Dec. 21, 1948. T. A. ST. CLAIR 2,456,890

VAPORIZER

Filed June 9, 1945

2 Sheets-Sheet 1

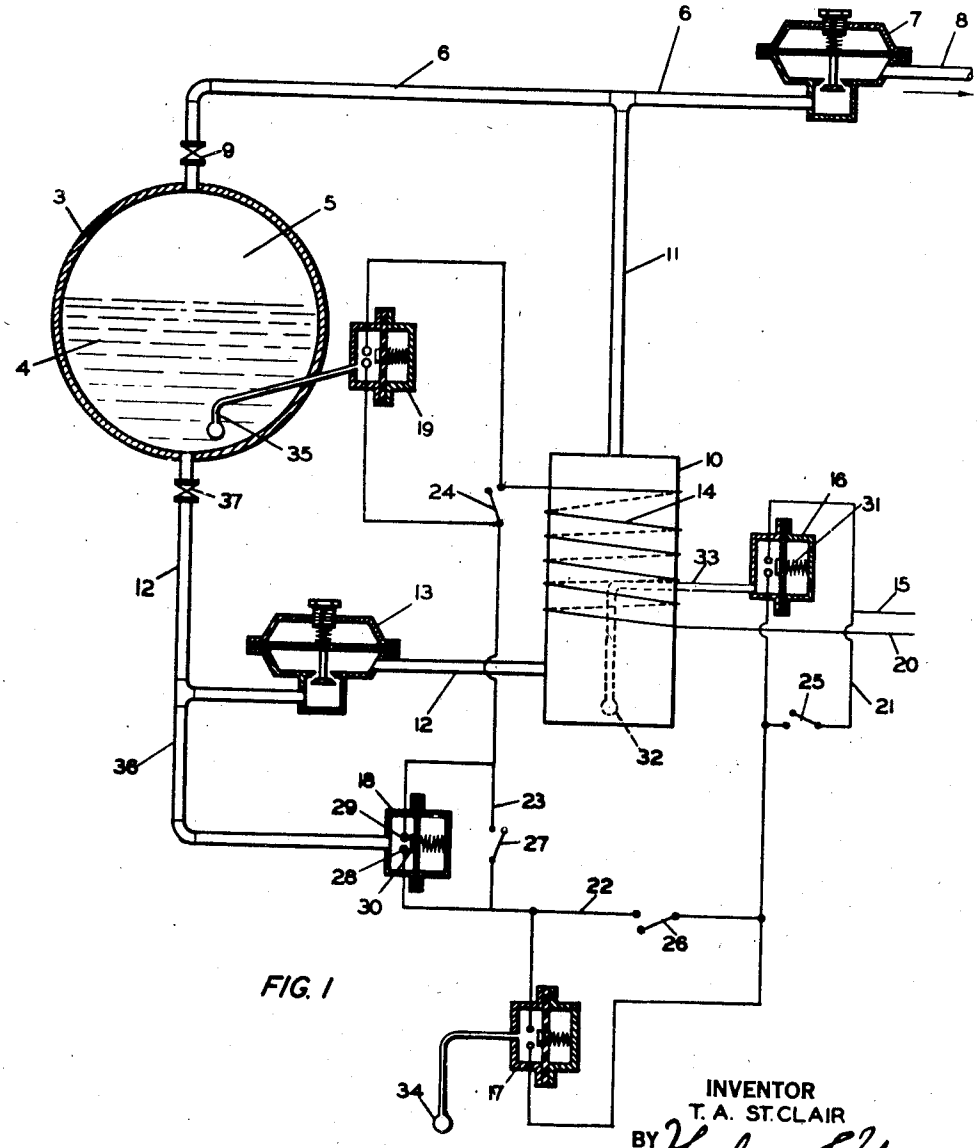

FIG. 1

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2 Sheets-Sheet 2

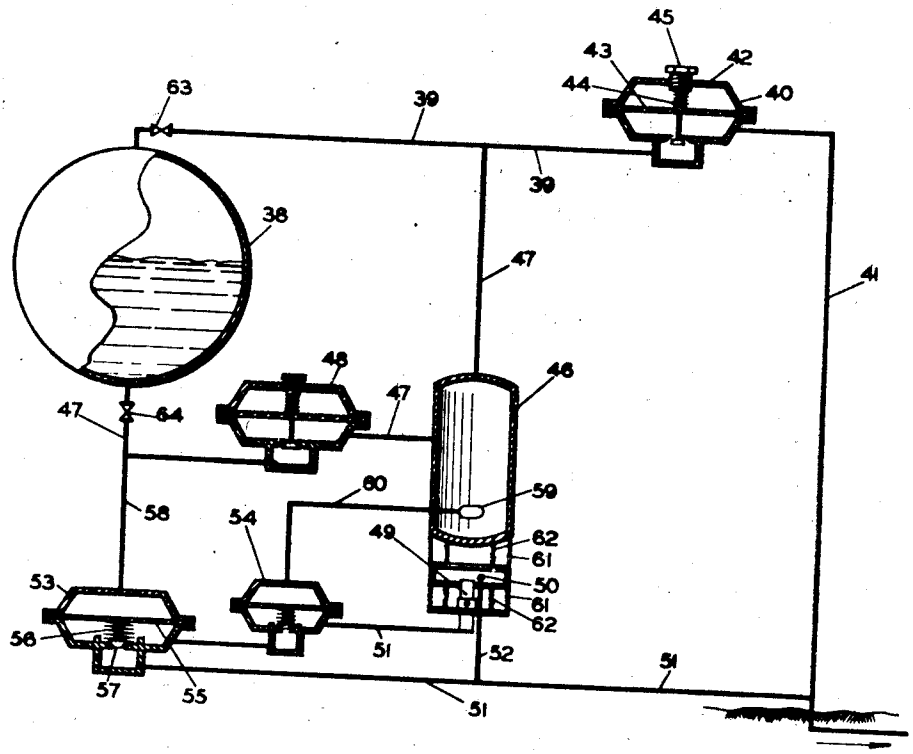

FIG. 2

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UNITED STATES PATENT OFFICE

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VAPORIZER

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12 Claims. (Cl. 62—1)

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This invention relates to vaporizers. In a more specific aspect it relates to vaporizers for liquefied inflammable gases. In another more specific aspect it relates to systems for the storage, vaporization, and pressure regulation of liquid petroleum gases such as butane, propane, or mixtures thereof.

One object of my invention is to provide a simplified system for vaporizing such gases.

Another object is to vaporize such gases when atmospheric heat is insufficient by applying heat in a safe manner.

Other objects are to reduce fire hazards and keep vapor lines free from liquid.

Another object is to vaporize and put pressure on such liquefied gases without heating the entire liquid content of the storage tank.

Other objects are to provide safe, cheap and economical systems for storing and vaporizing liquid petroleum gas.

Numerous other objects and advantages will be apparent to those skilled in the art upon reading the following specification and claims and studying the accompanying drawings in which:

Figure 1 is an elevational view with parts broken away and parts in section of a liquefied gas storage and vaporizing system embodying my invention.

Figure 2 is a view similar to Figure 1 of a modified system embodying my invention.

In Figure 1 a storage tank 3 is provided for liquefied gas 4 and vapors 5 of said gas. Vapors 5 are led through line 6 and pressure regulating valve 7 to line 8. Valve 7 keeps the pressure in line 8 below a predetermined pressure. Line 8 supplies burners, stoves and other equipment (not shown) in line 8. A cut-off valve 9 may be provided adjacent tank 3 if desired.

A vaporizing tank 10 is provided having a vapor outlet 11 connected to vapor line 8.

A liquid supply line 12 is provided containing a pressure regulator 13 to supply liquid to vaporizing tank 10 whenever the pressure in tank 10 falls below a predetermined pressure.

In order to heat tank 10, a heating unit 14 is provided which may consist of a helical coil of electric heating wire but obviously other forms of electric heaters may be employed.

An electric power supply line 15 is provided which is connected in series through electric switches 16, 17, 18, 19 and heating wire 14 with the return wire 20 of electric power line 15.

Each of switches 16, 17, 18 and 19 is provided with a switch bypassing line 21, 22, 23 and 24, respectively, which by-pass line may be closed by

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switches 25, 26, 27 and 24, respectively. Switch 24 as shown is the by-pass line 24.

As shown in switch 18, each of the switches consists of contacts 28 and 29, and a contact 30 to short across contacts 28 and 29 when the switch is closed.

Switch 16 has a spring 31 pressing against the diaphragm on which contact 30 is mounted and a thermal pressure fluid supply bulb 32 is disposed so as to be heated by said vaporizing tank 10, the vapor pressure of the liquid in said bulb 32 being conducted through pipe 33 to act against spring 31.

Bulb 34 is similar to bulb 32 but is exposed to the atmosphere. Bulb 35 is similar to bulb 32 but is exposed to conditions in tank 3.

Pressure from tank 3 is transmitted through lines 12 and 36 to open switch 18. Obviously line 36 could extend back to tank 3 parallel to line 12 without involving invention.

A shut-off valve 37 may be provided in line 12 preferably adjacent tank 3.

In Figure 2 a storage tank 38 is provided with a vapor line 39 leading to a regulator 40 which regulates the pressure of gas in supply line 41. The operation of regulator 40 is the same as that of 7 in Figure 1 and the atmospheric pressure through an opening 42 balances against the pressure in line 41 through a diaphragm 43 while a spring 44 presses against the diaphragm with a force regulated by bolt 45.

Oftentimes the vapor pressure in tank 38 is insufficient and this vapor pressure is increased by vaporizing tank 46 having a vapor exit line 47'.

The vaporizing tank 46 is supplied with liquid through liquid supply line 47 containing regulating valve 48 which is a substantial duplicate of regulating valves 7, 13, and 40 but which may be set for a different pressure of course. A burner 49 is provided to heat tank 46. Burner 49 may be lighted by a catalyst such as porous platinum (not shown) but it is preferred to have a pilot light 50. Gas for burner 49 is supplied through gas line 51 connected to line 41 and while pilot light 50 might be provided with a separate line running over to line 41 without departing from my invention, I prefer to have a pilot line 52 run merely to line 51 in order to save pipe. In line 51 at a point between line 52 and burner 49, regulator valves 53 and 54 may be inserted. The order of insertion of these valves is immaterial as either can be ahead of the other. And in some modifications either or both of 53 and 54 may be omitted with their function

Valve 53 contains a diaphragm 55 and a spring 56 urging valve 57 open. It will be observed that valve 54 is similarly arranged. A pressure line 58 is provided running from tank 38 to valve 53. Said line 58 may run between tank 38 and valve 53 without being connected to line 47 or may in the alternative run from valve 53 to a point on line 47 between tank 38 and valve 48. The latter arrangement is shown in the drawing. A thermal pressure fluid supply bulb 59 is located in heat exchange relation with tank 46 and transmits pressure through line 60 to valve 54 upon being heated.

To prevent explosions, concentric gauze cylinders 61 and 62 may be provided as flame will not travel through these gauze cylinders, the gauze being made out of metal.

Shut-off valves 63 and 64 may be provided in lines 39 and 47, respectively.

Operation

The operation of Figure 1 depends on which of switches 24, 25, 26 and 27 are closed and which are open.

When the vapor pressure in 5 is too low, the pressure in the lower portion of valve 13 becomes insufficient to resist the atmospheric pressure and the pressure of the spring inside of valve 13 and liquid flows through pipe 12 into vaporizing tank 10. Assuming switches 24, 25, 26 and 27 to all be open, electric current in line 15 will flow through switch 16, because tank 10 is cold, and will flow through switch 17 if the atmosphere is below a certain temperature. The electricity will necessarily flow through switch 18 because the pressure in tank 3 transmitted through lines 12 and 36 is insufficient as set forth above in relation to valve 13. Electricity will then flow through switch 19 if bulb 35 is below a predetermined temperature. The electricity will then flow through heating coil 14 and heat vaporizing tank 10, the electricity then returning through line 20 to the source of electric power (not shown).

Now if bulb 32 is heated above a predetermined temperature, switch 16 will open breaking the circuit and stopping the heating in coil 14.

If the atmospheric temperature rises above a predetermined temperature bulb 34 will open switch 17, preventing the heating of coil 14.

If the pressure in tank 3 rises above a predetermined pressure, switch 18 will open stopping the heating of coil 14.

If the temperature in tank 3 rises above a predetermined temperature, bulb 35 will open switch 19, stopping the heating of coil 14.

By means of switches 24, 25, 26 and 27, each one of switches 16, 17, 18 and 19, respectively, may be eliminated from the system by being shorted or by-passed. This provides a flexible system which will take into account the desired and selected factors and no other factors, but which may be changed to take in other factors by manipulating the proper switches in an obvious manner.

The operation of Figure 2 is similar to that of Figure 1 except that gas burner 49 is employed as a source of heat.

Upon failure of pressure in tank 38, valve 48 opens in a manner similar to valve 13 and liquid is vaporized in tank 46 because valve 53 has opened as spring 56 is stronger than the pressure in 58. Should tank 46 become overheated, bulb 59 will operate valve 54 to cut off the gas running to burner 49 and thus prevent further heating of tank 46.

It is believed obvious that I have disclosed illustrative embodiments of my invention capable of carrying out all the objects set forth above and that changes in shape, proportions and arrangement of parts and substitution of equivalent elements may be made without going outside the scope of my invention as defined by the following claims.

Having described my invention, I claim:

1. A storage and vaporizing system for liquefied gases comprising in combination a storage tank for the liquefied gas, said storage tank having a vapor outlet and a liquid outlet, a vapor supply conduit connected to said vapor outlet, a pressure regulating valve in said vapor supply conduit for limiting the vapor pressure in that portion of said vapor supply conduit on the other side of said regulating valve from said storage tank, a vaporizing tank, a liquid supply conduit connecting said liquid outlet and said vaporizing tank, a pressure regulating valve in said liquid supply conduit, said vaporizing tank having a vapor outlet, a connecting vapor conduit connecting the vapor outlet of said vaporizing tank with said vapor supply conduit at a point between said storage tank and said pressure regulating valve, means to heat said vaporizing tank comprising a main burner, a main burner supply conduit connecting said main burner and said vapor supply conduit at a point on the other side of said pressure regulating valve from said storage tank, a pilot burner, a pilot burner supply conduit connecting said pilot burner and said main burner supply conduit, a first fluid pressure actuated shut-off valve in said main burner supply conduit at a point between said pilot burner supply conduit and said main burner, a fluid pressure supply conduit connecting said liquid outlet of said storage tank and said first shut-off valve whereby a predetermined pressure in said storage tank closes said first shut-off valve, a second fluid pressure actuated valve in said main burner supply conduit at a point between said pilot burner supply conduit and said main burner, a thermal pressure fluid supply bulb disposed so as to be heated by said vaporizing tank, and a thermal pressure fluid conduit connecting said second shut-off valve and said supply bulb whereby a predetermined temperature in said vaporizing tank closes said second shut-off valve.

2. A storage and vaporizing system for liquefied gases comprising in combination a storage tank for the liquefied gas, said storage tank having a vapor outlet and a liquid outlet, a vapor supply conduit connected to said vapor outlet, a vaporizing tank, a liquid supply conduit connecting said liquid outlet and said vaporizing tank, a pressure regulating valve in said liquid supply conduit, said vaporizing tank having a vapor outlet, a connecting vapor conduit connecting the vapor outlet of said vaporizing tank with said vapor supply conduit, means to heat said vaporizing tank comprising a main burner, a main burner supply conduit connecting said main burner and said vapor supply conduit, a pilot burner, a pilot burner supply conduit connecting said pilot burner and said main burner supply conduit, a first fluid pressure actuated shut-off valve in said main burner supply conduit at a point between said pilot burner supply conduit and said main burner, a fluid pressure supply conduit connecting said liquid outlet of said storage tank and said first shut-off valve whereby a predetermined pressure in said storage tank closes said first shut-off valve, a second

fluid pressure actuated valve in said main burner supply conduit at a point between said pilot burner supply conduit and said main burner, a thermal pressure fluid supply bulb disposed so as to be heated by said vaporizing tank, and a thermal pressure fluid conduit connecting said second shut-off valve and said supply bulb whereby a predetermined temperature in said vaporizing tank closes said second shut-off valve.

3. A storage and vaporizing system for liquefied gases comprising in combination a storage tank for the liquefied gas, said storage tank having a vapor outlet and a liquid outlet, a vapor supply conduit connected to said vapor outlet, a vaporizing tank, a liquid supply conduit connecting said liquid outlet and said vaporizing tank, a pressure regulating valve in said liquid supply conduit, said vaporizing tank having a vapor outlet, a connecting vapor conduit connecting the vapor outlet of said vaporizing tank with said vapor supply conduit, means to heat said vaporizing tank comprising a main burner, a main burner supply conduit connecting said main burner and said vapor supply conduit, a pilot burner, a pilot burner supply conduit connecting said pilot burner and said main burner supply conduit, a fluid pressure actuated shut-off valve in said main burner supply conduit at a point between said pilot burner supply conduit and said main burner, and a fluid pressure supply conduit connecting said liquid outlet of said storage tank and said shut-off valve whereby a predetermined pressure in said storage tank closes said shut-off valve.

4. A storage and vaporizing system for liquefied gases comprising in combination a storage tank for the liquefied gas, said storage tank having a vapor outlet and a liquid outlet, a vapor supply conduit connected to said vapor outlet, a vaporizing tank, a liquid supply conduit connecting said liquid outlet and said vaporizing tank, a pressure regulating valve in said liquid supply conduit, said vaporizing tank having a vapor outlet, a connecting vapor conduit connecting the vapor outlet of said vaporizing tank with said vapor supply conduit, means to heat said vaporizing tank comprising a main burner, a main burner supply conduit connecting said main burner and said vapor supply conduit, a fluid pressure actuated shut-off valve in said main burner supply conduit and a fluid pressure supply conduit connecting said liquid outlet of said storage tank and said shut-off valve whereby a predetermined pressure in said storage tank closes said shut-off valve.

5. A storage and vaporizing system for liquefied gas comprising in combination a storage tank for said liquefied gas, a vaporizing tank, a liquid conduit and a vapor conduit connecting said storage and vaporizing tanks, a vapor supply line extending from said storage tank, and means for heating said vaporizing tank comprising an electric power line, switch means in said power line, means to operate said switch means upon the temperature in said vaporizing tank reaching a predetermined temperature, means to operate said switch means upon the pressure in said storage tank reaching a predetermined pressure, means to operate said switch means upon the temperature of the liquid in said storage tank reaching a predetermined temperature, means to operate said switch means upon the atmospheric temperature reaching a predetermined temperature, and an electric heater in said power line in heat exchange relationship with said vaporizing tank to heat said tank when the switch means is closed.

6. A storage and vaporizing system for liquefied gas comprising in combination a storage tank for said liquefied gas, a vaporizing tank, a liquid conduit and a vapor conduit connecting said storage and vaporizing tanks, a vapor supply line extending from said storage tank, and means for heating said vaporizing tank comprising an electric power line, switch means in said power line, means to operate said switch means upon the pressure in said storage tank reaching a predetermined pressure, means to operate said switch means upon the temperature of the liquid in said storage tank reaching a predetermined temperature, and an electric heater in said power line in heat exchange relationship with said vaporizing tank to heat said tank when the switch means is closed.

7. A storage and vaporizing system for liquefied gas comprising in combination a storage tank for said liquefied gas, a vaporizing tank, a liquid conduit and a vapor conduit connecting said storage and vaporizing tanks, a vapor supply line extending from said storage tank, and means for heating said vaporizing tank comprising an electric power line, switch means in said power line, means to operate said switch means upon the temperature in said vaporizing tank reaching a predetermined temperature, means to operate said switch means upon the temperature of the liquid in said storage tank reaching a predetermined temperature, and an electric heater in said power line in heat exchange relationship with said vaporizing tank to heat said tank when the switch means is closed.

8. A storage and vaporizing system for liquefied gas comprising in combination a storage tank for said liquefied gas, a vaporizing tank, a liquid conduit and a vapor conduit connecting said storage and vaporizing tanks, a vapor supply line extending from said storage tank, and means for heating said vaporizing tank comprising an electric power line, switch means in said power line, means to operate said switch means upon the temperature in said vaporizing tank reaching a predetermined temperature, means to operate said switch means upon the atmospheric temperature reaching a predetermined temperature, and an electric heater in said power line in heat exchange relationship with said vaporizing tank to heat said tank when the switch means is closed.

9. A storage and vaporizing system for liquefied gas comprising in combination a storage tank for said liquefied gas, a vaporizing tank, a liquid conduit and a vapor conduit connecting said storage and vaporizing tanks, a vapor supply line extending from said storage tank, and means for heating said vaporizing tank comprising an electric power line, switch means in said power line, means to operate said switch means upon the pressure in said storage tank reaching a predetermined pressure, means to operate said switch means upon the atmospheric temperature reaching a predetermined temperature, and an electric heater in said power line in heat exchange relationship with said vaporizing tank to heat said tank when the switch means is closed.

10. A storage and vaporizing system for liquefied gas comprising in combination a storage tank for said liquefied gas, a vaporizing tank, a liquid conduit and a vapor conduit connecting said storage and vaporizing tanks, a vapor sup-

ply line extending from said storage tank, and means for heating said vaporizing tank comprising an electric power line, switch means in said power line, means to operate said switch means upon the temperature of the liquid in said storage tank reaching a predetermined temperature, means to operate said switch means upon the atmospheric temperature reaching a predetermined temperature, and an electric heater in said power line in heat exchange relationship with said vaporizing tank to heat said tank when the switch means is closed.

11. A storage and vaporizing system for liquefied gases comprising in combination a storage tank, a vaporizer tank, a liquid conduit and a vapor conduit connecting said storage and vaporizer tanks, a vapor supply line extending from said storage tank, a pressure regulator valve in said supply line, means to heat said vaporizer tank, shut-off means for said heat means responsive to pressure in said storage tank, shut-off means for said heat means responsive to temperature in said vaporizer tank, and shut-off means for supply of liquid from said storage tank to said vaporizer tank responsive to pressure in said liquid conduit.

12. A storage and vaporizing system for liquefied gases comprising in combination a storage tank, a vaporizer tank, a liquid conduit and a vapor conduit connecting said storage and vaporizer tanks, a vapor supply line extending from said vaporizer tank, a pressure regulator valve in said supply line, means to heat said vaporizer tank, shut-off means for said heat means responsive to pressure in said storage tank, shut-off means for said heat means responsive to temperature in said vaporizer tank, and shut-off means for supply of liquid from said storage tank to said vaporizer tank responsive to pressure in said liquid conduit.

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