Nov. 21, 1944. B. W. TULLIS 2,363,099

BURNER FOR FUELS CONTAINING TETRAETHYL LEAD AND OTHER OBJECTIONABLE FOREIGN MATTER

Filed Aug. 3, 1942 2 Sheets-Sheet 1

Fig. 1.

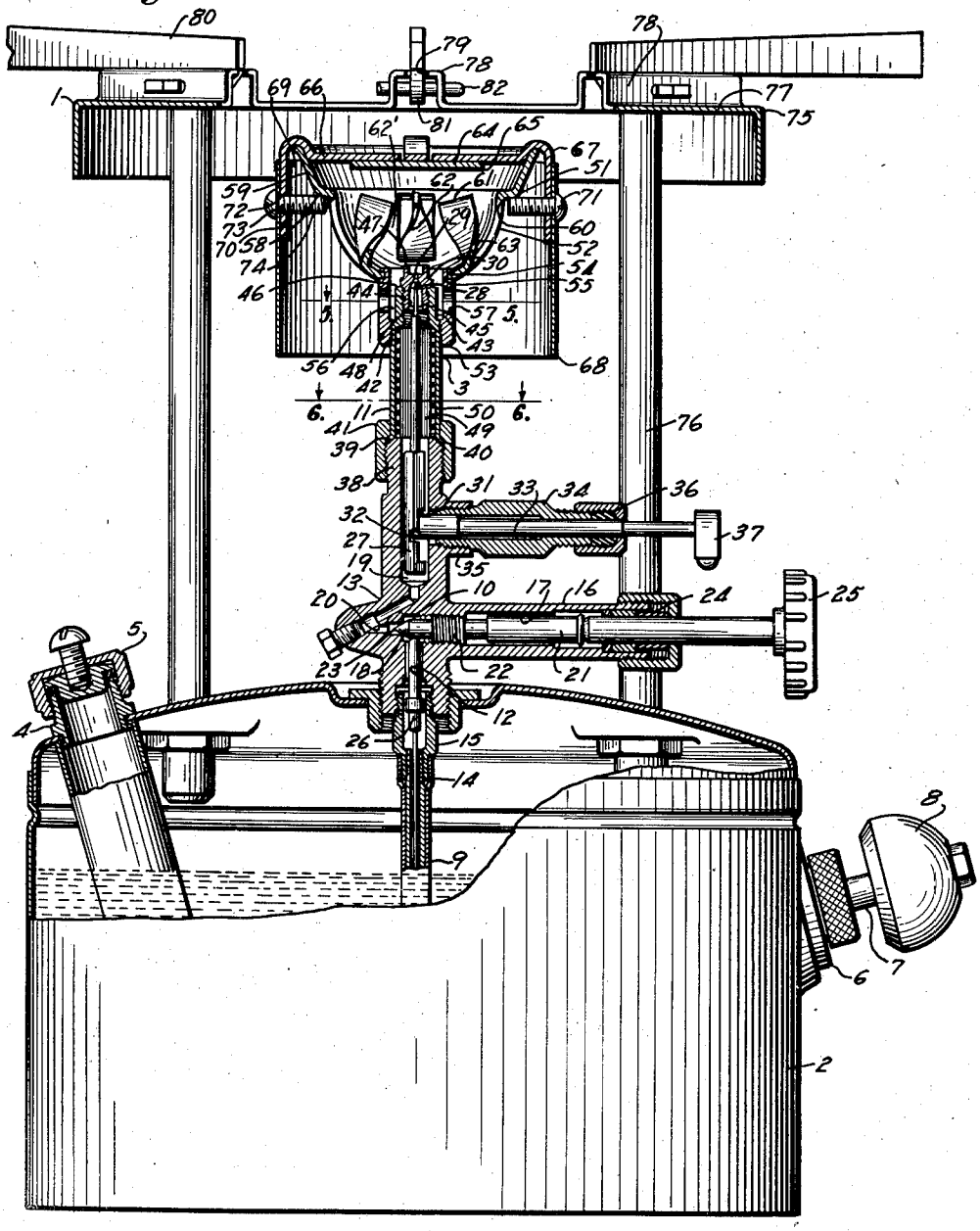

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Fig. 2.

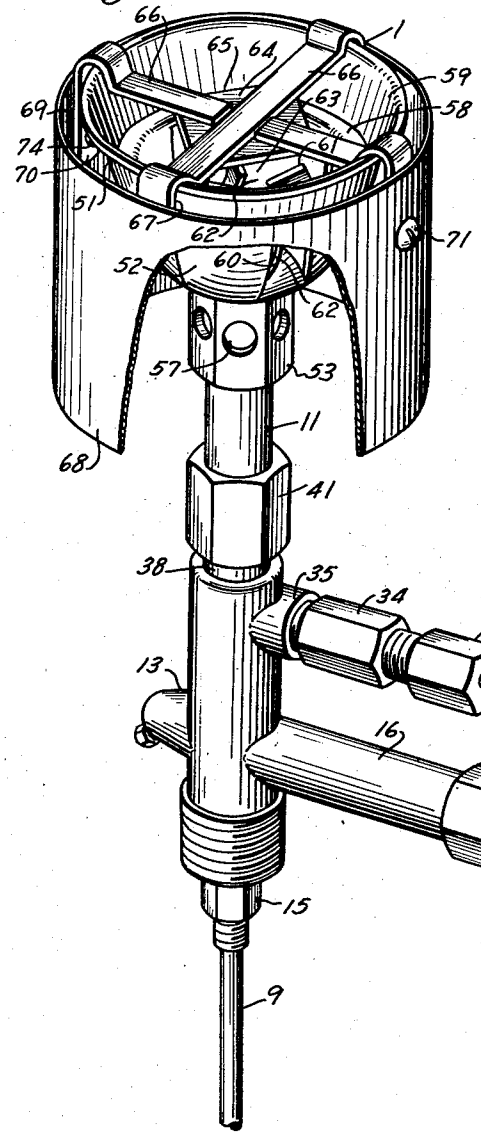


Fig. 3.

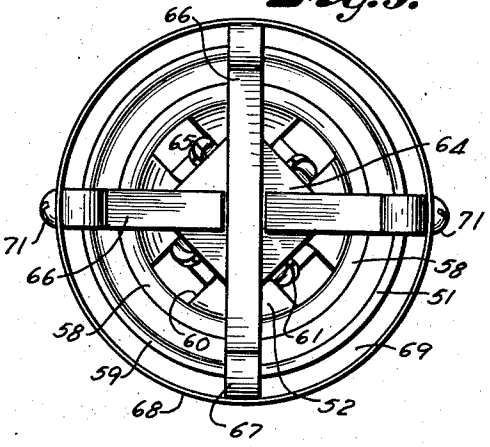


Fig. 4.

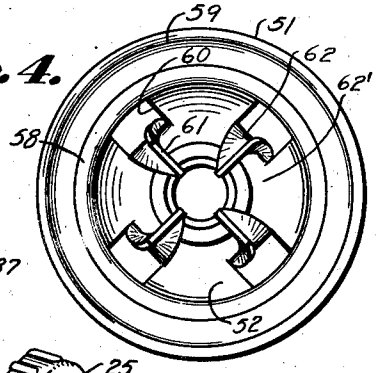


Fig. 7.

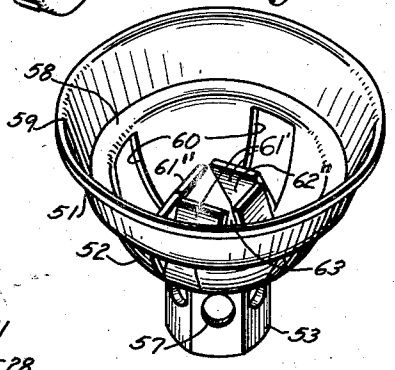


Fig. 5.

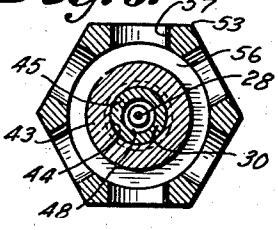
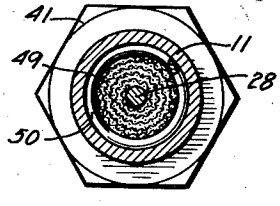


Fig. 6.



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2,363,099

BURNER FOR FUELS CONTAINING TETRAETHYL LEAD AND OTHER OBJECTIONABLE FOREIGN MATTER

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

Application August 3, 1942, Serial No. 453,378

13 Claims. (Cl. 158—68)

This invention relates to liquid fuel burners particularly of the type disclosed in my application for patent Serial No. 426,420, filed January 12, 1942, and entitled "Burner for fuels containing tetraethyl lead."

As disclosed in the aforementioned application, fuels containing gums, coloring matter, and antiknock compounds such as tetraethyl lead do not function satisfactorily in the gas generating type of burners for the reason that the foreign particles decompose or carbonize in the nozzle and generating zone of the burner. Consequently the generators and nozzle tips are clogged within a very few hours burning time. In small burners of the type disclosed in my previous application, for example those having an output of approximately 5,000 B. t. u. or less, these difficulties are overcome by conducting a predetermined amount of heat to the vaporizer tube for vaporizing only the low boiling fractions of the fuel within the tube so that the tetraethyl lead and the higher boiling fractions containing the gums, coloring matter and other foreign particles are discharged therefrom in liquid or atomized state, the principle being that the vaporized low boiling fractions maintain combustion of the undesirable particles exteriorly of the vaporizing tube. However, when large burners are considered, for example those having 10,000 B. t. u. heat output, I find that means is required to reduce the temperature of the vaporizer discharge tip. Otherwise heat of combustion is radiated thereto, which, supplemented by the heat conducted from the adjacent portion of the vaporizer tube, causes too high temperatures in the portions of the vaporizing zone most likely to become clogged.

The purpose of the present invention is, therefore, to provide means for getting sufficient heat to the vaporizer to vaporize an adequate amount of the low boiling fractions of the fuel and to distribute the heat so as to avoid vaporization of the contained compounds such as tetraethyl lead within the vaporizer tube or nozzle thereof.

Other objects of the invention are to maintain combustion at sufficient distance above the orifice of the discharge nozzle to avoid overheating of the nozzle and discharge end of the generating or vaporizing zone through absorption of radiant heat; to provide better mixture of the vaporized portions of the fuel with the unvaporized portions; to provide for simple adjustment of the air admitted to the combustion supporting zone of the burner; to regulate the point at which combustion is effected relative to the discharge tip of the vaporizer; and to provide for aspiration of cooling air around the discharge tip of the nozzle in sufficient quantity to maintain desired temperature but in insufficient quantity to support combustion below the desired level above said tip.

In accomplishing these and other objects of the invention, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a vertical section through a liquid fuel burning appliance equipped with a burner embodying the features of the present invention, the fuel tank of the appliance being shown in part elevation.

Fig. 2 is a detail perspective view of the vaporizer and burner unit removed from the appliance, a part of the draft shield being broken away to better illustrate the air inlet openings in the discharge nozzle of the vaporizer.

Fig. 3 is a plan view of the burner.

Fig. 4 is a plan view of the burner bowl with the flame deflector removed to show the tabs for controlling air flow and the level of combustion relative to the nozzle tip.

Fig. 5 is a cross-section on the line 5—5 of Fig. 1.

Fig. 6 is a cross-section on the line 6—6 of Fig. 1.

Fig. 7 is a perspective view of a burner equipped with a modified form of tabs.

Referring more in detail to the drawings:

1 designates a fuel burning appliance, for example a portable stove, equipped with a burner embodying the features of the present invention. While I have particularly illustrated a stove, it is to be understood that the invention is applicable to any heating or cooking appliance which is to be operated with a liquid type fuel.

The stove illustrated in conjunction with my improved burner is for general utility purposes, characterized by its ease of transportation, and is, therefore, one to which the present burner is especially adapted because of inability to obtain fuels free of anti-knock compounds in many localities in which such a stove is used.

The specific structure of the stove forms no part of the present invention but is illustrated to better disclose my invention, and is briefly described as including a tank or fount 2 for containing fuel to be supplied to the burner 3 embodying the present invention. The fuel, for example an ordinary motor fuel blended to have a high octane value and containing an antiknock compound such as tetraethyl lead, is ad-

mitted to the tank through a filler neck 4 ordinarily closed by a pressure-tight cap 5. Mounted within the tank is a pump 6 having a plunger (not shown) adapted to be reciprocated by a rod 7 extending through a packing unit in the wall of the tank and actuated by a knob 8 so as to provide sufficient pressure in the top of the tank for displacing the fuel by way of a conducting pipe 9 through a valve 10 to the generator or vaporizer tube 11 of the burner, later described. The pipe 9 is connected with the inlet port 12 of the valve 10.

The valve includes a body 13 having a threaded portion 14 engaged within the opening of a bushing 15. Projecting from the valve body is a lateral arm 16 provided with an internal axial bore 17 extending transversely of the port 12 and having a valve seat 18 therein which connects the port 12 with an upper bore 19 through an off-set connecting port 20. Rotatable within the bore of the arm 16 is a valve stem 21 having threaded connection as at 22 with a portion of the bore to effect movement of a conical valve 23 thereon to and from valving relation with the seat 18. The opposite end of the stem extends through a suitable packing assembly 24 and carries an operating knob 25. Reciprocable within the port 12 and bearing against the conical portion 23 of the valve stem is a fuel throttling rod 26 for effecting initial atomization of the fuel upon starting of the burner, as later described.

Carried within the upper bore 19 is the head 27 of a clean-out needle 28 that extends axially through the generator or vaporizer tube 11 and operates through the jet opening 29 of a nozzle 30, later described. The head 27 has a laterally opening recess 31 therein receiving an eccentric pin 32 on the end of a shaft 33 that is rotatably mounted within a nipple 34 threaded in a boss 35 projecting laterally from the body of the valve. The shaft 33 also extends through a packing assembly 36 and is operated by a handle 37. Formed on the upper end of the valve body is a threaded neck 38 having a bevelled annular seat 39 seating a flaring flange 40 of the vaporizer tube 11, the flange being retained in seated position by a union nut 41 threaded upon the neck 38. An upper portion near the end of the tube 11 is threaded, as at 42, and projecting thereabove is a section 43 to limit conduction of heat upward to the nozzle 30. The section 43 is of reduced diameter and has an internally threaded axial bore 44 for mounting the nozzle 30, previously mentioned. The nozzle includes a threaded skirt 45 turned into the threaded bore of the collar 43 and cooperating with an annular shoulder 46 to form a liquid-tight seal. Projecting above the shoulder 46 is an annular guard lip 47 encircling the jet opening or orifice 29. The inner diameter of the tube 11 is substantially greater than the diameter of the bores 48 of the nozzle.

In order to promote contact of the fuel with heat conductive surfaces, the tube 11 contains a roll of screen material 49 retained in roll form by a wire wrapping 50 as shown in Figs. 1 and 6.

The burner proper includes a bowl 51 having a substantially hemispherical portion 52 carried by an axial collar 53 that is fixed thereto by a flange 54 positioned in an opening 55 in the bottom of the bowl and having the upper edge spun against the inner face of the bowl. The collar 53 has an inner diameter conforming to the outer diameter of the tube 11 and has the lower portion thereof internally threaded to engage the external threads 42 on the upper portion of the tube 11. The reduced section 43 of the vaporizer tube, being of smaller diameter, cooperates with the collar 53 to form an annular air passageway 56 surrounding the discharge end of the vaporizer tube and the nozzle, which are located above the connection of the burner bowl with the tube 11. The threaded connection of the burner bowl with the tube provides a path for conduction of heat from the burner bowl to the vaporizer to supply sufficient heat for vaporizing the low boiling fractions of the fuel. The extent of the connection is only sufficient to conduct the amount of heat necessary to effect vaporization of the lower boiling fractions without vaporizing the higher boiling fractions and decomposing the undesirable components.

The collar 53 has an annular series of air inlet ports 57 through which air is drawn by the aspirating effect of the fuel discharged through the orifice 29. The upper part of the hemispherical portion fo the bowl has a laterally extending annular shoulder 58 which terminates in an upwardly and outwardly flaring rim 59. Formed in the sides of the hemispherical portion are a plurality of air inlet openings 60 formed by slitting the metal and pressing tongues or tabs 61 inwardly therefrom so that they converge upwardly. The tongues have substantially a 90° twist therein as indicated at 62 so the ends are positioned substantially radially with respect to the axis of the nozzle tip and are so arranged as to form substantially an opening 62' in spaced alignment with the nozzle 30 as best illustrated in Figs. 1 and 4. When thus formed the tongues are spaced apart at the side edges as indicated at 63 to permit entrance of air into the stream of fuel discharged from the nozzle of the generator. The openings 63 are relatively small so that the air supplied therethrough is insufficient to support combustion below the upper ends of the tongues. Consequently the flame of the burning fuel will be kept at an elevation in spaced relation with the discharge of the nozzle so that the radiant heat of the flame will have less effect thereon. The major portion of the air to the burner is taken through the openings 60 which directly connect with the space above the tongues and which provide sufficient air to support combustion of the fuel.

The twists 62 in the tongues give a directional movement to the air drawn through the openings 60 so that they create turbulence and better mixture of the air with the fuel and serve to bring the flame into contact with the burner bowl which causes additional heat to be conducted to the generator.

Carried upon the rim of the burner bowl is a deflector plate 64 against which the flame impinges and by which the flame is directed outwardly to lap the inner face of the flaring rim 59. The deflector 64 includes a substantially flat plate having the side edges 65 spaced from the rim to provide openings through which the deflected flame plays against the bottom of a vessel or the like supported by a grid, later described. The flame spreading across the burner bowl effects draft of combustion supporting air into the burner through the openings 60 to support combustion of the fuel.

The flame deflector is supported in position by means of radially extending arms 66 projecting

from the corners thereof and having hook-like portions 67 engaging over the rim of the burner bowl as shown in Fig. 2. In order to control the amount of combustion supporting air and prevent drafts from interfering with operation of the flame, the burner is encircled by a sleeve 68 spaced from the periphery of the burner bowl to provide an annular passageway 69 for flow of secondary air. The shield is supported in position by means of depending extensions 70 on the ends of the hook-like portions 67 of the arms 66. The shield extends downwardly over the vaporizer tube so that air moving into the burner passes in close relation thereto to cooperate with the heat conductive capacities of the burner bowl in maintaining the predetermined practically constant uniform temperature of the tube walls. The shield and the deflector plate are retained in position on the burner bowl by screws 71 threaded in openings 72 of the shield and registering openings 73 in the depending ends of the arms so that the shanks 74 of the screws engage under the annular shoulder 58 as illustrated in Fig. 1.

The grid previously mentioned includes a ring 75 supported from the fuel supply tank by rod-like posts 76. Formed in an inwardly extending annular flange 77 of the ring 75 is a plurality of upwardly formed elongated bosses 78 having slots 79 in the top thereof to mount grid fingers 80 thereon, the grid fingers having ear portions 81 depending from the lower side to accommodate pivot pins 82 that extend through the sides of the bosses and through the ears as shown in Fig. 1.

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 leaving an air space between the surface of the fuel and the top of the tank. The control valve is closed and the pump 6 operated to build up pressure within the tank so that upon cracking of the control valve 10, fuel is forced upwardly through the pipe 9, valve seat 18, port 19 and through the vaporizer tube 11 for discharge through the orifice 29 of the discharge nozzle 30. The cleaning out device may be operated by oscillating the shaft 33 to reciprocate the point of the needle 28 through the discharge orifice 29. Simultaneously with flow of the liquid fuel a portion of the air in the tank moves therewith to effect atomization of the fuel, the mixture being discharged upwardly through the valve body and vaporizer tube at sufficiently high velocity and pressure to be discharged from the nozzle in a fine mist which is readily ignited to start the burner. The resultant flame plays against the deflector 64 and is directed outwardly against the inner surface of the rim 59 to heat the metal thereof and cause an updraft of air from the lower end of the sleeve 68 through the openings 60 into the burner bowl, and through the passageway 69 formed between the deflector plate and the rim 59. The heat is conducted downwardly through the hemispherical portion of the bowl to the collar 53 thereof and through the threaded connection to the wall of the vaporizer or vaporizer tube 11, the rate of heat conduction being controlled by the extent of engagement of the threads, the thickness of the metal of the burner bowl, and the volume of air contacting the parts. The heat thus conducted is utilized to cause vaporization of the lower boiling fractions of the fuel. As soon as the gas begins to discharge into the burner bowl the fuel control valve 10 is opened sufficiently wide to allow movement of the stem of the throttling rod 26 upwardly along the conical end 23 of the valve stem 21 so that the lower end of the throttling rod 26 limits the inlet of the pipe 9 and only liquid fuel flows under pressure to the generating chamber. I find that ordinary leaded motor or automotive fuels may be preheated in the generator to approximately 400° F. to 450° F. without appreciable vaporization of the heavier fractions which contain the objectionable gums, tetraethyl lead, and the like. While the lead content may become volatile at these comparatively low temperatures it does not begin to separate and form solid deposits until the temperature rises to a higher degree. Therefore, since the burner structure is designed to maintain a fuel temperature within the vaporizer of approximately between 400° F. and 450° F. it is not sufficiently hot to effect vaporization of the higher boiling point fractions of the fuel or break down of the tetraethyl lead compound. Consequently these portions of the fuel are discharged from the vaporizer in the form of atomized liquid along with the vapor resulting from the low boiling point fractions. It is thus obvious that the portions of the fuel ordinarily tending to clog the vaporizer do not break down until they have passed the nozzle 30 and 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 brings the metal thereof to an intense heat.

Discharge of the fuel through the orifice 29 produces an aspirating effect to draw air through the ports 57 into cooling contact with the nozzle 30. The amount of air drawn therethrough supplemented by the air drawn through the openings 60 is not sufficient to support combustion below the upper ends of the tongues 61 so that the flame is spaced sufficiently from the nozzle tip to avoid overheating thereof. The tongues also act in effecting turbulence to assure better mixture with the vaporized fuel and promote dissipation of the objectionable components of the fuel. Should any objectionable matter be deposited it is so light and infinitesimal that the orifice of the nozzle is readily cleared thereof by the cleaning needle. Therefore the burner will operate over a long period of time without repair or replacement of the vaporizer tube and nozzle even though automotive fuels are used in the stove.

In Fig. 7 is shown a burner equipped with a modified form of tongues 61'. In this form the tongues are not twisted and the ends 61'' form a substantially rectangular opening 62'' through which the fuel mixture is discharged.

If it is desired to enrich the mixture of air and fuel the tabs may be bent up in closer relation with the air inlet openings of the burner bowl or if it is desired to make the mixture less rich the tongues may be bent down or further from the openings.

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

1. In a liquid fuel burner, a fuel vaporizer tube having a threaded exterior spaced from the discharge end of said tube, a nozzle mounted in the vaporizer tube above said threads, a burner bowl having air inlet openings for combustion supporting air, a collar on the burner bowl en-

gaging said threads of the vaporizer and provided with air inlet openings for admitting air around the nozzle above the engaging threads, and tongues carried by the burner bowl and converging upwardly and inwardly above the nozzle to limit flow of air immediately surrounding the nozzle to an amount insufficient for supporting combustion between the tongues and said nozzle.

2. In a fuel burner for burning liquid hydrocarbon fuels, a fuel vaporizer tube having a threaded exterior intermediate the ends of said tube, a nozzle connected with the vaporizer tube above said threads, a burner bowl having air inlet openings for combustion supporting air, and a collar on the burner bowl engaging said threads of the vaporizer and provided with air inlet openings for admitting air around the nozzle.

3. In a fuel burner for burning liquid hydrocarbon fuels, a fuel vaporizer tube having a threaded portion intermediate the ends of said tube, a nozzle mounted in the vaporizer tube above said threads, a burner bowl having air inlet openings for combustion supporting air, a collar on the burner bowl engaging said threads of the vaporizer and provided with air inlet openings for admitting air around the nozzle, and tongues carried by the burner bowl and converging upwardly and inwardly above the nozzle to limit flow of air immediately surrounding the nozzle to an amount insufficient for supporting combustion between the nozzle and said tongues.

4. In a fuel burner for burning liquid hydrocarbon fuels, a fuel vaporizer tube having a threaded exterior portion intermediate the ends of said tube, a nozzle mounted in the vaporizer tube above said threads, a burner bowl having air inlet openings for combustion supporting air, a collar on the burner bowl engaging said threads of the vaporizer and provided with air inlet openings for admitting air around the nozzle, tongues carried by the burner bowl and converging upwardly and inwardly above the nozzle to limit flow of air immediately surrounding the nozzle to an amount insufficient for supporting combustion between the tongues and said nozzle, a flame deflector over said tongues, and means supporting the deflector in heat conductive relation with the burner bowl for supplying vaporizing heat to the vaporizer through said threaded connection.

5. In a fuel burner for burning liquid hydrocarbon fuels, a fuel vaporizer tube having a threaded exterior portion intermediate the ends of said tube, a nozzle mounted in the vaporizer tube above said threads, a burner bowl having air inlet openings for combustion supporting air, a collar on the burner bowl engaging said threads of the vaporizer, and tongues carried by the burner bowl and converging upwardly and inwardly above the nozzle, said tongues being adjustable relative to said inlet openings of the burner bowl.

6. In a fuel burner for burning liquid hydrocarbon fuels, a fuel vaporizer tube having a threaded exterior portion intermediate the ends of said tube, a nozzle mounted in the vaporizer tube above said threads, a burner bowl having air inlet openings for combustion supporting air, a collar on the burner bowl engaging said threads of the vaporizer and provided with air inlet openings for admitting air around the nozzle, and tongues carried by the burner bowl and converging upwardly and inwardly above the nozzle to limit flow of air immediately surrounding the nozzle to an amount insufficient for supporting combustion between the tongues and said nozzle, said tongues being adjustable relative to said inlet openings of the burner bowl.

7. In a fuel burner for burning liquid hydrocarbon fuels, a fuel vaporizer tube, a nozzle mounted in the vaporizer tube, a burner bowl having heat conductive connection with the vaporizer tube and provided with air inlet openings for combustion supporting air, and tongues carried by the burner bowl and having a shape to effect turbulence of the air admitted through said openings, said tongues being arranged about the fuel stream discharged from the nozzle to limit flow of air immediately surrounding the nozzle to an amount insufficient for supporting combustion between the discharge tip and terminal ends of said tongues.

8. In a fuel burner for burning liquid hydrocarbon fuels, a fuel vaporizer tube, a nozzle mounted in the vaporizer tube, a burner bowl having air inlet openings for combustion supporting air, a collar on the burner bowl in heat conducting contact with the vaporizer tube and provided with air inlet openings for admitting air around the nozzle, and tongues carried by the burner bowl and having twists therein to effect turbulence and converging upwardly and inwardly above the nozzle to limit flow of air immediately surrounding the nozzle to an amount insufficient for supporting combustion between the tongues and said nozzle.

9. In an apparatus for burning a liquid hydrocarbon fuel composed of fractions having different boiling points, a burner bowl having an air inlet opening for admitting combustion supporting air into the burner bowl, a vaporizer having an end discharging into the burner, means for supplying fuel to the vaporizer, a heat conductive connection between the burner bowl and the vaporizer for conducting an amount of heat required to effect vaporization of a selected fraction of the fuel, said heat conducting connection having an opening in position for passing air into cooling contact with said discharge end of the vaporizer, and flame control means in the burner bowl and spaced from the discharge end of the vaporizer for limiting flow of said cooling air to an amount insufficient for supporting combustion in said space when the apparatus is in operation.

10. In an apparatus for burning a liquid hydrocarbon fuel composed of fractions having different boiling points, a fuel vaporizer, a burner bowl above the vaporizer having an air inlet for admitting combustion supporting air, means for supplying fuel to the vaporizer, a heat conductive connection between the burner bowl and the vaporizer for conducting an amount of heat required to effect vaporization of a selected fraction of the fuel, a nozzle tip on the vaporizer for discharging the fuel into the burner bowl, a flame deflector supported within the burner bowl in the path of the fuel discharged from the nozzle, and flame control means between the flame deflector and nozzle for retaining the flame in said burner bowl in spaced relation with the nozzle to limit the effect of radiated heat on the nozzle when the apparatus is in operation.

11. In an apparatus for burning liquid hydrocarbon fuel composed of fractions having different boiling points, a fuel vaporizer, a burner bowl above the vaporizer having an air inlet opening for admitting combustion supporting air to the burner, a flame deflector supported in

the burner bowl above said opening for deflecting flame into contact with the burner bowl, means for supplying fuel to the vaporizer, a heat conductive connection between the burner bowl and vaporizer to conduct heat for effecting vaporization of selected fractions of the fuel within the vaporizer, a nozzle on the vaporizer for discharging the fuel into the burner, said heat conductive connection having an opening positioned relative to the nozzle for passing air to disperse heat radiated from the flame deflector in the direction of said nozzle, and means in the burner between said openings for retaining the flame of combustion in spaced relation with the nozzle when the apparatus is in operation.

12. In an apparatus for burning liquid hydrocarbon fuel composed of fractions having different boiling points, a fuel vaporizer tube having a threaded exterior portion intermediate the ends of said tube, a burner bowl above the vaporizer having air inlet openings for admitting combustion air into the burner bowl, means for supplying fuel to the vaporizer, a collar on the burner bowl to receive heat from the burner bowl and having a threaded portion engaging said threads of the vaporizer for conducting an amount of heat required to effect vaporization of a selected fraction of the fuel, a nozzle tip in the vaporizer above said threads for discharging the fuel into the burner bowl, said collar having air inlet openings for admitting air around the nozzle, and means within the burner bowl and spaced from said nozzle for retaining the flame of combustion in said burner in spaced relation with the nozzle to limit the effects of radiated heat on the nozzle when the apparatus is in operation.

13. In an apparatus for burning liquid hydrocarbon fuel composed of fractions having different boiling points, a fuel vaporizer tube having a threaded exterior portion intermediate the ends of said tube, a burner bowl above the vaporizer having air inlet openings for admitting combustion air into the burner bowl, means for supplying fuel to the vaporizer, a collar on the burner bowl to receive heat from the burner bowl and having a threaded portion engaging said threads of the vaporizer for conducting an amount of heat required to effect vaporization of a selected fraction of the fuel, a nozzle tip in the vaporizer above said threads for discharging the fuel into the burner bowl, said collar having air inlet openings for admitting air around the nozzle, means within the burner bowl and spaced from said nozzle for retaining the flame of combustion in said burner in spaced relation with the nozzle to limit the effects of radiated heat on the nozzle when the apparatus is in operation, and a flame deflector supported within the burner bowl above the combustion air inlet openings for deflecting the flame into heating contact with the burner bowl.

BOYD W. TULLIS.