United States Patent [19]

Jerde

[11] **3,897,754**

[45] **Aug. 5, 1975**

[54] **LPG VAPORIZER**

[75] Inventor: **James B. Jerde**, San Leandro, Calif.

[73] Assignee: **Ransome Gas Industries, Inc.**, San Leandro, Calif.

[22] Filed: **Oct. 16, 1974**

[21] Appl. No.: **515,326**

[52] **U.S. Cl.** ..... **122/156;** 62/52; 122/33; 122/367 C; 122/448 R; 122/451 R

[51] **Int. Cl.²** **F22B 7/00;** F22B 35/00

[58] **Field of Search** ..... 122/33, 156, 367 R, 367 C, 122/448 R, 451 R; 62/52

[56] **References Cited**

UNITED STATES PATENTS

2,561,506	7/1951	Garretson	122/33 X
3,106,956	10/1963	Smith et al.	62/52 X
3,153,439	10/1964	Golden	62/52
3,603,101	9/1971	Sullivan	62/52
3,712,073	1/1973	Arenson	62/52

Primary Examiner—Kenneth W. Sprague
Attorney, Agent, or Firm—Lothrop & West

[57] **ABSTRACT**

An LPG vaporizer has an elongated upright pressure vessel substantially surrounded by a water jacket. There are upright flues around the pressure vessel and extending through the water jacket from a combustion chamber below the pressure vessel to a flue chamber above the pressure vessel. Parallel thermo-syphon tubes are disposed in the pressure vessel and open at their bottom and top into the water jacket. LPG liquid is supplied to the pressure vessel under float control and LPG gas is discharged from the pressure vessel, some being diverted for use in a burner in the combustion chamber.

4 Claims, 3 Drawing Figures

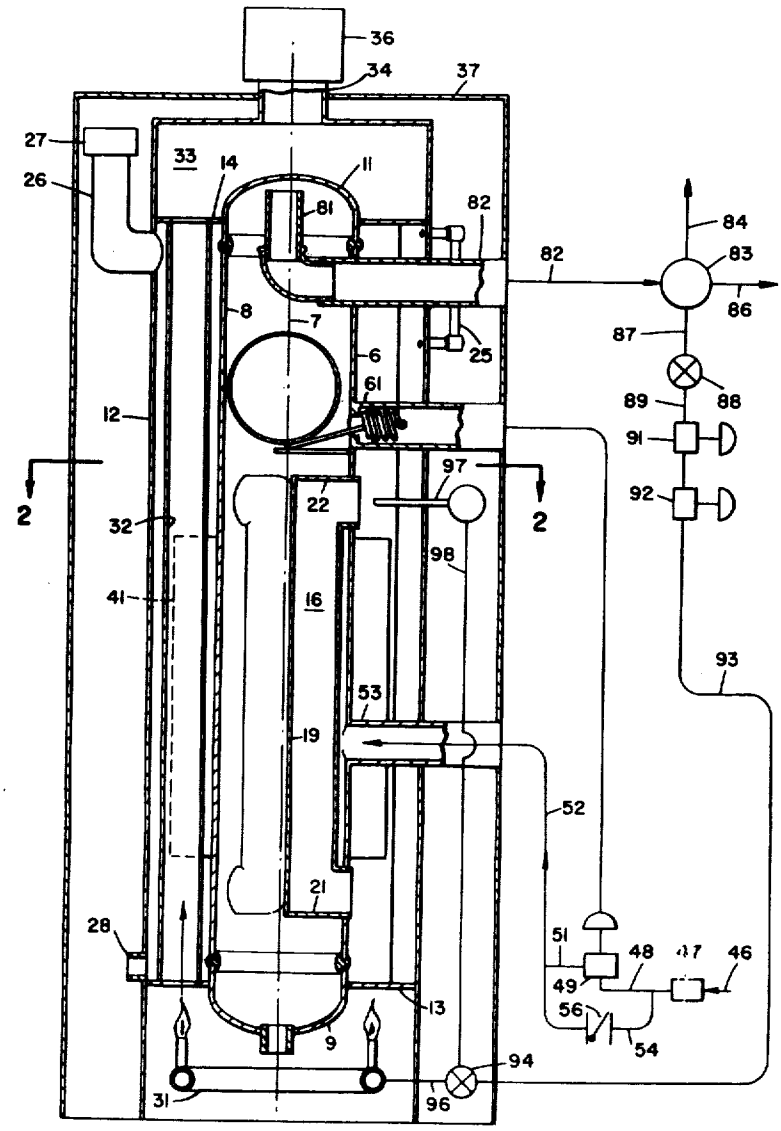
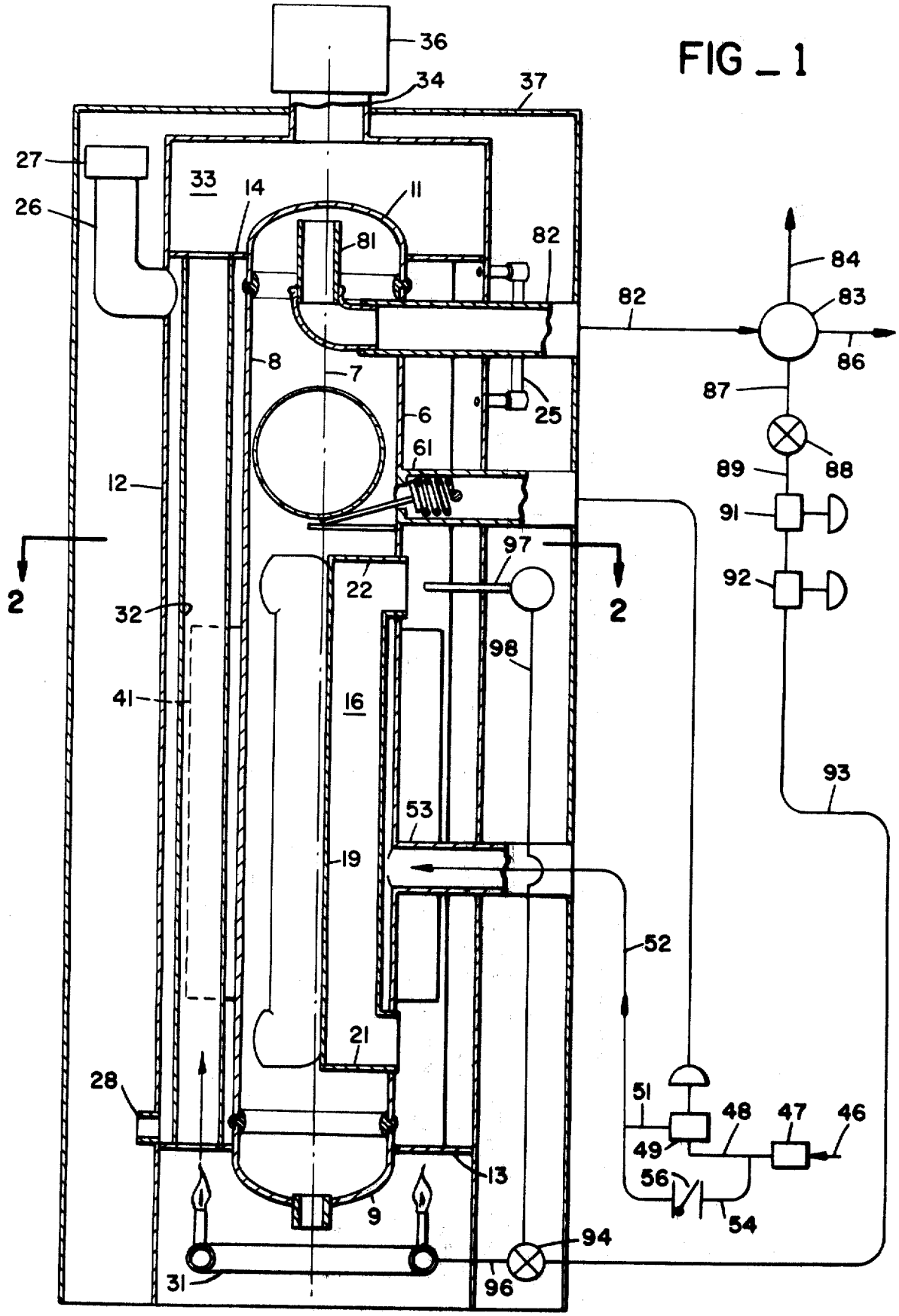


FIG _ 1


36
34
37
27
33
14
11
26
81
82
84
82
83
86
8
7
87
6
25
61
89
88
12
91
97
2
2
92
22
32
98
41
16
93
53
19
52
21
28
51
48
47
46
49
56
13
9
54
94
31
96

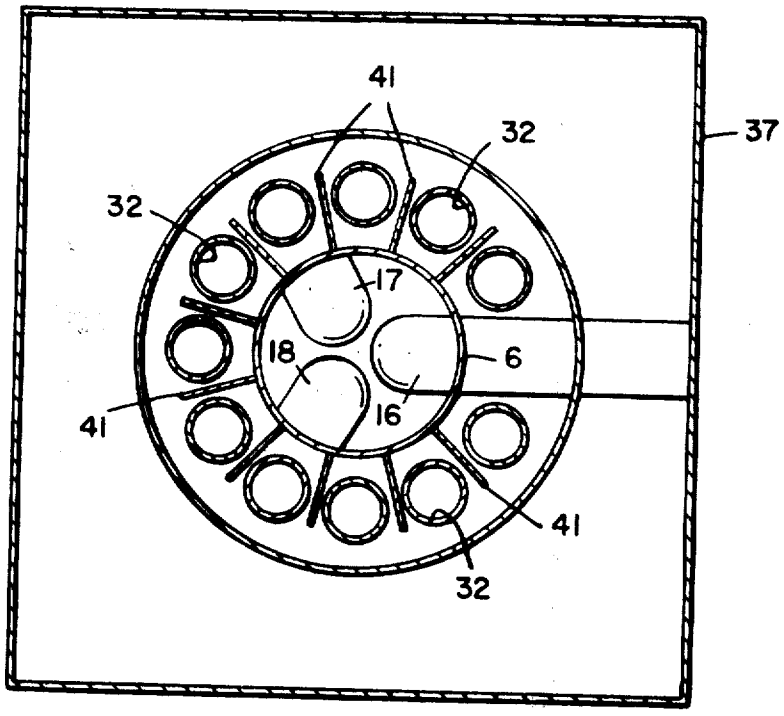


FIG _ 2

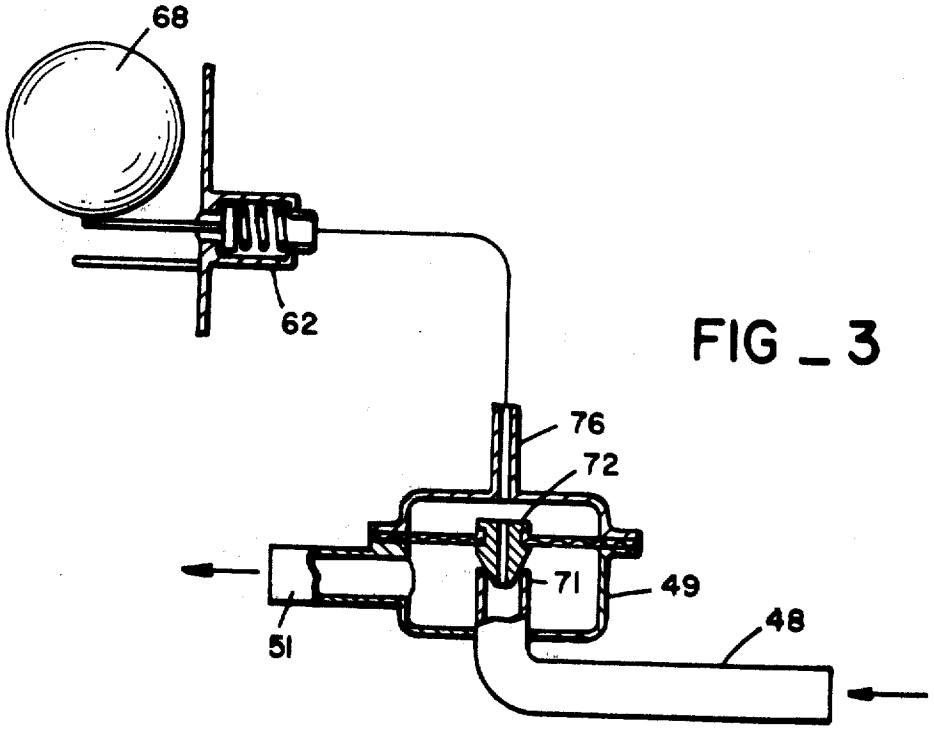


FIG _ 3

LPG VAPORIZER

The use of LPG gas is now widespread, the gas being a hydrocarbon or hydrocarbon combination which customarily is stored or reserved in liquid form and which is heated into vapor or gas form for utilization, some of the LPG gas itself being utilized as a fuel for heating additional, liquid LPG. There is a requirement for a relatively small, unitized vaporizer which can be used in multiples, if desired, and which will operate safely and consistently despite variant weather conditions, and which will also supply substantial amounts of vapor, even overload amounts for a short time, during the operation of the mechanism. In some installations there are sometimes deposits in the exhaust mechanism of the vaporizer of materials which are highly deleterious to long-term operation, and even in the gas circuitry there are sometimes deposits that are objectionable.

It is therefore an object of the invention to provide an LPG vaporizer which will satisfy the requirement for unitary construction and substantial temporary overcapacity and which will in general be safe, long-lived and economical to build, service and operate.

It is also an object of the invention to provide an LPG vaporizer which can function satisfactorily in various kinds of weather and with little or no deleterious deposits either in the exhaust system or in the internal circulating system.

It is a further object of the invention in general to provide an economically constructed, safe and versatile LPG vaporizer.

Other objects, together with the foregoing, are attained in the embodiment of the invention described in the accompanying description and illustrated in the accompanying drawings, in which:

FIG. **1** is partly diagrammatic and partly a crosssection on a vertical axial plane through a form of LPG vaporizer constructed pursuant to the invention;

FIG. **2** is a cross-section, the plane of which is indicated by the line **2—2** of FIG. **1**; and

FIG. **3** is a diagram showing one form of control instrumentality used with and in the vaporizer.

The vaporizer of the invention can be embodied in a widely variant number of forms, all retaining the desirable principles, but it has with commercial success been incorporated as a unit for single or multiple installation as shown herein. The present arrangement employs a pressure vessel **6** preferably of circular-cylindrical configuration symmetrical or substantially so about an axis **7** that is preferably arranged upright so that the vessel **6** is substantially vertical. Conveniently, the vessel **6** is fabricated of a circular-cylindrical central section **8** closed at its lower end by a lower head **9** and closed at its upper end by an upper head **11**, so that the resulting vessel can sustain considerable internal pressure.

Surrounding or nearly surrounding the pressure vessel **6** is a water jacket **12** also conveniently of circular-cylindrical configuration standing upright and coaxially with the pressure vessel and inclusive not only of an outer wall but also of a lower header plate **13** and an upper header plate **14.** The water jacket is augmented by a plurality of thermo-syphon tubes **16, 17** and **18,** each of which has an upright section **19** extending within the pressure vessel parallel to the axis **7** and having a lower end elbow **21** opening into the bottom part of the water jacket and also having an upper elbow **22** opening into the upper portion of the water jacket.

Near the upper end of the water jacket is a water filler tube **26** with a removable filler cap **27.** A gage glass **25** is fitted at the customary level range. At the lower end the water jacket is provided with a normally plugged drain fitting **28.** There is thus afforded an enclosed body of water substantially surrounding the major portion of the pressure vessel and augmented with thermo-syphon tubes so that there is a large surface for heat interchange between the interior of the pressure vessel and the water jacket, and so that there is beneficial water circulation for better heat transfer and favorable temperature conditions.

Beneath the lower header plate **13** the sides of the water jacket **12** extend downwardly to form a partial enclosure for a burner mechanism **31.** When operating, the burner supplies hot gas through various tubular flues **32** to an upper flue chamber **33** disposed within the extended walls of the water jacket above the upper end of the pressure vessel. The flues **32** are numerous and are arranged with their own axes parallel to the axis **7** and are disposed substantially all the way around the pressure vessel. Exhaust or spent flue gas from the chamber **33** is released through a vent duct **34** having a dissipating cap **36** of any convenient kind. The mechanism is conveniently housed within an enclosing cabinet **37** to protect against the weather and to conserve heat.

As an additional means for heat transfer between the water jacket and the pressure vessel there are provided fins **41** secured to and extending radially outwardly from the walls of the pressure vessel into the surrounding water jacket, the fins being interspersed between the flues **32.** For convenience in construction and other reasons, the fins are of a vertical height substantially less than that of the pressure vessel and in practice extend primarily between the lower elbow **21** and the upper elbow **22** of the various thermo-syphon tubes.

As part of the operational and controlling mechanism useful with the structure so far described, there is preferably afforded a pipe **46** connected to a supply of LPG liquid under pressure and received through a strainer or filter **47** in a supply line **48.** There is a control valve **49** for governing the flow of such liquid from the pipe **48** into a duct **51** connected to a line **52** ending in a pipe **53** opening into the interior of the pressure vessel **6.** Conveniently there is a check valve shunt line **54** around the valve **49** and inclusive of a check valve **56** therein. This permits back flow should pressure in the pressure vessel **6** become excessive.

To secure operation of the liquid control valve **49,** there is a pilot valve **61,** especially illustrated in detail in FIG. **3.** In a fitting **62** opening to the inside of the pressure vessel **6,** there is a seat **63** cooperating with a poppet disk **64** at the end of an actuating stem **66.** A spring **67** normally urges the poppet **64** closed. A float ball **68** within the pressure vessel at an appropriate level rests upon the stem **66** or, if the stem happens to be removed for service, rests alternatively in its lowermost position upon a cross rod **69** projecting from the wall of the vessel **6.** When there is sufficient liquid in the vessel to buoy the ball **68** above the stem **66,** the spring **67** retains the valve **64** closed, but when the liquid level falls and the ball float **68** descends by gravity, it rests upon the rod **69** and cocks or slants the rod so that the poppet **64** is rocked from its seat against the urgency of the spring **67** and is thus opened. Conse-

quently, the valve is opened and closed in accordance with liquid level within the pressure vessel.

Within the control valve **49** the liquid inlet pipe **48** terminates in a seat **71** on which a valve **72** may rest or from which the valve **72** may be displaced. The valve itself is in a flexible diaphragm **73** peripherally clamped within the housing of the valve **49.** There is a small passageway **74** through the valve member **72** and there is a duct **76** leading from the valve interior just above the diaphragm **73** to the fitting **62.**

In operation, there is normally liquid pressure in the pipe **48** against the valve **72** and that pressure is sufficient to lift that valve so that the liquid can flow out through the pipe **51** and the connector **52** and the fitting **53** to fill the deficient pressure vessel **6.** At the same time, there is some leakage of the incoming liquid through the duct **74** and through the duct **76** to flow in through the then-open valve **64,** because the level is low enough so that the valve disk **64** is cocked off its seat by the weight of the float ball **68.** When the liquid level rises sufficiently within the pressure vessel **6,** the float **68** lifts, and the valve disk **64** closes. Liquid flowing through the passage **74** fills and pressurizes the space above the diaphragm **73,** so that the valve **72** tends to close. When the valve is nearly closed, it is urged firmly onto its seat since the total pressure in the duct **48** communicated through the passageway **74** to the upper area of the diaphragm **73** is greater than the total pressure from below. There is a firm shutoff of the incoming liquid. When the liquid level eventually falls and the valve **72** is again opened under initial conditions, the pressure above the diaphragm **73** drops and the pressure beneath the valve **72** opens it. This condition obtains until the liquid level rises again when the ball **68** in lifting permits the valve **64** to close again. The cycle repeats itself, thus maintaining substantially a set or predetermined liquid level or level range within the vaporizer pressure vessel **6.**

Vapor derived from the liquid within the pressure vessel is collected beneath the upper end **11** thereof and flows outwardly from the pressure vessel through fittings **81** and a pipe **82** to a cross unit **83.** One of the branches **84** of the unit **83** is to a relief valve (not shown) to the atmosphere or waste so that any excessive pressure can be let go. Another branch **86** from the cross unit **83** is to the remote burner or burners supplied by this vaporizer unit. Another branch **87** of the valve **83** takes a portion of the generated gas and leads it through a shutoff valve **88** and through a line **89** and a pair of pressure regulators **91** and **92** to supply a line **93** leading through a thermal control valve **94** and a pipe **96** to the burner **31.** Thus the gas supplied to the burner **31** is utilized to afford additional vaporization of LPG.

In order to actuate the temperature valve or thermal valve **94,** there is mounted through the water jacket **12** a thermally responsive element **97** preferably disposed in the water jacket immediately opposite the outlet of an upper elbow **22** at the upper end of a thermo-syphon tube. The thermally responsive element **97** has a connection **98** for opening and closing the valve **94** in accordance with water temperature. This temperature is normally set so that the water in the water jacket is maintained substantially below its local boiling temperature, but, if desired, a liquid other than water or in addition to water may be utilized in the water jacket and a different temperature setting employed.

During the normal operation of this arrangement, the water in the water jacket is heated primarily from below and adjacent the flues **32.** It gradually increases in temperature and tends to rise. As this occurs, water within the thermosyphon tubes **16** tends to circulate downwardly on the inside of the pressure vessel and tends to return at the bottom elbows to the water jacket outside of the pressure vessel for reheating, having given up some of its heat to the contents of the pressure vessel. In this way there is maintained an accurate and vigorous water circulation within the otherwise relatively static body of water in the water jacket. Discounting the few degrees in temperature difference necessary to maintain the thermo-syphon circulation, it is generally true that the temperature of the water within the water jacket is maintained relatively uniform. The vaporization within the pressure vessel consequently takes place uniformly therein and especially at a carefully controlled and well maintained temperature.

An exception is in the event there should be an extraordinary demand for vapor from the vaporizer. In this event additional incoming liquid is vaporized not only by reason of the heat derived instantaneously from the burner **31,** but also from heat which has previously been derived therefrom and is currently stored in the surrounding jacket water. This operation of overcapacity gas supply is productive of a lowering of water temperature and cannot be continued indefinitely, but is a valuable adjunct in supplying sudden overload surges.

The normally even temperature of the gas conversion is effective to reduce unwanted deposits in the flue system, which sometimes occur when there are wide variations in vaporizing temperature, and the same uniform temperature characteristic is also helpful in reducing deposits within the control valves **83, 88, 91, 92** and **94.** The net result of the use of a vaporizer as described is to provide a compact unit which can be used in multiple and which is safe, substantially free of service requirements and is efficiently effective.

What is claimed is:

1. An LPG vaporizer comprising an elongated pressure vessel generally symmetrical about an upright axis, a water jacket substantially surrounding said pressure vessel, means forming upright flues extending through said water jacket and arrayed around said pressure vessel, a combustion chamber adjacent the lower end of said pressure vessel and opening to said flues, means in said combustion chamber for burning fuel, a flue chamber adjacent the upper end of said pressure vessel and opening to said flues, thermo-syphon tubes parallel to said axis extending at least partially through said pressure vessel and open at the upper and lower ends thereof to said water jacket, an LPG inlet to said pressure vessel, and an LPG outlet from said pressure vessel.

2. A vaporizer as in claim **1** including thermal fins on said pressure vessel extending into said water jacket.

3. A vaporizer as in claim **1** including a first flow control valve in said LPG inlet, a float in said pressure vessel above said thermo-syphon tubes, and means for operating said first flow control valve in response to the position of said float.

4. A vaporizer as in claim **1** including a second control valve for said fuel burning means, and a temperature-responsive device in said water jacket adjacent the upper end of one of said thermo-syphon tubes for operating said second control valve.

* * * * *