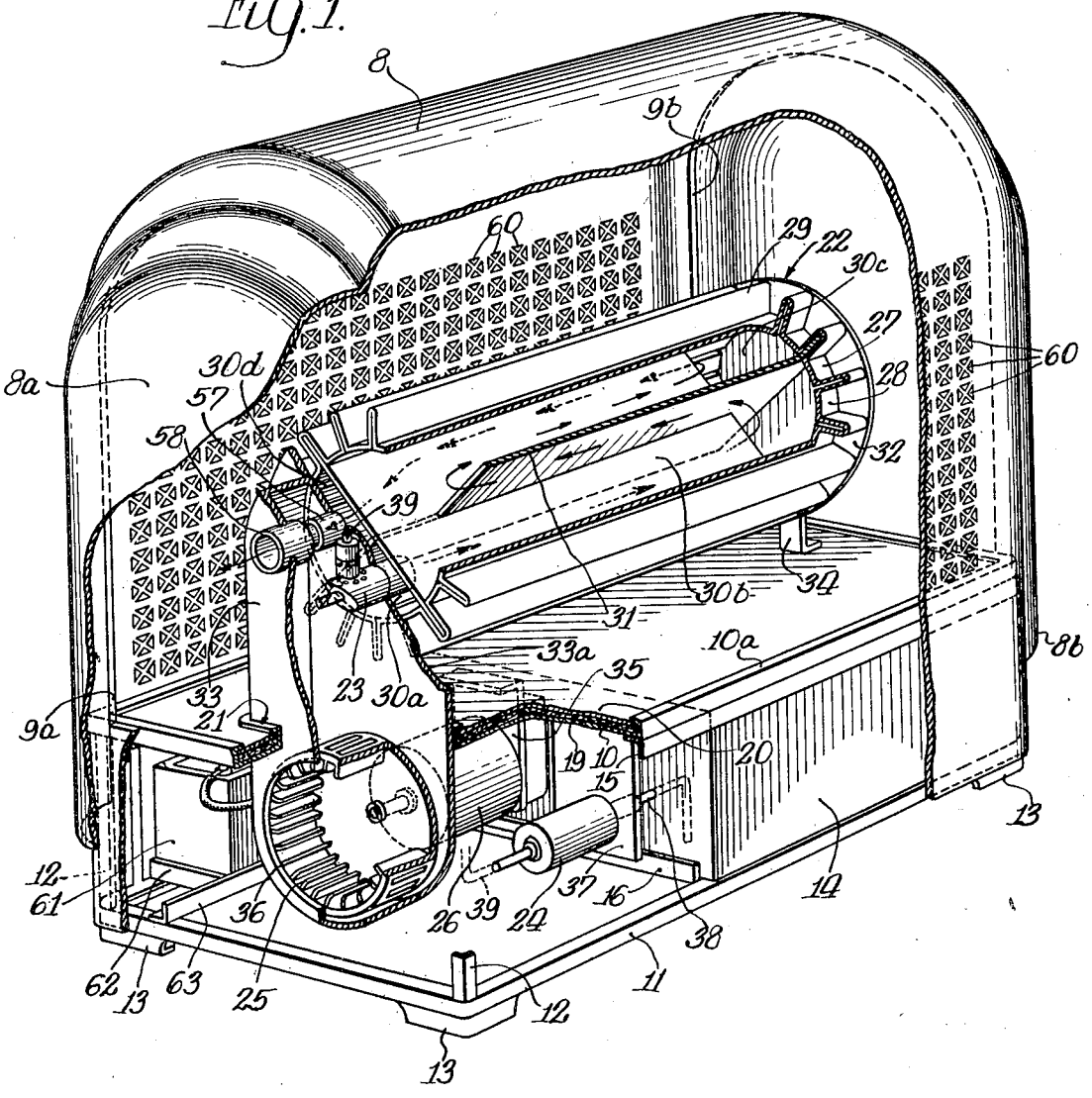
March 19, 1946. H. B. HOLTHOUSE 2,396,657

PORTABLE HEATER

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Fig. 1.



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PORTABLE HEATER

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Fig. 3.

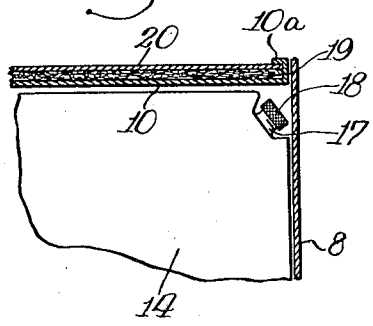


Fig. 2.

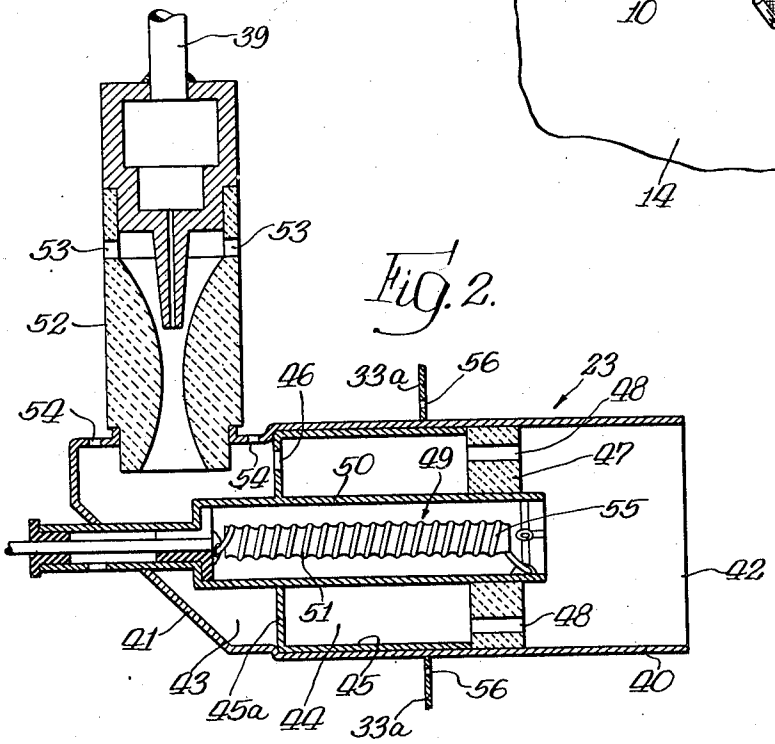
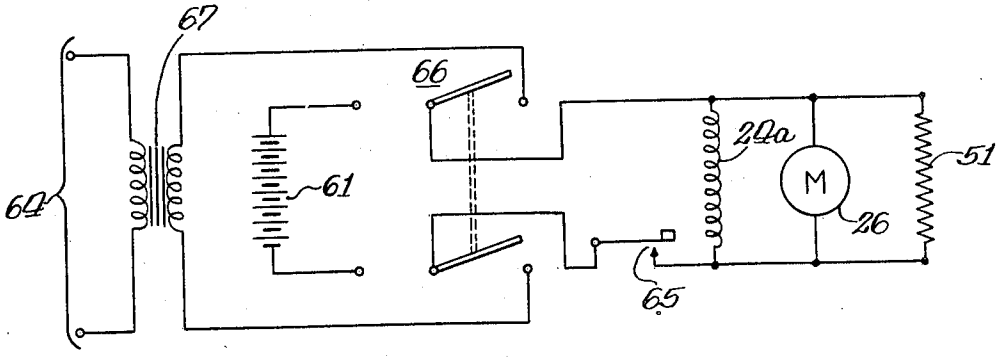


Fig. 4.



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2,396,657

PORTABLE HEATER

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Application July 17, 1943, Serial No. 495,153

7 Claims. (Cl. 126—93)

The present invention relates to portable self-contained air heaters and has for one of its objects the provision of an improved and completely self-contained air heater which is light in weight and operates with high efficiency.

It is another object of the invention to provide an improved portable air heater of the combustion type which utilizes electrical equipment exclusively in the delivery of fuel to the combustion chamber and in producing efficient combustion of the fuel within the combustion chamber.

According to another object of the invention, all heated parts of the heating unit are enclosed to provide for maximum safety of heat radiation, by utilizing an apertured heat radiating cover which is readily detachable to permit servicing of the heater unit and filling of the fuel reservoir which is built into the unit.

It is a still further object of the invention to provide an improved portable liquid heater of the character described which is simple in arrangement, rugged in construction, is comprised of a minimum number of parts, and is adapted for efficient operation over a prolonged service life with but a minimum of servicing.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which:

Fig. 1 is a corner perspective view, partially in section, illustrating a portable air heater characterized by the features of the present invention;

Fig. 2 is a side sectional view of certain of the parts provided in the heater shown in Fig. 1;

Fig. 3 is a fragmentary sectional view illustrating certain other parts provided in the heater; and

Fig. 4 is a circuit diagram illustrating in schematic form the circuit arrangement of the electrically operated parts of the heater shown in Fig. 1.

Referring to the drawings and more particularly to Fig. 1 thereof, the improved portable radiant air heater there illustrated comprises a supporting structure of substantially rectangular form having a base 11 and a dividing wall 10 arranged in spaced-apart relation one above the other in the order named. At the left ends of the wall 10 and base 11, a pair of corner columns 12 are provided to maintain the two named parts of the supporting structure in spaced-apart relation. The base 11 is provided with four corner feet 13 which serve to maintain the lower edge surfaces of the structure above the floor or other surface upon which it is supported. A fuel reservoir in the form of a tank 14 is provided between the wall 10 and the base 11, this tank having its lower side edges resting upon the upper edge of the base 11 and its upper side edges embraced by L-shaped members 15 which bear against the under edge surfaces of the wall 10 and are suitably secured thereto. At its lower left edge, as viewed in Fig. 1 of the drawings, the tank 14 is supported by an L-shaped cross member 16 which extends between and is secured at its ends to the side portions of the base 11. This tank is rigidly mounted between the wall 10 and the base 11 in the illustrated position thereof and serves to support the wall 10 at the right end portion thereof. It includes a fuel inlet neck 17 which is threaded to receive a cover cap 18 and is provided in an inset edge portion of the tank, in the manner shown in Fig. 3 of the drawings, beneath the right end portion of the wall 10.

As pointed out below, the heat radiating structure of the unit is disposed above the wall 10. For the purpose of preventing the radiated heat energy from being transmitted to liquid fuel within the tank 14, a heat insulating wall 19 is provided directly above the wall 10. More specifically, the wall 10 is covered with a layer of asbestos material or the like, which is maintained upon the top surface of the wall by means of a superimposed metal wall 20, the edge portions of which are embraced within the beaded or flanged edges 10a of the supporting wall 10. Again referring to Fig. 3 of the drawings, it will be noted that the heat insulating wall 19 is coextensive with the upper surface of the tank 14 so that it covers the inlet neck 17, thereby to prevent heat from being radiated to this portion of the fuel reservoir. The composite wall structure as made up of the three identified parts 10, 19 and 20, is also provided with an opening 21 which is utilized for a purpose to be later described.

Briefly considered, the heating unit as provided in the portable heater, comprises a heating structure 22 which is supported above the wall 20 and has a combustion chamber formed therewithin, a fuel conditioning unit 23, an electrically operated fuel pump 24 for delivering fuel from the tank 14 to the fuel conditioning unit 23, and air moving means in the form of a fan 25 which is driven by an electric motor 26 to supply combustion air to the fuel conditioning unit 23

and the combustion chamber formed within the heating structure 22. More specifically considered, the structure 22 comprises a tubular body 27 of unit construction which is provided with alternate peripheral sections 28 and radially extending fin elements 29. The fin elements 29 are bent double so that their inner ends are open to the bore or space within the tubular member 27. This space is divided axially into four series connected passages 30*a*, 30*b*, 30*c* and 30*d* by means of a substantially X-shaped partition member 31. The edge portions of the partition member 31 are fitted within the upper open ends of certain of the fin elements 29 and are welded therein to provide a rigid assembly. At its right end, as viewed in Fig. 1 of the drawings, the combustion chamber is closed by means of a plate 32 which is seam welded to the adjacent edge portions of the tubular member 27 to seal the end of this member against the escape of combustion gases from the combustion chamber. At its left end, the tubular member 27 is sealed by the inner wall portion 33*a* of a housing shell 33 which fits within the opening 21 extending through the composite partition wall 10, 19, 20. This shell completely covers the open end of the tubular member 27 and the end openings into the fins 29 and is welded to the edge surfaces of the tubular member to seal the left end of this member against the escape of combustion gases from the combustion chamber. The housing shell 33 is also provided with three additional side walls which enclose the fuel conditioning unit 23 and the air moving fan 25 to provide an air pressure chamber from which combustion air may be delivered to the fuel conditioning unit and the combustion chamber. More specifically, the shell 33 fits snugly within the partition wall opening 21 and is suitably secured within this opening to provide a rigid support for the left end of the tubular member 27. At its right end, this member is supported upon the composite wall structure by means of a suitable bracket piece 34.

The fan and motor assembly is likewise supported from the partition structure at the underside thereof. Thus, the motor 26 is mounted upon the underside of the partition wall 10 by means of a bracket piece 35, and the motor shaft is journaled within a bearing member provided in the wall 33*a* of the housing shell 33. This shaft extends within the housing shell to support the fan 25 opposite an air admission port 36 which is cut in the left side wall of the shell 33. The electrically operated fuel pump 24 is likewise mounted upon the underside of the partition wall 10 by means of a bracket piece 37. This pump is of the electromagnetically actuated type and may be of any desired commercial construction. At its inlet side, this pump is connected to the fuel reservoir by means of an inlet tube 38 which is sealed within an opening provided in the end wall of the tank 14 and includes a downwardly extending neck opening at a point adjacent the bottom of the tank. The outlet side of the pump 24 is connected to the air conditioning unit 23 by means of a second conduit 39 which extends through an opening provided in the partition wall structure 10, 19, 20.

As best shown in Fig. 2 of the drawings, the fuel conditioning unit 23 includes a housing 40 which is closed at one end 41 and is open at its opposite or outlet end 42 for fluid connection with the passage 30*a* of the combustion chamber. This tubular member is seam welded within a fuel inlet opening provided in the shell wall 33*a* at a point overlying the mouth of the passage 30*a*, so that its open end 42 is disposed well within the combustion chamber passage 30*a* and its closed end 41 is disposed within the pressure chamber of the shell 33. The tubular member 40 is formed of a relatively high heat conductive material and includes an air and fuel mixing chamber 43 adjacent the closed end thereof and an equalizing chamber 44 disposed centrally thereof. These two chambers are separated by the heat conductive partitioning end wall 45*a* of a cup 45 which is telescoped within the tubular member 42. More specifically, the two chambers 43 and 44 are in fluid connection through perforations 46 which extend over the upper portion of the partition wall 45*a*. The equalizing chamber 44 is in turn separated from the passage 30*a* of the combustion chamber by a heat insulating plate 47 having perforations or ports 48 arranged peripherally thereof. An electric heating unit 49 is positioned axially within the tubular housing member 40 and is suitably mounted within axially aligned openings provided in the two walls 45*a* and 47 and the end wall 41 of the tubular housing member. This unit comprises a tubular shell 50 having disposed therewithin a resistance heating wire element 51 which extends through that portion of the tubular member 40 within which the mixing and equalizing chambers are formed.

The fuel conditioning unit 23 also supports a fuel injection nozzle 52 which opens into the mixing chamber 43 and is supported within an opening provided in the tubular member 40 at a point adjacent the closed end 41 thereof. This nozzle terminates one end of the fuel conduit 39 extending to the outlet side of the pump 24, and is provided with air ports or apertures 53 for admitting air from the pressure chamber into the fuel stream within the nozzle. Additional air is supplied to the mixing chamber 43 directly from the pressure chamber through openings 54 formed in the closed end 41 of the tubular member 40 around the fuel injection nozzle 52. During normal operation of the heater, the fuel admitted into the mixing chamber 41 from the nozzle 52 is directed against that portion of the tube 50 which is disposed within the mixing chamber 43 and also against the walls of the mixing chamber. Because of the high heat conductivity of the tubular member 40 and its thermal connection with the partition plate 45*a* and the tubular member 40, the enumerated parts are readily and rapidly heated to at least a fuel vaporizing temperature upon energization of the resistance element 51.

The vaporization of the fuel within the mixing chamber 43 facilitates the mixture thereof with the air supplied to the mixing chamber, so that a substantially complete vaporous air and fuel mixture passes into the equalizing chamber 44 through the perforations 46 in the partition plate 45*a*. The equalizing chamber 44 functions to reduce the degree of turbulence of the mixture and, together with the partition plate 48, serves to disperse the mixture uniformly over the cross-sectional area of the conditioning unit outlet end 42. A mixture of substantially uniform fuel density is thus admitted into the passage 30*a* of the combustion chamber for burning. The combustion of the mixture is initiated by the passage of the mixture about the end 55 of the resistance element 51, the degree of ignition heat provided at this end of the resistance element

being determined essentially by the wattage input to the resistance element. For the purpose of supplying additional combustion air to the fuel mixture injected into the combustion passage 30a from the conditioning unit 23, the housing shell end wall 33a is provided with ports 56 arranged around the tubular housing shell 40. These ports communicate with the combustion chamber passage 30a and the pressure chamber within the shell 33. Combustion gases developed by the burning of the fuel mixture within the connected passages 30 are exhausted from the combustion chamber by a pair of tubular members 57 and 58 which communicate with the combustion chamber passage 30d through an opening in the wall 33a of the shell 33. More specifically, the smaller tubular member 57 is mounted within the opening through the wall 33a and is provided with one end which extends within the passage 30d and with an opposite end disposed adjacent the inner end of the larger tubular member 58. The last-mentioned member is anchored within an opening through the opposite side wall of the housing shell 33 so that combustion gases transmitted through the two tubular members are exhausted to the atmosphere. If desired or necessary, a flexible hose connected to the outwardly extended end of the tubular member 58 may be used to conduct the combustion gases outside of the room or other closed space within which the heater is located. With the two members 57 and 58 arranged in the manner just described, an annular space is provided between the adjacent open ends thereof, which space communicates with the pressure chamber within the shell 33. Thus, during operation of the fan 25, air is driven through the tubular member 58 to create a suction or low pressure vacuum at the mouth of the exhaust opening from the combustion chamber passage 30d, whereby scavenging of the products of fuel combustion from the combustion chamber is efficiently effected.

For the purpose of enclosing all parts of the heating unit described above, thereby to prevent those parts of the heater which are raised to high temperatures from being contacted during operation of the heater and to enhance the pleasing appearance of the heater, an apertured cover or housing 8 is provided. This cover is adapted to be telescoped over the heater unit so that the side walls thereof snugly embrace the sides of the supporting structure, and is provided with stepped skirt portions 8a and 8b at opposite ends thereof which are spaced outwardly from the ends of the supporting structure and stop short of the lower side edges of the cover. Preferably, the cover 8 is formed of a decorative, heat resistant plastic material so that any desired artistic color effect may be obtained. The ends of the supporting structure are embraced by end members 9a and 9b which extend transversely of the cover 8 at the ends thereof and are edge mounted within the cover. These end members are respectively provided with enlarged openings, the lower edges of which are substantially flush with the top edge of the flange 10a formed about the partition wall 10, so that heat may be radiated directly against the inner surfaces of the cover skirt portions 8a and 8b. Suitable stop means may be provided within the cover 8 for engaging the flange 10a during downward movement of the cover in order to prevent the lower edge portion of the cover from projecting beneath the lower edge of the base 11.

The sides of the cover 8 are provided with a symmetrical pattern of heat radiating apertures 60. While the configuration of the apertures may be of any desired form, a pleasing appearance is imparted to the cover structure by utilizing the illustrated pattern, wherein each set of four triangular shaped apertures is of substantially square configuration and the several sets of apertures are arranged in horizontal and vertical alignment to cover rectangular areas at each side of the cover.

In order to provide for operation of the heater without electrical attachments to a source of electrical current, a storage battery 61 may be incorporated in the structure for the purpose of energizing the electrically operated parts of the heater. As shown in Fig. 1 of the drawings, this battery is mounted upon the cross piece 16 and the base portions of the right angularly disposed flanged members, two of which are illustrated at 62 and 63 as being supported upon the base 11 and the cross piece 16. The third flanged member, not shown, extends parallel to the illustrated member 63 and is mounted upon the upper edge of the base 11. With this arrangement, the flanges of the three flanged members define a seat within which the lower edges of the battery 61 may be confined to restrain the battery against longitudinal or transverse movement relative to the remaining parts of the heater structure.

The electrically operated parts of the heater may be arranged for parallel energization, either from the storage battery 61 or from any other available current source of appropriate voltage. To this end, the heating element 51, the fan driving motor 26 and the operating winding 24a of the solenoid fuel pump 24 may be connected in parallel in the manner illustrated in Fig. 4 of the drawings. These three elements may be connected for energization from the battery 61 or a source of current indicated by the bracketed terminals 64 through the contacts of an on-off switch 65 and the contacts of a double-pole throw switch 66. In order to adapt the three elements 24a, 26 and 51 for selective energization from the battery 61 or an available 110 volt source of commercial current, for example, a voltage step-down transformer 67 is connected between the terminals 64 and the external source terminals of the switch 66. The three circuit elements 65, 66 and 67 may, if desired, be mounted upon the base 11 beneath the partition wall structure 18, 19, 20 in any suitable manner. Preferably, however, the on-off switch 65 is so arranged that the operating element therefor may be actuated without removal of the cover 8 from the supporting structure. This may be accomplished by providing a suitable edge recess along one side of the cover 8, which recess is telescoped over the operating element of the switch 65 as the cover 8 is positioned over the supporting structure.

In utilizing the above-described heater for the heating of a desired space, operation of the unit may be initiated by supplying current to the motor 26, the operating winding 24a of the pump 24 and the heating element 51 by operation of the on-off switch 65 to its closed circuit position. The three enumerated elements may obviously be energized either from the battery 61 or through the transformer 67 from a current source connected to the terminals 64, depending upon the position of the double pole—double throw switch 66. When the motor 26 is energized, the resulting operation of the fan 25 causes air to be sucked into the pressure chamber within the shell 33

beneath the lower edges of the base 11 and through the opening 36 in the housing shell 33. As a result, the pressure of the air confined within the shell 33 is increased above atmospheric pressure so that air is forced into the fuel conditioning unit 23 through the ports 53 and 54, and into the passage 30a of the combustion chamber through the ports 56. Air is also forced outwardly through the tubular member 58 to effect scavenging of the combustion chamber in the manner explained above. Incident to the operation of the pump 24, fuel is withdrawn from the fuel tank 14 and delivered through the conduits 38 and 39 to the injection nozzle 52, and is transmitted through this nozzle to the mixing chamber 43 for mixing with the combustion air. From this point, the fuel mixture is transmitted through the tubular member 40 and is ignited at the open end 42 of this member in the exact manner previously explained. Combustion of the gases continues throughout the four connected passages 30 of the combustion chamber so that heat energy is conducted through the walls and fins of the structure 27 to the air confined within the cover 8. The completely burned combustion gases are finally exhausted through the aligned tubular members 57 and 58.

From the above explanation it will be understood that the transfer of heat from the combustion chamber to the air within the cover 8 is accomplished in a highly efficient manner, since substantially the entire surface of the walls which confine the combustion chamber are exposed for heat conduction therethrough. Accordingly, the temperature of the air surrounding the structure 27 is rapidly raised to cause circulation of the air through the apertures 60 of the cover 8. Thus, a thermally induced flow of air through the apertured cover 8 is produced which serves to disperse the heated air throughout the area within which the heater is disposed. In this regard it may be pointed out that the walls of the structure 27 are heated a cherry red during operation of the heater and may be viewed through the apertures 60 of the cover to provide a pleasing appearance.

If it is desired to inspect any part of the heater unit, to remove the storage battery 61 from its supporting seat for charging, or to refill the fuel tank 14, such operations may be readily accomplished by lifting the cover 8 off of the supporting structure to expose all parts of the unit, including the fuel refilling neck 17 of the tank 14. Thus, it will be understood that all parts of the heater are readily accessible for inspection and repair and that the tank 14 may be easily refilled as required. It will also be understood that with the cover 8 enclosing the heating unit, none of the heated parts of the unit are exposed for direct contact. Accordingly, there is no danger of a person being burned through contact with the heater, and the possibility of inflammable materials being brought into contact with heated parts of the unit is minimized. Moreover, the presence of the heat insulating wall 19 between the heated parts of the unit and the fuel tank 14 positively prevents the liquid fuel within the tank from being raised to its ignition temperature.

While one embodiment of the invention has been disclosed, it will be understood that various modifications may be made therein, which are within the true spirit and scope of the invention.

I claim:

1. A self-contained portable air heater comprising a supporting structure provided with a base and a wall supported above said base, a fuel reservoir mounted upon said base, a heating unit supported above said wall and including means defining a combustion chamber having a fuel inlet opening therein, a fuel conditioning unit provided with means for discharging a mixture of fuel and air into said combustion chamber, electrically operated ignition means for igniting the fuel mixture within said combustion chamber, electrically operated means supported between said wall and said base and operative to deliver fuel from said reservoir and air to said fuel conditioning unit, a heat insulating wall interposed between said heating unit and said fuel reservoir, and an apertured cover adapted to be telescoped downwardly over said supporting structure to provide an apertured air heating chamber within which said combustion chamber is substantially centrally disposed.

2. A self-contained portable air heater comprising a supporting structure provided with a base and a wall supported above said base, a fuel reservoir mounted upon said base, a heating unit supported above said wall and including means defining a combustion chamber having a fuel inlet opening therein, a fuel conditioning unit provided with means for discharging a mixture of fuel and air into said combustion chamber, electrically operated fuel preheating and ignition means included in said fuel conditioning unit, electrically operated means supported between said wall and said base and operative to deliver fuel from said reservoir to said fuel conditioning unit, electrically operated air moving means also supported between said wall and said base beneath said fuel conditioning unit, said wall having an opening therein above said air moving means, means including a housing shell fitting within said opening for providing a pressure chamber within which said air moving means and said fuel conditioning unit are disposed, and a heat insulating wall interposed between said heating unit and said fuel reservoir.

3. A self-contained portable air heater comprising a supporting structure provided with a base and a wall supported above said base, a fuel reservoir mounted upon said base, a heating unit supported above said wall and including means defining a combustion chamber having a fuel inlet opening therein, a fuel conditioning unit provided with means for discharging a mixture of fuel and air into said combustion chamber, electrically operated fuel preheating and ignition means included in said fuel conditioning unit, electrically operated means supported between said wall and said base and operative to deliver fuel from said reservoir to said fuel conditioning unit, electrically operated air moving means also supported between said wall and said base beneath said fuel conditioning unit, said wall having an opening therein above said air moving means, means including a housing shell fitting within said opening for providing a pressure chamber within which said air moving means and said fuel conditioning unit are disposed, a heat insulating wall interposed between said heating unit and said fuel reservoir, and an apertured cover adapted to be telescoped downwardly over said supporting structure to provide an apertured air heating chamber within which said combustion chamber is substantially centrally disposed.

4. A self-contained portable heater comprising

a supporting structure provided with a base and a wall supported above said base, a fuel reservoir mounted upon said base beneath said wall, a heating unit supported above said wall and including means defining a combustion chamber having a fuel inlet opening therein, a fuel conditioning unit provided with means for discharging a mixture of fuel and air into said combustion chamber, electrically operated means for igniting the fuel mixture within said combustion chamber, electrically operated means supported between said wall and said base and operative to deliver fuel from said reservoir and air to said fuel conditioning unit, and an apertured cover adapted to be telescoped downwardly over said supporting structure to provide an apertured chamber within which said combustion chamber is disposed.

5. Portable heating apparatus comprising a supporting structure provided with a base and a wall disposed above said base, a fuel reservoir mounted upon said base beneath said wall, a heating unit supported above said wall and including means defining a combustion chamber having a fuel inlet opening therein, a fuel conditioning unit disposed above said wall and provided with means for discharging a mixture of fuel and air into said combustion chamber through said inlet opening, electrically operated fuel preheating means included in said fuel conditioning unit, electrically operated means for delivering fuel from said fuel reservoir to said conditioning unit, electrically operated air moving means supported between said wall and said base beneath said fuel conditioning unit, said wall having an opening therein above said air moving means, and means cooperating with said opening to provide a pressure chamber within which said air moving means and said fuel conditioning unit are disposed.

6. Portable heating apparatus comprising a supporting structure provided with a base and a wall disposed above said base, a fuel reservoir mounted upon said base beneath said wall, a heating unit supported above said wall and including means defining a combustion chamber having fuel inlet and exhaust openings therein, a fuel conditioning unit disposed above said wall and provided with means for discharging a mixture of fuel and air into said combustion chamber through said inlet opening, electrically operated fuel preheating means included in said fuel conditioning unit, electrically operated means for delivering fuel from said fuel reservoir to said conditioning unit, electrically operated air moving means supported between said wall and said base beneath said fuel conditioning unit, said wall having an opening therein above said air moving means, means including a housing shell fitting within said opening for providing a pressure chamber within which said air moving means and said fuel conditioning unit are disposed, and tubular means extending across said pressure chamber and communicating with said exhaust opening to transmit exhaust gases from said combustion chamber to the atmosphere, said tubular means communicating with said pressure chamber to transmit air to the atmosphere and thus produce a low pressure at said exhaust opening.

7. A self-contained portable heater comprising a supporting structure provided with a base and a wall disposed above said base, a fuel reservoir mounted upon said base beneath said wall, a heating unit supported above said wall and including means defining a combustion chamber having a fuel inlet opening therein, a fuel conditioning unit disposed above said wall and provided with means for discharging a mixture of fuel and air into said combustion chamber through said inlet opening, electrically operated means for delivering fuel from said fuel reservoir to said conditioning unit, electrically operated air moving means supported between said wall and said base beneath said fuel conditioning unit, said wall having an opening therein above said air moving means, means cooperating with said opening to provide a pressure chamber within which said air moving means and said fuel conditioning unit are disposed, and an apertured cover adapted to be telescoped downwardly over said supporting structure to provide an apertured chamber within which said combustion chamber is disposed.

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