Nov. 21, 1944. B. W. TULLIS 2,363,098

BURNER FOR FUELS CONTAINING TETRAETHYL LEAD

Filed Jan. 12, 1942 2 Sheets-Sheet 1

Fig. 1.

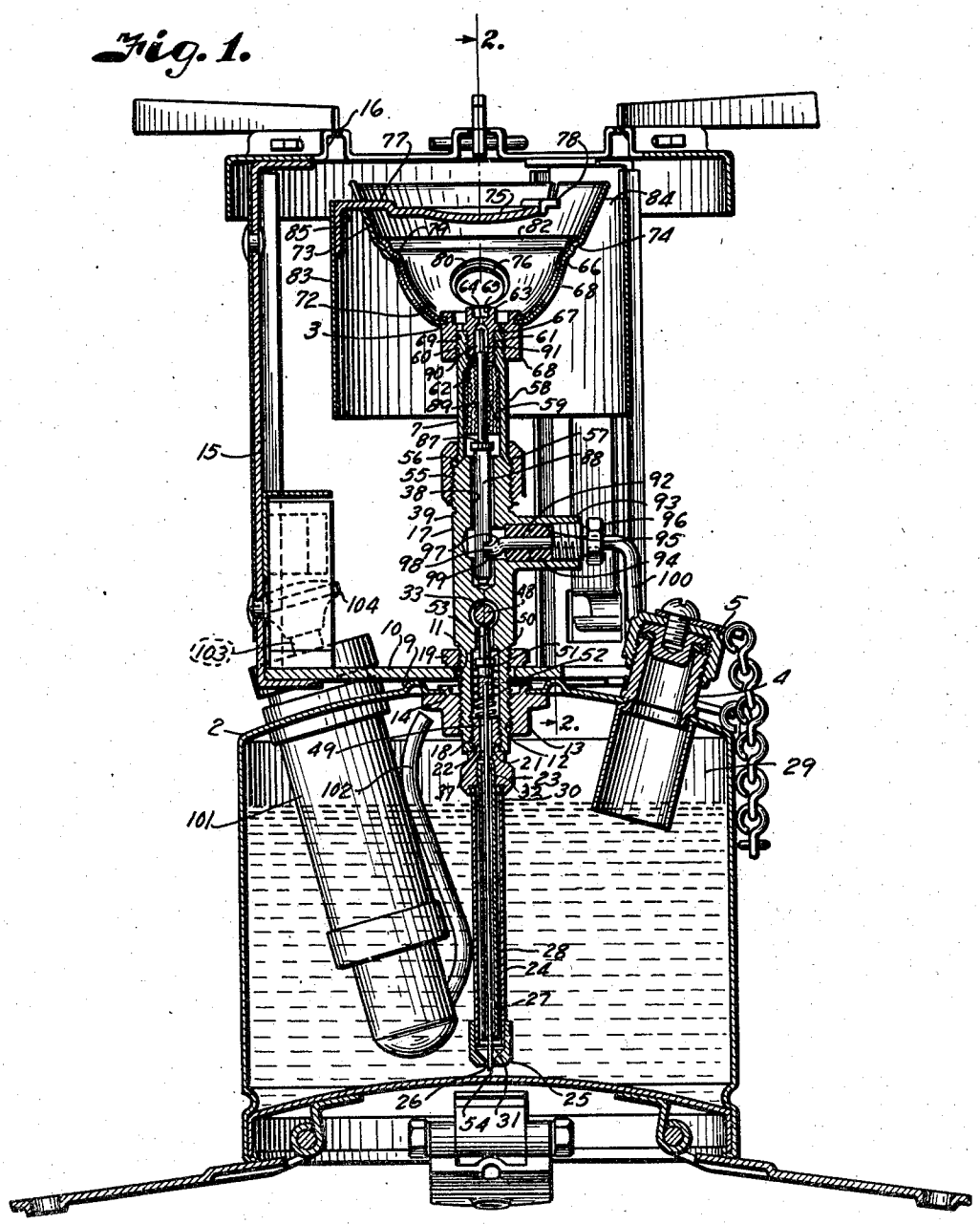

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Fig. 2.

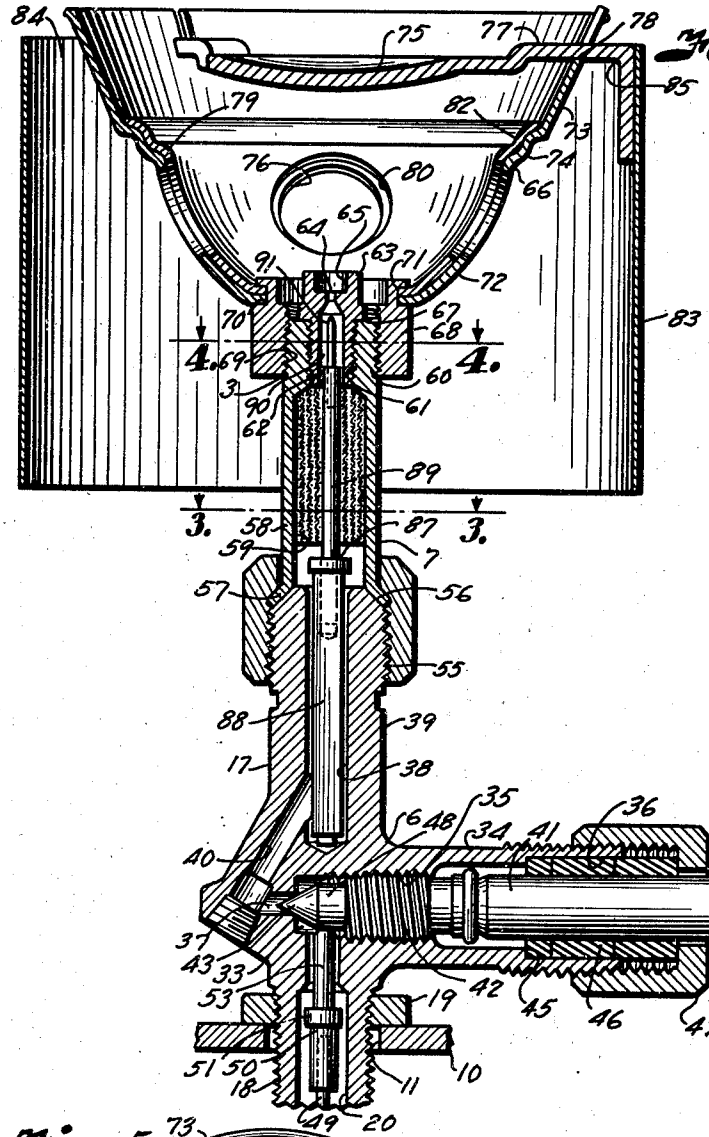


Fig. 3.

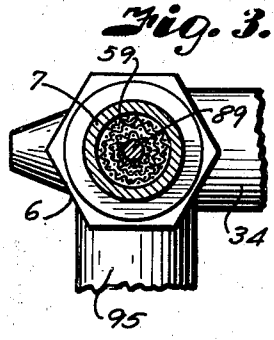


Fig. 5.

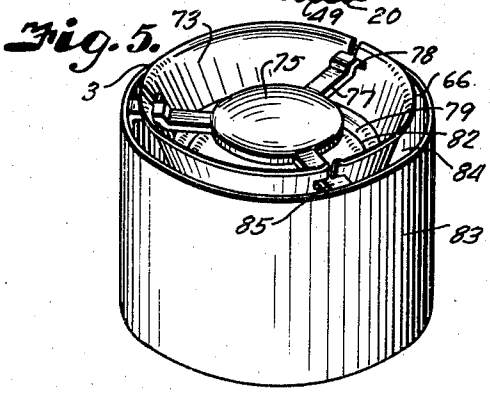
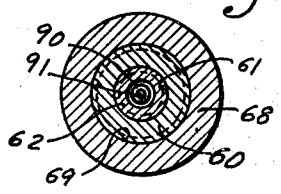


Fig. 4.



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UNITED STATES PATENT OFFICE

2,363,098

BURNER FOR FUELS CONTAINING TETRAETHYL LEAD

Boyd W. Tullis, Wichita, Kans., assignor to The Coleman Lamp and Stove Company, Wichita, Kans., a corporation of Kansas

Application January 12, 1942, Serial No. 426,420

9 Claims. (Cl. 158—67)

This invention relates to liquid fuel burning appliances and particularly those for burning low boiling point petroleum hydrocarbons such as straight run gasolines and naptha. However, fuels of this type are not always conveniently obtainable and in many localities are not available when needed. Consequently attempts have been made to use present day automotive or motor fuels as they are always convenient to obtain even at the most remote outpost of civilization, but fuels of this character have not functioned in such appliances for the reason that they contain considerable solid material such as hydrocarbon gums and coloring materials, as well as antiknock compounds, for example tetraethyl lead. When these materials pass through the extremely hot zone of the generating devices of such appliances they clog the generators within a very few hours burning time. This is attributed to carbonizing of the gums and decomposition of the tetraethyl lead within the generator by reason of the intense heat required to effect complete vaporization of the fuel before it is supplied to the burners of the appliances.

It is, therefore, the purpose of the present invention to provide a burner structure and arrangement thereof which operates satisfactorily using automotive fuels containing tetraethyl lead and other extraneous materials which ordinarily cause clogging of conventional equipment.

Another object of the invention is to provide a simple and inexpensive burner structure for a great variety of cooking and heating appliances and which is particularly adapted for military use and for general utility use by motorists, hunters, sportsmen and exploration parties, because a suitable fuel for the burner is always near at hand, namely the fuel tank of their motor vehicle, aircraft, motor boat, or the like.

Further objects of the invention are to incorporate with the burner features permitting use of motor fuels, instant lighting by air atomization of the fuel, a shield for limiting external cooling effects upon the bowl of the burner, and a mechanism for cleaning the discharge orifice of the vaporizer.

In carrying out my invention, I find that automotive fuels and the like may be used successfully by initially vaporizing a part of the fuel, that is by vaporizing the low boiling point fractions within a vaporizer and discharging the liquid tetraethyl lead and higher boiling point fractions which contain the gums from the vaporizer in liquid or atomized state. The low boiling point fractions, or those vaporized, provide sufficient readily combustible vapor to maintain combustion of the higher boiling point fractions and the tetraethyl lead through contact thereof with the flames resulting from the evolved vapors. The burning fuels are then caused to impinge upon surfaces approaching incandescence and spread thereby into contact with sufficient air to assure complete combustion.

In accomplishing these results, I have provided improved burner structure, illustrated in the accompanying drawings, wherein:

Fig. 1 is a vertical section through a stove equipped with a fuel supply and burner apparatus constructed in accordance with the present invention.

Fig. 2 is an enlarged vertical section through the burner, vaporizer and control valve on the line 2—2 of Fig. 1.

Fig. 3 is a cross-section through the vaporizer on the line 3—3 of Fig. 2.

Fig. 4 is a cross-section through the heat conducting connection between the burner bowl and wall of the vaporizer.

Fig. 5 is a detail perspective view of the burner.

Referring more in detail to the drawings:

1 designates a stove equipped with a burner and fuel supply means embodying the features of the present invention. It is to be understood, however, that the invention is adaptable to any heating or cooking appliance which is to be operated with a hydrocarbon type fuel. The stove illustrated in conjunction with my improved burner is one of general utility type, characterized by its ease of transportation and is, therefore, one to which the burner is especially adapted.

The specific structure of the stove is illustrated and described in detail in an application on Portable stove, filed January 12, 1942, Serial No. 426,421, and other than the burner and fuel supply means and control mechanisms, constitutes no part of the present invention.

The stove includes a tank 2 for containing fuel to be supplied to the burner 3 which may be an ordinary motor fuel, for example a gasoline blended to have a high octane value and containing an antiknock compound such as tetraethyl lead. The fuel is admitted to the tank 2 through a filler neck 4 ordinarily closed by a pressure-tight cap 5. Connected with the tank is a fuel control valve 6 carrying a vaporizer tube 7, which in turn supports the burner 3. Carried by the tank on an annular bead 9 is a spider 10 having an opening 11 registering with a threaded bore 12 in a bushing 13, the bushing 13 being

sealed within an opening 14. Carried by the arms of the spider are posts 15 extending upwardly alongside of the burner and carrying a grid 16 for supporting a cooking vessel over the flame of the burner 3.

The valve 6 includes a body 17 having an externally threaded leg 18 projected through the opening in the spider and threaded into the bushing 13 whereby the valve is supported in rigid position on the tank and the spider is anchored in position on the bead 9 by a jam-nut 19 threaded on the leg and bearing against the upper surface of the spider, as best shown in Fig. 1. Formed in the leg 18 of the valve body is a bore 20, having a threaded portion 21 in which the threaded neck 22 of a nipple 23 is threaded. The nipple 23 carries an outer tube 24 which depends into the fuel contained in the tank and carries a cap 25 on the lower end thereof having an inlet orifice 26 located in close proximity to the bottom of the tank. Also carried by the nipple 23 is an inner tube 27 of smaller size than the outer tube to form an annular passageway 28 therebetween which communicates at its upper end with the air space 29 above the level of the liquid in the tank through openings 30 so that under certain conditions air is discharged into chamber 31 of the cap 25 to effect atomization of fuel admitted through the orifice 26. The nipple 23 has an upper bore 32 connecting with the upper end of the inner tube through which fuel is discharged into the bore 20 and from the bore 20 into a chamber 33 in the valve body. The chamber 33 aligns with a lateral arm 34 of the valve body having a threaded axial bore 35 and a packing containing chamber 36.

Formed in the valve body coaxially with the bores of the arm 34 is a port 37 having connection with an axial bore 38 opening downwardly within an axial arm 39 of the valve body through an angularly arranged port 40. Rotatably mounted within the bores of the arm 34 is a valve stem 41 having a threaded portion 42 engaging the internal threads of the bore 35 and having a conical end 43 arranged so that the point thereof enters the port 37 for shutting off or throttling flow of fuel to the upper bore 38 of the valve body. The outer end of the valve stem projects from the arm 34 of the valve body and carries a knob 44 whereby the valve may be rotated to move the conical end 43 thereof to and from the port 37.

Contained within the bore 36 and seated against an internal shoulder 45 therein is a packing 46 retained in sealing relation with the valve stem by a packing nut 47 threaded upon the arm 34 of the valve body. The conical end of the valve is spaced from the threaded portion 42 by a cylindrical portion 48 which, when the valve is closed or slightly opened, extends across the bore 20 to effect depression of a throttling rod 49, the throttling rod having a head 50 freely mounted in the bore 20 and provided with an annular collar 51 for seating one end of a coil spring 52 having its opposite end seating against the nipple 23 for retaining a stem 53 on the head of the throttling rod in contact with the valve stem. The throttling rod also includes a wire 54 extending downwardly through the bore of the nipple, through the inner tube, and through the inlet orifice 26 whereby the effective area of the orifice is limited so that fuel passing therethrough is caused to move at sufficient velocity in proportion to a stream of air being discharged into the chamber 30 by way of the passage 28, producing an atomized fuel mixture, which mixture is discharged through the atomizer to the burner to start operation of the burner, as later described. After starting operation, the valve is opened so the stem 53 rides against the conical end of the valve stem responsive to action of the spring 52 which lifts the throttling rod out of the inlet orifice 26 to allow full flow of fuel therethrough to supply the full demand of the burner and forms a liquid seal to prevent further flow of air downward through tube 24.

The upper portion of the axial arm 39 is externally threaded, as at 55, and is provided with a bevelled edge 56 for seating a flared flange 57 on the base of the vaporizer tube 7. The vaporizer tube includes a cylindrical wall portion 58 forming an internal vaporizing chamber 59. The wall portion 60 of the vaporizer above the chamber 59 is substantially thicker than the lower portion so as to better retain the amount of heat necessary in maintaining a selected temperature for controlling vaporization of a selected portion of the fuel passing into the vaporizer so that other portions, that is those normally causing the vaporizer to clog, are discharged as an atomized liquid, as later described. The thickened wall portion of the vaporizer tube is internally threaded, as indicated at 61, mounting the threaded neck 62 of a nozzle tip 63 having a relatively small discharge or burner feeding orifice 64 opening into a counterbore 65 which allows the fuel discharged from the nozzle to spread within the bowl 66 of the burner 3. The nozzle tip has an annular shoulder 67 so that when it is threaded into the thickened end of the vaporizer tube the shoulder seats tightly against the tube to provide a tight joint.

The burner bowl 66 includes a relatively thick collar or base portion 68 formed of heat conductive material and having an axially threaded bore 69 engaging the external threads on the thickened portion of the tube to provide a close connection therebetween and a ready path for the heat conducted from the burner bowl to the vaporizer tube. Attention is here directed to the fact that the amount of conductive metal, and extent of the thread connection, are accurately determined, as these factors govern the temperature at which the vaporizing tube operates, which in turn determines the temperature of the liquid fuel being partially vaporized. This fuel temperature is maintained below the vaporizing temperature of the liquid tetraethyl lead or non-hydrocarbon compounds which pass through the nozzle tip 63 and orifice 64 in liquid form together with the vaporized portion of the fuel. Only gasolines or light napthas whose composition provides ample fractions of low temperature volatility will thus operate, therefore, this invention is directed to such fuels. So also, any device which has its vaporizer operating at temperatures sufficiently high to completely vaporize kerosene, naptha or gasoline, will not accomplish the purpose of my invention since the lead in solid form will be deposited within the vaporizer, quickly clogging same.

For example, since the boiling point of tetraethyl lead is approximately 400° F. and 450° F. under pressure at which the fuel in my stove is usually subjected during operation, I have provided a structure which coordinates the elements of conductivity and radiation to maintain during operation a temperature of the fuel being partially vaporized at a point which will vaporize

within the vaporizing member that major portion of the fuel possessing low temperature volatility which vapor acting under pressure causes other compounds such as tetraethyl lead and those fractions of the hydrocarbon fuel having high temperature volatility to be discharged from the nozzle 63 in liquid form to be subsequently vaporized and combusted in the burner bowl 72—73. The temperature of the burner bowl in operation, the character and thickness of the bowl, the extent of contact of bowl to the vaporizing tube, and the conductivity of the vaporizing tube itself are all coordinated with the factor of radiation to maintain the required temperature of the fuel being vaporized as above set forth. The periphery of the collar 68 has an annular shoulder 70 encircling a flange 71 encircling the threaded bore 69 thereof in spaced relation with the nozzle tip. The burner bowl has an upwardly and outwardly curved lower portion 72 of substantially semispherical shape, an outwardly flaring upper portion 73, and an intermediate corrugated belt portion 74. The inner surface of the flaring portion 73 is contacted by flames resulting from ignition of the fuel and impinging against a deflector plate 75.

The deflector 75 includes a substantially concavo-convex member of smaller diameter than the flange portion of the bowl so that the periphery thereof cooperates with the flare of the bowl in forming an annular flue-like passageway for the deflected flames and to effect draft of combustion supporting air into the burner bowl through air inlet openings 76 in the semispherical portion thereof, the member 75 being turned so that the convex side faces the burner and forms an upwardly and outwardly deflecting surface which becomes heated intensely. The flame deflector is supported in position by means of radially extending arms 77 projecting from the periphery thereof and extending through slots 78 in the burner bowl. Cooperating with the semispherical portion of the burner bowl and encircling the flange 71 is an inner bowl 79 closely contacting the burner bowl and having openings 80 therein registering with the air inlet openings 76. The rim of the inner member has corrugations 82 corresponding to the corrugations 74 previously described.

In order to control movement of combustion supporting air, limit external cooling effects on the burner bowl, and prevent drafts from interfering with operation of the flame, the portion of the burner bowl that is contacted by the flame is encircled by a tube-like shield 83 which is spaced from the periphery of the burner bowl and which extends downwardly thereof to provide an annular passageway 84 for the discharge of secondary air. The shield is supported in position on extensions 85 of the arms 77. The shield also extends downwardly over the vaporizer tube so that the air moving into the burner passes in close relation with the vaporizer tube to cooperate with the heat conductive capacities thereof in maintaining the desired predetermined uniform temperature of the vaporizer walls.

In order to assist in vaporization of the fuel, the vaporizing chamber has a plurality of layers of screen-like material for distributing the conducted heat to the fuel moving through the chamber.

In order to assure that the orifice of the nozzle tip is kept clean, the burner is provided with a clean-out device 87, including a head 88 of rectangular cross-section guidingly supported in the bore 38 of the valve body and has a stem 89 projecting through the vaporizer chamber into an enlarged bore 90 of the nozzle tip which receives a needle 91 of sufficient diameter to be projectable through the orifice 64. The clean-out device is operated by a rock shaft 92 rotatably supported in a laterally extending arm 93 of the valve body. The shaft extends through a packing 94 contained in a shouldered bore 95 of the arm and which is pressed in sealing contact with the rock shaft by a packing gland 96. The inner end of the rock shaft has a crank arm 97 having a pin portion 98 engaged in a transverse groove 99 formed in the head 88 of the clean-out device so that when the shaft is rotated the needle 91 is moved through the outlet orifice 64 to clear it of any matter that may be lodged therein. The end of the rock shaft projecting outwardly from the packing gland is bent laterally to provide a handle 100 by which it is readily oscillated.

Air pressure is supplied to the fuel tank through the control valve when the valve is open and to effect atomization when starting the burner. The air is supplied by means of a pump 101 carried by the top of the tank and having a barrel portion projecting thereinto. The pressure outlet of the pump has connection with the air space above the fuel through a duct 102 as shown in Fig. 1. Contained in the pump barrel is a plunger (not shown) which is actuated by a plunger rod 103 carrying an actuating knob 104.

In operating the burner constructed and assembled as described, a fuel, for example an ordinary automotive gasoline, is poured into the tank through the filler neck 4 up to the outlet end thereof, which leaves the air space 29 in the top of the tank. The control valve 6 is closed and the plunger rod 103 of the pump 101 is actuated to build up pressure within the tank to force the fuel upwardly through the inner tube 27 when the control valve 6 is open. The clean-out device 87 may be actuated by rocking the shaft 92 with the handle 100 to raise and lower the needle 91 through the orifice 64 of the nozzle tip. The control valve is then opened slightly, whereupon liquid in the tank is discharged through the inlet orifice 26, which, because of the throttle rod 49, is a relatively small quantity, to produce a readily ignited mixture with the air passing from the tank downwardly through the annular space 28 between the tubes 24 and 27.

The mixture is discharged upwardly through the valve body and vaporizer tube at sufficiently high velocity and pressure to be discharged from the nozzle tip in a fine mist, which is readily ignited to start the burner. The resultant flame plays against the deflector and is directed outwardly upon the inner surface of the flaring portion of the burner bowl to heat the metal thereof and cause an updraft of air from the lower end of the tubular shield 83 through the openings 76 and 80, into the burner bowl, and through the passage 84 formed between the deflector 75 and flaring portion of the bowl. It will be noted that the portion of the shield which encircles the flame contacting portion of the burner bowl limits external cooling effects on the bowl. The heat is conducted downwardly through the semispherical portion of the bowl to the collar 68 thereof and through the threaded connection into the thickened wall portion 69 of the vaporizer tube, the rate of heat conduction being controlled, as above stated, by the extent of engagement of the collar with the vaporizer tube and

the thickness of the metal of the burner bowl so that the heat is utilized to cause vaporization of the lower boiling point fractions of the fuel mixture passing through the vaporizing chamber. As soon as gas begins to discharge into the burner bowl, the control valve 6 is opened sufficiently wide to allow movement of the stem of the throttling rod upwardly along the conical end 43 of the valve stem 41 under influence of the spring 52, which spring raises the throttling end of the rod from the inlet orifice 26 so that liquid fuel is delivered from the tank into the vaporizer tube. I find that ordinary leaded motor or automotive fuels may be preheated to approximately 400° F. and under some conditions may be raised to 450° F. without appreciable distillation of the heavier fractions which contain the objectionable gums and lead. The tetraethyl lead content becomes volatile at these comparatively low temperatures and does not begin to separate and form solid deposits until the temperature reaches 400° F. and under operating pressure might rise to 450° F. Therefore, since the burner structure is designed to maintain a vaporizer temperature between 400° and 450° F. it is not hot enough to effect vaporization of the higher boiling point fractions of the fuel or break down of the tetraethyl lead compound, consequently these parts are discharged from the vaporizer in the form of atomized liquid into burning vapor resulting from the vaporized lower boiling point fractions. It is thus obvious that the portions of the fuel ordinarily tending to clog the burner cannot break down until they have reached the hotter zone in the burner bowl where they are readily consumed in the flame and substantially complete combustion is effected. The flame playing against the deflector soon brings the metal to an intense heat. It is obvious that the partially vaporized fuel is delivered upon the superheated deflector plate with considerable force and at atmospheric pressure, which assures complete vaporization and causes dissipation of any solid particles that might be formed in the burner bowl.

The deflected flame playing upon the flared wall of the burner bowl supplies heat to the vaporizer almost entirely through conduction and since the movement of combustion supporting air through the burner is substantially constant, the temperature of the vaporizer is kept approximately uniform and cannot reach the point where the objectionable elements are deposited in the vaporizing chamber and clog the orifice of the needle tip. Should any objectionable matter be deposited it is so light and infinitesimal that the orifice of the nozzle tip is readily cleared thereof by the cleaning needle. Therefore the vaporizer will operate over a long period of time without repair or replacement even though automotive fuels are used in the stove.

What I claim and desire to secure by Letters Patent is:

1. An apparatus for burning liquid hydrocarbon fuel containing a compound which produces objectionable deposits when said compound is heated to decomposing temperature, including a burner bowl for burning said fuel and having an air inlet to supply combustion supporting air into the burner bowl, a vaporizer having a nozzle tip provided with a fuel outlet orifice arranged to discharge into the burner bowl, means for supplying said fuel to the vaporizer, said vaporizer having a thick wall portion surrounding the nozzle tip and spaced from the outlet orifice, heat conducting means having a portion in position to be heated by combustion within the burner bowl and having a limited portion in variable heat conductive contact with said thick wall portion of the vaporizer for conducting an amount of heat necessary to maintain the fuel within the vaporizer at a vaporizing temperature below the decomposing point of said compound so that the compound is discharged into the burner bowl without being decomposed in the vaporizer, a clean-out needle supported in the vaporizer, and means for selectively projecting the needle through the orifice of said nozzle tip.

2. An apparatus for burning liquid hydrocarbon fuel containing a compound which produces objectionable deposits when said compound is heated to decomposing temperature, including a burner for burning said fuel and having an air inlet to supply combustion supporting air into the burner, a vaporizer having an externally threaded end, a fuel discharge nozzle projecting from said end of the vaporizer to discharge fuel into the burner, means for supplying said fuel to the vaporizer for discharge into the burner, and a collar having heat conductive connection with the burner to conduct heat of combustion within the burner and having threads engaging the threaded end of the vaporizer to conduct said heat to the vaporizer, said collar being adjustable to vary the extent of engagement of the threads so that heat may be conducted in an amount substantially proportional to the extent of engagement of said threads for maintaining the fuel within the vaporizer at a vaporizing temperature below the decomposing point of said compound so that the compound is discharged into the burner without being decomposed within the vaporizer.

3. An apparatus for burning liquid hydrocarbon fuel containing a portion which produces objectionable deposits when heated to decomposing temperature, including an open top burner bowl for burning said fuel and having an air inlet to supply combustion supporting air into the burner bowl for maintaining combustion of fuel within the burner bowl, a vaporizer having an outlet discharging into the burner bowl, means for supplying the liquid hydrocarbon fuel to the vaporizer under pressure, fuel atomizing means cooperating with the fuel supply means for initially delivering air with the fuel for atomizing said fuel discharged into the burner bowl during starting operation to initially heat the burner bowl, and a heat conductive connection between the burner bowl and said vaporizer to conduct a predetermined amount of heat from the burner bowl to the vaporizer for heating the fuel within the vaporizer to a temperature below the decomposing point of said objectionable portion of the fuel and sufficient to vaporize portions of the fuel having a lower distillation point whereby the objectionable portion is discharged from the vaporizer into the burner bowl in substantially liquid form and said other portions in vapor form for continuing operation of said apparatus.

4. An apparatus for burning liquid hydrocarbon fuel containing a portion which produces objectionable deposits when heated to decomposing temperature, including an open top burner bowl for burning said fuel and having an air inlet to supply combustion supporting air into the burner bowl for maintaining combustion of fuel within the burner bowl, a vaporizer having an outlet discharging into the burner bowl, means for supplying the liquid hydrocarbon fuel to the vaporizer under pressure, fuel atomizing means cooperating

with the fuel supply means for initially delivering air with the fuel for atomizing said fuel discharged into the burner bowl during starting operation to initially heat the burner bowl, and a collar having heat conductive connection with the burner bowl and engagement with a limited portion of said vaporizer below said outlet to conduct a predetermined amount of heat from the burner bowl to the vaporizer for heating fuel within the vaporizer to a temperature below the decomposing point of said objectionable portion of the fuel and sufficient to vaporize portions of the fuel having a lower distillation point whereby the objectionable portion is discharged from the vaporizer into the burner bowl in substantially liquid form and said other portions in vapor form for continuing operation of said apparatus.

5. An apparatus for burning liquid hydrocarbon fuel containing a portion which produces objectionable deposits when heated to decomposing temperature, including an open top burner bowl for burning said fuel and having an air inlet to supply combustion supporting air into the burner bowl for maintaining combustion of fuel within the burner bowl, a vaporizer having an outlet discharging into the burner bowl, means for supplying the liquid hydrocarbon fuel to the vaporizer under pressure, fuel atomizing means cooperating with the fuel supply means for initially delivering air with the fuel for atomizing said fuel discharged into the burner bowl during starting operation to initially heat the burner bowl, a flame deflector, means supporting the flame deflector within the open top of the burner bowl to deflect flame resulting from combustion of said atomized fuel into contact with an upper portion of the burner bowl to initially heat the burner bowl, and a heat conductive connection between the burner bowl and said vaporizer to conduct a predetermined amount of said heat from the burner bowl to the vaporizer for heating fuel within the vaporizer to a temperature below the decomposing point of said objectionable portion of the fuel and sufficient to vaporize portions of the fuel having a lower distillation point whereby the objectionable portion is discharged from the vaporizer into the burner bowl in substantially liquid form and other portions of the fuel in vapor form for continuing operation of said apparatus.

6. An apparatus for burning liquid hydrocarbon fuel containing a portion which produces objectionable deposits when heated to decomposing temperature, including an open top burner bowl for burning said fuel and having an air inlet to supply combustion supporting air into the burner bowl for maintaining combustion of fuel within the burner bowl, a vaporizer having an outlet discharging into the burner bowl, means for supplying the liquid hydrocarbon fuel to the vaporizer under pressure, fuel atomizing means cooperating with the fuel supply means for initially delivering air with the fuel for atomizing said fuel discharged into the burner bowl during starting operation to initially heat the burner bowl, a heat conductive connection between the burner bowl and said vaporizer to conduct a predetermined amount of heat from the burner bowl to the vaporizer for heating the fuel within the vaporizer to a temperature below the decomposing point of said objectionable portion of the fuel and sufficient to vaporize portions of the fuel having a lower distillation point whereby the objectionable portion is discharged from the vaporizer into the burner bowl in substantially liquid form and said other portions in vapor form for continuing operation of said apparatus, and a shield encircling the burner bowl for limiting external cooling effects on said burner bowl.

7. An apparatus for burning liquid hydrocarbon fuel containing a portion which produces objectionable deposits when heated to decomposing temperature, including an open top burner bowl for burning said fuel and having an air inlet to supply combustion supporting air into the burner bowl for maintaining combustion of fuel within the burner bowl, a vaporizer having an outlet discharging into the burner bowl, means for supplying the liquid hydrocarbon fuel to the vaporizer under pressure, fuel atomizing means cooperating with the fuel supply means for initially delivering air with the fuel for atomizing said fuel discharged into the burner bowl during starting operation to initially heat the burner bowl, a flame deflector, means supporting the flame deflector within the open top of the burner bowl to deflect flame resulting from combustion of said atomized fuel into contact with an upper portion of the burner bowl to initially heat the burner bowl, a heat conductive connection between the burner bowl and said vaporizer to conduct a predetermined amount of said heat from the burner bowl to the vaporizer for heating fuel within the vaporizer to a temperature below the decomposing point of said objectionable portion of the fuel and sufficient to vaporize portions of the fuel having a lower distillation point whereby the objectionable portion is discharged from the vaporizer into the burner bowl in substantially liquid form and said other portions in vapor form for continuing operation of said apparatus, and a shield encircling the portion of the burner bowl contacted by said flame for limiting external cooling effects on said burner bowl.

8. An apparatus for burning liquid hydrocarbon fuel containing a compound which produces objectionable deposits when said compound is heated to decomposing temperature including, an open top burner bowl for burning said fuel and having an air inlet to supply combustion supporting air into the burner bowl, a vaporizer having an outlet for discharge into the burner bowl, means for supplying said fuel to the vaporizer for discharge into the burner bowl, heat conductive means connecting the burner bowl with a limited portion of said vaporizer for conducting an amount of heat from the burner bowl to the vaporizer necessary to maintain the fuel temperature within the vaporizer below the decomposing temperature of said compound so that the compound is discharged into the burner bowl without being decomposed in the vaporizer, a flame deflector located in the burner bowl within the path of discharge from the vaporizer and in position to be contacted by the flame resulting from combustion of fuel in the burner bowl for deflecting the flame into contact with an upper portion of the burner bowl, and a shield encircling the portion of the burner bowl contacted by said flame for limiting external cooling effects on the burner bowl.

9. An apparatus for burning hydrocarbon fuel containing a compound which produces objectionable deposits when said compound is heated to decomposing temperature including, an open top burner bowl for burning said fuel and having an air inlet to supply combustion supporting air into the burner bowl, a vaporizer having an outlet for discharge into the burner bowl, means for supplying said fuel to the vaporizer for discharge

into the burner bowl, heat conductive means connecting the burner bowl with a limited portion of said vaporizer for conducting an amount of heat from the burner bowl to the vaporizer necessary to maintain the temperature of fuel within the vaporizer below the decomposing temperature of said compound so that the compound is discharged into the burner bowl without being decomposed in the vaporizer, a flame deflector located in the burner bowl within the path of discharge from the vaporizer and in position to be contacted by the flame resulting from combustion of fuel within the burner for deflecting the flame into contact with an upper portion of the burner bowl, and a shield encircling the portion of the burner bowl contacted by said flame and depending below said heat conductive means for limiting external cooling effects on said heat conductive means.

BOYD W. TULLIS.