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L. L. PALMER ET AL
COMBUSTION APPARATUS

3,376,100

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2 Sheets-Sheet 1

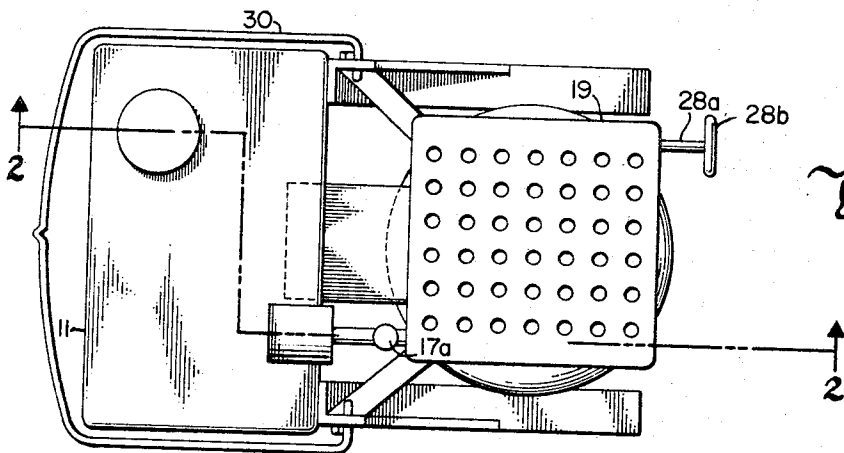


Fig. 1

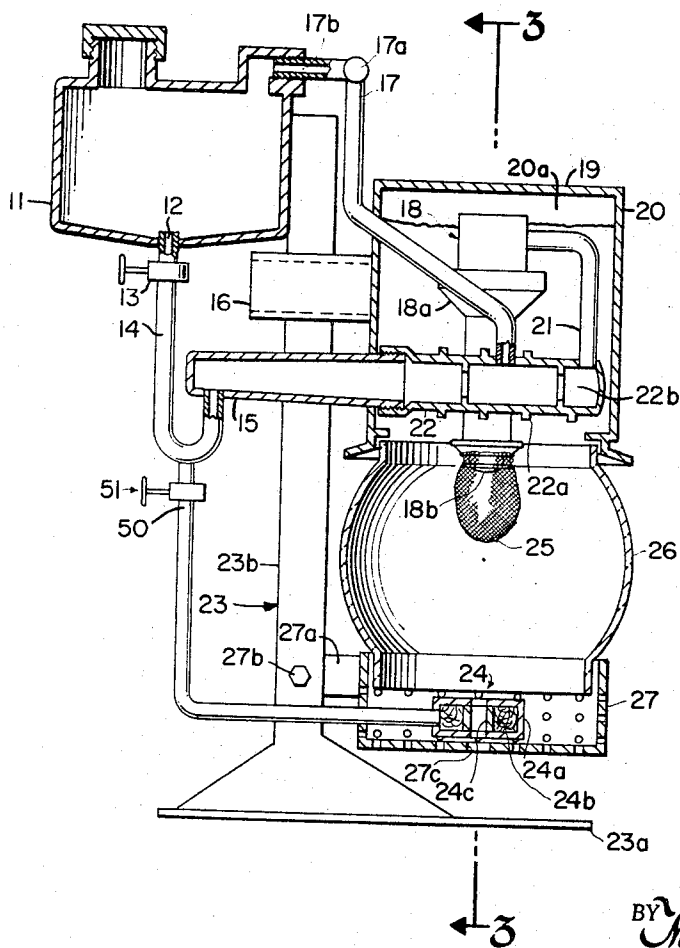


Fig. 2

INVENTORS:
LONDON L. PALMER
ERNEST W. WEAVER, SR.
BY *Myron E. Glick*
-attys

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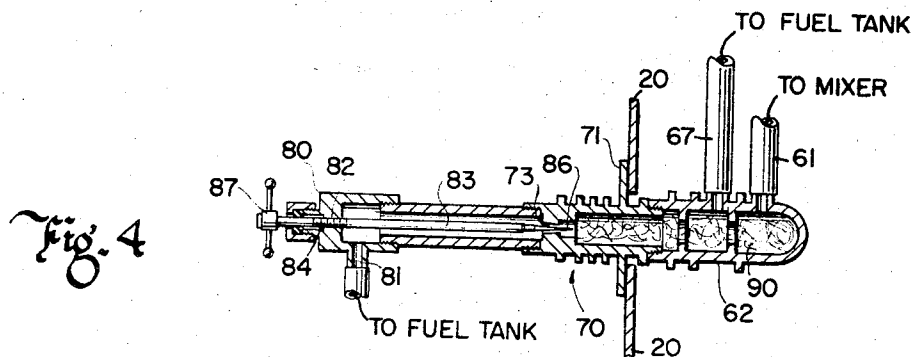
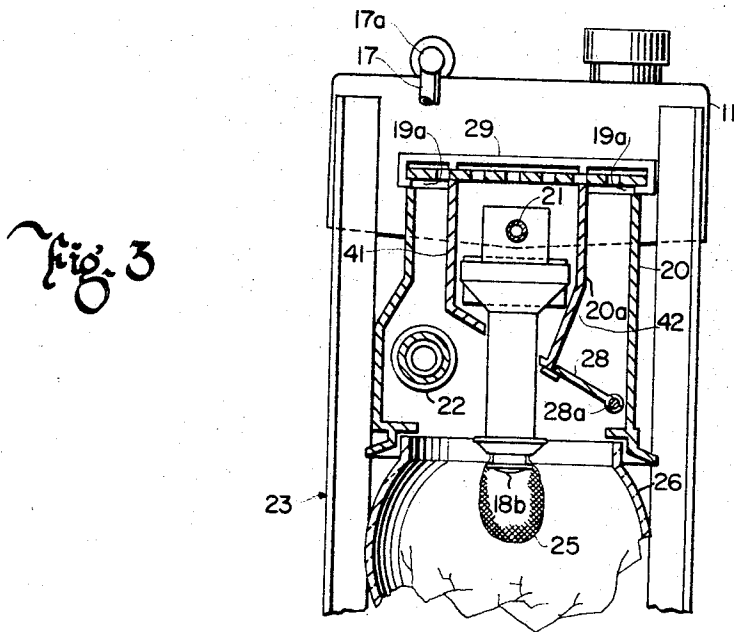
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INVENTORS.
LANDON L. PALMER
ERNEST W. WEAVER, SR.
BY *Myron. E. Ellick*
- atty. -

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COMBUSTION APPARATUS

Landon L. Palmer and Ernest W. Weaver, Sr., Toledo, Ohio, assignors, by direct and mesne assignments, to Alfred E. Rhoden, Toledo, Ohio

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ABSTRACT OF THE DISCLOSURE

Combustion apparatus in which fuel is gravity fed from an air tight container through a valve in a fine, continuous stream to a vaporizer. Heat from the vaporizer is prevented from vaporizing fuel behind the valve so that an exact control over the amount of fuel vaporized, and thus burned, is maintained. Vaporized fuel is fed back to the container to maintain a desired equilibrium of pressure.

This invention relates to combustion apparatus in general, and, particularly to portable combustion apparatus which may be used to provide light, or heat for cooking, and in which vaporizable liquid fuel is used.

There have been a great many attempts in the past to improve the efficiency and safety of heating and lighting devices, particularly of the portable variety. For example, forced air feeds to increase the amount of combustible mixture available for consumption have improved these devices, but have also increased the original cost, maintenance, and problems in handling and storage since most of the devices work from liquid fuels which are highly inflammable and explosive in certain mixtures. Most developments have come in the area wherein the liquid fuel utilized is gasoline. While combustion apparatus which utilizes gasoline is satisfactory in some instances, the nature of the vapor from the gasoline makes it dangerous for use aboard boats and in enclosed areas since the gasoline vapor is heavier than air and tends to collect in the bottom or bilge area of a boat, in the bottom of an enclosed area, and thus is not readily removable by ordinary ventilating systems. Further, if a fire does occur from the use of gasoline, it is difficult to extinguish. Gasoline may also be toxic in contacts with clothes and skin.

While the apparatus disclosed and described herein may use a hydrocarbon fuel such as gasoline, it provides a superior performance with an alcohol such as methyl or ethyl. An alcohol fire can be doused with water since the alcohol is miscible with water while gasoline and kerosene are not. Alcohol is not toxic to the skin or objectionable for contact with clothes. If methyl alcohol is utilized, the combustion end product of CO₂ is more readily attained with ordinary amounts of oxygen available in the air and subsequent efficiency of combustion will avoid the production of CO, thereby avoiding the toxicity of carbon monoxide. This is not true with the fuels having more carbon such as gasoline. Further, alcohol vapor is easily removable by ordinary ventilating systems. However, prior efforts to provide combustion apparatus for alcohol, particularly for use as a lamp, have not proved satisfactory.

Accordingly, it is an object of this invention to provide an improved combustion apparatus.

It is a further object of this invention to provide an improved combustion apparatus which may be utilized to provide light, act as a space heater, or to provide heat for cooking and other uses.

A still further object of this invention is to provide improved combustion apparatus including a closed fuel system, which is safe and easily operable, and which reduces moving parts to a minimum, thereby reducing maintenance problems.

The invention features combustion apparatus which

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comprises a fuel container adapted to be made air tight and a vaporizer means connected to and adapted to vaporize fuel from the container. Means are provided for regulating fuel flow from the container to the vaporizer.

Mixer and burner means are connected to the vaporizer. The container is disposed to provide fuel to the vaporizer by a gravity feed. The burner portion of the mixer and burner means is disposed to heat the vaporizer. Means are provided for feeding back vaporized fuel under pressure to the fuel container. The connecting means between the container and the vaporizer is advantageously made from a material having a relatively low heat conductivity. The vaporizer is preferably made from material having high heat conductivity and further having internal and external fins to aid in the conduction of heat from the burner means to the fuel inside the vaporizer.

The combustion apparatus may further include a starting burner means disposed to heat the vaporizer. The starting burner means may be also utilized to ignite the main burner means. The vapor feed back means may include a check valve means to prevent fuel flow through from the fuel container to the vaporizer. Means are provided for selectively diverting part of the heat from the main burner means away from the vaporizer. If the burner means is being utilized to provide light, an incandescent means is disposed adjacent the burner which is responsive to heat to provide light. If the combustion apparatus is being utilized as a stove or other heating means, then a support grill or other means may be utilized to support items to be heated above the burner means.

Other objects, advantages and features of the invention will become apparent when the following description is taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a plan view of the combustion apparatus embodying the teachings of this invention;

FIGURE 2 is a side elevational view of the apparatus illustrated in FIGURE 1, taken partly in section along the lines 2-2 of FIGURE 1;

FIGURE 3 is a front elevational view of the apparatus of FIGURE 2, taken partly in section along the lines 3-3 of FIGURE 2; and

FIGURE 4 is a cross-sectional view of an alternate fuel feeding device for use herein.

Referring to the drawings, there is illustrated combustion apparatus embodying the teachings of this invention which comprises a fuel tank or container 11 having a strainer means 12 situated in the fuel feed port at the bottom of the tank or container 11. The tank 11 is connected to a vaporizer means 22 via a flow regulating means 13. The means 13 may comprise a valve means which is utilized to provide flow control for the fuel and to shut off the flow of the fuel entirely. A liquid fuel tube 14 having a U-shaped fuel collection section connects the flow regulating means 13 to a vaporizer extension 15. The vaporizer extension 15 is preferably made of stainless steel or some similarly relatively low heat conductivity material, so that liquid fuel will not be partially vaporized in the liquid fuel feed tube 14. The vaporizer means 22 has a plurality of internal and external fins 22a and 22b to improve heat conductivity from the exterior of the vaporizer 22 to the interior thereof.

The vaporizer 22 is connected via a conduit 21 to a mixer and burner assembly 18. This may be any conventional fuel gas or vapor burning device suitable for use herein, for example, one in which a jet of vaporized fuel entrains air through an adjustable air shutter in the mixer portion 18a and presents the mixture at the burner tip 18b for burning. A conduit 16 provides for entry for atmospheric air to the mixer and burner assembly 18 inside an inner housing 20a which excludes entry of combustion products from inside of housing 20. A perforated

top plate 19 of the housing 20 provides release upwardly for the products of combustion from housing 20 and a draft effect for inner housing 20a. Referring to FIGURE 3, it will also be noted that vents 19a have been provided between the top plate 19 and the housing 20 to provide further exit areas for the products of combustion.

Support means generally indicated at 23 may include upright standards 23b and horizontal foot plates 23a to support the combustion apparatus. Strut means 27a and fastening means 27b may be provided to retain in place a perforated globe support 27. A glass globe 26 may be then held securely between the globe support 27 and the housing 20. If the combustion apparatus is being utilized for lighting purposes, a mantle 25 or other suitable incandescent means is supported adjacent the burner 18b to provide incandescence and light in response to heat from the burner 18b.

A starting burner means indicated generally at 24 is advantageously used to heat the vaporizer to get the lamp started. The starting burner 24 may comprise an enclosure or casing 24a having a rock wool fiber or other porous fuel storage means 24b encased in the enclosure 24a and held in position by a porous chimney means 24c, which may be insulating fire brick. Alcohol or other suitable fuel is poured into the porous fuel storage area 24b through a port, not shown, preferably until the fuel storage area is saturated. The fuel will proceed to the interior of the chimney through the porous or pervious chimney liner 24c by capillary action. The starting burner 24 may be ignited by inserting a flame through a perforation 27c in the globe support 27 and into the interior of the chimney 24c. The starting burner 24 may be shut off by inserting a plug into the chimney 24c. The starting burner 24 may be made an integral part of the globe support 27. Sufficient fuel may be put into the fuel absorbing area 24b of the starting burner to provide ignition of the main combustion apparatus.

In operation, the valve or flow regulating means 13 is closed and liquid fuel, preferably alcohol, is put into the tank 11. The vaporizer 22 is then heated for a short time by the starting burner 24. Valve means 13 is opened to provide a flow of liquid fuel to the vaporizer means 22. The liquid fuel is vaporized in the vaporizer 22 which is preferably made of material such as brass which has a good heat conductivity, with the exterior and interior ribs 22a and 22b assisting in heat transfer to the interior of the vaporizer 22. The fuel is vaporized and is fed under pressure through conduit 21 to the mixer means 18a. A jet of vaporized fuel entrains air through an adjustable air shutter and feeds the mixture to the burner 18b. The burner 18b is ignited and the combustion apparatus is in operation.

After a flame appears at burner 18b, the starting burner may be shut off. The flame from 18b heats the vaporizer 22 to continue the vaporizing action. A portion of the vapor from the vaporizer 22 is fed back through conduit 17 to the fuel tank or container 11. This equalizes the pressure and allows fuel to be fed by gravity at the desired rate through the flow regulating means 13. A check valve or other means 17a may be included in the conduit 17 to prevent accidental sloshing or feeding of fuel back through conduit 17 to the vaporizer. Further, the use of a check valve 17a enables the connection of the feed back line 17 to any portion of the tank 11, even below fuel level. However, in most instances the feed back line 17 may be connected at the top of the fuel tank thereby allowing the use of the combustion apparatus without the check valve 17a. If the combustion apparatus is to be used aboard a boat or in other circumstances where there may be considerable pitching and moving about of the combustion apparatus, then the check valve 17a may be desirable. It is advantageous to provide a sized orifice 17b in the outlet end of the feed back conduit 17 in order to maintain a desired balance of pressure or an equilibrium

between the tank 11 and vaporizer 22 for a desired flow rate to the tank and to the burner.

The brightness of the light and/or the rate of fuel burning at the burner tip 18b is regulated by the valve 13. Therefore, if more heat is required for heating material placed above the burner 18b the valve 13 may be opened further. In some instances, the vents 19a at the side of the housing 20 may be sufficient to vent the combustion products and to provide the heat necessary for items placed directly on the perforated top plate 19. However, if it is desired to expose the hot combustion products to a bigger under surface of the item being heated, a grill means 29, such as a wire mesh grill or other suitable apparatus, may be snapped in place on top of the perforated top plate 19 allowing the combustion products to go up through the perforations in the plate 19 and transfer heat to the bottom of the item being heated.

Referring to FIGURE 3, it will be noted that there is provided a double chimney or flue arrangement having separate chimneys 41 and 42. Damper means 28 mounted on a shaft 28a and turnable by knob 28b (FIGURE 1) is provided to selectively divert a part of the heat away from the vaporizer 22. Under normal operations, the damper means 28 is opened to a position resting against the outer wall of the chimney 42 and, in this instance, the housing 20. However, if the combustion apparatus is being operated in a very cold or very windy location, it may be necessary to close the damper means 28 to the position shown in FIGURE 3 to pass all of the exhaust combustion products from the burner 18b past the vaporizer 22 located in chimney 41. This insures sufficient heat to cause the combustion apparatus to continue operation under even the most adverse conditions.

Any liquid fuel can be used in the combustion apparatus, but it is preferably a fuel that will vaporize without leaving any appreciable residue such as tar, carbon or gum. Such fuels include methyl or ethyl alcohols or petroleum distillates or mixtures of these.

Although the combustion apparatus as shown in the embodiments herein has the components thereof arranged for most advantageous use as a lamp primarily and as a heating device secondarily, it is evident that the components can be rearranged or modified to be used as a space heater or a cooking stove primarily. Further, conventional mixing and burning apparatus may be substituted so that the fuel is burned as a torch suitable for metal work. However, the principles of operation are shown in the embodiment illustrated herein which provide a combustion apparatus having a minimum number of moving parts, virtually no maintenance problems, and which provides a combustion apparatus for providing light or heat and which is safe for operation under any conditions and in any location.

Referring again to FIGURE 2, it should be noted that a fuel line 50 may be connected between the tank 11 or, as shown, the bottom of the U of the U-shaped liquid fuel tube 14 and the starter burner 24. A valve means 51 is provided in fuel line 50. The valve 51 may be adapted to meter a predetermined starting charge of fuel to the starting burner 24. The burner 24 may then be utilized as hereinbefore described.

Alternatively, the valve means 51 may be adapted to provide a continuous flow of fuel to burner 24. The burner 24 may then be ignited and burned continuously as a source of heat for the vaporizer, acting as a secondary burner. The burner 18b is then free to be moved to any position desired to furnish light from a different angle or to be moved closer to a cooking support to provide more heat for cooking. The apparatus may now be viewed as having burner means, which includes a primary burner 18b as a primary source of heat and light, and a secondary burner 24 which may be used for starting and for maintaining the vaporizer hot. The first arrangement is preferable when using the apparatus as a light since less fuel is consumed.

Referring to FIGURE 4, there is illustrated an alternative embodiment of a vaporizer and valve control means that may be utilized in the apparatus illustrated in FIGURES 1 through 3. A vaporizer 62 may be utilized which is similar to the vaporizer of the other embodiment, this vaporizer also having a feed back conduit 67 and a mixer-burner feeding conduit 61. However, the vaporizer extension 15 of FIGURE 2 has been eliminated and replaced with a needle-valve seat extension generally indicated at 70, which is secured to vaporizer 62 by a male-female threading arrangement. A large radial fin member 71 may abut against the housing 20 when the extension 70 has been connected to vaporizer 62. A needle-valve seat 73 is formed in the opposite end of the extension 70.

A cap-elbow member 80 is attached to the left end of extension 70 by male-female threading arrangements or other suitable means. The member 80 has a passage 81 for connection to the fuel tank 11 or liquid fuel tube 14 so that fuel is received from the tank for transmission to the vaporizer. A threaded opening 82 is formed in member 80 to receive and guide a needle valve 83 having threads 84 formed thereon which are complementary with threads 82. The threads 82 and 84 cooperate to guide and to provide for advancement to and retraction from the needle means 86 in and out of the needle-valve seat 73 formed in extension 70. In actual practice, an additional cap having compressible packing material therein may be attached to member 80 around the stem 87 of the needle valve 83 as is well known in the prior art to control possible leaks through the threads 82, 84.

Radiation baffle means 90 are placed inside vaporizer 62 and may extend into extension 70. The means 90 may comprise copper strips, stainless steel strips, glass fibers or strips of other material which are not affected by fuel or heat. The primary purpose of the material 90 is to effect a baffling of heat radiation from the vaporizer 62 to the needle valve seat 73 to prevent liquid behind the valve seat from forming pockets of vapor which might interfere with the steady flow of fuel through the needle valve arrangement. The material 90 is not so tightly packed as to require a wick type passage of fuel therethrough, but the strips, fibers, etc., are sufficiently close together to perform the radiation baffling function. Other types of radiation baffles may be used between the vaporizer and the needle valve.

In operation, the apparatus of FIGURE 4 receives fuel from the tube 14 or tank 11. The valve 13 of FIGURE 2 may now be a completely "on" or "off" type to provide an additional safety factor and fuel saving device. Liquid fuel is then delivered to the needle valve arrangement of member 80—extension 70. Under pressure of gravity and the balancing vapor feedback pressure a fine, continuous stream of fuel is delivered to the vaporizer 62 for vaporization. The needle valve arrangement thus allows a very fine control of fuel delivered and a continuous vaporization of the delivered fuel. This is particularly important when smaller quantities of fuel are being delivered when the light is turned down low. Adjustment of fuel delivery and thus the intensity of the light is controlled by the needle valve arrangement.

In contrast, the apparatus of FIGURE 2 delivers fuel over the left inner edge of the extension 15. While this is operational and provides good light and heat, the flow over the edge may be discontinuous on occasion because of the type of fuel, surface tension, very small fuel flow, etc. This results in discontinuous vaporization which, although it does not interfere with the operation, may cause varying intensities of light when operated at the dimmer levels.

It is to be noted that proportional dimensions shown in the drawings are without significance since in some cases dimensions have been enlarged to clearly show the invention. It is also apparent that, within the scope of this invention, modifications may be made as discussed

hereinbefore, the present disclosure being merely illustrative and the following claims covering all variations thereof.

We claim:

1. Combustion apparatus comprising a fuel container adapted to be made airtight, a vaporizer adapted to vaporize fuel from said container, means for regulating fuel flow and the rate of fuel consumption from said container to said vaporizer including a needle valve at one end of the vaporizer for delivering a fine and continuous stream of fuel directly into the vaporizer, mixer and burner means connected adjacent the other end of the vaporizer to receive vaporized fuel directly from said vaporizer, said container being disposed to provide fuel to said needle valve and said vaporizer by gravity feed, means disposed to heat said vaporizer, means for preventing the heat of and in said vaporizer from vaporizing fuel behind said needle valve, and means for feeding back vaporized fuel to said fuel container to equalize pressures and permit gravity flow of fuel from said container.

2. Combustion apparatus as defined in claim 1 in which said heat preventing means includes connecting means between said needle valve and vaporizer which is constructed to have relatively low heat conductivity.

3. Combustion apparatus as defined in claim 1 in which said vaporized fuel feed back means includes check valve means to prevent fuel flow therethrough from said container.

4. Apparatus as defined in claim 1 in which said heat preventing means includes radiation baffle means between said vaporizer and said needle valve.

5. Combustion apparatus comprising a fuel container adapted to be made air tight, a vaporizer adapted to vaporize fuel from said container, means for regulating fuel flow from said container to said vaporizer including valve means for delivering a fine and continuous stream of fuel to the vaporizer, mixer and burner means connected to said vaporizer, said container being disposed to provide fuel to said vaporizer and valve means by gravity feed, said burner means disposed to heat said vaporizer, means for preventing the heat of and in said vaporizer from vaporizing fuel behind said valve means, means for feeding back vaporized fuel under pressure to said fuel container, double chimney means, and means for selectively diverting part of the heat from said burner means away from said vaporizer and up one of said chimneys.

6. Combustion apparatus comprising a fuel container adapted to be made air tight, a vaporizer adapted to vaporize fuel from said container, means for regulating fuel flow from said container to said vaporizer including valve means for delivering a fine and continuous stream of fuel to the vaporizer, mixer and burner means connected to said vaporizer, said container means being disposed to provide fuel to said vaporizer and valve means by gravity feed, means disposed to heat said vaporizer, radiation baffle means for preventing the heat of and in said vaporizer from vaporizing fuel behind said valve means including strips of material disposed in said vaporizer to effect a baffling of heat radiation from said vaporizer to said valve means, and means for feeding back vaporized fuel under pressure to said fuel container.

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JAMES W. WESTHAVER, *Primary Examiner*.