April 9, 1963 M. D. HUSTON 3,084,735

COMBUSTION RING AND AIR SUPPLY MEANS FOR HYDROXYLATING BURNER

Filed Aug. 9, 1960 3 Sheets-Sheet 1

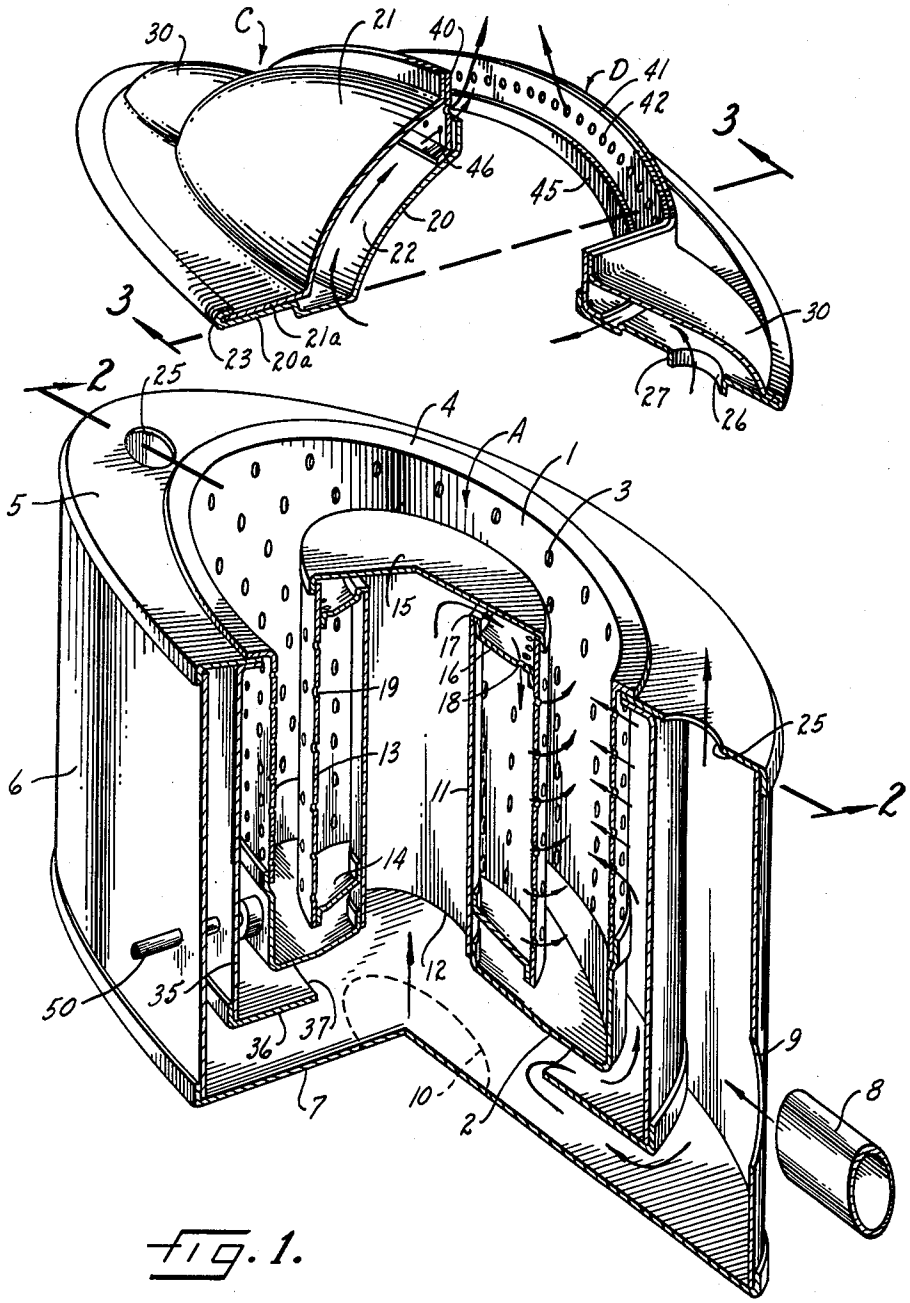


Fig. 1.

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Filed Aug. 9, 1960 3 Sheets-Sheet 2

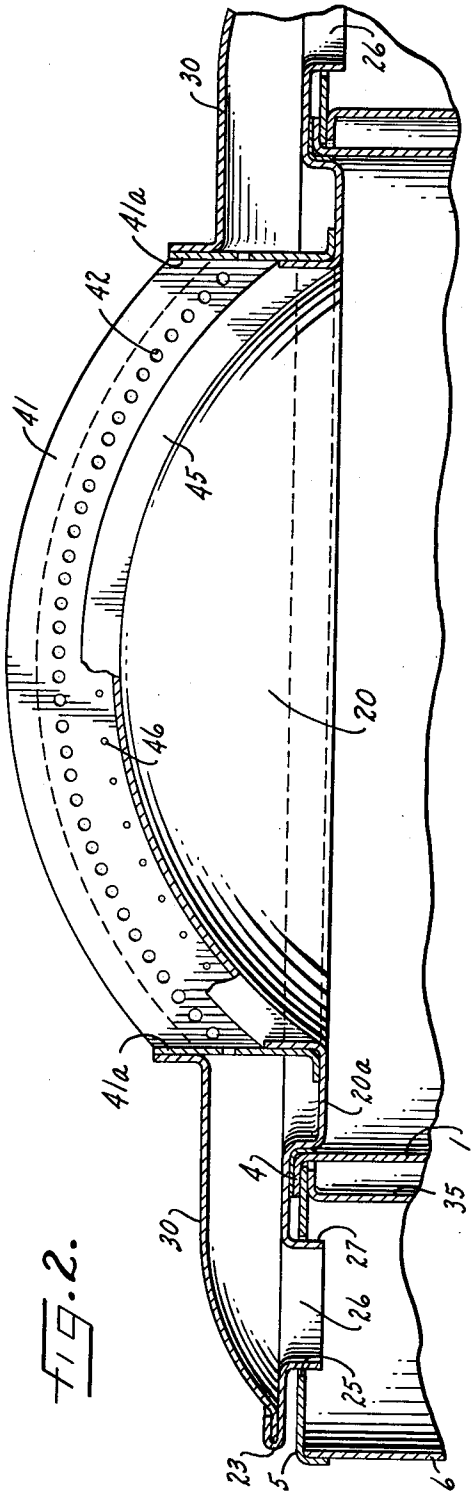


FIG. 2.

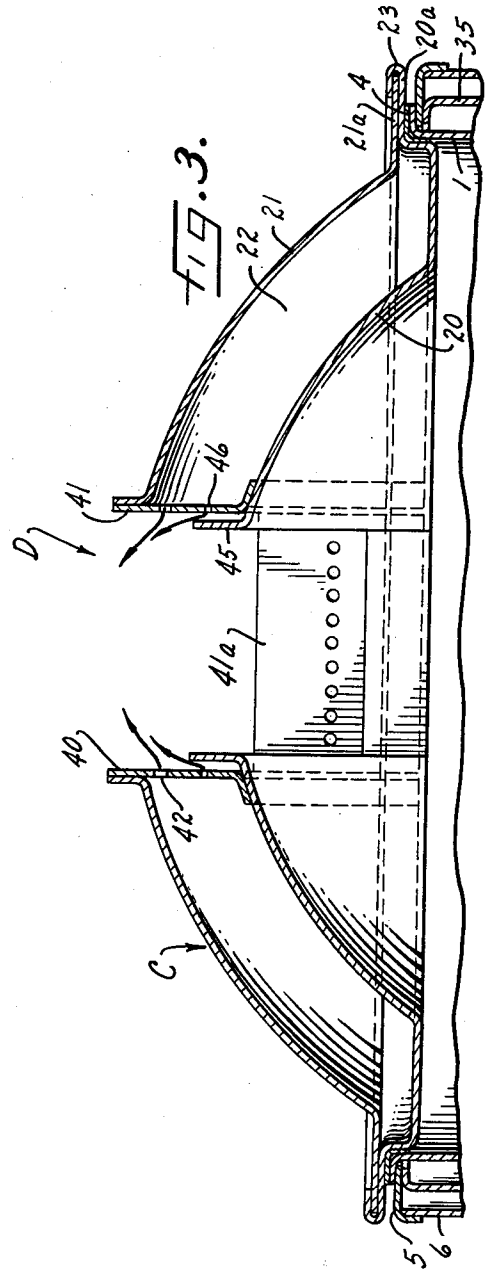


FIG. 3.

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Filed Aug. 9, 1960 3 Sheets-Sheet 3

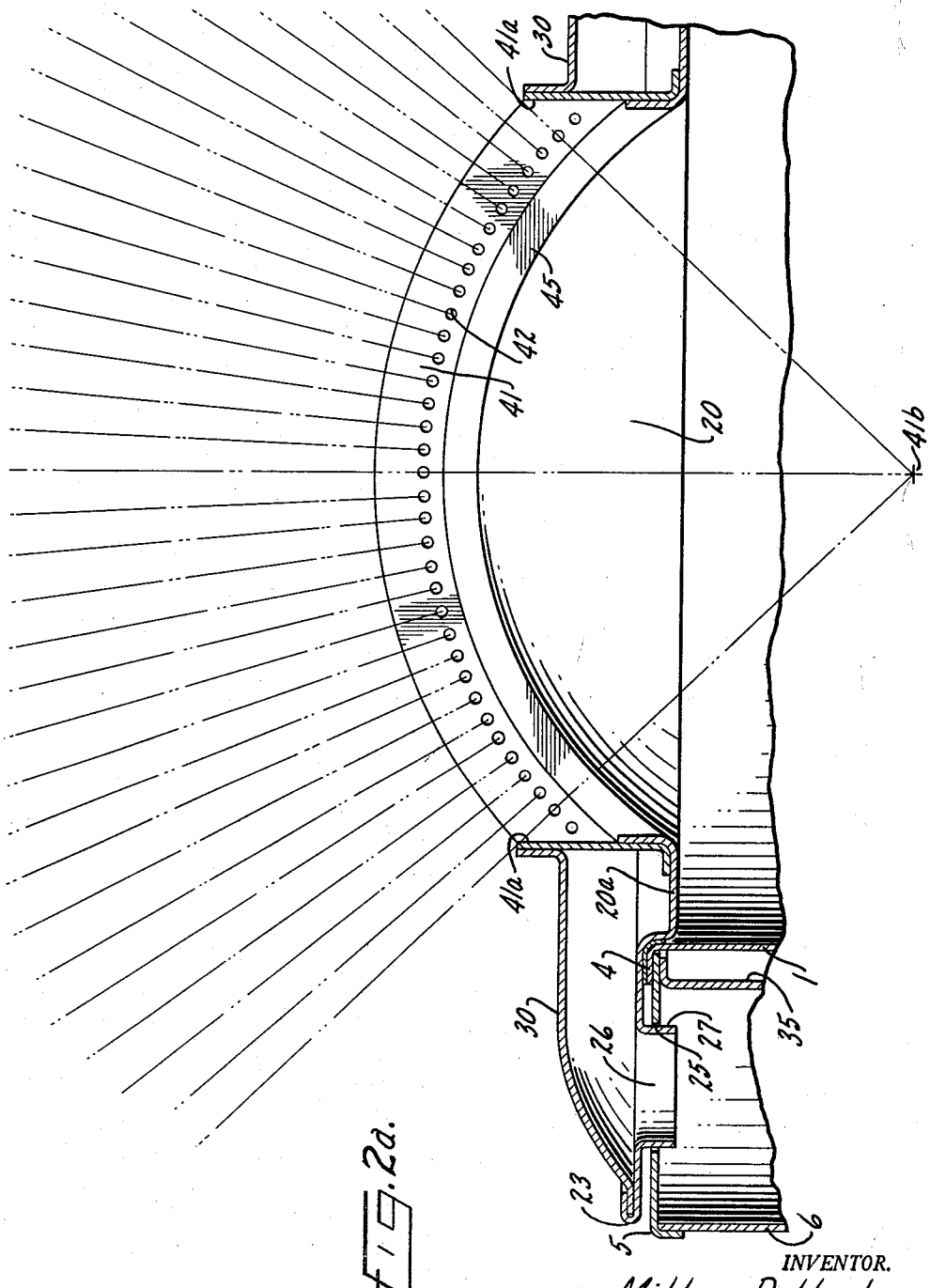


FIG. 2a.

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United States Patent Office 3,084,735 Patented Apr. 9, 1963

3,084,735

COMBUSTION RING AND AIR SUPPLY MEANS FOR HYDROXYLATING BURNER

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Filed Aug. 9, 1960, Ser. No. 48,464
3 Claims. (Cl. 158—91)

The present invention is directed to vaporizing pot type liquid fuel burners. One purpose is the provision of a vaporizing burner pot for liquid hydrocarbon fuels which operates with maximum economy and efficiency.

Another purpose is to provide an improved means and method for supplying secondary air to a primary rich mixture of air and vaporized hydrocarbon.

Another purpose is to provide improved means for locating the zone of combustion of a vaporizing pot type burner.

Another purpose is to provide improved means and method for defining or shaping the flame of such a burner.

Other purposes will appear from time to time in the course of the specification and claims.

I illustrate the invention more or less diagrammatically in the accompanying drawings wherein:

FIGURE 1 is a perspective exploded view, with parts in section, illustrating the pot assembly of the present invention with the secondary air inlet assembly and flame ring upwardly removed;

FIGURE 2 is a section, on a somewhat enlarged scale, on the line 2—2 of FIGURE 1; and

FIGURE 2*a* is a section, on a somewhat enlarged scale, similar to FIGURE 2.

FIGURE 3 is a section on the line 3—3 of FIGURE 2.

Like parts are indicated by like symbols throughout the specification and drawings.

Referring to the drawings, A generally indicates a hydroxylating burner pot. The pot includes a circumferential side wall 1 and a bottom wall 2. The side wall is formed or provided with a plurality of primary air inlet apertures 3 spaced circumferentially about the pot and located at different levels in the pot. It will be understood that in the normal use of the pot the apertures 3 are of sufficient number and cross-sectional area to provide a somewhat scanty supply of primary air for mixture with the liquid hydrocarbon supplied to and vaporized within the pot. The pot is shown as having an upper, outwardly extending flange 4 shown as overlying a top closure ring 5 which extends to and is suitably secured to an outwardly spaced, circumferentially extending side wall housing 6. The housing 6 is shown as provided with a bottom wall 7 which, with the housing 6 and the closure ring 5, surrounds and defines an air space about the burner pot A. The various parts described are preferably secured to each other in substantially air-tight and gas-tight relationship, for example, by welding. Suitable means are employed for delivering air to the space within the enclosure thus formed. In FIGURE 1, I illustrate a blower duct 8 which may extend from a motor-driven blower, not herein illustrated since the details of the blower do not of themselves form part of the present invention. It will be understood that the outlet or delivery duct 8 from the blower extends to a suitable aperture 9 which may be in the bottom 7 or the housing side wall 6. It is illustrated as formed in the side wall of the housing 6. Air from a suitable blower or blowing system may thus be delivered to the interior of the housing 6 and thereby to the interior of the pot A. Where natural draft is employed, it will be understood that any suitable air admission aperture may be employed. I may, for example, employ the aperture 10, illustrated in dotted line in FIGURE 1 in the housing bottom 7.

Preferably, but not necessarily, the pot A may be provided with an axial, upwardly extending, central passage or tube 11 communicating with and surrounding an axial aperture 12 in the pot bottom 2. Surrounding the tube 11 is a suitable heating element for heating the rising vaporized mixture. It is shown as including an outer wall 13 with its bottom closure 14 extending to and being sealed in relation to a lower portion of the axial tube 11. 15 is a top closure plate. As shown in FIGURE 1 an intermediate supporting partition is employed with a central aperture 17 through which the air which passes upwardly through the axial tube 11 may flow. The partition 16 is apertured as at 18 to admit air into the space surrounded by the tube 11, the outer wall 13, the bottom closure 14, and the intermediate partition 16. The wall 13 is provided with a plurality of air outlets 19 which are so related in total cross-sectional area to the apertures 18 as to ensure the maintenance of a relatively low air pressure in the space above described. The air inlets 19 are relatively closely spaced, and their purpose is to support a localized complete combustion of the vaporized mixture at a number of small, closely spaced jets. These jets of flame have for function to heat the mixture of primary air and vaporized hydrocarbon rising in the pot, as will later appear.

In considering the operation of the pot it will be understood that primary air supplied about the pot A will reach the interior of the pot through the primary air inlets 3. Liquid fuel is supplied to the bottom of the pot, for example, through any suitable fuel inlet or pipe 50. The details of fuel admission are not of themselves significant or important in the present invention, but it will be understood that a supply of liquid fuel is delivered to the interior of the pot and that this liquid fuel is vaporized by the heat of combustion taking place in or just above the pot. The fuel vaporized by such combustion rises in the pot and receives, through the air inlets 3, only enough air to provide a relatively rich and not fully combustible mixture. It will be understood that the primary air is admitted into the pot in jets of relatively high velocity so far as concerns the entry of air through the pot side wall primary apertures 3. However, the air is admitted in much slower jets through the small apertures 19 of the sleeve 13, and these small, slow jets of air provide pinpoints of full combustion effective to heat the rising primary rich mixture.

The parts and apertures are so proportioned that the total supply of primary air to the rising mixture is insufficient to produce a fully combustible mixture. Though the localized combustion from the low pressure apertures 13 permits low pressure air to produce local spots of full combustion, these are effective only to heat the rising rich mixture. The jets of primary air which enter through the pot wall are at substantially higher pressure, they mix with the vaporized fuel, and merely supply primary air to the vaporized fuel without producing a combustible mixture. Until secondary air is added to produce the final lean mixture, combustion of the upwardly rising rich mixture cannot take place. The secondary air employed to produce a combustible mixture is supplied entirely, or substantially entirely, through the secondary air admission structure or combustion structure, generally indicated at C. The secondary air admission structure may advantageously be formed for unitary application and removability, although it is not essential to the practice of my invention that it be removable. A removable structure is shown in FIGURE 1 as including a lower dome 20 and an upper dome 21 which are spaced apart to form a plenum chamber or space, indicated at 22. The domes 20 and 21 may be secured together about their edges by connecting abutting flanges 20*a* and 21*a* which may be crimped together or secured, as at 23, to provide

an air-tight or gas-tight chamber. Air is admitted to this space 22, for example, through apertures 25 in the ring 5 which register with apertures 26 in the bottom dome structure 20. The apertures 26 may be surrounded by downwardly extending flanges 27 which may enter the apertures 25 and prevent unintended lateral displacement of the structure C upon the upper end of the pot assembly. Any suitable upper ducts 30 may be employed, if necessary, to direct air rising through the apertures 25, 26 to enter the secondary air chamber 22. As shown, these are formed by upwardly deforming the flange 21*a*. To summarize, the primary air for the primary mixture flows into the interior of the pot A through the inlet apertures 3 in the pot side wall 1. Preferably, the entire secondary air supply flows directly upwardly through the apertures 25 in the ring 5, and thus into the space 22.

I find it advantageous to provide a baffling or shielding structure shown as including a cylindrical wall 35 surrounding the pot side wall 1 and secured in air-tight relation to the flange 4 and the ring 5. The shielding or baffling structure includes also a bottom ring 36, with a central aperture 37.

The secondary air is delivered to the rising primary mixture through a series of secondary air apertures in communication with the space 22. In the particular structure herein shown the domes 20 and 21 are arranged or shaped to define a slot, generally indicated at D. This slot, in horizontal plan view, may be generally rectilinear and may extend either from side to side of the pot or may be somewhat shorter than the inside diameter of the pot, as shown in FIGURE 2. This slot is bounded or defined on two opposite sides by parallel walls 40, 41, each wall extending generally vertically between the lower dome member 20 and the upper dome member 21. They are connected by end walls 41*a*. Each such wall has a plurality of secondary air inlet apertures 42 which are preferably larger in diameter and more closely spaced than the primary air inlets 3 of the pot side wall 1. The secondary air inlet apertures 42 may, if desired, be continued also across the end walls 41*a*. It will be understood that sufficient air is thereby supplied through these secondary air inlets to add to the rising mixture of primary air and vaporized hydrocarbon a sufficient secondary air supply to convert the original rich, incombustible mixture into a lean, fully combustible mixture. Combustion takes place at or just above the level of the secondary air inlets 42. While I may employ various means for supplying the secondary air at this point, I find that a closely spaced row of secondary air inlets 42 provides a practical structure. I may also, under most circumstances, find it advantageous to provide impinging or upwardly rising air to the individual jets of flame which form at the secondary air inlets 42. As one system of flame propagation I provide a spaced, upwardly extending flange 45 spaced inwardly from each of the walls 40, 41. Each wall 40, 41 is then provided with a plurality of propagator feed holes 46, preferably of substantially smaller diameter than the secondary air inlets 42, which direct a limited supply of secondary air into the space between each wall 40 or 41 and its associated spaced flange 45. This propagating air is directed upwardly to the bases of the flame jets extending inwardly from the secondary air inlets 42, and these jets are thereby prevented from dancing or vibrating in relation to the surfaces of the walls 40, 41. Combustion begins at or close to the base of each jet, even though air enters through the inlets 42 at relatively high pressure. This system of upwardly extending flanges may also be extended across the end walls 41*a* if such walls have secondary air inlets formed therein.

The domed or arched walls 41 are formed about an axis 41*b* which is below the walls and, in effect, within the confines of the pot. Accordingly, each of the apertures 42 which supply secondary air to the rising mixture will be formed in an arc about the axis 41*b*. The secondary air supplied through these apertures will combine with the rising mixture to provide a fan-shaped flame. Each of these secondary air apertures 42 will direct a stream of air which is along a radius from the axis or center 41*b*. This particular construction is shown in detail in FIGURE 2*a*.

Whereas I have described and shown a practical and operative device, nevertheless many changes may be made in size, shape, number and disposition of parts. The pot A may be cylindrical, or it may be otherwise shaped; it may, for example, be somewhat oval in horizontal cross-section, as shown in FIGURE 1. Whereas a major characteristic of my invention is that the entire secondary air supply is provided through a combined plenum chamber and flame ring, the shape of this plenum chamber and flame ring may be widely varied. When the pot and the secondary air assembly C are shaped as shown in FIGURES 1 to 3, inclusive, I provide a fan-shaped flame somewhat similar in shape to the flame of the old fashioned kerosene lamp with its woven wick. However, where a different shape of flame is desired a different shape of secondary air flame ring and plenum chamber may be employed.

The use and operation of the invention are as follows:

I provide a structure for burning liquid hydrocarbons which includes a unitary flame ring and secondary air supply assembly which may advantageously be made removable from the burner. In the lower half of FIGURE 1 the burner assembly proper is shown, including the burner pot, in which the liquid fuel delivered through the duct 50 is vaporized, and where the vaporized hydrocarbon is combined with primary air delivered through the inlets 3 in the pot side wall to form a rich mixture. This rich mixture, which does not include enough air for full combustion, is heated, as it rises in the pot, by the local pinpoint combustion on the surface of the inner sleeve or mushroom 13. Thus there rises to the top of the burner pot A an adequately heated mixture of primary air and vaporized hydrocarbon ready to receive the necessary supply of secondary air. In the upper half of FIGURE 1, and in FIGURES 2 and 3, a combined flame ring and secondary air supply delivery means is illustrated, which may be readily applied to, and removed as a unit from, the pot assembly shown in the lower half of FIGURE 1. The air supplied to the plenum chamber 22 between the domes 20 and 21 is in such volume that, when it reaches the upwardly flowing primary or rich mixture it creates with that mixture a lean final mixture, ready for full combustion. The final, full combustion takes place at and above the secondary air inlets 42.

In the particular structure herein shown I illustrate a flame ring assembly which defines a relatively flat flame which may be compared to the flame of the kerosene lamp of earlier days. The location of the bounding walls of the flame outlet is such as to define a relatively flat flame which is supplied at its base with secondary air, and which is, therefore, both formed and positioned by the location of the secondary air inlets 42.

Whereas it may be advantageous to employ the particular shape of flame ring or flame forming structure herein shown, other forms may be employed. For example, whereas I find the domed shape advantageous in many circumstances, a flat flame ring assembly may be employed. And whereas I find an elongated flame slot advantageous, where a flattened flame is desired, it will be understood that the shape of the flame may be varied to suit the desire of the operator. For example, a flat plenum chamber may be made to surround a circular central aperture.

Whereas I have shown in FIGURE 1 a central air diffusing and mixture heating structure, including the upwardly extending tube 11 and its surrounding sleeve 13, I do not wish to limit myself to such structure except so far as is claimed herein. The secondary air supply and flame assembly, as shown, for example, at C in FIGURE

1, may be used with burner pots in which the central structure is entirely omitted, and in which not only is all the primary air received through the pot side wall, but no air at all is delivered upwardly through the center of the pot.

Where a central air diffuser is employed, as shown, for example, in FIGURE 1, the liquid fuel is shielded from the flame at the top of the pot. Therefore, in order to evaporate the incoming fuel as fast as it flows into the pot it is necessary to conserve heat, and, preferably, positively to heat the rising mixture; hence, the advantage of the diffuser structure with its arrangement for maintaining pinpoints of full combustion over the surface of the diffuser sleeve. It will be understood, however, that, under some circumstances, it may be possible to dispense altogether with the use of the central air diffusing and mixture heating structure.

The perforation of the pot A may be substantially varied. It is, in the main, advantageous to tilt the lower row of primary air apertures downwardly, as shown in detail in copending application Serial No. 838,818, filed on August 28, 1959, for "Burner Units and Methods," of which I am a co-inventor, now Patent No. 3,017,925.

In the use of the device, and especially where air under forced draft is employed, the cylindrical wall or shield 35 is preferably used. It may, under some circumstances, be omitted when natural draft is used. With the structure as shown in full line in FIGURE 1 all air delivered to the interior of the housing 6 comes through the fan delivery duct 8 and initially impinges against and circulates around the shield or wall 35. In effect, it impinges on the shield and collects in an inefficient plenum chamber between the shield and casing and then is fed upwardly through a large central aperture axially aligned with the burner bottom. Some of the air goes up through the central tube 11 and supplies the air diffuser structure. Some of the air is fed between the burner bottom and the shield cap or bottom flange or ring 36 to the area surrounding the outside of the pot. This air then enters the primary air holes 3 in the pot side wall. As shown in FIGURE 2 some of the air which enters the space within the housing wall 6 flows upwardly through the apertures 25 to supply the air necessary for the secondary air supply assembly above described.

It will be understood that, regardless of the shape of flame desired, or the shape of flame aperture used, secondary air is introduced about the periphery of the flame aperture. Preferably, the entire supply of secondary air is thus supplied, and combustion will be initiated at and above the level at which the secondary air is supplied about the periphery of the flame aperture. The flame can burn only where and when the secondary air is introduced. While not strictly necessary, it is advantageous to admit the secondary air through a plurality of relatively large, relatively closely spaced air inlets, with the preferred further provision of means for supplying flame stabilizing air upwardly to the base of the jets extending inwardly from the various secondary air inlets. The direction of a supply of air to the base of the flame of each secondary jet provides efficient and substantially silent combustion. Where, as in the structure of FIGURE 1, the row of secondary air inlets is curved, each pair of opposing jets from the opposite sides of the flame aperture or slot impinge in the center and leave the aperture upwardly generally at right angles. Since the illustrated secondary air structure is domed, the air, and thus the final mixture and the flame, emerge in a fan shape. Since the gas or rich mixture burns wherever the secondary air is introduced, a fan-shaped flame is produced which burns along the transversely rectangular flame slot. The doming of the slot gives the flame its fan-like shape. It is a matter of choice whether or not secondary air is admitted through the end walls of the flame aperture.

It will be understood that ambient air may be admitted to the plenum chamber, but that, preferably, especially where a pressure system is employed, air is best admitted to the interior of the plenum chamber from the space about the pot. This has for one advantage that the secondary air is partially preheated, even though it travels exteriorly of the cylindrical shield or wall 35.

Whereas I have described the opening between the walls 40 and 41 as a flame opening or aperture, it will be understood that, since the secondary air supply apertures are arranged along this opening, the combustion or flame actually originates in the opening.

I claim:

1. In a burner, and in combination with a burner pot of the vaporizing, hydroxylating type, the pot having a side wall formed with primary air inlet apertures and having means for supplying a liquid hydrocarbon to the interior of the pot, with said primary apertures being effective to supply sufficient primary air for forming, with the evaporated hydrocarbon, a rich, incombustible primary mixture, a housing member surrounding said burner pot, means for supplying air to said housing, and a primary mixture outlet from the burner pot, a unitary structure adapted to be mounted upon said burner pot and a housing member for supplying secondary air to said primary mixture discharged from said pot and for, at the same time, positioning and shaping a flame to a desired location and form, when said mixture is burned, which structure includes upper and lower spaced wall members secured together at their outer peripheries, said wall members, inwardly of their peripheries being bowed upwardly in spaced relation and defining in part a generally dome-shaped plenum chamber, the bottom wall of the plenum chamber being provided with an air inlet aperture in communication with the inside of the housing member, the upwardly bowed portions of said wall members being slotted, and a generally vertical wall member joining the edges of said slots, said vertical wall member closing said plenum chamber and defining a substantially upright flame shaping flow passage in communication with said outlet from said burner pot, the transverse cross section of said flow passage being substantially longer than it is wide whereby a relatively flat, generally upright flame is formed thereby when said mixture is burned, said flame shaping flow passage being bounded by opposed, generally parallel, generally upright wall portions having at least two rows of secondary air apertures therein, said rows of apertures being disposed at different levels and arcuately arranged to conform generally to the dome-shaped contour of the plenum chamber, one of said rows of holes directing secondary air from said plenum chamber inwardly across said flow passage in sufficient quantity to convert a rich mixture flowing upwardly therethrough to a mixture adequately lean for combustion, and an arcuate baffle disposed in front of a lower row of said holes for directing secondary air upwardly around the peripheral surfaces of a mixture flowing through said flow passage.

2. The structure of claim 1 characterized by said housing being substantially air-tight and having a transverse upper wall member underlying the lower wall member of the plenum chamber, means for delivering air from the interior of such housing to the plenum chamber of the flame defining structure including an air outlet aperture in said transverse wall of the housing, and means for maintaining the air inlet aperture in the bottom wall of the plenum chamber in register with said air outlet aperture in the transverse wall of said housing, while permitting ready upward removal of the flame defining structure said last-mentioned means including a protuberance carried by one of said wall members and engaged with the aperture in the other of said wall members.

3. A flame forming assembly for support upon the upper end of a pot-type burner, said assembly including a hollow member having upper and lower wall members secured together at their peripheries and defining in part a generally annular plenum chamber, said upper and lower wall members inwardly of their peripheries being up-

wardly bowed in spaced relation and each provided with an elongated slot, the walls of the slots being connected by a substantially vertical wall member forming an upright flow passage for the fuel-air mixture from the pot, opposed portions of the wall of said flow passage being provided with at least two rows of secondary air inlet apertures in communication with the interior of the plenum chamber, said rows of secondary air passages being arranged at different levels and being arcuately contoured to conform substantially to the transverse contour of the dome-shaped plenum chamber, one of said rows of secondary air apertures being disposed to direct air from the plenum chamber inwardly across said flow passage, and an arcuate baffle member disposed in front of a lower row of said apertures and formed to direct air upwardly around the periphery of a stream of air-fuel

mixture flowing upwardly through said flow passage, and means for delivering air to the plenum chamber.

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