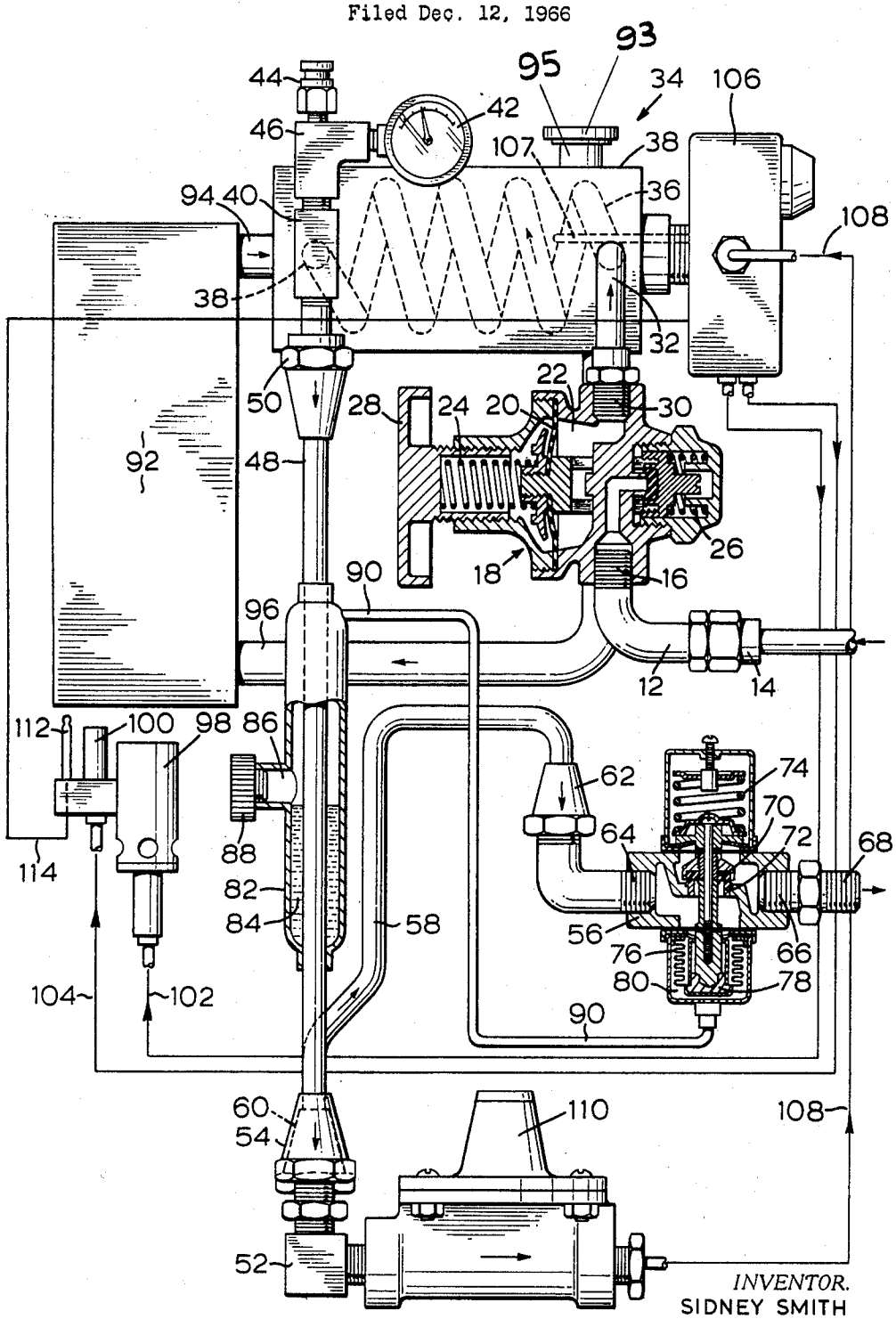
Nov. 4, 1969 S. SMITH 3,475,916

VAPORIZER

Filed Dec. 12, 1966




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United States Patent Office 3,475,916 Patented Nov. 4, 1969



3,475,916

# VAPORIZER

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Filed Dec. 12, 1966, Ser. No. 600,918
Claims priority, application Canada, Nov. 3, 1966, 974,706
Int. Cl. F17c 13/02, 7/00, 9/02
U.S. Cl. 62—52 2 Claims

## ABSTRACT OF THE DISCLOSURE

A liquid vaporizer with pressurized temperature sensing means operable to deliver vapor at a predetermined minimum temperature and to prevent delivery of liquid.

This invention relates to the vaporizing of liquid.

In particular this invention relates to a control and vaporizing system which is adapted to prevent liquid being discharged.

Fuels such as propane are commonly stored under pressure in a liquid state as this considerably reduces the volume of the fuel. Vapor can be obtained by drawing off vapor from the top of the storage tank but if large volumes are drawn off in this manner the container becomes extremely cold and the rate of delivery of the vapor is substantially reduced by this cooling. If the fuel is taken from the storage tank in liquid form without any substantial pressure drop, then any amount of fuel can be drawn off without substantially affecting the temperature of the storage tank. The present invention is concerned with the vaporization of the liquid phase fuel.

Liquid vaporizers are commonly used for vaporizing liquid phase propane and other fuels to provide fuels for anyone of a multitude of applications. The most common and well known vaporizer used for this purpose is in the form of a high pressure container having a floating ball control valve for regulating the flow of liquid into the vaporizing chamber. Liquid enters the vaporizing chamber from above and continues to fill into the container until the floating valve rises to a level at which it closes the input opening. The liquid within the vaporizing chamber is vaporized by means of an open burner which heats the lower end of the container. It has been found that due to the pressure drop occurring at the inlet opening of the vaporizing chamber, there is a tendency for condensation of moisture to accumulate and freeze in the area of the inlet opening with the result that the floating control valve cannot properly close the input opening. If the input is not closed properly then liquid may enter the vaporizing chamber and leave the vaporizing chamber in a liquid state.

It is an object of the present invention to provide an improved liquid vaporizer control system whereby no unvaporized liquid can be discharged from the vaporizing system.

It is a further object of this invention to provide a vaporizer control system capable of sensing the temperature of the output vapor and regulating the rate of flow of the output gas in relation to the output temperature.

The present invention overcomes the difficulties described above by firstly providing an input pressure control means for regulating the pressure of the liquid before it enters the vaporizer. The liquid then passes to a vaporizer which is preferably in the form of an indirectly heated heat exchanger. By providing indirect heating of the heat exchanger, the control system is suitable for indoor use which has not normally been permitted with the vaporizer of the type described above. After



the liquid has been vaporized it passes to a discharge control valve. Temperature sensing means is provided in the line between the heat exchanger and the output control valve. The temperature sensing means senses the temperature of the gas leaving the heat exchanger and if this temperature falls below a predetermined level the temperature sensing means activates the outputs control valve to reduce the rate of discharge of gas and thereby increase the duration of the heating period. The temperature sensing means provides a means for ensuring that no liquid will pass from the output valve.

With these and other objects in view the present invention relates to a liquid vaporizer control system which includes an input pressure control means for controlling the pressure of liquid entering the system, vaporizing means for vaporizing the liquid in the system and output vapor control means connected to the vaporizer. The system also includes temperature sensing means for sensing the temperature of the vapor output coming from the vaporizer. The temperature sensing means is adapted to regulate the output vapor flow control means to control the rate of flow of the output vapor from the output flow control to prevent the discharge of liquid from the system.

The invention will be clearly understood after reference to the following detailed specification read in conjunction with the drawings wherein:

The figure is a perspective view of a liquid vaporizing control system according to an embodiment of the present invention.

Referring to the figure of the drawings it will be seen that the liquid enters the vaporizer by way of conduit **12**. The conduit **12** is provided with a suitable coupling for connecting the vaporizer to a pressurized liquid storage tank such as those commonly used for storing liquid propane. The liquid then passes to the inlet port **16** of an input pressure control regulator generally indicated by the reference numeral **18**. The regulator **18** is shown in section in the figure and it will be apparent that it is of the well known type which employs a diaphragm **20** for balancing the pressure within the valve chamber **22** against the pre-set net load applied by the springs **24** and **26**. The load applied by the springs **24** and **26** can be adjusted by means of the hand wheel **28**, and it is the adjustment of this regulator which determines the output pressure of the vapor delivered by the vaporizer. When the fluid pressure within the valve chamber **22** exceeds the pre-set value, the pressure on the diaphragm will cause the valve to move towards a closed position and thereby reduce the input flow. The liquid leaves the pressure control regulator by way of the outlet port **30** and passes by way of the conduit **32** to the heat exchanger which is generally indicated by the reference numeral **34**.

In the embodiment illustrated the heat exchanger is in the form of a simple coil **36** which is surrounded by a water jacket **38**. The coil **36** is an extension of the inlet conduit **32**. The liquid enters the coil **36** by way of the conduit **32** and it is vaporized as it passes through the heat exchanger and the vapor leaves the heat exchanger by way of conduit **38**. The conduit **38** communicates with a T-shaped coupling **40**. One end of the T-shaped coupling **40** is connected to a pressure indicator gauge **42** and a pressure relief valve **44** by means of a connector **46**. The pressure relief valve will blow to relieve the pressure within the entire vaporizing system if the pressure within the system exceeds a predetermined level. The pressure gauge **42** serves to indicate the output pressure of the vapor from the heat exchanger. The other end of the T coupling **40** is connected to a conduit **48** by means of a suitable coupling indicated at **50**. The con-

duit **48** is preferably made from a metal having a high rate of conductivity such as copper. The conduit **48** is connected at its other end to a manifold **52** by means of a suitable coupling **54**. The manifold is in turn connected to the output vapor control valve **56** by means of conduit **58** and coupling **60** and **62**. The modulating valve **56** is adapted to modulate the flow of vapor from the vaporizer. The valve **56** is provided with an inlet port **64** and an outlet port **66**. The outlet port **66** is provided with a gas coupling **68** which is adapted to be connected to a suitable conduit for conveying the outlet vapor to a gas burner or other similar apparatus. The valve **70** is normally urged against the valve seat **72** by means of the compression spring **74** to prevent the flow of vapor through the valve. The force required to open the valve may be adjusted by adjusting the compressive force applied by the spring **74**. The valve **70** is moved upwardly and away from the valve seat **72** by the application of pressure to the bellows **76** against which the lower end of valve stem **78** reacts. The pressure within the valve chamber **80** is provided by the temperature sensing means as will be described hereinafter.

The temperature sensing means includes a sleeve **82** which surrounds a portion of the conduit **48** and is brazed or welded at either end to the conduit **48** to form a fluid tight chamber **84** surrounding the conduit **48**. A passage **86** is formed in the wall of the sleeve **82** to provide a means for filling the chamber **84** and a suitable fluid tight closure **88** is provided for closing the passage **86**. One end of a capillary tube **90** opens into the upper end of the chamber **84** and the other end of the capillary tube **90** is connected to closure chamber **80** of the modulating valve **56**.

When in use the chamber **84** is partially filled with a liquid having a boiling point at a temperature substantially equal to the minimum temperature of the vapor to be discharged by the vaporizer. The liquid is introduced to the chamber **84** after evacuation of a substantial portion of the air from the chamber **84**, capillary tube **90** and chamber **80** of valve **56**. The temperature sensing fluid is introduced into the temperature sensing chamber under pressure to fill the chamber with liquid up to the level of the passage **86**. The remainder of the chamber **84**, and the capillary tube **90** and chamber **80** are filled with the gas derived from boiling the temperature sensitive fluid. The temperature sensing system is pressurized to a point where the boiling point of the fluid within the system is substantially equal to the minimum temperature of vapor to be delivered by the vaporizer.

As previously indicated the heat exchanger **34** comprises a jacket **38** surrounding the conduit **36**. One end of the heat exchanger is connected to a water boiler **92** by means of a conduit **94** and the other end of the heat exchanger is connected to the lower end of the water boiler **92** by means of a conduit **96**. A pressure relief cap **93** closes the passage **95** through which the system is filled with a suitable heating fluid such as water. Preferably the water in the heat exchanger will contain a sufficient amount of an antifreeze solution to prevent freezing of the system. The water in the water boiler is heated by a main burner **98** and the heated water leaves the water boiler by way of conduit **94** and passes through the heat exchanger **34** to return to the lower end of the boiler by way of conduit **96**. The circulation of water is such as to provide a simple and efficient counter flow heat exchanger capable of heating the liquid entering the tubes **36** to a degree sufficient to completely vaporize the liquid. The main burner **98** and the pilot burner **100** are gas burning burners which are supplied by way of conduits **102** and **104** from a regulator **106**. Vapor is supplied to the regulator by way of conduit **108** which is connected to one end of a lower pressure regulator **110**. The low pressure regulator **110** is connected to the manifold **52** and draws a small quantity of vapor from the main vapor circuuit and supplies



this vapor at low pressure to the regulator **106**. A thermocouple **112** is mounted adjacent the pilot burner **100** and serves to indicate whether or not the pilot is properly ignited. The thermocouple is connected to the regulator **106** by way of lead **114** and if the pilot burner is not properly ignited the thermocouple **112** will cause the regulator **106** to prevent the passage of fuel to the main burner and to the pilot burner.

The regulator **106** is provided with a thermostat probe **107** which extends into the heat exchanger **34** and the setting of the thermostat controls the supply of fuel to the main burner. The pilot flame is intended to be constantly ignited during the operation of the apparatus and as previously indicated the failure of the pilot flame will prevent the passage of fuel to the main burner. It will be apparent from the foregoing that the apparatus is entirely self-contained and can therefore be portable.

As previously indicated the apparatus of the present invention is particularly suitable for the vaporization of liquid phase propane gas and the following detailed description of the operation of the apparatus makes reference to apparatus which is pre-set and adjusted for the vaporization of liquid phase propane.

In presetting the apparatus the input regulator **18** is adjusted to permit a maximum discharge pressure to the heat exchanger of the order of 30 pounds per square inch. The thermostat temperature control in the heat exchanger is adjusted to a control temperature of approximately 150° F. The temperature sensing bulb is filled with Freon 12 to provide a reservoir of liquid Freon 12. The spring pressure applied to the output modulating valve is adjusted to approximately 60 p.s.i. It will be understood that the above settings are given as an example of suitable settings for the vaporization of liquid phase propaane and are not intended to limit the scope of the present invention.

After the aforegoing adjustments have been made the coupling **14** is attached to the outlet from a liquid phase propane storage tank. The liquid from the tank passes to the input pressure control valve **18** and the pressure of the liquid is dropped to approximately 30 pounds per square inch. In view of the fact that there is no substantial pressure drop before the liquid reaches the valve **18** there will be no significant cooling of the line conveying the propane to the apparatus. Normally the liquid pressure discharged from a propane tank at 70° F. will be in the neighbourhood of 124 p.s.i. The liquid passes out of the pressure control valve and into the heat exchanger. The water in the heat exchanger will normally have sufficient heat to vaporize the propane coming from the discharge valve. In this respect it should be noted that propane at a pressure of 30 p.s.i. will boil at 10° F. The vaporized propane leaves the heat exchanger and passes into the conduit **48**. As the vapor passes through the portion of the conduit **48** which lies within the temperature sensing bulb the conduit **48** will be heated or cooled depending upon the temperature of the propane vapor. If the temperature of the propane passing through the conduit **48** is less than 55° F. the Freon within the temperature sensing bulb will condense and this will cause a reduction of pressure within the capillary tube which will in turn permit the output regulating valve to close. If on the other hand the temperature of the propane is in excess of 55° then the Freon will boil and the pressure in the capillary tube will be sufficient to maintain the outlet control valve in an open position to permit the vaporized propane to pass out of the vaporizer. When the propane vapor enters the manifold **52** a portion of the vapor will enter the low pressure regulator **110** and will pass through the low pressure regulator to the control regulator **106**. The control regulator in turn will supply vapor to the pilot burner which may then be ignited and the thermostat which is immersed in the heat exchanger will regulate the flow of propane to the main burner. If the tempera-

ture of the water in the heat exchanger drops below approximately 140° the valve supplying propane to the main burner will be opened and if the temperature exceeds approximately 170°, the valve supplying propane to the main burner will be closed. The thermocouple **112** serves to indicate that the pilot flame is properly ignited and the thermocouple therefore acts as a safety device to prevent the discharge of propane to the main burner when the pilot light is not properly ignited.

Various modifications of the present invention will be apparent to those skilled in the art without departing from the scope of the invention.

For example it will be apparent that the apparatus could operate without the pressure control regulator **18** provided that the liquid was received by the unit at low pressure. This could be done by attaching a low pressure regulator to the storage tank, however, this would mean that the supply line to the vaporizer would be extremely cold after only a very short running period.

A familiar modification could be carried out by replacing the water heated vaporized with an electrical heating unit or other similar heating means. However the method described hereinbefore is a simple and effective method which permits the apparatus to be self sustaining and herefore portable.

It will also be apparent that the Freon 12 may be replaced by other similar fluid having a boiling point at a temperature substantially equal to the control temperature of the output vapor. Generally it has been found that the common refrigerants are suitable temperature sensing fluids for the vaporization of most liquid phase fuels. For example, Freon 22 may be used instead of Freon 12 or propane itself may be used in the temperature sensing tube. Furthermore the apparatus and principle may be applied to the vaporization of various substances normally stored in a liquid phase condition.

These and other modifications of the present invention will be apparent without departing from the scope of the invention.

What I claim is:

**1.** A liquid vaporizer for delivering vapor at a predetermined minimum temperature comprising; vaporizing means connectable to a source of low pressure liquid to be vaporized, output flow control means, conduit means connecting said vaporizing means and said output vapor flow control means, a sleeve surrounding at least a portion of said conduit to form a fluid tight chamber about said conduit, second conduit means communicating between said chamber and said output vapor flow control means, a pressurized temperature sensing fluid within said chamber and said second conduit means, said pressurized fluid having a boiling point at about the predetermined minimum temperature of the vapor to be produced by the vaporizer such that the passage of fluid or liquid through said conduit at a temperature which is higher or lower than the predetermined control temperature causes variations in pressure applied to the output flow control means and thereby regulates the rate of flow of the vapor discharged from the vaporizer, said output flow control means being adjusted to close when a temperature lower than predetermined control temperature is detected to stop the flow of the output.

**2.** A liquid vaporizer as claimed in claim **1** wherein said vaporizing means includes, a vaporizing tank, vaporizing passage means for conveying the liquid to be vaporized through said tank, heating fluid in said tank, heating fluid temperature sensing means in said tank, heating means for heating said heating fluid, control means for directing a portion of the vapor produced by said vaporizing means to said heating means when the temperature of the heating fluid in said tank drops below a predetermined level, and said control means being operative to interrupt the flow of vapor to said heating means when the temperature of the heating fluid exceeds a predetermined level.

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U.S. Cl. X.R.

48—102; 122—33; 165—40; 236—99; 431—41