March 1, 1938. H. C. LITTLE 2,109,946

OIL BURNER

Filed Oct. 31, 1934 2 Sheets-Sheet 1

FIG. 1.

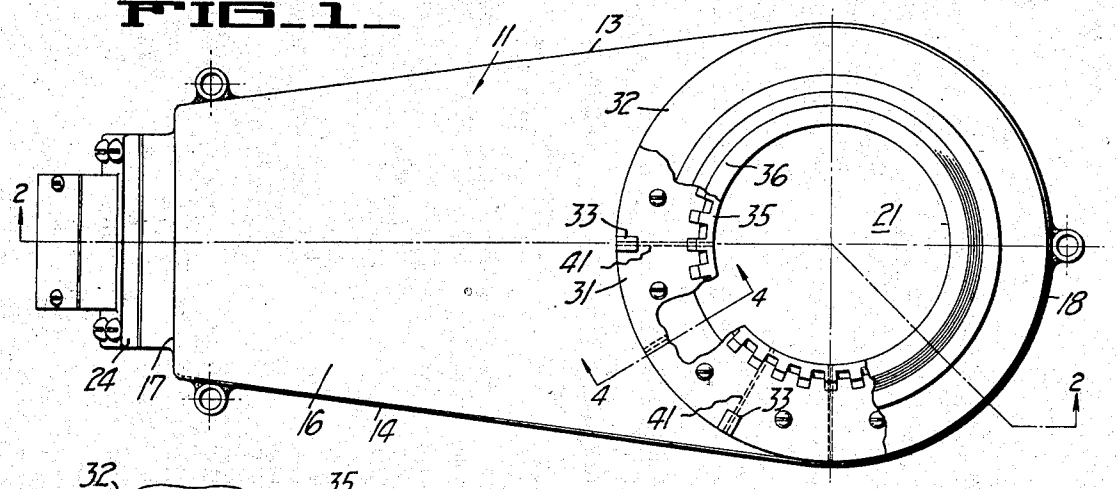


FIG. 3.

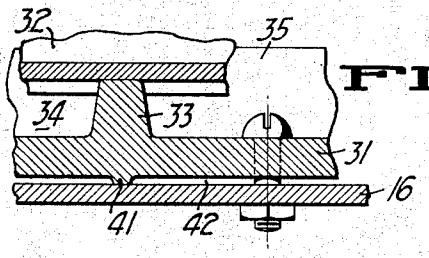


FIG. 2.

FIG. 4.

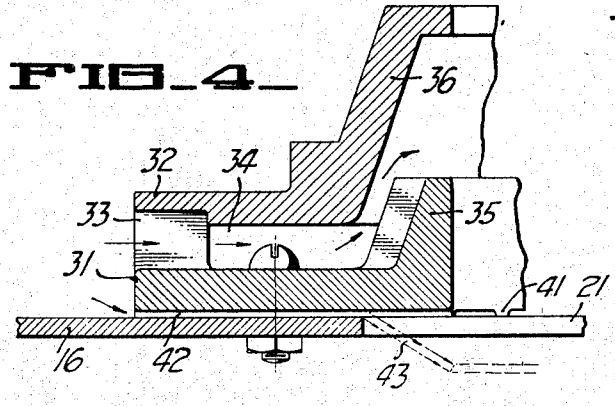
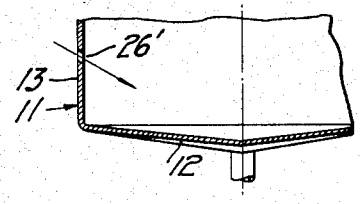


FIG. 5.



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FIG. 6.

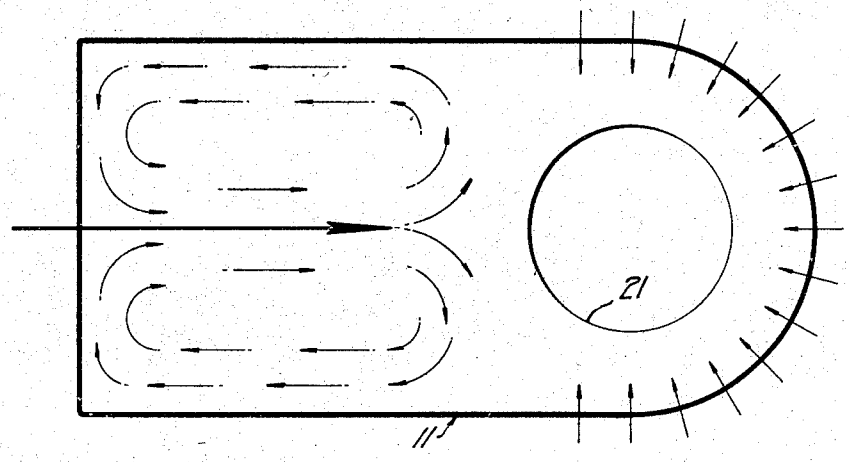
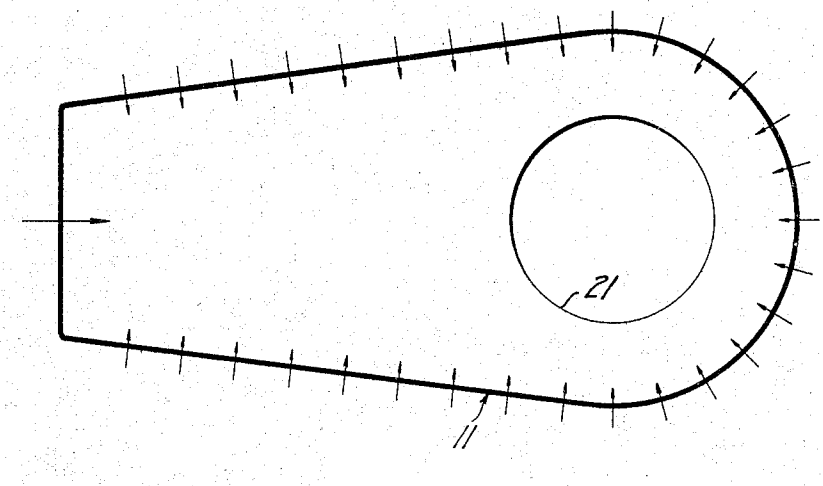


FIG. 7.



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OIL BURNER

Harry C. Little, San Rafael, Calif.

Application October 31, 1934, Serial No. 750,774

12 Claims. (Cl. 158—92)

The invention relates to oil burners, particularly of the natural draft type, and to processes of burning oil in such burners such as those disclosed in my copending applications Serial Numbers 702,688 and 702,689, of which the present application is a continuation in part.

Oil burners of the above type generally operate through the heating and volatilization of oil and the hydroxilization of the volatile oil or the mixing of the volatile oil with primary air, so called, and then in causing the passage of the hydroxilized products together with secondary air, so called, into a combustion chamber for burning. Usually for carrying out this process of burning, a generator casing of one form or another is employed which provides for the introduction of liquid oil and primary air and the volatilization of the oil and the passage of the hydroxilized mixture to a burner opening for burning. In most of these instances the heat for volatilizing of the oil is supplied to the generator casing by deflection or thermal contact with the burning products at the burner opening.

While oil burners of the above type have in the past been quite successful in operation, especially after the generation of gas was started and the burner brought up to full operating conditions, considerable annoyance and difficulty has usually attended the initiation of the burner operation and the initial generation of gas. In most cases on starting the burner when the same was cold, the first flame procured would sputter, frequently back fire and occasionally go out before the burner could be brought up to normal generation and operation. I have found that these difficulties and especially the back firing can be substantially entirely eliminated by rearranging the introduction of the primary air into the generator casing from that which has been heretofore used. It has been previously considered sufficient in the matter of primary air introduction to enter a quantity of air to the generator casing proportionate to the amount of gas volatilized so as to carry on the processes of hydroxilization prior to the burning. I have found, however, that not only is this quantity of primary air of importance, but also that of equal importance is the effect of the entrance of such air on the flow of gas in the generator casing. For instance, the matter of back firing and sputtering and similar disturbances may be attributed directly to the presence of eddy currents in the generator chamber which circulate rare burnable mixtures of gases back through the generating portion of the casing. In accordance with the present invention and as a principal object thereof, I have devised a new method of primary air introduction into the generator casing which eliminates substantially all eddy or other disturbing currents therein and which insures at all times an uninterrupted and uniform progression of volatile oil and air through the generator casing.

Another object of the invention is to provide an improved structure in the generator casing which will provide a greatly improved starting operation of the burner.

A further disadvantage of burners of the present type which have been heretofore available has been the presence during operation of the burner of a rumbling vibration in the generator casing and a pulsating variance in the heighth of the flame. I have found that both of these disturbances are the result of imperfect introduction of secondary air to the hydroxilized mixture for burning and have in the present invention, and as one of the principal objectives thereof, accomplished by means of a change in the secondary air introduction, the substantially complete elimination of the aforesaid disturbances and the attainment of a stable quiet burner operation.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawings:

Figure 1 is a plan view of a burner constructed in accordance with my invention and having portions thereof broken away to better disclose the structure of the burner thereof.

Figure 2 is a longitudinal sectional view taken substantially on the plane of the line 2—2 of Figure 1.

Figure 3 is a fragmentary sectional view taken on the plane of the line 3—3 of Figure 2.

Figure 4 is a fragmentary enlarged sectional view taken substantially on the plane of the line 4—4 of Figure 1.

Figure 5 is a fragmentary sectional view taken substantially on the plane of the line 5—5 of Figure 2.

Figures 6 and 7 are diagrammatic representations showing the difference between the primary

air introduction of my burner and of the burners heretofore used.

With reference to the drawings the burner of my invention comprises a generator housing 11 of a generally elongated rectangular shape including a bottom 12, opposed sides 13 and 14, a top 16 and front and rear ends 17 and 18. As here shown, entrance of oil to the housing is arranged to be effected through an inlet fitting 19 at the front of the casing and in accordance with heaters of this general type the oil is volatilized by the heat in the casing and mixed with a certain amount of primary air and passed out of the casing through a burner opening 21, usually provided, as here shown, in the rear of the top 16. Preferably the bottom 12 of the casing is sloped downwardly from the forward end of the casing and from the sides towards the center so as to afford a natural gravitation of the oil from the inlet and towards the hotter rear end of the casing to insure complete volatilization of the lower oil fractions.

In the present embodiment of the invention, the burner operation is initiated by means of a hot wire heating element 22 which is mounted in the casing adjacent the oil inlet and is arranged, together with the assistance of the air present in the casing, to volatilize and ignite the oil first entering. The burning oil gases then move generally with the flow of the oil down the inclined bottom to under the opening 21, serving as they move to both heat the casing and cause further volatilization of the oil, and then pass up through the opening where secondary air is available to support complete combustion of both the burning and unburnt gases. In burners heretofore available it was considered entirely sufficient to limit the introduction of primary air to the casing during this initial burning operation to a rate slower than the rate of volatilization of the oil so that in a relatively short period of time after first ignition of the oil, the gaseous oil in the casing would be too rich to burn and as a result the burning would be forced to take place above the casing outlet where the combustion was desired. In this sense the casing 11 has been identified as a generator casing in that it served to volatilize the oil and mix the volatilized products with a proper amount of primary air to cause what is commonly called hydroxilation or a state where burning will most readily and most efficiently take place on the addition of further or secondary air.

However, in previous burners of the type to which the present burner is related, considerable difficulty and annoyance frequently attended the starting of the burner operation. For instance after first ignition of the oil and prior to reaching a stable operating condition, the burning in the casing would be spasmodic, frequently backfire through the casing and sometimes go out entirely and have to be restarted several times before a proper generation of gas was attained. By careful analysis of the operation of these burners, I have found that these initial burning disturbances have been due principally to the presence of eddy currents and other major circulating streams of air and gas in the casing which caused spasmodic reversals in the flow of the generated gas from towards the burner opening where desired back to the front of the casing. I have also found that these undesirable currents resulting from burning disturbances may be entirely eliminated by controlling the introduction of primary air to the casing. In previous burners the passage of primary air to the casing was principally through a relatively large opening in the front of the casing and such passage was augmented by a few scattered smaller openings through the side walls of the casing towards the rear thereof. Since on initial burning and volatilizing of the fuel in the casing a rather considerable amount of air is required to support combustion and hydroxilizing of the volatile gas, it will be understood that the velocity of flow through the front opening of the casing would necessarily be relatively high. As this front opening was generally positioned at approximately the center of the casing transversely thereof, the effect of this relatively large center stream of air was to set up on either side of the stream, eddy currents which swept along the sides of the casing portions of lean burnable gas mixtures which caused spasmodic burning and back-firing at the forward portion of the casing while the main burning of the oil was being carried towards the rear portion of the casing. Thus, the deleterious effect of this center stream of air was in general to establish reverse currents in the generator casing and thereby delay the attainment of a steady operating condition in the casing wherein the gas mixture would be uniformly too rich to burn.

With the foregoing in mind, I have in the present burner construction entirely eliminated these former defects by greatly reducing the size of the front center opening 23 here provided in a cover plate 24 mounted on the front end of the casing and by extending the side openings 26 over the full length of the sides substantially to the front of the casing. With the number of primary air openings thus considerably increased, it is possible in order to obtain the desired quantity of primary air in the casing to reduce the size of these openings to a degree where the effect of the air streams passing therethrough on any general circulatory movement of the gases in the casing will be negligible. Also the distribution of the openings along the sides of the casing are arranged to afford an accumulatively increased presence of air in the casing from the front to the rear end thereof with the result that the initial flame produced in the casing will move rearwardly under the influence of a generation of gas therebehind too rich to burn and a lean, rarefied condition of the gas thereahead. Preferably certain of the lower openings 26′ in the side walls are, as shown in Figure 5, inclined downwardly and inwardly so as to direct the air therethrough towards the bottom of the casing and over the oil body thereon.

The difference in the introduction of primary air to the burner casing of the burners heretofore available as contrasted to my structure is diagrammatically illustrated in Figures 6 and 7 of the drawings. In Figure 6 is shown the effect of a strong central stream of air through the casing in setting up on either side thereof eddy currents of the character above described. In Figure 7 is contrasted my arrangement wherein the size and velocity of the entering air streams is so reduced and so uniformly distributed about the casing that no disturbing circulating or eddy streams may be set up. Thus, on initiation of burner operation the oil first entering the casing will flow over the bottom thereof and on reaching the heater element will be volatilized and ignited. This initial burning will, as may be understood, be free to move rearwardly in the casing since there is in this direction a constantly

increasing supply of primary air available while this same burning will heat and volatilize the oil subsequently entering the casing at a faster rate than is permitted the introduction of primary air to the rear thereof. As a result, the volatilization to the rear of the moving burning zone produces a gas mixture too rich to burn but which on expansion will have the tendency to urge the burning zone ever rearwardly in the casing. Thus, when the burning zone reaches the rear of the casing and under the burner opening the same will rise to the outside of the burner opening where a sufficient further quantity of air is available to support combustion. With this condition reached the burner may be considered in stable operation for it will thereafter produce a sufficient excess of volatilization of oil over the amount of air introduced to prevent a return of the burning condition within the casing proper.

The improved arrangement of the primary air openings is further beneficial to the burner operation after the same reaches a stable condition. This follows directly from the increased distribution and availability of primary air at the front of the generator casing with a resultant increased uniformity and longer period thereby afforded for a thorough mixing of the air with the volatile oil. Since the burner efficiency and nicety of operation is to a large extent dependent on the character of the hydroxilization which takes place in the generator housing, the importance of my primary air introduction in this regard will be readily understood.

Cooperating with this improved introduction of primary air to the casing, I have provided an improved structural arrangement of the casing itself for producing a faster and more uniform movement of the burning zone on ignition from the front of the casing to the rear and to the outside thereof. This has been effected by providing a lengthwise taper in the burner housing so as to enable a progressive expansion of the generated gas towards the rear of the casing while presenting a contracting action on these gases towards the front of the casing. This relationship is here carried out, as illustrated in Figure 1, by forming the side walls **13** and **14** with a divergently tapered relation from the front to the rear of the casing. Thus, on initial burning of the oil the volatilized products will be freer to expand in the direction of the rear of the casing than they will be towards the forward end of the casing and any tendency towards a reversal in flow may in this manner be minimized or entirely avoided.

The addition of secondary air to the gases generated and mixed in the casing and the burning of these gases forms an additional and important feature of my invention. As may be best seen from Figures 2 to 4, there is mounted on the top **16** of the generator casing and about the opening **21**, a pair of ring plates **31** and **32** which are spaced vertically as by peripherally set lugs **33** on the plate **31** to define between the plates an annular passage **34** for introducing secondary air to the upward stream of gases therethrough. Preferably the plates are provided with transversely opposed upturned collar portions **35** and **36** which divert the incoming air vertically and generally parallel and into the rising column of hydroxilized gas. In the present embodiment, the outer periphery of the collar portion **35** is notched so as to afford a greater thermal contacting area of the plate **31** with the entering secondary air and a preheating of this air prior to mixing with the fuel gases and burning.

As a result of this construction the burning of the fuel gases starts adjacent the ring plates and continues thereabove up into the combustion chamber of the furnace which is here shown in part with the walls **37** of the chamber mounted on the upper ring plate **32** about the burner opening. Where the burner is to be used in connection with a furnace having a relatively small combustion chamber, a dome shaped spreader **38** may be used over the upper ring plate to confine a portion of the combustion therein and reduce the heighth of the flame from that it would otherwise assume. As here shown, the dome is provided with cross slots **39** through which the burning and unburnt gases may escape and is preferably formed of a plastic composition which during combustion will be heated to incandescence and radiate a considerable amount of heat into the generator casing to assist in the volatilization of the oil.

The general arrangement for the introduction of recondary air as above outlined has in the past been to a greater or lesser extent carried out. However, in previous burners there have been certain attendant burner noises and variations in the flame produced which applicant has traced to the arrangement of secondary air introduction and has in the present burner entirely obviated. For instance, the somewhat cross passage of the secondary air across the burner opening sets up, if permitted to do so, a vibrating column of gas in the casing which produces an annoying rumbling or roar. Also with commonly existant introduction of secondary air and combustion, the flame produced will periodically raise and lower in height, moving to a position at one end of its cycle well above the ring plates and to a position at the other extreme of the cycle down approximately into the generator housing. Both the rumbling and the flame variation have been eliminated in the present invention by providing a second burning zone at the base of the bottom ring plate **31** and substantially in the plane of the burner opening **21** of the casing. As may be best seen from Figures 3 and 4, the plate **31** is spaced slightly from the top of the casing by means of radially extending lugs **41** provided on the under side of the plate to thereby define a ring passage **42** for entering a small amount of secondary air immediately about the discharge opening **21** of the casing. Preferably the opening in the ring plate **31** is of a smaller diameter than the opening **21** whereby the inner portion of the plate will overlie the outer periphery of the casing opening. In accordance with the present arrangement the amount of the secondary air admitted through the passage **42** is limited by the spacing of the ring plate **32** to substantially confine the burning supported thereby to under the overlying portion of the plate. In this manner the small ring of flame **43** thus produced and here indicated in Figure 4 in dotted lines, will be reflected somewhat by the overhanging plate to extend downwardly into the casing and, as may be understood, a considerable portion of the heat therefrom will by direct radiation or reflection from the ring plate be available in the casing for volatilizing the oil. Thus, an important function of this small ring flame is to maintain a constant and stable volatilization of oil in the casing, but in addition the flame in its action on the seconary air supply entirely

eliminates the rumbling vibration within the casing and stabilizes the flame height.

I claim:

1. A natural draft oil burner comprising, an elongated horizontally arranged generator housing provided with an oil inlet adjacent one end thereof and a burner opening adjacent the other end thereof having a vertical axis at substantially right angles to the longitudinal axis of said housing, said burner having means for supplying pre-heated secondary air thereto, and oil igniting means adjacent said first end arranged on initiation of operation of the burner to vaporize and ignite incoming oil, said housing having divergently extending walls providing a progressively increasing passage area from said ignition means to said burner opening and spaced perforations distributed along said divergent walls, said perforations admitting jets of air which extend into the housing for a substantially constant distance where they are dispersed and then flow rearwardly to the burner opening at substantially uniform distances apart, for even distribution throughout the housing.

2. A natural draft oil burner comprising, an elongated horizontally arranged generator housing provided with an oil inlet adjacent one end thereof and a burner opening adjacent the other end thereof having a vertical axis at substantially right angles to the longitudinal axis of said housing, said burner having means for supplying pre-heated secondary air thereto, and oil igniting means adjacent said first end arranged on initiation of operation of the burner to vaporize and ignite incoming oil, said housing having divergent longitudinal sides providing a progressively increasing passage area from said ignition means to said burner opening and a progressively decreasing passage area from said ignition means to said inlet and spaced perforations distributed along said divergent walls, said perforations admitting jets of air which extend into the housing for a substantially constant distance where they are dispersed and then flow rearwardly to the burner opening at substantially uniform distances apart, for even distribution throughout the housing.

3. A natural draft oil burner comprising, a horizontally arranged burner housing provided with a burner opening adjacent one end thereof and having its axis at substantially right angles to the axis of said housing, said burner having means for supplying pre-heated secondary air thereto and oil inlet means adjacent the opposite end thereof and having intermediate divergent walls providing a chamber progressively increasing in cross-sectional area from said inlet means to said opening, and oil vaporizing and igniting means positioned intermediate said opening and inlet means and spaced perforations distributed along said divergent walls, said perforations admitting jets of air which extend into the housing for a substantially constant distance where they are dispersed and then flow rearwardly to the burner opening at substantially uniform distances apart, for even distribution throughout the housing.

4. An oil burner comprising, a burner casing of elongated form arranged horizontally and provided at one end thereof with an oil inlet and a burner opening located near the opposite end thereof and arranged with its axis at substantially right angles to the axis of said casing, said burner having means for supplying pre-heated secondary air thereto, and said casing having the side walls thereof perforated to afford entrance to the casing of primary air for mixing with the oil, and an igniting element mounted in said casing intermediate said ends and arranged on starting the operation of the burner to vaporize and ignite incoming oil, said side walls being divergently extended from the end adjacent said inlet to the end adjacent said burner opening to provide a progressively increasing passage area in the casing in the direction of the divergence of said side walls the spaced perforations admitting jets of air which extend into the casing for a substantial distance where they are dispersed and then flow rearwardly to the burner opening at substantially uniform distances apart for even distribution throughout the casing.

5. An oil burner comprising, a casing provided adjacent one end thereof with an oil inlet and adjacent the other end and in the top thereof with a burner opening and being arranged to heat and vaporize oil passing therethrough for burning of the oil vapor at said opening, primary air inlet means to said casing, a burner throat mounted on said top in registration with said opening and being provided with secondary air inlet means for supporting combustion of the oil vapor and primary air, and a second secondary air inlet means provided to said throat and communicating with the base of said throat at said opening and arranged to provide a burning ring of the oil vapor and primary air substantially in the plane of said casing top whereby the heat therefrom will be directly communicated into said casing for vaporizing said oil.

6. An oil burner comprising a carburetor casing having divergent sides provided with a plurality of air inlet openings, the divergent sides of the casing causing the entering jets of air to flow in substantially uniformly spaced relation, from end to end of the casing, and a discharge opening and adapted to vaporize oil and mix same with primary air for delivery to said opening, and means for directing secondary air about said opening for burning said carbureted mixture and means for causing said secondary air to take an undulated course in flowing to said opening.

7. An oil burner comprising, a carburetor casing having perforated divergent side walls and a discharge opening and adapted to vaporize oil and mix the same with primary air for delivery to said opening, a collar surrounding said opening, a ring member mounted around said collar and defining therewith an annular passage substantially paralleling the axis of said opening for conducting secondary air to said opening to support combustion of the carbureted mixture of oil, vapor and primary air, and a plurality of ribs mounted in said passage and causing the introduction of said secondary air to said carbureted mixture to take an undulated course to said opening.

8. An oil burner comprising, a generator casing arranged for the introduction of oil and primary air and adapted to vaporize said oil and mix the same with said air and provided with a burner opening in the top thereof for escape of the oil vapor and air mixture, a ring member mounted on said casing top in registration with said opening to provide a burner throat and being of a smaller diameter than said opening so as to position a portion of said member in overhanging relation to the edges of said opening, a second member surrounding said ring member and providing therebetween an annular passage for conveying air to the upper end of said burner

throat to support combustion thereat, said ring member and casing defining a passage for conveying air to the region of said overhanging base portion of said ring member and providing for the initial mixing of such air at said overhanging portion to support combustion at the base of said ring member to maintain a substantially constant rate of vaporization of oil in said casing.

9. An oil burner comprising, a generator casing arranged for the introduction of oil and primary air and adapted to vaporize said oil and mix the same with said air and provided with a burner opening in the top thereof for escape of the oil vapor and air mixture, a ring member mounted in registration with said opening to provide a burner throat, a second member spaced from said ring member and providing therebetween an annular passage for conveying air to the upper end of said burner throat to support combustion thereat, said ring member and casing defining a passage for conveying air to a position immediately adjacent to the edge of said opening and providing for the initial contact of such air with said oil vapor and primary air at said base position to support a limited zone of combustion at said edge for maintaining a substantially constant rate of vaporization of oil in said casing.

10. An oil burner comprising, a generator casing arranged for the introduction of oil and primary air and adapted to vaporize said oil and mix the same with said air and provided with a burner opening in the top thereof for escape of the oil vapor and air mixture, a ring member mounted on said casing top in registration with said opening to provide a burner throat, a second member surrounding said ring member and providing therebetween an annular passage for conveying air to the upper end of said burner throat to support combustion thereat, and a plurality of ribs mounted in said passage to increase the surface for transfer of heat to the incoming air.

11. An oil burner comprising, a horizontally arranged elongated generator housing provided with an oil inlet adjacent one end thereof and a burner opening adjacent the other end thereof and leading from the casing in a direction at substantially right angles to the longitudinal axis of said casing, said burner having means for supplying pre-heated secondary air thereto, and, said housing having divergent walls leading to said last named end to provide a progressively increasing passage area towards said burner opening, and spaced perforations distributed along said divergent walls, said perforations admitting jets of air which extend into the housing for a substantially constant distance where they are dispersed and then flow rearwardly to the burner opening at substantially uniform distances apart for even distribution throughout the housing.

12. An oil burner comprising, a generator casing arranged for the introduction of oil and primary air and adapted to vaporize said oil and mix the same with said air and provided with a burner opening in the top thereof for escape of oil vapor and air mixture, a ring member mounted in registration with said opening to provide a burner throat, a second member spaced from said ring member and providing therebetween an annular passage for conveying air to the upper end of said burner throat to support combustion thereat, and a second secondary air inlet means providing a confined passage for air and leading directly to the region of said opening at the base of said throat to support a limited zone of combustion thereat and substantially within said casing for maintaining a substantially constant rate of vaporization of oil in said casing.

HARRY C. LITTLE.