heat into gas and rises upwardly in the coil 14, as indicated in Figure 2, being discharged from the upper end of the coil 14 through the pipe 18 into the separator 19 at a midpoint thereof. There is thus provided in this tall and narrow separator receptacle 19 a vapor space 19a above the connection 18 and a liquid trap 19b below such point of connection into which any liquid carried through the coil 14 and into the separator 19, usually in the form of a mist, may fall or precipitate. Such liquid has free egress out through the return line 20 and back into the inlet pipe 12 to mix or combine with the incoming liquefied gas entering the coil 14.

Some of the advantages of this improved method and apparatus are:

I. An adequate supply of gaseous fuel at all times;

II. A uniform composition fuel at all times; and

III. The permissible location of tanks above-ground eliminating the corrosion problem and resulting hazard of underground tanks and in general promoting safety by allowing free inspection of the above-ground tank.

While an advantage has been specified with reference to above-ground tanks this is not to say that the invention is limited to such tanks. On the contrary it will be apparent to those skilled in the art that the invention is equally applicable to products drawn from the underground tanks.

It will be observed that there are no valves, nor valves operated by pressure responsive devices, in the coil 14, connections 18 and 20 nor in the separator 19, and no such valve in the supply line 12 at or near the point of connection of the return pipe 20, nor in the supply line 12 between the pipe 20 and the heat exchanger or vaporizer 13—14. Without valves the same pressure obtains in the coil 14 as in the separator 19. Consequently the liquid in the coil and separator will seek its own level, with the exception of a small excess amount of liquid which will be entrained by the gas as it is formed in the coil 14.

This condition is indicated in Figure 2. This balance of liquid level in the coil 14 and liquid chamber of the separator 19 causes a balance which is automatic without the use of valves so long as there is free and unimpeded flow of the gases and liquid in the connections 18, 20, and 21 and the supply line 12 when the system is conditioned (turned-on) for normal operation. Any interference with this balance and with this automatic operation which is continuous in action would destroy the efficiency of the system. It is the combination of the heating coil 14 with the separator 19 in the relation shown that secures a continuous supply of gaseous fuel at all times. As the liquid is evaporated completely it will be apparent that the consumer's line receives at all times a gas of uniform B. t. u. content.

With this invention it becomes possible to use

above-ground storage tanks for liquid petroleum gases in almost any climate. The use of the above-ground tanks will eliminate corrosion, fire and explosion hazards as above indicated, and also makes possible cheaper installation, which in turn will make the system available to more people throughout the country. From the dealer's standpoint, the improved system means a very sharp decline in the number of service calls from consumers.

With the present system the fuel going through the consumer's appliances will be of the same B. t. u. content the year round. Heretofore many of the dealers used summer and winter grades of fuels which vary in the percentage of the components of the liquefied petroleum gas. The invention opens the use of liquefied petroleum gas to industrial fields, where in the past large loads on such systems have resulted in a diminished supply of the gas, and consequently the use of these gases was unsatisfactory.

In Figure 1 the consumer's line 21 is shown as being tapped by a consumption branch line 24 for supplying the burner 25 of the water heater 17. A valve 26 is shown as controlling the supply of the gas to the burner 25.

Referring more particularly to Figure 3 a slight modification is shown with reference to the separator in that a float valve 27 is shown in the upper portion of such separator. This float valve 27 is normally open by the gravity of its weight and is closable against a valve seat 28 formed in a suitable diaphragm 29 which is mounted in the upper part of the separator 19. A cotter pin or other detent 30 in the valve stem 31 encounters spider 32 of the diaphragm and limits the descent of the valve 27 with reference to its seat 28. This float valve is an additional safety precaution in the event the water in receptacle 13 around coil 14 should freeze, for instance due to faulty operation of the water heater 17 or other means which may be provided to heat the vaporizer 13—14. Such freezing would allow the liquid to pass through the coil and through the separator and on up through the consumer's line. However, liquid rising up through the vapor space in the separator 19 and reaching the float valve 27 will float this valve up and into closed position against its seat 28 thus protecting the consumer's line 21 and in fact closing off the entire system. This float valve is of course optional equipment and is, of course, not a valve or pressure responsive device such as referred to in the fourth and fifth paragraphs herein next above.

The invention has been illustrated and described as to only a single physical embodiment, but it will be understood that the same is susceptible of different forms and modifications. Also the invention has been illustrated and described, and has been made, particularly with reference to a liquefied petroleum gas combination, but in so far as it is applicable to other products the appended claims will cover all such other uses of the invention.

What is claimed is:

1. In a dispensing system for liquefied petroleum gases, a jacketed vaporizer having an intake for liquid and a discharge for vapor, means for supplying said liquefied gases under pressure to said intake of the vaporizer, a separator column having vapor and liquid condensation spaces therein, the vapor space being substantially above the vaporizer, a connection between the discharge of the vaporizer and the vapor space of the separator, an unobstructed return connection between the condensation space of the separator and the intake of the vaporizer, a pipe between the upper end of the separator and a gas burning heating appliance, and a pipe connection between said appliance and the jacket of said vaporizer for circulating a heating medium to the vaporizer.

2. In a dispensing system for liquefied petroleum gases, a vaporizer in communication with a source of liquid supply under its own pressure, an elongated separator column adjacent the vaporizer with portions extending above and below the vaporizer, a connection between the vapor discharge of the vaporizer and an intermediate point of the separator, a second connection between the lower part of the separator and the intake of the vaporizer, said connections being free and open at all times, a dispensing outlet at the upper end portion of said separator, and a float valve in the upper part of the separator, the valve of which being closable upwardly to control said dispensing outlet.

3. In a dispensing system for liquefied petroleum gases, a tank for liquefied petroleum gases under their own pressure, a supply line from the tank, a heat exchanger comprising a receptacle in communication with a source of circulating hot fluid supply, and a closed coil in said receptacle having its lower end connected to said supply line, elongated separator tower adjacent the coil and extending appreciably and substantially above the coil, an unobstructed connection between the upper end of the coil and the separator at approximately the same height as the top of said coil, a second unobstructed connection between the lower end of said separator and the intake of said coil, the lower portion of the separator extending below said last-mentioned connection, and a consumer's line leading from the upper part of the separator.

4. In a dispensing system for liquefied petroleum gases, a source of supply liquefied petroleum gases under pressure, a vaporizer constructed and dimensioned to heat a stream of liquefied gases passing therethrough above the boiling point of the highest boiling constituent thereof at the prevailing pressure in said vaporizer, a feed line supplying a flow of said liquefied gases from said supply source to said vaporizer, a separator column with a portion extending a substantial distance above said vaporizer to provide vapor chamber of substantial volume, a connection between the vapor discharge of the vaporizer and an intermediate point of the separator, a second connection between the lower part of the separator and the intake of the vaporizer, said vaporizer and separator and the connections between the vaporizer discharge and the separator and between the separator and the intake of the vaporizer being devoid of pressure responsive means and being in open communication at all times one with another and with said feed line, whereby all the liquefied gases pass through the vaporizer and from the vaporizer to the separator during normal operation of the system, and a consumer's line being fed from the upper end portion of the vapor chamber.

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