UNITED STATES PATENT OFFICE

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OIL BURNER NOZZLE

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4 Claims. (Cl. 299—120)

in which secondary air is discharged in a blast into the combustion chamber 11. The member 14 also is provided with a plurality of circular openings 17 surrounding the opening in through which additional quantities of secondary air also are discharged into the combustion chamber 11 around the periphery of the blast of secondary air introduced through the nozzle opening 16. Disposed concentrically with and just inside of the secondary air airifice or nozzle 16 is a primary fuel and air mixing nozzle indicated generally at 18. The nozzle 18 comprises an outer tubular member body 19 containing an inner tubular member or body 21, the two tubular bodies being adapted to be assembled as a unit and secured by a nut 22 to an air supply conduit 23 projecting from the casing 24 of an oil burner fuel and air pumping or supply mechanism, only partially shown. The fuel and air supply mechanism may be of any suitable type wherein pumping mechanism is provided for supplying liquid fuel and air to the nozzle 18 at relatively low and substantially equal pressures and wherein fan or other suitable means is provided for supplying secondary air to the secondary air nozzle 14 which is located about the primary fuel and air mixture nozzle 18. For a more complete description of an oil burner system of this type and the primary and secondary air, and the fuel pumping, metering and fan mechanism employed therein, reference may be had to the co-pending applications for United States Letters Patent of Howard E. Earl, Serial No. 2,581, filed January 17, 1948, for Oil Burner System, now Patent No. 2,554,491; Howard E. Earl, Serial No. 772,970, filed September 9, 1947, for Motor Compressor Unit, now Patent No. 2,542,121; and Robert W. Withereill, Serial No. 15,718, filed March 8, 1948, for Oil Burner Pumping Unit.

The liquid fuel referred to is supplied to the nozzle 18 by a conduit 25 which is connected to the hollow interior of the inner tubular member 21 by a tube or conduit 27. A spring 28 disposed about the tube 27 and abutting the adjacent ends of the conduit 25 and the inner tubular member 21 holds the inner tubular member 21 within the outer tubular member 19 and in contact with the front end of the latter.

The primary air supply conduit 23 surrounds the fuel supply conduit 25 and the tube 21 and supplies primary air to the nozzle 18 through the annular space therebetweenth. Such air is supplied to the nozzle 18 through a plurality of air supply passages indicated at 29, these passages being formed between the outer and inner tubu-
lolar bodies or members indicated at 19 and 21 respectively.

Referring particularly to Figs. 2 to 5, the outer body 19 is provided with a front wall 31 in which a knife-edge orifice indicated at 32 is concentrically formed. The orifice 32 forms the extremity of a frusto-conical surface indicated at 33 which provides the interior surface of the front wall 31.

The inner tubular member 21 is provided with a closed front end 34 from a central portion of which projects a conical tip 36 which extends toward the orifice 32 in concentric relation therefrom. The front end 34 comprises a planar surface indicated at 37 which extends normally with respect to the axis of the inner tubular member 21 about the base of the tip 36 and which is in turn surrounded by an annular tapering seat indicated at 38, which is adapted to engage and to closely fit the inner tapering surface 33 of the front wall 31 of the body 19.

The annular seat 38 when engaging the front wall 31 in the manner described divides the front end of the nozzle 18 into a tip chamber 39 and an annular mixing chamber 41 which is formed about the front end of the inner tubular member 21 in anterior relation to the seat 38. The annular mixing chamber 41 is formed between an outer cylindrical surface 42 formed from the front of the inner tubular member 21 and the inner cylindrical surface 43 of the outer tubular member 19. The remainder of the exterior surface of the inner tubular member 21 is located by a plurality of planar surfaces indicated at 44 which extend as planar chords across the inner cylindrical surface of the outer member 19 and between the ends of which are formed arcuate longitudinally extending seats indicated at 46. Seats 46 divide the space between the exterior and interior tubular members 19 and 21, respectively, into the longitudinally disposed air supply passages previously indicated by the numeral 29, and the passages 28 which communicate at their forward ends with the annular mixing chamber indicated by the numeral 41.

The fuel supply conduit 26 and the tube 27 supply the fuel to be used in forming a primary charge in the nozzle 18 to a fuel supply passage indicated at 47 which is formed interiorly of the outer tubular member 19. Between the passage 47 and the annular mixing chamber 41 is a plurality of fuel supply ports or passages indicated at 48, and by which latter ports or passages fuel is supplied from the passage 47 to the annular chamber 41. The passages 48 are equally spaced with respect to one another and are offset with respect to the axis of the inner tubular member 21 in such manner as to have a tangential relation to the annular chamber 41 at the ends of the passages 48 which communicate with the annular chamber 41. The outer ends of the passages 48 communicate with the annular chamber 41 approximately midway between the front and rear ends of the annular chamber 41 and are formed in such a way as to provide relatively sharp knife edges over which fuel from the interior of the member 21 is supplied to the annular chamber 41. The ends of the passages 48 communicate with the annular chamber 41 approximately midway between the central portions of the ends of the air supply passages 29 which also communicate with the annular chamber 41.

Formed across the annular seat 38 between the annular chamber 41 and the tip chamber 39 are a plurality of spirally formed passages indicated at 49, these latter passages having forward ends 51 which communicate with the passages 39 and rearwardly disposed ends 53 which communicate with the annular chamber 41. The ends 51 terminate in the tip chamber within the planar surface 37 surrounding the tip 36 and in such manner as to have a tangential relation to the tip chamber 39. The ends 53 communicate with the annular chamber 41 at an angle with respect to the annular chamber 41 and therefore have a similar tangential relation to the annular chamber 41. The ends 53 communicate with the annular chamber 41 between the ends of the passages 48 and somewhat nearer the annular seat 38.

The cross sectional contour of the passages 49 is considerably less than the cross sectional contour of the annular chamber 41, of the passages 29, and of the chamber 39. Under such circumstances air which may be supplied by the passages 29 will flow into the annular chamber 41 and thence will flow in a plurality of spiral paths, through the passages 48 and into the tip chamber 39. The passages 48 being much smaller than the other passages and chambers referred to, it will be evident that the velocity of the fluid in the passages 48 will be considerably greater than the velocity of the air in the other passages referred to. Also, due to the slope or spiral relation of the passages 49 to the annular chamber 41 and the tip chamber 39, it will be apparent that such air at such higher velocities within the passages 48 will tend to cause rotation of the air supplied to the chamber 41 and that which is discharged into the chamber 39. Since the fluid in all of such passages will rotate in the direction offering the least resistance, it will be apparent that the air and liquid fuel admitted to the annular chamber 41 from the air and fuel supply passages 28 and 48, respectively, will rotate in the annular chamber 41 in a clockwise direction, as the nozzle appears in Figs. 4 and 5. For the same reason, it will be apparent that the fluid discharged by the passages 48 in the annular chamber 41 also will rotate in a clockwise direction in the tip chamber 39, as the nozzle appears in Fig. 5.

It will be apparent from Fig. 4 that the passages 48 are somewhat inclined toward or facing the direction of rotation of fluid in the annular chamber 41 which will cause the passages to provide particularly sharp knife edges over which the liquid fuel from the passages 48 is supplied to the annular chamber 41.

Due to the relation of the ends of the passages 29, 48, and 49 which communicate with the annular mixing chamber 41, it will be apparent that air which is supplied to the annular chamber 41 through any one of the passages 29 will tend to flow across the outer end of an adjacent passage 48 before reaching the end of the passage 48 which is beyond such adjacent passage 48, all relative to the clockwise rotation of fluid in the annular chamber 41.

With respect to any primary fuel and air mixture discharged from the knife-edge orifice 32 at the front of the nozzle 18, it will be apparent that the fuel in such mixture will be required to pass over a pair chamber 41 of air delivered being discharged as such primary mixture. These edges include the edges formed at the outer extremities of the passages 48, the edges at the opposite ends of the passages 49, and the knife edge of the orifice 32. Such sharp knife edges tend to finely divide or atomize the fuel and hence to thorough-
ly mix the fuel with the air as the fuel and air rotate in the mixing chamber 41, as such fuel and air pass through the passages 45, as such fuel and air rotate within the tip chamber 39, and as such fuel and air is discharged through the orifice 32.

To initially ignite the primary fuel and air mixture so formed by the nozzle 18, there is provided a pair of electrodes 54, the ends of which terminate in spaced relation immediately beyond the orifice 32. After such ignition, the primary fuel and air mixture referred to will be projected through the orifice 16 in the secondary air nozzle 14 where the secondary air will be mixed with the burning primary mixture in the proper ratio to complete the combustion of the fuel supplied by the nozzle.

While I have illustrated and described a preferred embodiment of my invention, it is understood that this is capable of modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. An oil burner nozzle comprising an outer tubular body having a circular knife-edge orifice formed coaxially therewith at the front end thereof, an inner tubular body within said outer body and having a front end formed to provide an annular seat disposed in engagement with said outer body and being spaced from said outer body by an opposite side of said seat to provide a tip chamber communicating with said orifice and an annular mixing chamber separated from said tip chamber by said seat, said front end of said inner tubular body having a conical tip projecting toward said orifice and concentrically with respect thereto, one of said bodies being formed to provide a plurality of passages across said seat between said mixing chamber and said tip chamber, the cross section of said passages being materi ally less than that of said annular chamber, said passages being formed in similarly sloped relation and being symmetrically related to said mixing chamber and said tip chamber with the opposite ends of said passages opening into said mixing chamber and said tip chamber in directions tangently related to said chambers so as to include a unidirectional rotation of fluid in said mixing chamber and said tip chamber, a plurality of spaced oil supply ports communicating between the interior of said inner tubular body and said annular chamber and through which is supplied oil to said annular chamber, said ports having a relation to said annular chamber forming relatively sharp edges across the line of flow of fluid in said annular chamber, said sharp edges being positioned between the opposite ends of said annular chamber and in advance of said passage ends in said annular chamber, said inner body on the side of said annular chamber remote from said annular seat being formed to provide a plurality of seats engaging the interior of said outer body for dividing the space between said inner and outer bodies into a plurality of longitudinally disposed air supply passages communicating at their forward ends with said annular chamber, and through which air supply passages air under pressure is supplied to said annular chamber, said oil supply ports communicating with said annular chamber between said forward ends and said passage ends and discharging jets of oil into the air supplied through said air supply passages, said nozzle construction being such that oil is mixed with air and such mixture is rotated in said annular chamber and in flowing from said annular chamber into said passages such mixture breaks over the edges of said passages and changes direction, and said mixture further breaks over the edge of said orifice and changes direction in passing from said tip chamber through said orifice.

2. An oil burner nozzle according to claim 1 in which the front end of said inner tubular body is provided with a non-circular conical orifice to said orifice and disposed concentrically with respect thereto, said passage ends projecting into said tip chamber in a direction so as to project a mixture of oil and air toward a wall of said tip chamber opposite said conical tip whereby said mixture will whirl around said tip chamber and break over the knife edge thereof.

3. An oil burner nozzle comprising an outer tubular body having a circular knife-edge orifice formed coaxially therewith at the front end thereof, an inner tubular body within said outer body and having a front end formed to provide an annular seat disposed in engagement with said outer body and being spaced from said outer body by an opposite side of said seat to provide a tip chamber communicating with said orifice and an annular mixing chamber separated from said tip chamber by said seat, said front end of said inner tubular body having a conical tip projecting toward said orifice and concentrically with respect thereto, one of said bodies being formed to provide a plurality of passages across said seat between said mixing chamber and said tip chamber, the cross section of said passages being materially less than that of said annular chamber, said passages being formed in similarly sloped relation and being symmetrically related to said mixing chamber and said tip chamber with the opposite ends of said passages opening into said mixing chamber and said tip chamber, the cross section of said passages being not greater than that of said annular chamber, said passages being formed in similarly sloped relation to one another and being symmetrically related to said mixing chamber and said tip chamber with the opposite ends of said passages opening into said mixing chamber and said tip chamber in directions tangently related to said chambers so as to include a unidirectional rotation of fluid in said mixing chamber and said tip chamber, a plurality of spaced oil supply ports communicating between the interior of said inner tubular body and said annular chamber and through which is supplied oil to said annular chamber, said ports having a relation to said annular chamber forming relatively sharp edges across the line of flow of fluid in said annular chamber, said sharp edges being positioned between the opposite ends of said annular chamber and in advance of said passage ends in said annular chamber, said inner body on the side of said annular chamber remote from said annular seat being formed to provide a plurality of seats engaging the interior of said outer body for dividing the space between said inner and outer bodies into a plurality of longitudinally disposed air supply passages communicating at their forward ends with said annular chamber, and through which air supply passages air under pressure is supplied to said annular chamber, said oil supply ports communicating with said annular chamber between said forward ends and said passage ends and discharging jets of oil into the air supplied through said air supply passages, said nozzle construction being such that oil is mixed with air in said annular chamber and such mixture breaks over the edges of said passages and changes direction in flowing from said annular chamber into said passages and is projected toward a wall of said tip chamber, and such mixture further breaks over the edge of said orifice and changes direction in passing from said tip chamber through said orifice.

4. An oil burner nozzle comprising an outer tubular body having a circular knife-edge orifice formed coaxially therewith at the front end thereof, an inner tubular body within said outer body and having a front end formed to provide an annular seat disposed in engagement with said outer body and being spaced from said outer body on opposite sides of said seat to provide a tip chamber communicating with said orifice and an annular mixing chamber separated from said tip
chamber by said seat, said front end of said inner tubular body having a conical tip projecting toward said orifice and concentrically with respect thereto, one of said bodies being formed to provide a plurality of passages across said seat between said mixing chamber and said tip chamber, the cross section of said passages being materially less than that of said annular chamber; said passages being formed in similarly sloped relation and being symmetrically related to said mixing chamber and said tip chamber with the opposite ends of said passages terminating in equally spaced relation within said mixing chamber and said tip chamber, said passage ends opening into each of said chambers in directions tangentially related to said chambers, said passages being adapted to induce a unidirectional rotation of fluid in said mixing chamber and said tip chamber, a plurality of spaced oil supply ports communicating between the interior of said inner tubular body and said annular chamber and opening into said annular chamber between the opposite ends of said annular chamber and in advance of said passage ends in said annular chamber, said inner body on the side of said annular chamber remote from said annular seat being formed to provide longitudinally disposed seats engaging the interior of said outer body for dividing the space between said inner and outer bodies into a plurality of longitudinally disposed air supply passageways communicating at their forward ends with said annular chamber, said oil supply ports communicating with said annular chamber between said forward ends and said passage ends and discharging jets of oil into the air supplied through said air supply passageways, said nozzle construction being such that oil is mixed with air in said annular chamber and such mixture breaks over the edges of said passages and changes direction in flowing from said annular chamber into said passages, and such mixture further breaks over the edge of said orifice and changes direction in passing from said tip chamber through said orifice.

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