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3,402,985

BURNER RECIRCULATING CHAMBER CONSTRUCTION

Filed Feb. 25, 1966

3 Sheets-Sheet 1

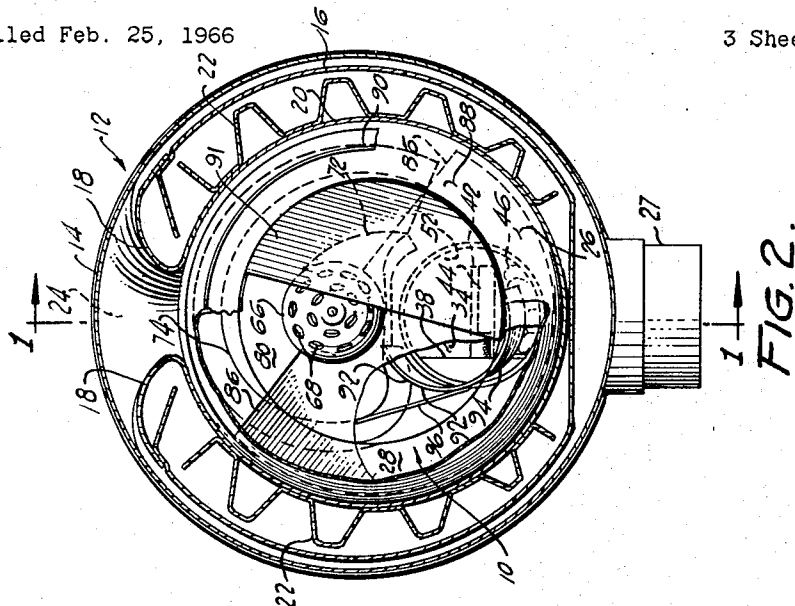
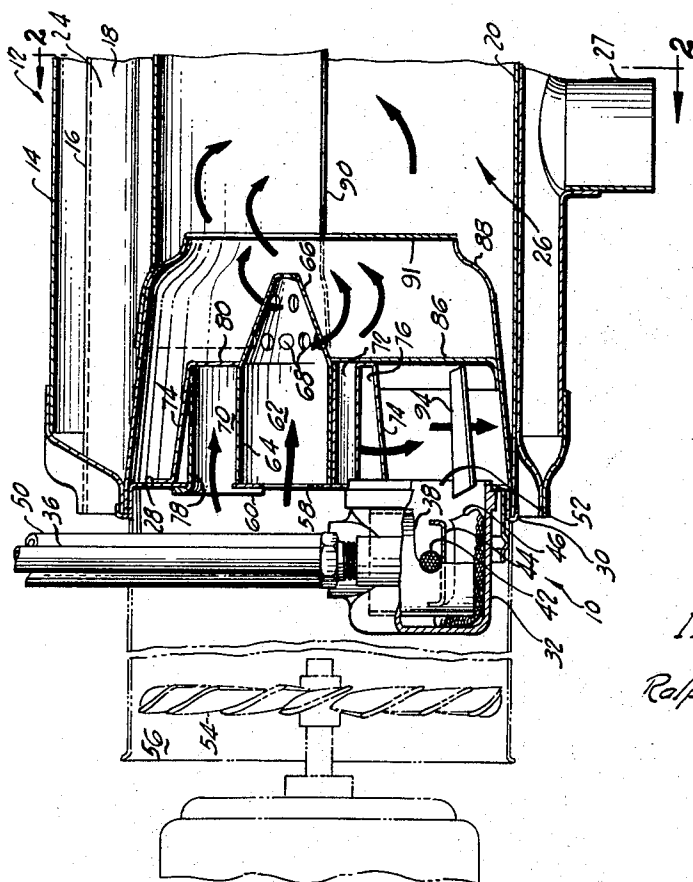


FIG. 1.



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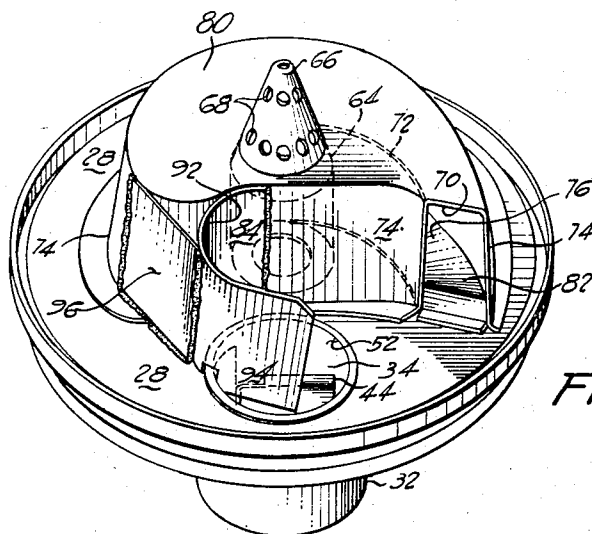


FIG. 4.

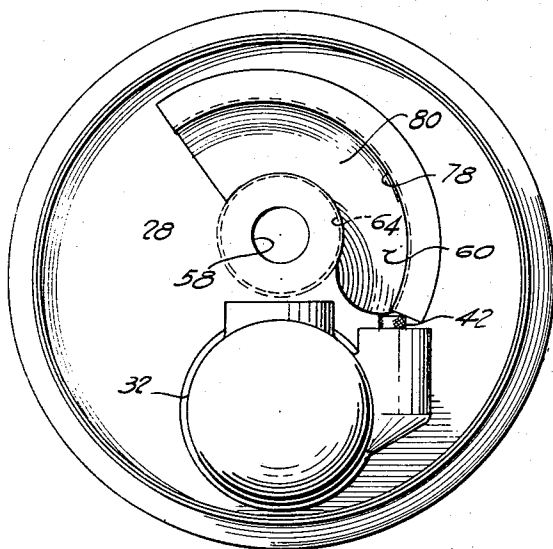


FIG. 3.

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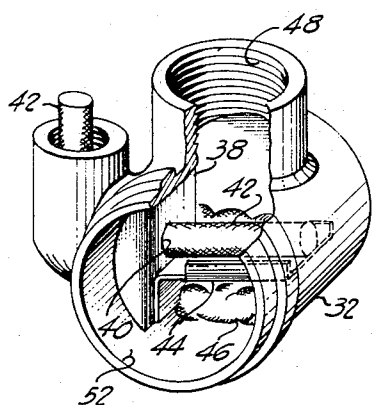
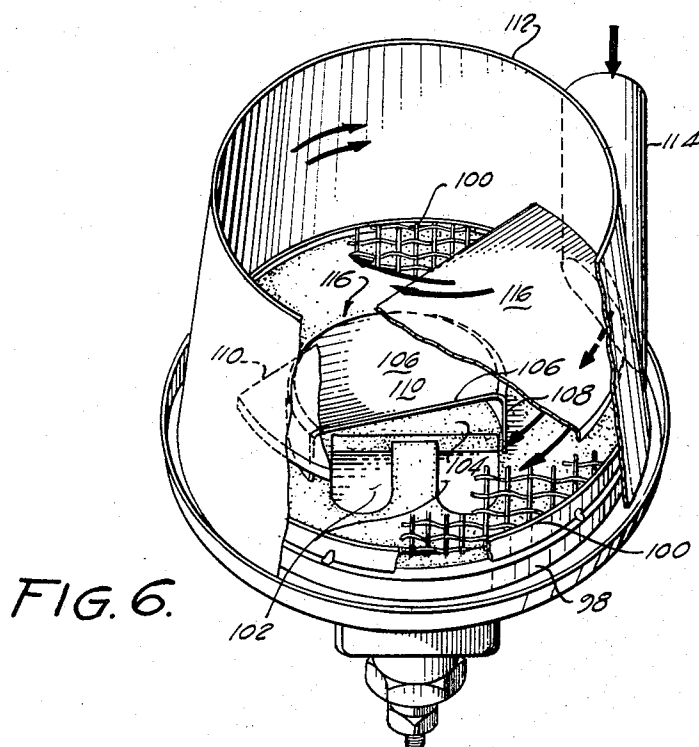
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3 Sheets-Sheet 3



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BURNER RECIRCULATING CHAMBER CONSTRUCTION

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ABSTRACT OF THE DISCLOSURE

A recirculating chamber for a vaporizing combustion type heater utilizing a scroll-shaped nozzle for driving combustion air in an arcuate path past a portion of an opening formed in a wall through which vaporized fuel exits. An arcuate baffle projecting from the wall having an edge terminating in the air stream and circumscribing another portion of the opening in a direction transverse to the air path for dividing the air into a main stream and a recirculated part. The recirculated part thereby being caused to move past the other opening portion for entrainment of fuel in the air stream. A target baffle at the end of the arcuate baffle and perpendicular thereto confining and controlling both the recirculating air and the main stream.

The present invention relates in general to burners for use in small capacity diesel fuel consumption heaters and more particularly to a burner construction providing reduced coking and smoke together with greater flame stability.

Aircraft and vehicle heaters employ surface vaporizing type burners in which a liquid fuel is vaporized from a wick by an igniter for combustion and combustion is maintained by forced draft combustion air. The forced draft combustion air is driven at high velocity past a recirculating vaporizing chamber in which the vaporized fuel is burned. In this arrangement the problems of coking, smoking and flame stability are aggravated due to variations in air/fuel ratio and heat release when heavier grades of distillate fuels containing high carbon contents, commonly known as DF1, DF2 or DFA, are burned.

It is therefore one object of the present invention to provide an improved recirculating vaporizing chamber for use in a vaporizing combustion type heater to reduce coking and smoke and improve flame stability when fuels of the above mentioned type are burned.

Other objects and features of this invention will become apparent on examination of the following specification and claims together with the drawings, wherein:

FIG. 1 is a longitudinal sectional view of a burner and heat exchanger assembly taken generally along the line 1—1 in FIG. 2 and incorporating the principles of the present invention;

FIG. 2 is a sectional view of the assembly taken generally along the line 2—2 in FIG. 1;

FIG. 3 is a rear view of the burner assembly plate;

FIG. 4 is a perspective view of the burner assembly;

FIG. 5 is a perspective view of the fuel inlet and ignition portion of the burner assembly; and,

FIG. 6 is a perspective view of another burner assembly incorporating the principles of the present invention with portions of the assembly partially broken away.

In FIG. 1 a burner assembly and a portion of a heat exchanger assembly are generally indicated by the reference characters 10 and 12, respectively. The burner assembly 10 and particularly the assembly 12 are generally similar to that shown and described in U.S. Patent No. 2,850,004.

The heat exchanger assembly 12 is defined by an outer

circumferential wall 14 having inwardly deformed portions at opposite ends joining a second wall 16. The wall 16 is generally annular but has inwardly folded radial wall sections 18 along a portion of its periphery. Sections 18 are joined to a second interrupted annular wall 20 spaced inwardly of wall 16. The space between the two walls 16 and 20 is provided with a series of heat exchanger fins 22 which aid in transferring heat to incoming air entering the space between walls 16 and 20 at one end thereof and exiting at the other end thereof as explained in said patent. The space between sections 18 and the interruption in wall 20 define a passageway 24 communicating exhaust burner gases from the burner assembly 10 and a chamber 26 defined by wall 20 to the space between walls 14 and 16 for exit through an outlet conduit or stack 27. The chamber 26 is closed at one end by a wall, not shown, and the burner assembly 10 is located at the opposite end of chamber 26.

The burner assembly 10 comprises a circular burner plate 28 with a peripheral flange 30 seated against the end of wall 20 to close the end of the chamber 26. A hollow boss 32 is provided on the rear of plate 28 below the horizontal axis and adjacent the vertical axis of the plate to provide a fuel vaporizing chamber 34. Metered fuel is supplied to the chamber 34 from an inlet pipe 36 through an opening in the upper wall of boss 32. A vertical partition 38 in chamber 34 divides the chamber and an opening 40, best seen in FIG. 5, in partition 38 receives a wick portion 42 for conducting fuel from the pipe 36 through opening 40. The wick portion 42 is supported on a horizontal platform 44 and additional wick material 46 is disposed below the platform 44.

A glow type igniter (not shown) is provided in the chamber 34 through a second opening 48 in the top wall of the boss 32 and leads for the igniter extend through a conduit 50. The igniter comprises an electrical element for vaporizing the fuel supplied to the wick 42 until the fuel is heated to its combustion temperature. Once the fuel is ignited, combustion is self-sustaining and a flame detector switch (not shown), controlled by a sensing element (not shown) in chamber 26, for example, serves to deenergize the igniter in any well known manner. The heated vaporized fuel in chamber 34 exits through an opening 52 extending through plate 28.

Combustion air is supplied to assembly 10 by a blower indicated at 54 from a chamber 56 to the rear of plate 28, as seen in FIG. 1. The combustion air is extended both through an opening 58 just above the center of plate 28 to provide secondary combustion air and through an arcuately extending opening 60 in plate 28.

The central opening 58 communicates with a passageway 62 defined by an annular wall 64 projecting from the front of plate 28, with the annular wall terminating in a nose cone 66 having a series of perforations 68 for introducing the secondary combustion air into the burning vaporized fuel.

The arcuate opening 60 is disposed radially from opening 58 and is initiated adjacent the horizontal axis of plate 30 and extends in a counterclockwise direction, as seen in FIG. 3, to a position beyond the vertical axis of plate 30. Opening 60 communicates with a circumferential or arcuate passageway 70. An inner wall is formed for passageway 70 by a portion of wall 64 from adjacent the lower edge of opening 60 for approximately 180°. A wall 72, extending spirally or tangentially outward of wall 64, as best seen in FIG. 4 from adjacent the end of opening 60 toward the outer edge of plate 28, thereafter forms the inner wall of passageway 70.

A wall 74, spaced from wall 64, forms the outer wall of passageway 70 to maintain the air in passageway 70 in an arcuate or spiral flow path. Wall 74 (see FIG. 4) is initiated from a position adjacent the nozzle end of

wall 72 and extends in a somewhat arcuate shape tangent to the wall 64 in a radial direction from right to left as seen in FIG. 4 to form a back or closed end for passageway 70, and then wall 72 extends in a circumferential direction and terminates spaced from the end of wall 72 and below wall 80 to form a step nozzle 76 for passageway 70 below wall 80 and above plate 28. The space, triangular in cross section, between walls 72, 74 and 64 serves as insulation space. An insulating and rigidifying baffle wall 78 (FIG. 1) has its ends joined to wall 74 adjacent the initiation of opening 60 and adjacent the end of opening 60, and is spaced therefrom intermediate those positions.

The wall 80, spaced from plate 28 by a distance corresponding to the axial length of wall 64, serves to confine the air in passageway 70 until it exits from between walls 72 and 74 at opening 76 in a generally spiral path. In addition, a ramp plate 82, extending between walls 72 and 74 from opening 76 at an incline to plate 28, provides improved control of the air stream exiting from the air nozzle 76. The nozzle 76 is a step nozzle with the end of wall 74 extending slightly beyond the end of wall 72 to direct a high velocity air stream tangentially past opening 52.

The air stream thus moves in a generally outward spiral path from opening 76 past a recirculating chamber 84 adjacent opening 52 and partially defined by a target baffle 86 parallel to plate 28 and a generally conical baffle 88 extending from adjacent the periphery of plate 28 into chamber 26. Target baffle 86 extends from adjacent step nozzle 76 for approximately 180°. A crossover baffle 90 is attached to baffle 88 and burning fuel moves in chamber 26 until it passes the end of baffle 90, whereafter it exits through passage 24. The opening at the end of baffle 88 adjacent chamber 26 is also partially closed by a baffle plate 91, which serves to cover about 180° of the opening in baffle 88 at a position calculated to enhance spiral flow.

To aid in overcoming the deleterious situations previously described, an arcuate baffle plate 92, projecting from plate 28 into abutment with target baffle 86, is provided adjacent opening 52. Baffle plate 92 is initiated adjacent the portion of wall 74 tangent to wall 64 and generally follows the periphery of opening 52 for a distance of approximately 90° in a direction counter that of the air stream exiting from nozzle 76 to form a concave wall facing the stream. The plate 92 is then formed with a lip 94 projecting somewhat over more than half the lower portion of the opening 52. The lip 94 is given a slight upward tilt in a direction away from plate 28 and defines an opening between it and baffle 88 for passage of the air stream tangentially past chamber 84. A support plate 96 is connected between the circumferential portion of wall 74 and plate 92.

The air stream exiting from opening 76 flows generally tangentially past opening 52 with baffle 92 diverting a portion of the stream into a recirculating flow in chamber 84. The recirculating flow then moves in tangential relationship with the air stream from nozzle 76 and a portion is entrained therein. Combustion occurs between baffles 88 and 92 in the high velocity air stream to provide the main flow and extending about wall 74 and exiting over the top of target baffle 86 and thence through the opening in baffle 88. A small flame swirls about in chamber 84 due to the entrainment of sufficient low velocity air to maintain a pilot flame, and as the fuel vaporizes in chamber 84 it is pulled or entrained into the high velocity air stream in non-turbulent streamlined flow. The mixture swirling in chamber 84 also contains inert gases such as CO₂, H₂O and N₂ which act as a buffer to aid in preventing coking and smoke chains while the high rate of vaporization from the wick maintains it cool. The recirculation prevents a fuel vapor barrier from forming at the vicinity of opening 52 and instead disperses the vapor. Thus, the recirculation chamber 84 is generally defined

by baffle 92, wall 74, and the tangential air stream issuing from nozzle 76.

In FIG. 6 another type of burner assembly is illustrated using the principles of the present invention. A burner plate 98 having a wire mesh or wick retainer 100 holds a wick material in engagement with one face of the plate. An opening 102 permits vaporized fuel from an igniter chamber to pass into a recirculating chamber 104 defined by a housing 106. The housing 106 is formed by a circular wall 108 having an integrally formed end wall 110 spaced from the plate 98. The walls 108 and 110 are truncated along a line transverse to the plate axes and extending across a corner of opening 102. The housing 106 serves so as to entrain a portion of a main air stream exiting in a tangential direction through an opening in a conical baffle 112 from a conduit 114. A target baffle 116 spaced about 1/4" from wall 110 directs the main air stream into a spiral flow.

The main flow circulates about the exterior of wall 108 and exits through the opening in the conical baffle while a portion of the air stream is entrained by housing 106 and then reenters the main air stream due to the tangential boundary in non-turbulent streamlined flow.

The foregoing description is directed to an improved burner for use with heavier grade fuels with the inventive concepts of said burner believed set forth in the accompanying claims.

What is claimed is:

1. A vaporizing burner of the type including means for vaporizing fuel in a chamber having a wall in which an opening is formed through which vaporized fuel exits, the improvement comprising means for driving combustion air in an arcuate path axially confined on one side by said wall and directed past a first portion of said opening, a baffle projecting perpendicularly from said wall in an arcuate path initiated adjacent an inner radial point of said air path and extending about another portion of said opening into said first portion in a curve transverse to the direction in which said air stream is driven and terminating in said air stream at a position generally parallel to said air stream for separating said stream into two parts with one of said parts directed by said arcuate baffle towards said radial point for subsequent entrainment in said stream and the other part constituting the main air stream, a conical baffle encircling said main air stream, arcuate baffle and said opening for radially confining said main air stream, and a planar target baffle opposite said opening and located adjacent the projecting end of said arcuate baffle with said target baffle meeting the inner surface of said conical baffle for a predetermined arc to axially confine both parts of said air stream between said wall and conical baffle for an angular distance corresponding to said predetermined arc to complete a recirculating chamber for said one part of said air stream while providing an exit for said main air stream between said conical baffle and said target baffle.

2. A vaporizing burner of the type including an igniter extending into a chamber having a wick carrying fuel with said chamber having a wall with an opening therein through which said vaporized fuel exits, the improvement comprising means for driving combustion air axially confined on one side by said wall past a portion of said opening in a spiral path having an axis parallel to the axis of said opening and directed past a first portion of said opening, a baffle projecting perpendicularly from said wall in an arcuate path initiated adjacent an inner radial point of said air path and extending about another portion of the periphery of said opening and following the periphery of said opening into said first portion in a direction transverse to the direction in which said air stream is driven and terminating in said air stream at a position generally parallel to said air stream for intercepting a portion of said combustion air to form a mixture of said intercepted air and vaporized fuel adjacent said opening to be entrained in said driven combustion air

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with the unintercepted portion of said air stream constituting the main air stream, and a semicircular target baffle spaced adjacent the end of said baffle plate and opposite said opening for axially confining both said intercepted and main air streams.

3. A vaporizing burner of the type including an igniter extending into a chamber having a wick carrying a diesel fuel with said chamber having a wall with an opening therein through which said vaporized fuel exits, the improvement comprising a step nozzle through which combustion air axially confined on one side by said wall is driven in a spiral path about an axis parallel to the axis of said opening and adjacent a first portion of the periphery of said opening, a baffle spaced from and encircling said opening, nozzle and combustion air for radially confining said path, an arcuate baffle projecting in a direction parallel to said axes and extending from adjacent said step nozzle about another portion of the periphery of said opening with said arcuate baffle thereafter following the periphery of said opening in a direction transverse to said spiral path and terminating in and generally paral-

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lel to said path for separating said combustion air into a recirculated air stream driven across the other portion of said opening for reentrainment in said combustion air and a main air stream, and a planar baffle spaced adjacent the end of said arcuate baffle and opposite said opening for confining both said recirculated and main air streams axially with said main air stream being axially confined for a distance corresponding to the angular distribution of said planar baffle.

References Cited

UNITED STATES PATENTS

77,124	4/1868	Suhr	158—4
1,660,106	2/1928	Stroud	158—91
2,208,851	7/1940	McIlvaine et al.	158—91
2,507,081	5/1950	Allen et al.	158—28 X
2,663,366	12/1953	Harris	158—91 X
2,850,004	9/1958	Fairbanks	126—116

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