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2,230,276

COMBUSTION APPARATUS

Filed Oct. 29, 1937

2 Sheets-Sheet 1

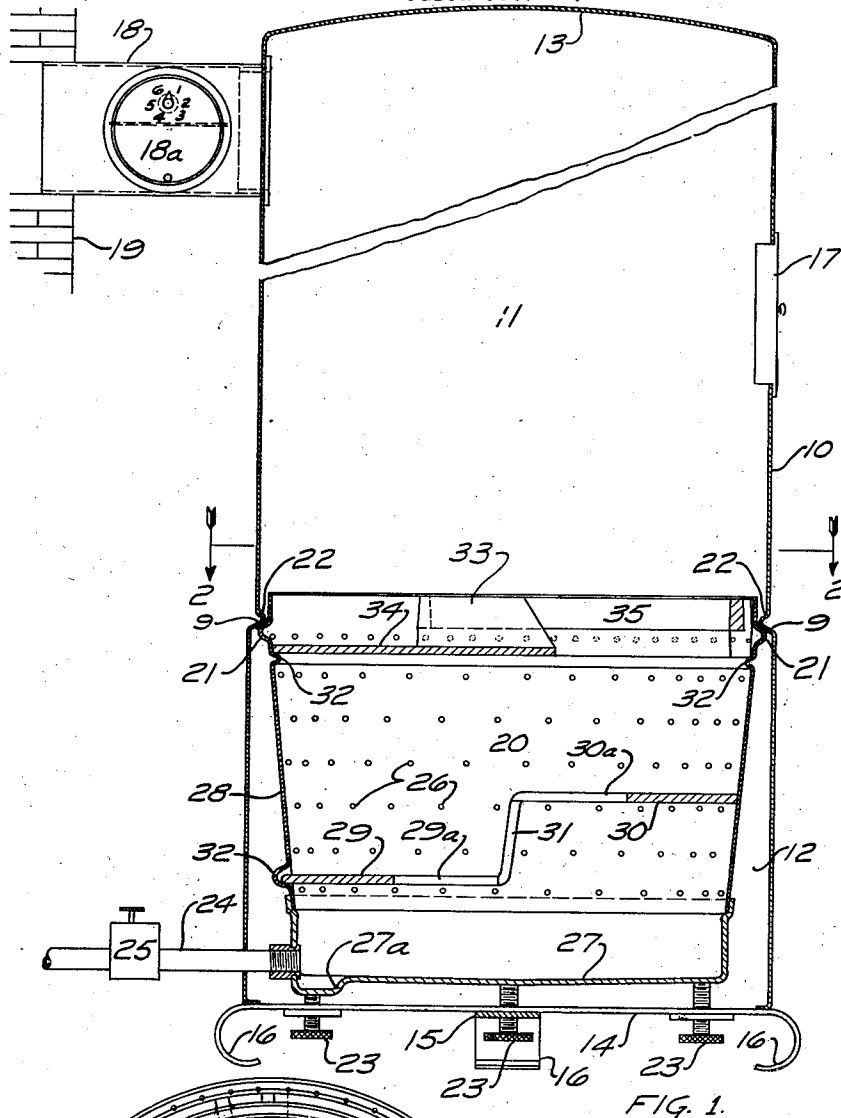


FIG. 1.

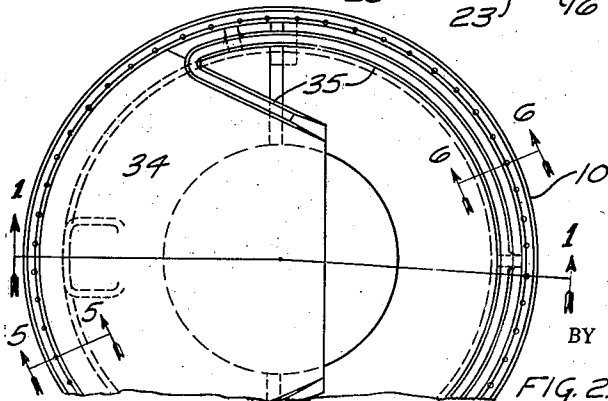


FIG. 2.

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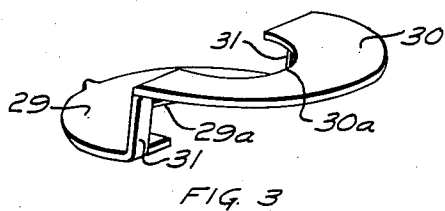
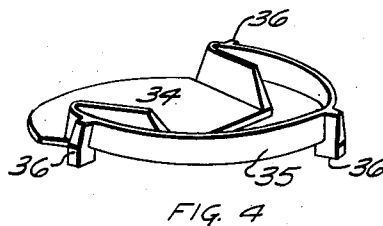
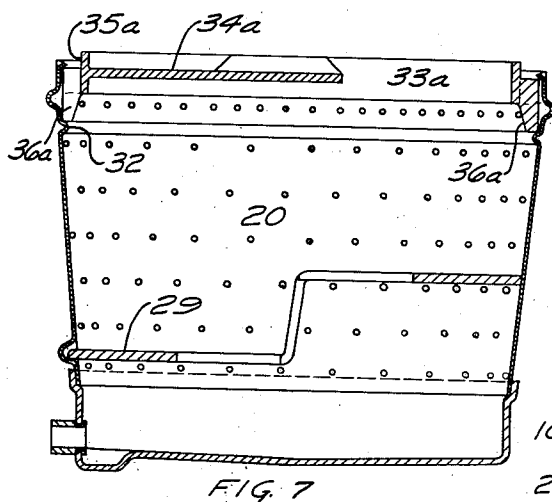
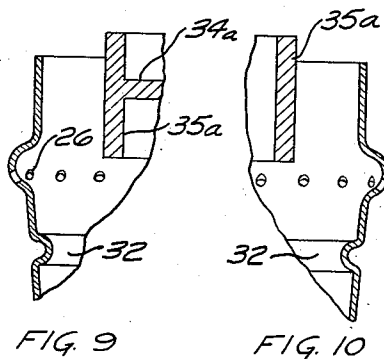
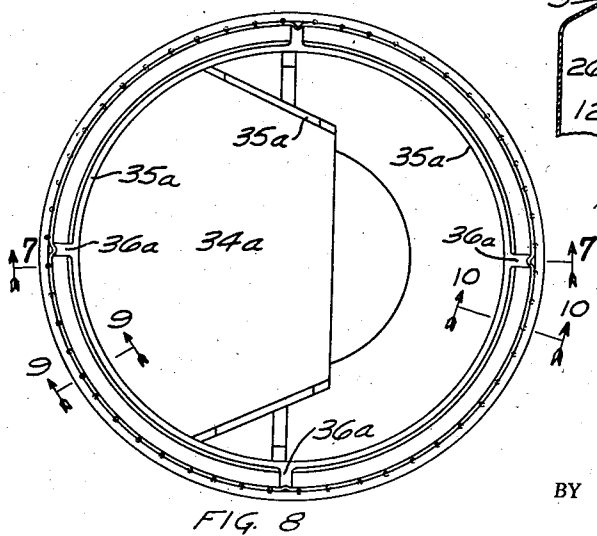
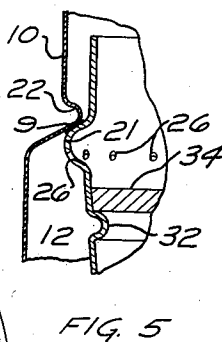
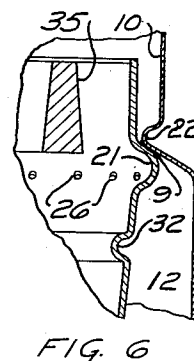
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2 Sheets-Sheet 2



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COMBUSTION APPARATUS

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8 Claims. (Cl. 158—91)

This invention relates to combustion apparatus and more particularly to oil burners of the vaporizing pot type.

The principal object of the invention is the provision of a novel form of burner adapted to operate to produce a clean and efficient combustion throughout a wide range of fuel consumption. This object is attained through the combination with a unique top wall construction of a novel baffle construction for the interior of the burner. The baffles and top wall are formed to control the flow of gases and air within the apparatus in a manner to produce the most efficient combustion while at the same time eliminating undesirable eddy currents. The efficiency and cleanliness of the burner is visually evidenced by the production of a flame which is blue in color at all stages of operation.

For the purpose of illustration only, a burner embodying the present invention is herein shown and described as forming a part of a space heater of the radiant type. However, it will be readily apparent that the burner may be used with other kinds of heating and cooking apparatuses.

In the drawings:

Figure 1 is a vertical sectional view of a space heater of the radiant type equipped with a burner embodying the present invention;

Figure 2 is a sectional view taken on substantially the line 2—2 of Figure 1;

Figure 3 is a perspective view of the baffle means forming a part of the burner shown in Figures 1 and 2;

Figure 4 is a perspective view of the top wall for the burner shown in Figures 1 and 2;

Figure 5 is an enlarged fragmentary sectional view taken on the line 5—5 of Figure 2;

Figure 6 is an enlarged fragmentary sectional view taken on the line 6—6 of Figure 2;

Figure 7 is a cross-sectional view of a modified form of burner taken on substantially the line 7—7 of Figure 8;

Figure 8 is a top plan view of the burner shown in Figure 7;

Figure 9 is a fragmentary sectional view taken on the line 9—9 of Figure 8; and

Figure 10 is a fragmentary sectional view taken on the line 10—10 of Figure 8.

The space heater shown in Figure 1 includes a cylindrical shell 10, the upper portion of which serves as a combustion chamber 11, and the lower portion of which serves as an air jacket or burner compartment 12. The upper extremity of the cylindrical shell is closed with a top wall 13. The lower extremity of the shell 10 is mounted upon

supports 14 and 15. These supports consist of relatively narrow metal straps extending beneath the shell 10 in crossed relation and are secured to the lower edge of the shell adjacent their extremities. The opposite extremities of each of the straps are bent back upon themselves to form legs 16 which serve to support the heater in spaced relation to the floor.

The shell 10 is provided with an opening affording access to the combustion chamber 11 which is normally closed by a door 17. Products of combustion are withdrawn from the combustion chamber 11 through an exhaust pipe 18 having one end connected to a chimney 19, and the other end connected to the upper extremity of the combustion chamber. The exhaust pipe 18 is preferably provided with an automatic draft regulator 18a.

A burner 20 is mounted in the burner compartment 12 formed in the lower portion of shell 10. The burner is formed with a radially outwardly extending annular rib 21 adjacent its upper extremity. This rib is adapted to engage a co-operating rib formed in the shell 10 intermediate the combustion chamber 11 and the burner compartment 12. The burner 20 is held against the rib 22 by means of a plurality of set screws 23 which are threadedly mounted in the supporting straps 14 and 15, the straps being identical. The free ends of the screws 23 engage the bottom of the burner 20. It is essential that there be no material leakage of air through the joint formed by the ribs 21 and 22. To that end any suitable form of asbestos gasket, 9, may be positioned between the ribs as shown in Figure 1. Of course, the entire heater must also be substantially leak-proof to obtain the best results.

Oil is admitted to the burner through a supply pipe 24 from a source not shown. The volume of oil admitted to the burner is controlled by a regulating valve illustrated diagrammatically at 25. It will be understood that the regulating valve 25 may be either of the manual or automatic operating type.

Air is admitted to the burner compartment 12 through the bottom of the shell 10. It will, of course, be understood that the supporting straps 14 and 15 do not materially close off the bottom of the shell 10. Air from the burner compartment 12 is drawn into the burner 20 by the draft created in the chimney 19 through a plurality of air inlet openings 26 formed in the side wall of the burner.

The details of the construction of burner 20, in which the present invention resides, are best

shown in Figures 1 to 6 inclusive. The burner includes a bottom wall 27 and a tapered side wall 28. The tapered side wall is preferably of frusto-conical form, although it need not necessarily be of that specific form. In order to define the shape of the side wall in generic terms, it will hereinafter be referred to as being tubular. Preferably, the bottom wall 27 is formed of a pan-like sheet metal stamping and the lower extremity of the tubular sheet metal side wall 28 is welded to the upper edge of the pan.

The bottom wall is provided with a shallow depression 27a adjacent its outer periphery. Fuel is supplied to this depression by the supply pipe 24 through an opening formed in the burner adjacent the junction between the side wall and the bottom wall and immediately over the depression 27a.

The sheet metal side wall 28 is formed with a plurality of air inlet openings 26 preferably arranged in vertically spaced horizontal rows. As shown in Figure 1, there are a total of 7 of these rows of air inlet openings. The uppermost row is formed in one side of the annular bead 21 whereby the openings in this row direct the air entering therethrough upwardly.

The burner illustrated in Figure 1 is shown in proper proportion. Its essential dimensions are:

	Inches (approx.)
Height	9½
Inside diameter at top	11½
Inside diameter at bottom	10

Number	Inches (approx.)
Holes in bottom row	26 Diameter of each hole .098
Holes in next row above	26 Diameter of each hole .078
Holes in next row above	26 Diameter of each hole .078
Holes in next row above	26 Diameter of each hole .078
Holes in next row above	26 Diameter of each hole .086
Holes in top row	52 Diameter of each hole .113

The size of the holes 26 may be varied within slight limits without materially effecting the operation of the burner, although for a burner of the size mentioned above the number and size of the holes are preferably as above recited.

Sometimes it is desirable to eliminate certain of the holes 26 in order to control the direction of flow of gases within the burner. For example, the operation of the burner is improved somewhat by eliminating a few (2 to 6) of the holes immediately over the partition 29 and immediately above the partition 30. By eliminating these holes, without changing the spacing of the remainder of the holes in the same row, there is removed any tendency of the air to interfere with the free flow of the gases from the lower portion of the burner (below partition 29) into the intermediate portion thereof (between partitions 29 and 30) and from the intermediate portion of the burner into the upper portion (above partition 30) thereof.

The interior of the burner 20 is provided with baffle means, the function of which will be described presently. This baffle means consists of a pair of horizontally extending and vertically spaced apart partitions 29 and 30. For convenience in assembling, the partitions 29 and 30 are unitarily connected to each other by vertically extending connecting members 31 of limited radial and circumferential extent. The construction of these partitions and the manner in which they are connected to each other is best shown in Figure 3.

Partition 29 extends from one side of the burner only part way across the burner. It is located in spaced relation to the bottom wall 27

immediately over the fuel receiving depression 27a, and with one row of air inlet openings 26 positioned below it.

Partition 30 is located in vertically spaced relation above partition 29 and extends only part way across the burner from the opposite side of the burner. Three rows of air inlet openings 26 are located below partition 30.

The mounting of partitions 29 and 30 within the burner 20 is facilitated by integrally joining the partitions through means of the connecting members 31. When so integrally connected the partitions are preferably mounted in the burner by providing a recess 32 in the side wall 28 for the reception of a peripheral portion of the partition 29. With the peripheral portion of partition 29 mounted in the recess 32, the peripheral portion of partition 30 contacts the opposite side of the burner and securely positions the entire baffle assembly within the burner.

As clearly shown in Figures 1 and 3, the partitions 29 and 30 are formed to provide an unrestricted vertical passageway through the burner. For that purpose, the central portion of partition 29 is cut away at 29a and the central portion of partition 30 is cut away at 30a.

Adjacent its upper extremity and below the annular rib 21, the side wall 28 is formed to provide a radially inwardly extending annular rib 32. A top wall construction 33 is mounted within the burner, being seated upon the rib 32. The construction of the top wall 33 is best shown in Figure 4. As there shown, it consists of a horizontal partition-like portion 34 of a size to extend only part way across the burner. The partition 34 is generally pie-shaped and associated with the diagonal sides thereof is a vertically extending flange 35. Flange 35 extends along the diagonal sides of the partition 34 and completely around the portion of the burner not occupied by the partition 34, but in spaced relation to the side wall of the burner. The lower edge of flange 35 is arranged in vertically spaced relation above the partition 34. It is supported from the rib 32 by means of supports 36 secured to the flange 35.

By spacing the lower edge of vertical flange 35 above partition 34, the uppermost row of air inlet openings 26 is located above the upper surface of partition 34 and below the lower edge of vertical flange 35. This relation of these parts is of importance, and is shown on an enlarged scale in Figures 5 and 6. As there shown, it will be seen that the air admitted through a portion of the uppermost row of air inlet openings 26 will be directed over the top of partition 34, while the air admitted through the remainder of these uppermost openings will be directed against the side of the vertical flange 35. By spacing the vertical flange 35 from the adjacent air inlet openings 26, opportunity is afforded for the forming of a premixture of fuel vapors and the air admitted through these openings, before combustion of the premixture thus formed is precipitated by the air striking against the flange. Combustion is believed to be precipitated and maintained at this point, whenever there is either a sufficient or an excess supply of fuel vapors, because of the mechanical mixing of the fuel vapors and air, which results from the air impinging against the flange 35. In the absence of such a mechanical mixture the formation of a combustible gas is dependent primarily upon the mixing of the fuel vapors and air by diffusion. This is not a stable method of producing

a combustible mixture and it may be adversely effected by fluctuations in draft, eddy currents, etc.

If at least some of the air admitted through the uppermost row of air inlet openings 26 were not directed against the flange 35 there would be no certainty of maintaining combustion at that point. Consequently combustion might become separated from the burner and move up into the combustion chamber and even out of the chimney. When that occurs there is always a possibility of re-ignition of the gases in the combustion chamber and burner under explosive conditions.

By spacing the flange 35 away from the holes 26, fuel vapors are permitted to intervene between the flange and the side wall of the burner so that there is a degree of premixing effected before combustion is precipitated by the impingement of the air against the flange 35. This is desirable in order to obtain clean and efficient combustion in the higher operating stages.

As will fully appear from the description of the operation of the burner, it is the air directed against the flange 35 through a portion only of the holes 26 in the top row of holes which serves to fix the uppermost point at which combustion may be initiated. In other words, only a portion of the holes in a single row of holes constitute the so-called final fire-fixing holes. This is a unique feature in a burner of the vaporizing pot type. Heretofore it has been thought necessary to utilize at least all of the holes in one or more complete rows of holes for fire fixing purposes at the high fire stage of operation. In the present construction only approximately sixty percent of the holes in one row are used. Moreover, these sixty percent may, in the present construction, be of a different size than the remainder of the holes in the same row, as well as of a different size than the holes in the other rows.

As previously mentioned, partition 34 forming a part of top wall 33, extends only part way across the burner. As best shown in Figures 1 and 2, partition 34 is located on the same side of the burner as the low partition 29. Also as best shown in Figures 1 and 2, all of the partitions 29, 30 and 34 are so formed as to provide an unrestricted vertical passageway upwardly through the burner 20.

The operation of the burner shown in Figures 1 to 6 inclusive is as follows:

Oil is admitted to the depression 27a in the bottom wall 27 through the supply pipe 24. When the oil thus admitted is first ignited, combustion initially occurs exclusively within the lower part of the burner 20 below partition 29. At this stage of operation partition 29 serves to protect the small quantities of fuel vapors being generated from being diluted by an excess of air from the openings higher up in the burner, and also serves to promote the normal premixing action of the air entering below partition 29 with the small quantity of fuel vapors generated by excluding eddy currents from higher up in the burner.

As the flow of oil to the burner is increased, the zone of combustion moves out from under the partition 29 over into the center of the apparatus and into that portion of the burner below the partition 30. At this stage of operation, which may be called the lower intermediate stage of operation, the partition 30 serves the same

function as the partition 29 did at the low fire stage of operation.

Upon a still further increase of the volume of oil admitted to the apparatus, the zone of combustion will move into the space above partitions 29 and 30 and then there will occur that stage of operation which may be referred to as the higher intermediate stage. At such stage of operation, the partition 34 forming a part of top wall 33 serves to protect and foster the premixing of air and oil vapors in exactly the same manner as did the partitions 29 and 30 at the previous stages of operation.

Upon opening the valve to the maximum oil flow, combustion moves still higher in the apparatus and becomes more or less localized at and above the vertical flange 35. At this stage of operation there is set up within the combustion chamber 11 eddy currents moving in a counter-clockwise direction (Fig. 1) which tend to sweep the air admitted through the openings 26 immediately above and adjacent the partition 34 toward the opposite side of the apparatus while it commingles with the premixture of air and oil vapors arising from the lower part of the burner. At the same time, the air admitted through those inlet openings 26 immediately adjacent the vertical flange 35 is precipitating and maintaining combustion adjacent the flange.

A peculiar phenomenon exists in connection with this stage of operation. Combustion will be maintained adjacent the vertical flange 35 regardless of the amount of fuel that may be admitted to the apparatus. In other words, even in the case of an excess of fuel, combustion will always be maintained in the locality between the flange 35 and the adjacent side of the burner 20 and immediately above that locality. This is due to the peculiar construction of this part of the burner, by means of which at the higher fire stages of operation there is always maintained a relatively lean mixture of fuel vapors and air, combustion of which is positively effected by the mechanical mixture resulting from the air striking the outer side of the flange 35.

From the foregoing description it will be apparent that the partitions 29, 30 and 34 serve to foster the maximum amount of premixing and to prevent undesirable interference with the premixing action while maintaining an unrestricted vertical passageway through the burner to assure maximum capacity of operation.

The modified form of burner shown in Figures 7 to 10 inclusive is identical to the burner shown in Figures 1 to 6 inclusive except for the top wall construction. In this modified form of burner the top wall 33a is similar to the top wall 33 except for the fact that the partition 34a is located midway between the vertical extremities of the vertical flange 35a, and the vertical flange 35a extends completely around the burner in spaced relation to the sides thereof. The entire top wall is supported upon narrow supports 36a which rest on the rib 32 as shown in Figures 7 and 8.

In this modified construction the entire top wall is located above the uppermost row of air inlet openings 26, so that the air admitted through all of these openings is directed against the outer surface of the vertical flange 35a.

The operation of the modified form of burner shown in Figures 7 to 10 inclusive is the same as that of the burner shown in Figures 1 to 6 inclusive, except at the highest stage of operation a ring of combustion is maintained com-

pletely around the vertical flange 35a. Of course, under normal operation the major volume of combustion at the highest stage of operation will occur adjacent the opening in the top wall defined by the partition 34a and the flange 35a.

The scope of the invention is indicated by the appended claims.

I claim:

1. A burner of the character described comprising a bottom wall, a tubular side wall, a lower partition extending only part way across the burner from one side thereof, a higher partition extending only part way across the burner from the opposite side thereof, a top wall having an imperforate portion extending only part way across the burner adjacent the top thereof, the imperforate portion of said top wall and the lower partition being disposed on the same side of the burner, said top wall including a vertical flange extending around at least a portion of the perimeter of the burner in spaced relation to the burner side wall, and a plurality of air inlet openings formed in the side wall of the burner above and below each of said partitions, said air inlet openings including a plurality of circumferentially spaced openings arranged to direct the air entering therethrough against said vertical flange.

2. A burner of the character described comprising a bottom wall, a tubular side wall, a lower partition extending only part way across the burner from one side thereof, a higher partition extending only part way across the burner from the opposite side thereof, a top wall having an imperforate portion extending only part way across the burner adjacent the top thereof, the imperforate portion of said top wall and the lower partition being disposed on the same side of the burner, said top wall including a vertical flange extending around at least a portion of the perimeter of the burner in spaced relation to the burner side wall, and a plurality of air inlet openings formed in the side wall of the burner, said air inlet openings being disposed above and below the top wall and each of said partitions, the air inlet openings above the top wall including a plurality of circumferentially spaced openings arranged to direct the air entering therethrough against said vertical flange.

3. A burner of the character described comprising a bottom wall, a tubular side wall, a lower partition extending only part way across the burner from one side thereof, a higher partition extending only part way across the burner from the opposite side thereof, a top wall having an imperforate portion extending only part way across the burner adjacent the top thereof, the imperforate portion of said top wall and the lower partition being disposed on the same side of the burner, said top wall including a vertical flange extending around at least a portion of the perimeter of the burner in spaced relation to the burner side wall, and a plurality of air inlet openings formed in the side wall of the burner below the top wall and above and below each of the partitions, said air inlet openings including a plurality of circumferentially spaced openings

arranged to direct the air entering therethrough against said vertical flange.

4. A burner of the vaporizing pot type comprising a tubular side wall, means for delivering liquid fuel to the burner in regulatable quantities to be vaporized in the burner, a plurality of vertically spaced horizontal rows of air inlet apertures formed in the side wall, said apertures being proportioned and arranged to introduce air to the burner for premixing with fuel vapors generated in the burner at certain rates of oil flow to the burner, a vertical flange extending part way around the top of the burner in uniformly spaced relation to the side wall of the burner whereby the vapors discharged from the burner pass around the vertical flange on both sides thereof, the construction and arrangement of said vertical flange and at least some of the apertures in the uppermost row of apertures being such that the air admitted through said apertures is directed against the vertical flange.

5. A burner of the character defined in claim 4 wherein the total volume of air admitted to the apparatus through the air inlet openings which are arranged to direct the air entering therethrough against the baffle is approximately one-third of the total air admitted to the burner by all of said air inlet apertures.

6. A burner of the vaporizing pot type comprising a bottom wall, a tubular side wall, means for delivering liquid fuel to the burner in regulatable quantities to be vaporized in the burner, a plurality of vertically spaced horizontal rows of air inlet apertures formed in the side wall of the burner, the size and spacing of said air inlet apertures being such that the air delivered to the burner therethrough is premixed with the oil vapors generated in the burner at certain rates of oil flow to the burner in advance of combustion, and baffle means arranged in vertically spaced relation within the burner to direct the fuel vapors generated in the burner along a serpentine pathway in passing from the bottom to the top of the burner, said baffle means comprising a lower partition extending only part way across the burner from one side thereof, an intermediate partition extending only part way across the burner from the opposite side thereof, and a top wall extending only part way across the burner from the same side of the burner occupied by the lower partition said partitions and top wall being formed to provide an unrestricted passageway from the top to the bottom of the burner whereby the heat from combustion localized at the top of the burner may be radiated directly to the bottom of the burner.

7. A burner of the character defined in claim 6 wherein one of the horizontal rows of air inlet apertures is located above the top wall and the remainder of said rows are located below the top wall.

8. A burner of the character defined in claim 6 wherein said air inlet apertures are located above, below and between the two partitions and the top wall.

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