Feb. 20, 1945. J. G. BEHRENDT ET AL 2,369,999

BURNER

Filed Nov. 10, 1941

Fig. 1

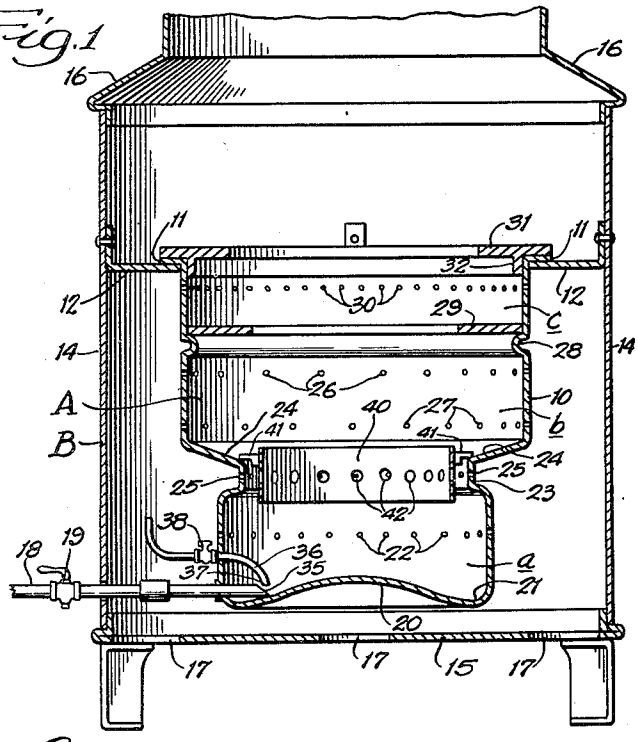


Fig. 3

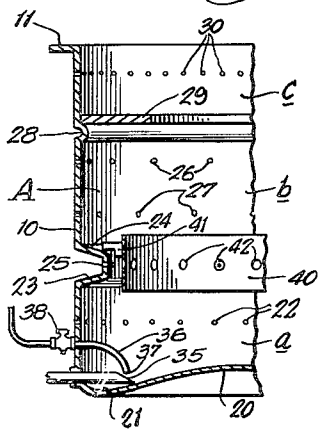
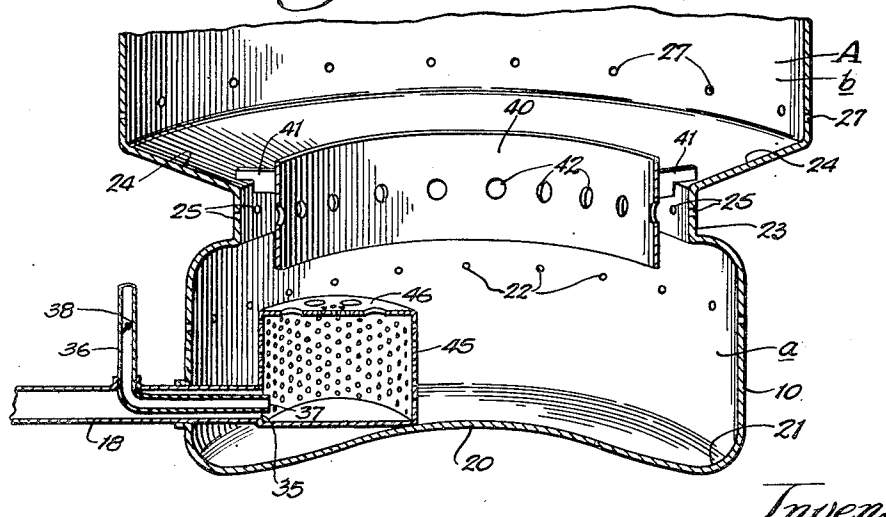


Fig. 2



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2,369,999

BURNER

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Application November 10, 1941, Serial No. 418,482

2 Claims. (Cl. 158—91)

This invention relates to a liquid fuel vaporizing burner. One of our objectives is to provide a liquid fuel burner with a wide range of combustion stages, varying from a very low fire to an extremely hot fire with a high degree of combustion efficiency maintained over the entire range.

More particularly, the improvements of this invention are concerned with means for providing initially, during the primary stage of combustion, an ample air supply localized with respect to the flame which, in consequence, will burn cleaner and hotter. With such a burner we also may use with advantage a vaporizing ring, located preferably at a point inwardly of the pot walls and intermediately of upper and lower combustion chambers therein, the ring being positioned opposite a circular row of air inlet openings and being itself provided with relatively large openings therethrough, whereby to act as a medium for diffusing the currents of air entering into the burner. It is a further object of this invention to provide a burner having the features noted which is adapted for any of the very specialized and different needs and uses which may arise. Such a burner possesses also the advantages of being simple and economical of manufacture and assembly.

Other and further objects of this invention will be apparent from the ensuing description wherein reference is made to the accompanying drawing which illustrates certain preferred embodiments of our improved burner in the manner following:

Figure 1 is a vertical sectional view of a heating cabinet equipped with the present burner;

Fig. 2 is an enlarged fragmentary sectional perspective view showing in detail the lower combustion chamber of a burner in which the means for localizing part of the air supply is somewhat modified from the construction shown in Fig. 1; and

Fig. 3 is a fragmentary view in vertical section showing a burner of modified construction in that its upper and lower combustion chambers are of substantially the same diameter.

As herein shown, a fire pot A is provided with circular walls 10 having at the top an outwardly turned flange 11 adapted to be rested upon and be sustained by bracket arms 12 which are extended inwardly from the side walls 14 of a heating unit B here shown as a cabinet or stove which comprises a bottom 15 and a top 16 which is fitted upon the upper end of the cabinet, all as indicated clearly in Fig. 1. Through the bottom 15 apertures 17 are formed for admitting air to the interior of the cabinet.

Referring particularly to Fig. 1, the fire pot, which is adapted to receive its fuel from a supply source (not shown) through a conduit pipe 18 equipped with a control valve 19, may comprise three superposed firing chambers *a*, *b* and *c*, the lowermost chamber *a* being here shown as smaller in diameter than those above. The bottom of this lowermost burner which serves also as the base of the fire pot is raised centrally as at 20 so as to form adjacent the peripheral walls of the burner an annular trough 21 to receive liquid fuel delivered through the supply pipe 18. At a point about midway of the height of the lowermost chamber, a single circumferential row of spaced ports 22 is formed through the peripheral wall of the burner.

The fire pot is also formed with an inwardly extending crimp 23 defining a circumferential ledge 24 below which, at an innermost point of the crimp, is formed a plurality of closely spaced perforations 25 through which air may enter the burner at an elevation where the minimum diameter obtains. The crimp partially separates the lowermost from the middle firing chamber which may be of increased diameter, and which may be provided with upper and lower circumferential rows of ports 26 and 27, respectively. An inwardly extending bead 28 serves as support for an annular baffle plate 29 which partially separates the middle from the uppermost firing chamber *c*.

This top chamber is provided near its upper edge with a single row of ports 30 of increased diameter, or number, or both, to admit a relatively large volume of air into the burner at this point. An annular plate 31, which is mounted upon the top of the fire pot, provides an upper baffle and axial outlet for the flames and products of combustion. The opening in the plate is somewhat greater in diameter than is the opening in the lower baffle plate 29, for a reason that will be later pointed out. The top baffle plate may be centered, as by depending lugs 32 which engage with the burner walls 10.

A feature of special importance is the air inlet opening adjacent the delivery end of the fuel pipe 18 one form of which is shown in Figs. 1 and 3. This pipe which enters the lower combustion chamber at a point adjacent its bottom terminates relatively close to the burner wall 10 through which it extends. The discharge end 35 of this pipe is shown as facing inwardly and upwardly, being positioned closely adjacent the bottom of the burner, and at or within the an-

nular fuel trough peripherally thereof. A special air duct for the fuel pipe is also provided, this taking the form of a pipe 36 which extends from and is supported by the burner wall 10 at a point above the fuel pipe and arranged to conduct therethrough a supply of undiluted fresh air for delivery at its inner end 37 at a point closely adjacent the discharge end of the fuel pipe. As shown, a control valve 38 may be fitted to the air pipe whose inlet end extends upwardly to a point above the air ports 22 in the lowermost combustion chamber. By this arrangement the incoming fuel, which initially in the primary stage of combustion is burned mainly at the discharge end of the fuel pipe, is supplied with a regulable amount of supporting oxygen delivered at the heart of the flame.

Another form of means for localizing part of the air supply is shown in Fig. 2 wherein the discharge end 35 of the fuel pipe 18 terminates upon the inner face of a pilot cylinder here shown as foraminous cage having perforated walls 45 surmounted by a top 46 through which are openings of larger size. This cage may rest upon the pot bottom 20, relatively close to its walls 10, the fuel entering the cage being free to escape therefrom to flow around into the annular trough 21. The pot walls closely surround the fuel pipe at the point where it passes therethrough, in accordance with usual practice. Within the fuel pipe is accommodated an air duct in the form of a pipe 36 whose delivery end 37 terminates at or just beyond the discharge end of the fuel pipe 18. At a point exteriorly of the pot the air pipe emerges laterally through the walls of the fuel pipe, and rises therefrom to a point which is preferably above the line of air ports 22 in the lowermost firing chamber of the burner. In this construction an undiluted supply of air is delivered to the point where combustion originates, and the flames, particularly in the initial stage of firing, will tend to follow along the walls of the cage to assure complete combustion with resulting clean operation.

A modification in the form of the fire pot is illustrated in Fig. 3 wherein the pot walls are shown as of uniform diameter from top to bottom except at the points where the inward crimps 23 and 28 are provided. In all other respects the burner construction may be the same as that already described. For certain conditions of use such a pot having a uniform diameter from end to end may be preferred, although it is lacking in some of the advantages arising from an enlargement of the two upper combustion chambers, as compared with the one at the bottom, all as will be presently pointed out.

In connection with the burners hereinbefore described we may also use a thin vaporizing ring 40 which lies opposite the circumferential row of ports 25 in the crimp 23. This ring which is of substantially less diameter than is the crimp has a relatively greater vertical dimension so as to present its upper and lower edges above and below the proximate crimp face. To facilitate its support centrally within the burner, we provide a plurality of notched arms 41 extending radially from the ring toward the walls of the fire pot and so formed as to rest upon the ledge 24. The vaporizing ring is itself provided with a circumferential row of spaced ports 42 of larger diameter than are the ports 25 opposite thereto in the adjacent crimp.

When operated, fuel is supplied through the supply pipe 18, combustion being initiated at the bottom of the lower firing compartment *a*, close to the peripheral walls of the burner. As heat is generated, air is drawn in through the various ports to support combustion within the fire pot. Initially, in its first stage, combustion will start at the discharge orifice of the fuel pipe and then extend around the annular trough at the bottom, but with a rise in temperature vaporization will take place to an increasing extent, producing in later stages an ever vertically higher zone of mist at the bottom of the fire pot with the result that the visible combustion will rise to a point well up in the lowermost compartment.

During the initial stage of combustion, air supporting the combustion is delivered substantially into the heart of the flame which issues from the fuel supply pipe. This feature is of advantage because the air is delivered undiluted and directly to the central point of combustion without being dispersed or diffused throughout the lower combustion chamber. The ratio of the admixed air and fuel may be controlled, if desired, by the valve means which is interposed in the air pipe, or in the fuel pipe, or both. The provision of the air duct which localizes the delivery of air at a point adjacent the base of the fire initially produced in the low firing stage, makes for a cleaner and hotter flame. At such a time, the draft is least, and the need for an auxiliary localized delivery of supporting air is greatest. During the succeeding stages of firing this air duct continues to supply undiluted air to a point well within the burner adjacent its base, and so enriches the combustible mixture with a consequent gain in heat resulting from a flame which is clean throughout.

By the provision of the inwardly extending crimp a constriction is afforded to slow the upward progress of the combustible gases, the ports 25 therein providing (1) the dominant oxygen supply for the burner in the low combustion stage, and (2) the primary oxygen supply when vaporization is proceeding at the faster rate in the higher combustion stages. As the gases move upwardly into the middle firing chamber which may be of relatively greater diameter, they tend to expand laterally so that their upward travel becomes outward as well. With a middle chamber of enlarged diameter the effect is to delay the upward movement of the gases, thereby providing greater opportunity for air entering the fire pot through the lines of ports 25, 27 and 26, to produce a completely combustible mixture. The commingling of the air and vaporized fuel is also promoted (1) by confining the liquid fuel to an annular area adjacent the peripheral walls of the burner, thereby causing the combustion, initially at least, to remain close to such walls where the entering air first meets with the rising gases to support the combustion at that point; and (2) by delivering further quantities of air to support combustion at the points where travel of the gases is slowed down, if a constricting crimp be employed, and where lateral expansion of the gases starts upon entering the middle firing chamber and elsewhere therein as the combustion gases proceed on their way.

Continuing on upwardly, movement of the gases is retarded by the baffle plate 29 through the central opening of which they pass into the topmost chamber *c* and thence out through the central opening, somewhat larger, of the top baffle plate 31. It is in this topmost chamber that the maximum supply of air is admitted to support combustion. This may be termed a "sec-

ondary" supply, inasmuch as it is admitted at a point remote from the source of combustion. The effect of this final and plentiful admixture of oxygen is to produce a clean flame during high fire operation.

With a burner answering to this general description a vaporizing ring **40**, as best shown in Fig. 2 may be used to advantage. Without such a ring, the air entering through the ports **25** tends to be rifled in from all sides. This results in an opposing action which produces to some extent a hindrance to firing in the intermediate combustion stage. The air so rushing in exerts a cooling effect which will tend to retard combustion at or near the walls of the burner. The vaporizing ring counteracts these tendencies. This is due in part to the vertical dimension of this ring which is sufficient to act as a baffle for arresting the incoming currents of air and producing a dispersion thereof. Upon striking the vaporizing ring, the air streams are halted so as to reduce the velocity thereof, but through the larger openings in the ring much of the air will be permitted to pass, but with diminished force. The result is that the air streams are broken up, some passing down and around the lower edge of the ring, some passing upwardly beyond the top of the ring, but much of it, with diminished force, passing through the ring into a zone centrally of the burner to support combustion which is taking place therewithin. The vaporizing ring itself becomes quite hot and, in consequence, the vapors passing upwardly, whether inside or outside of the ring, are heated to enhance combustibility of the fuel. This promotes the combustion process adjacent the walls of the burner, tending to prevent deposit thereon of unconsumed carbon particles. The combustion is, in consequence, improved so as to be characterized by an intense blue flame which fills the upper two chambers of the burner.

We claim:

1. In a burner, a fire pot having an apertured top, a bottom, and sides therebetween with air ports therethrough at a point relatively close to the bottom, the pot bottom being raised centrally to provide an annular fuel trough adjacent the pot sides, means forming an annular constriction extended inwardly from the pot sides at a point above the air ports in the pot sides and spaced from its bottom defining a lowermost firing chamber and acting to retard egress of combustible gases therefrom, means for supplying fuel to the fire pot comprising a pipe having a discharge orifice adjacent the pot bottom within the annular trough thereof at a point inwardly of its sides, and means for delivering an auxiliary supply of undiluted air to support combustion at the fuel pipe orifice comprising a duct leading from a point exteriorly of the burner pot to a point therewithin and terminating in a single discharge orifice adjacent the pot bottom at a point substantially coincidental with the discharge orifice of the fuel pipe, the inlet end of the air duct being open to the atmosphere exteriorly of the burner and the discharge orifices of the fuel pipe and air duct being faced toward and closely adjacent each other at a point inwardly of the pot sides at least as far as the pot constriction means thereabove to insure a commingling of the fuel and air streams issuing therefrom immediately upon discharge thereof at a point adjacent and within the annular trough at the pot bottom.

2. In a burner, a fire pot having an apertured top, a bottom, and sides therebetween with air ports therethrough at a point relatively close to the bottom, means forming an annular constriction extended inwardly from the pot sides at a point above the air ports in the pot sides and spaced from its bottom defining a lowermost firing chamber and acting to retard egress of combustible gases therefrom, there being a plurality of air ports for admitting air to the pot interior in the plane of the constricting means, a vaporizing ring with ports therethrough supported within the pot opposite the air ports in the plane of the constricting means spaced inwardly thereof and serving to deflect vertically a portion of the air streams entering therethrough, means for supplying fuel to the fire pot comprising a pipe having a discharge orifice adjacent the pot bottom at a point inwardly of its sides, and means for delivering an auxiliary supply of undiluted air to support combustion at the fuel pipe orifice comprising a duct extending from a point exteriorly of the burner pot to a point therewithin and terminating in a single discharge orifice adjacent the pot bottom at a point substantially coincidental with the discharge orifice of the fuel pipe, the inlet end of the air duct being open to the atmosphere exteriorly of the burner and the discharge orifices of the fuel pipe and air duct being faced toward and closely adjacent each other at a point inwardly of the pot sides at least as far as the pot constriction means thereabove to insure a commingling of the fuel and air streams issuing therefrom immediately upon discharge thereof at a point adjacent the pot bottom.

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