March 21, 1939. W. TSCHUDY ET AL 2,151,060

APPARATUS FOR PREPARING FUEL FOR COMBUSTION

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Fig. 1.

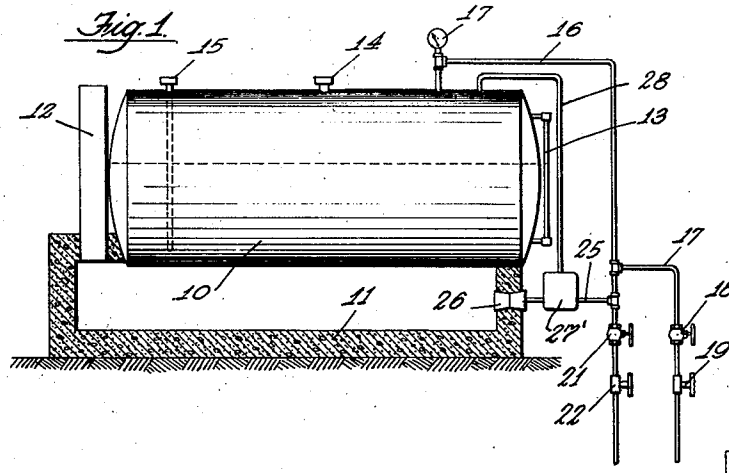
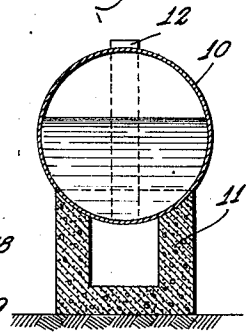
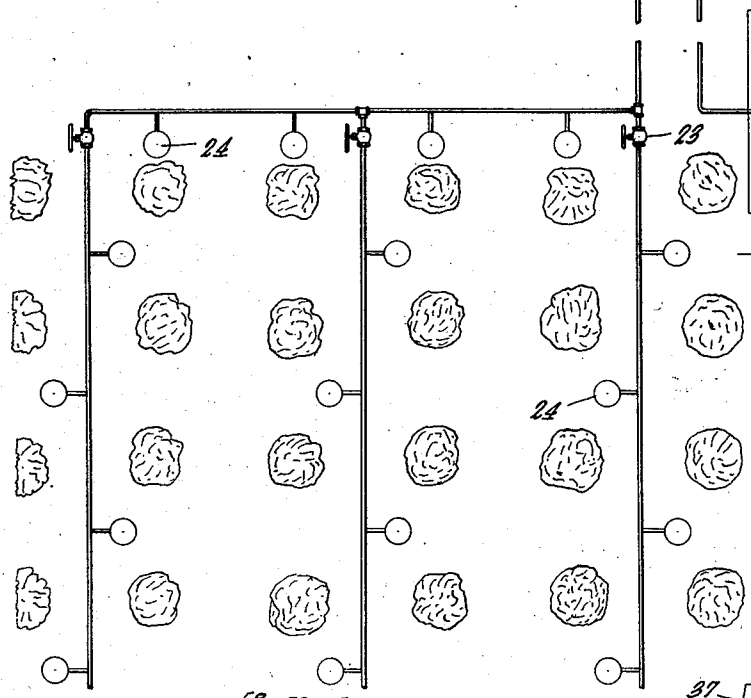


Fig. 2.





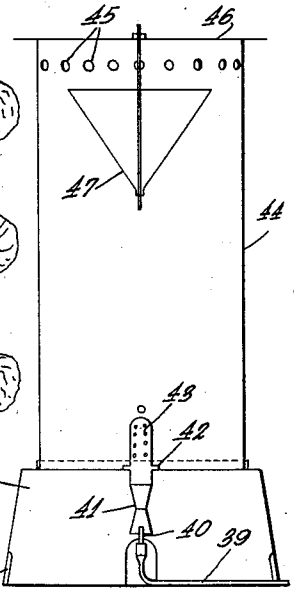


Fig. 6.

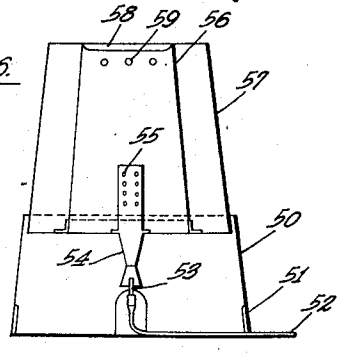


Fig. 5.

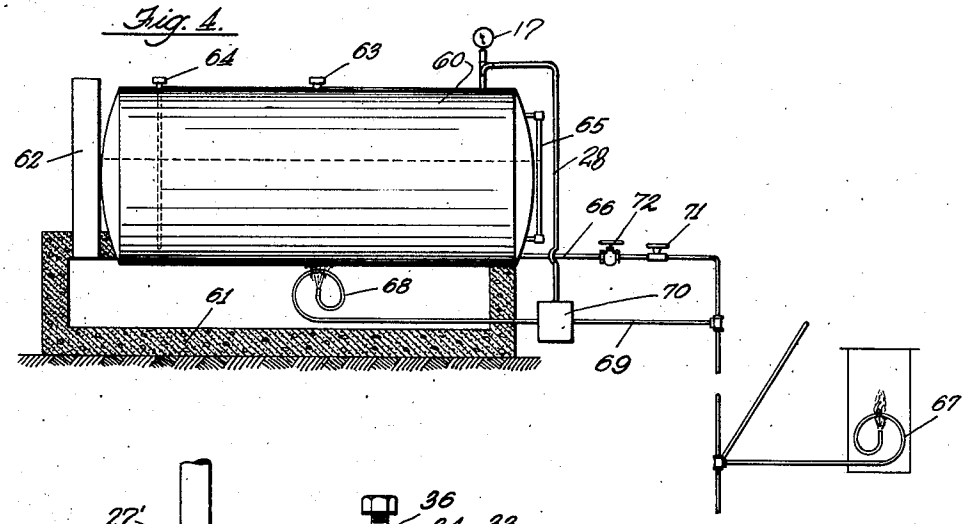
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APPARATUS FOR PREPARING FUEL FOR COMBUSTION

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Fig. 4.



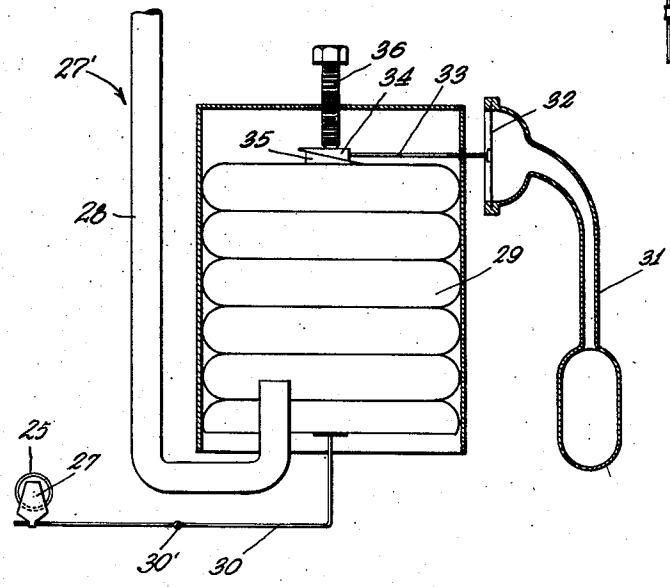


Fig. 3.

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APPARATUS FOR PREPARING FUEL FOR COMBUSTION

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7 Claims. (Cl. 158—53)

This invention relates to improvements in an apparatus for preparing fuel for combustion. It concerns, particularly, an apparatus which has been primarily designed for heating orchards, groves, and other outdoor vegetation so as to prevent damage from frost. The present apparatus may also be used as a complete heating system for a small farm in that it can be used to heat the orchards, groves, and other vegetation and also supply fuel to a farmhouse for domestic purposes.

An object of the invention is to provide an apparatus which utilizes hydrocarbon gases of the butane-propane series or equivalent fuels. These fuels will naturally volatilize quite readily under ordinary atmospheric conditions of temperature and pressure. The gases of the butane-propane series may be rendered liquid and handled as such by imposing a pressure. They are colorless and highly volatile and are clean to handle. They produce a flame which, under proper conditions of combustion, is smokeless, generating a high heat.

In keeping the gases of the butane-propane series in a storage tank and in liquid form, it is necessary to convert the liquid into a gas or vapor for combustion. This conversion may take place in accordance with the present system either in the storage tank itself or at or near the burner or burners, or at any intermediate point between the storage tank and the burner. When the pressure under which the gases are kept is relieved, the release of the pressure produces a quick volatilization of the liquid. This volatilization has a cooling effect upon the remaining liquid with the result that the remaining liquid shortly has its temperature greatly reduced. With the lowered temperature the tendency of the liquid gases to volatilize under the reduced pressure becomes retarded so that eventually a point of equilibrium is reached where the volatilization of the liquid is too slow to supply the demand created by the burner or burners.

Specifically, an object of the present invention is to provide a system for counteracting the tendency of the volatilizing to so reduce the temperature of the remaining liquid that the demand made by the burner or burners cannot be supplied.

Another object of the invention is to provide a system having the above mentioned characteristics which automatically serve to maintain a supply of gas which has been converted from the liquid at the desired pressure.

Another object of the invention is to provide an improved form of orchard heater designed to use in conjunction with the improved system.

With the foregoing and other objects in view which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention wherein:

Fig. 1 is a schematic view illustrating the preferred construction embodying the invention.

Fig. 2 is a vertical section taken substantially upon the line 2—2 upon Fig. 1.

Fig. 3 is a vertical section illustrating in detail an arrangement of parts which may be employed to effect an automatic operation of the system.

Fig. 4 is a schematic view illustrating a modified apparatus embodying the invention.

Fig. 5 is a view in vertical section through one form of orchard heater which may be employed in conjunction with the improved system.

Fig. 6 is a vertical section through an alternative form of orchard heater which may be employed.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout and particularly to Figs. 1, 2, and 3, the improved apparatus in its preferred form consists of a suitable storage tank 10, preferably mounted over a concrete fire box 11, at one end of which there may be a flue 12. This storage tank is preferably supplied with a liquid level gauge 13 or any other device for indicating the quantity of liquid fuel in the storage tank. The tank is provided with a filling valve 14 and a discharge valve 15. The outlet from the tank is indicated by a pipe 16 which may be provided with a pressure gauge 17 indicating the pressure of the gaseous fuel which collects in the top of the tank. Pipe 16 may lead to any suitable burner or set of burners. It is shown on the drawings as being branched, one branch indicated at 17 having a valve 18 and a pressure regulator 19. This branch may lead to a suitable burner such as at 20, such as a stove burner in a farmhouse used for domestic purposes. In such a case the pressure regulator 19 is so adjusted as to reduce the pressure of the gas to the desired degree for stove burner purposes.

The other branch of pipe 16 is provided with a valve 21 and a pressure regulator 22. This branch in turn may be branched, the various branches having valves 23 and supplying suitable orchard heaters, indicated at 24, which may be suitably located throughout a grove, such as an orange grove.

A third branch of pipe 16 indicated at 25 leads

to a burner 26 in the end of the fire box 11, which is opposite the flue or stack 12. Branch 25 is controlled by means of a thermopressurestat assembly 27' including a valve indicated at 27 (see Fig. 3), and in the preferred form of construction this valve is automatically regulated.

Liquid fuel in the form of liquefied butane gas or a mixture of butane-propane and similar hydrocarbons is maintained under pressure considerably above atmospheric in tank 10. In opening valve 18 or valves 21 and 23 to supply gaseous fuel from the top of tank 10 to a burner, the pressure within the tank is reduced. This reduction of pressure enables the butane to volatilize or vaporize within the tank. Depending upon the demand created by supplying the various burners which may have been turned on, the liquid fuel has its temperature reduced by the volatilization. The greater the demand and the greater pressure reduction in tank 10, the greater will be the volatilization and reduction of temperature of the liquid. If this situation is permitted to continue, the temperature of the liquid is so greatly reduced that it will no longer vaporize with sufficient rapidity to supply the demand unless precautionary measures are taken. To counteract this cooling of the liquid by its vaporization, more fuel is supplied burner 26. It receives some of the vaporized fuel and burns it in the fire box beneath the tank, thus keeping the liquid sufficiently warm to cause it to vaporize with the rapidity required by the open burners.

While the rate at which heat is supplied to the tank in this manner may be manually controlled, we prefer to have it automatically controlled as by a thermopressurestat assembly 27'. To this end a pressure pipe 28 leads from the top of tank 10 to the interior of a bellows 29 (see Fig. 3). This bellows has one end connected to a lever 30 pivoted at 30' to a fixed structure which opens and closes valve 27. When the pressure in the top of tank 10 and which is conveyed by pipe 28 to the interior of bellows 29 is greatly reduced, the bellows may contract with the result that valve 27 opens, supplying additional fuel to burner 26 and thus increasing the quantity of heat supplied to tank 10 to cause the liquid fuel therein to be maintained at the proper temperature to vaporize with sufficient rapidity to supply the demand and to maintain the required pressure in pipe 16 and its various branches. When, however, pressure within tank 10 increases, which may be due to an excessive burning in the fire box or a shutting of valve 18 or 21, or some of valves 23, the increased pressure expands bellows 29, thus tending to close valve 27 and reducing the quantity of heat supplied to tank 10. In this way the quantity of heat supplied to tank 10 is automatically made inversely proportional to the pressure therein and a reduction of pressure causes additional heat to be supplied whereas an increase of pressure reduces the heat supplied.

A simultaneous thermostatic control may also be utilized and for this purpose there is illustrated on Fig. 3 a thermostat consisting of container 31 containing a heat expansive fluid operable on a diaphragm 32. This diaphragm is connected by means of a rod 33 to a wedge 34 slidable between a counterpart wedge 35 and an adjusting screw 36. When the temperature within the orange grove is lowered the contraction of the fluid within container 31 causes wedge 34 to be drawn toward the right with the result that the bellows 29 may bodily move upward irrespective of the pressure conditions. The upward movement of the bellows produced by the shifting of the wedge and irrespective of pressure conditions is sufficient to open valve 27 to supply additional fuel to burner 26. It will be understood that when temperature in the grove goes down it becomes desirable to supply additional fuel to the heaters 24 therein. The thermostat in this way increases the heat supplied to tank 10 and thus increases the rate of vaporization of the liquid to supply the demand for this additional fuel in the grove. Likewise, a rise in temperature in the grove causes the thermostat to shift wedge 34 toward the left, thus tending to close valve 27 irrespective of the pressure conditions. It will be understood that where the thermostat is used in conjunction with the bellows that both temperature and pressure variations automatically control valve 27.

The bellows 29 is always urged into uppermost position either by the weight of valve 27 or a counterweight applied to the left hand end of lever 30 or it may be urged into uppermost position by springs (not shown).

It is not essential that the automatic temperature and pressure control for valve 27 be employed. An inferior construction may be provided by using merely a hand operated valve in place of valve 27, which can be roughly adjusted to suit conditions. It is also not essential that the automatic control be located immediately in the neighborhood of the tank. A remote control may be utilized if desired.

The types of heaters which may be used with the improved system may be any conventional heater designed to burn gaseous fuel. We have illustrated two types of heaters which may be employed, one being designed to heat the surrounding atmosphere principally by radiation. This type of heater is illustrated in Fig. 5, consisting of a frusto-conical sheet metal base 37 having air inlets 38. The pipe supplying the fuel is indicated at 39 and extends into the base, having an upwardly directed nozzle 40 which discharges into the throat of a venturi 41. This venturi is supported on the base by means of lugs 42 and has burner perforations 43. A stack 44 is mounted on the base over the venturi and has apertures 45 near its top providing outlets for the products of combustion. On top of the stack there is a cover 46 suspending a reflector 47 of inverted conical shape. The gaseous fuel discharged through nozzle 40 and through the throat of venturi creates an induction of air which mixes with the fuel and the mixture burns issuing through apertures 43 in the stack. The products of combustion issue through apertures 45 and to a certain limited extent heat the air by convection. Much of the heat generated, however, radiates to stack 44 and, in turn, is radiated therefrom through the surrounding air toward adjacent vegetation. The reflector 47 receives considerable heat which rises within the stack and reflects this heat back against the walls of the stack which, in turn, radiates it.

In Fig. 6 there is illustrated a type of heater relied upon to heat the surrounding air principally by convection. This type of heater is designed to warm a large volume of air a few degrees in temperature. This heater consists of a base 50 having air inlet apertures 51, and the supply pipe 52 extends into the base having an upwardly directed nozzle 53 discharging into the throat of a venturi 54 having burner apertures or perforations 55. Thereover there is posi-

tioned a radiator 56 surrounded by a mantle 57. The space between the radiator and the mantle is open at the top and bottom except for supporting brackets or spiders. The top of the radiator is covered by a cover plate 58, immediately beneath which there are apertures 59 for the products of combustion to escape. The fuel in this type of heater on burning heats the radiator 56 principally by radiation and some convection. The mantle 57 receives considerable heat from the radiator by radiation, and air on passing upwardly between the radiator and mantle will be heated by these parts. The air will freely circulate therethrough by convection and will become warmed. In this type of construction the intention is to heat a large volume of air but to heat it only a few degrees, this being sufficient to prevent frost or freezing in adjacent vegetation.

On Fig. 4 there is illustrated a modified form of construction for handling and preparing the fuel. In this type of construction, the storage tank 60 is supported on a fire box 61 having a stack 62. 63 designates a filling valve and 64 a discharge valve. A gauge glass is indicated at 65 for indicating the liquid contents of the tank, Liquefied butane or similar fuel of the butane-propane series is maintained in the tank and is discharged through an outlet 66. In this form of construction the fuel passing through pipe 66 is in liquid form and is not converted into a gas until it reaches the locality of the burner. One type of burner is illustrated on the figure indicated at 67. In this burner it will be noted that a portion of the pipe is bent over the locality of the flame so as to receive heat. Consequently, although liquid butane is fed through pipe 66 directly to the burner and reduction in pressure at the burner enables the butane to vaporize, cooling the liquid in the pipe, the supplying of heat from the burner itself to the liquid counteracts the tendency of the vaporization created by the reduction in pressure to reduce the temperature of the liquid to such an extent that it would otherwise shortly stop the flame at the burner. Consequently, in this type of construction fuel will continue to burn freely at the desired rate. As a means for preserving pressure in the tank, a burner 68 similar to that shown at 67 is located within the fire box and receives fuel through a branch pipe 69 which may be provided with a thermopressurestat valve assembly 70 similar to an automatic valve arrangement such as is illustrated in Fig. 3. If desired, a pressure regulator 71 may be located in line 66, regulating the pressure at which fuel is delivered to the burners which may be lower than that which it is desired to maintain normally in tank 60. The vapor pressure pipe 28 leads from the top of the reservoir to the assembly 27' which includes a valve similar to the valve 27 except that it controls the flow of liquid instead of gases. It is desirable to employ a hand operated valve and to regulate the flow of the liquid fuel to the heating burners as well as to the reservoir burner in addition to the pressure regulator 71.

From the above described constructions it will be appreciated that a novel system is provided enabling the use of hydrocarbons such as butane or other gases of the butane-propane series. The apparatus is such as to enable the butane to be stored in liquid form, thus reducing the storage space required and the continued vaporization of the fuel and the maintenance of the desired pressure without involving a reduction of temperature of the liquid fuel to such an extent that the vaporization will not supply the demand made by the burners.

In Fig. 3 we illustrate in a somewhat diagrammatic manner an instrument which for sake of terminology may be designated as a thermo-pressure-stat. This is an important instrument in regulating the flow of gas to the burner 26 of Fig. 1 or the flow of liquid fuel to the burner 68 of Fig. 4. It will be noted by the prior description in the specification that the control of valve 27 in fuel pipe 25 is by the combined action of the bellows, which is the pressure part of the instrument, and the actuation of the diaphragm 32 which is the thermostat part of the instrument. The control of the supply of fuel is not entirely by the external temperature developing a simple thermostat control nor is it solely by the pressure in the tank as indicated by the bellows 29 but the combination of both of these devices into a single instrument give a control of the fuel to the burners underneath the tank to properly supply the fuel to the burners exposed to external atmosphere as for instance in the orchard heater burners.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

We claim:

1. An apparatus for preparing and using a fuel of the butane-propane type or series, comprising in combination a closed reservoir in which the fuel is maintained in liquid form together with the vaporized fuel, an atmospheric burner exposed to the atmosphere for heating, a conduit from the reservoir to the said burner through which fuel is supplied by the vapor pressure in the reservoir, means to heat the reservoir to replace the heat lost from the liquid due to vaporization of such liquid in the reservoir and a means to regulate the reservoir heater governed by the vapor pressure in the reservoir, together with the atmospheric temperature approximate to the burner, whereby as the vapor pressure decreases, the heat to the reservoir heater is increased and as the atmospheric temperature decreases, the heat of the reservoir heater increases, and vice versa.

2. An apparatus as claimed in claim 1, the reservoir heater comprising a reservoir burner, a fuel connection means from the reservoir to said reservoir burner whereby fuel is forced from the reservoir to the reservoir burner by the vapor pressure in the reservoir and the regulating means comprises a valve in the reservoir burner supply with means to actuate said valve by contraction or expansion of vapors under the vapor pressure of the reservoir and a thermostat exposed to the atmosphere approximate to the atmospheric burner.

3. An apparatus for preparing and using a liquid fuel which volatilizes under ordinary atmospheric conditions for combustion, comprising in combination a closed storage reservoir for containing the liquid fuel at a super-atmospheric pressure, a heater burner, a conduit for conveying fuel from the reservoir to the heater burner, a heater for the reservoir, the heater for the reservoir comprising a reservoir burner for heating such reservoir with a fuel connection means from the reservoir to said reservoir burner for fuel forced to the reservoir burner by the vapor pressure in the reservoir and a means to regulate the flow of the fuel to the reservoir burner governed

by the vapor pressure in the reservoir and the atmospheric temperature approximate to the heater burner whereby as the vapor pressure in the reservoir decreases, the reservoir burner fuel is increased and as the atmospheric temperature decreases, the reservoir burner fuel increases.

4. An apparatus for preparing and using a fuel of the butane-propane type or series comprising in combination a closed reservoir in which the fuel is maintained in liquid form, together with vaporized fuel at the top of the reservoir, a heating burner, a conduit from the upper part of the reservoir to the burner through which fuel gas is supplied by the vapor pressure in the reservoir, a reservoir burner, a gas connection from the reservoir to said reservoir burner with a control valve therein and means to automatically operate said valve whereby as heat is extracted from the liquid fuel in the reservoir by vaporization in the reservoir due to the supply of fuel to the heating burner, the valve is operated to give an increased gas supply to the reservoir burner to thereby add heat for vaporization of the liquid fuel in the reservoir and hence increase the gas supplied to the heating burner and vice versa, the means to automatically operate the valve including a thermostat exposed to the atmosphere approximate to the heating burner whereby as the atmospheric temperature decreases, the opening of the valve is increased and vice versa.

5. An apparatus for preparing and using a fuel of the butane-propane type or series comprising in combination a closed reservoir in which the fuel is maintained in liquid form, together with vaporized fuel at the top of the reservoir, a heating burner, a conduit from the upper part of the reservoir to the burner through which fuel gas is supplied by the vapor pressure in the reservoir, a reservoir burner, a gas connection from the reservoir to said reservoir burner with a control valve therein and means to automatically operate said valve whereby as heat is extracted from the liquid fuel in the reservoir by vaporization in the reservoir due to the supply fuel to the heating burner, the valve is operated to give an increased gas supply to the reservoir burner to thereby add heat for vaporization of the liquid fuel in the reservoir and hence increase the gas supplied to the heating burner and vice versa, the means to automatically operate the valve comprising a means responding to the vapor pressure in the reservoir whereby as the vapor pressure decreases, the said valve is opened and vice versa, and a means including a thermostat exposed to the atmosphere approximate to the heating burner whereby as the atmospheric temperature decreases, the opening of the valve is increased, and vice versa.

6. An apparatus for preparing and using a fuel of the butane-propane type or series, comprising in combination a closed reservoir in which the fuel is maintained in liquid form together with vaporized fuel, a heating burner exposed to the atmosphere for heating, a liquid connection from the reservoir to the burner, a reservoir burner for heating the reservoir, a liquid fuel connection means from the reservoir to said reservoir burner with a valve therein, the fuel being forced to the burners by the vapor pressure in the reservoir and a means to automatically regulate said valve to increase the fuel supply to the reservoir burner in accordance with the liquid fuel required for the heating burner to maintain the desired atmospheric temperature whereby as the heat is extracted from the liquid in the reservoir by vaporization of the fuel, the valve is opened to increase the flow of fuel to the reservoir burner and vice versa, the control means for the liquid fuel valve including a thermostat exposed to the atmosphere in proximity to the heating burner whereby decrease of the atmospheric temperature operates to increase the opening of the valve and vice versa.

7. An apparatus for preparing and using a fuel of the butane-propane type or series, comprising in combination a closed reservoir in which the fuel is maintained in liquid form together with vaporized fuel, a heating burner exposed to the atmosphere for heating, a liquid connection from the reservoir to the burner, a reservoir burner for heating the reservoir, a liquid fuel connection means from the reservoir to said reservoir burner with a valve therein, the fuel being forced to the burners by the vapor pressure in the reservoir and a means to automatically regulate said valve to increase the fuel supply to the reservoir burner in accordance with the liquid fuel required for the heating burner to maintain the desired atmospheric temperature whereby as the heat is extracted from the liquid in the reservoir by vaporization of the fuel, the valve is opened to increase the flow of fuel to the reservoir burner and vice versa, the control means for the liquid fuel valve including a thermostat exposed to the atmosphere in proximity to the heating burner whereby decrease of the atmospheric temperature operates to increase the opening of the valve and vice versa, and including a pressure responsive means connected to the top of the reservoir whereby changes of vapor pressure in the reservoir change the valve opening, a decreasing vapor pressure increasing the valve opening and vice versa.

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