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BURNER OF THE PROJECTED FLAME TYPE

James William Pennington, Chicago, Ill., assignor to Inland Steel Company, Chicago, Ill., a corporation of Delaware

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This invention relates to a burner, which is adapted particularly for use under conditions requiring projection of a flame of high intensity. Such burners are useful, for example, in the melting of metal in furnaces of the open hearth type, although not necessarily limited to such application.

An object of the invention is to improve the efficiency of burners of the general character herein disclosed, and to obtain maximum combustion of the fuel with higher flame temperatures.

Another object is to produce a burner of the character stated, which is self-cleaning, and capable of operating through extended periods of time without servicing.

Another object is to so construct the burner as to greatly extend its useful life, while at the same time reducing the cost of manufacture and the cost of maintenance thereof.

The foregoing and other objects are attained by the means described herein and illustrated upon the accompanying drawings, in which:

Fig. 1 is a cross-sectional view showing part of an open hearth furnace, with the improved burner of the invention being illustrated in side elevation.

Fig. 2 is an enlarged cross-sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a side elevation view, partly broken away, showing a forward tube support member incorporated in the burner nose.

Fig. 4 is a side elevation view, partly broken away, showing a part of the tube support member.

Fig. 5 is a vertical section taken at the rear portion of the burner, showing the structure on an enlarged scale.

Fig. 6 is a cross-sectional view taken on line 6—6 of Fig. 5.

Fig. 7 is a vertical section, at twice the scale of Fig. 5, showing the forward or nose end of the burner.

Fig. 8 is a fragmentary end elevational view of the nose end of the burner illustrated by Fig. 7.

Fig. 9 is a front view of a modified form of burner.

Fig. 10 is a cross-sectional view taken on line 10—10 of Fig. 9.

In Fig. 1 of the drawings, a burner 10 embodies the invention is shown mounted in place on a furnace such as an open hearth, for example. The burner extends through a port 12 in the furnace wall, and may be supported upon trunnions 13 journaled in bearing brackets 14, one at each side of the burner. The brackets may be secured to a transverse beam 15 supported by the furnace wall or otherwise. The burner may be swung or rocked upon the trunnions 12, as by means of a screw 16 and handwheel 17, for directing the flame of the burner to a desired angle upon the melt which rests upon the hearth forwardly of the burner.

The nose end 18 of the burner is adapted to deliver into the furnace, a combustible atomized mixture of oil, gas, oxygen and steam, or various combinations thereof. The gas used may be coke oven gas, illuminating gas, or the equivalent, and in some instances various grades or types of tar, pitch, or the like, is substituted for the oil or mixed therewith to form a proper viscous fuel. Referring to Figs. 1 and 6, the supply pipe for viscous fuel or oil is indicated at 19; the supply pipe for gas or gaseous fuel is shown at 20; the supply pipe for oxygen or its equivalent is at 21; steam pipes are shown at 22, 23, 24 and 25, and pipes for a cooling fluid, such as water, are indicated by the characters 26, 27, and 28. Pipe 23 is furnished with a cock 29 and a cap 30, which constitute a blow-off arrangement for clearing the cooling system of dirt, sediment, and any foreign matter that might accumulate therein. Cooling fluid normally may enter the pipe 27 which conveys it to the forward end of the encircling water jacket 31 of the burner, whereas pipe 28 exhausts the cooling fluid from the jacket. The flow of cooling fluid through the jacket preferably is continuous.

It should be understood that the various pipes mentioned in the paragraph next above are usually connected with sources of supply which can be controlled by means of valves or otherwise, and due to the fact that the burner is rockable upon its trunnions 13, the connections are necessarily flexible. Flexible hoses or swivel couplings are suitable for the purpose.

At the left or rear end of the burner is located the atomizer 32 for viscous fuel. Within the atomizer, fuel from the supply pipe 19 is directed through a nozzle 33 into the mixing chamber 34 where it is met by a blast of steam from the steam pipe 22, and atomized thereby before passing through an orifice 35 leading to the fuel delivery tube 36.

Atomized fuel entering the fuel delivery tube 36 at 35, travels the full length of said tube and is discharged at the burner nose (Fig. 7). Surrounding the atomized fuel delivery tube 36 is a
fuel tube heater, which may be in the form of a jacket tube spaced from the fuel delivery tube as shown, the passageway thereby established being adapted to convey a heating medium, such as steam along substantially the full length of the fuel delivery tube. The jacket tube is to be discharged at the burner nose, in a manner to be described, and has as one of its functions the maintenance of a thoroughly atomized and highly combustible condition of the viscous fuel. The fuel heating steam is introduced to the jacket or passageway by way of steam pipe, which feeds the steam into a chamber of the atomizer housing. The housing forward wall supports the rear end of jacket tube by means of a threaded connection at the packing gland. Gland may be welded or otherwise fixed to the end of the jacket tube, as at 43.

The fuel delivery tube may be maintained in concentric spaced relation to the jacket tube, by threading it into a bore of an intermediate wall of the atomizer housing, as at 44. As will be evident, the steam chamber is separated from the atomizing chamber by said intermediate wall.

In a manner somewhat similar to that just described, a delivery tube for oxygen or an equivalent gas for supporting combustion, is incorporated in the burner structure. The tube, threaded or otherwise fixed as at 47 within the housing section, communicates with a chamber to which oxygen or an equivalent combustion supporting gas is fed from a controlled source by means of the pipe 21. A header for the oxygen delivery tube may be in the form of a jacket tube surrounding the tube in spaced relation, providing a passageway or jacket to be supplied with steam or other heating medium fed by way of pipe 28 to the steam chamber. It will be seen that the jacket is placed in communication with the steam chamber, by supplying the jacket tube with a fixed bushing which is externally threaded and engaged by threads of a bore in the housing wall. This connection and the connection at 47 serve to maintain the tubes spaced and concentric. At the rear of housing section, a flange provides a mounting means for the atomizer, which has a similar cooperative mounting flange.

Referring to Fig. 7, it will be noted that the oxygen delivery tube and its jacket extend substantially to the nose of the burner, in substantial parallelism with the fuel delivery tube and its heating jacket. All of these elements are surrounded by an inner cooling jacket tube of large diameter, extending substantially from the burner nose rearwardly to the housing. At its rear end, the inner cooling jacket tube may be supported in any suitable manner, for example as illustrated by Fig. 5, wherein the coupling ring is shown provided with a bore to receive the inner jacket tube, with provision made for a gasket or packing ring to prevent leakage about the outer surface of the tube. The gasket or packing may be held in compressed condition about tube by means of a gland threaded engaging the threaded bore of the coupling member as shown. An enlarged inner bore of the gland forms a passageway whereby the entire open end of the inner cooling jacket tube is placed in communication with a large chamber of housing section, which is fed with gaseous fuel by the large pipe. This gaseous fuel, as previously stated, may be coke oven gas, illuminating gas, or a combustible gas of any other type. The flow of such gas preferably is controlled at the source, or at some location in the supply line exteriorly of the burner. Leakage of gas into the water jacket and steam chamber is precluded by the packings and. A tight connection, of course, is perfected in any known manner, at the flanges and of the housing parts and.

Gas from the chamber may flow through the opening in the tubes with the cooling jacket member, to finally emerge from the burner nose at the large spaces and of Fig. 8, where the gas mingles with the oxygen, the atomized fuel oil, and the steam from the heating jackets.

The gas tube, if supplied with a gas that carries particles of impurities, may require cleaning from time to time. Periodic or intermittent cleaning, or continuous cleaning if preferred, may be effected by incorporating in the burner a high pressure nozzle for steam or other fluid, capable of dislodging such particles that might form out through the burner nose. The nozzle, as disclosed by Figs. 5 and 6, may be formed in the housing as an arcuate narrow slot in communication with a steam chamber fed by the supply pipe. The nozzle slot preferably is located close to the open end of the gas delivery tube, in position to dislodge any particles resting in the lowest portion of the tube. Preferably, the accuracy of the slot approximates that of the inside diameter of the gas tube, and may extend about the tube periphery 120 degrees or more, as clearly illustrated by Fig. 6. The inner wall of the chamber may be integral with the housing, and may be cut away or depressed slightly at to accommodate the jacket tube which is in close proximity to the nozzle slot at the depression.

From the foregoing, it will be understood that a blast of steam or other high pressure fluid directed into the chamber by pipe, will strike and move, toward the forward end of the burner, any accumulation of particles that might be carried over by the gas and lodged in the gas delivery tube. Coke oven gas, for example, will often carry impurities that may lodge in the gas delivery tube, and by means of the nozzle arrangement herein disclosed, such impurities easily and quickly may be removed at intervals, by simply directing a high pressure fluid to the nozzle. The supply of high pressure fluid may be controlled by a two-way valve interposed in steam pipe, by preference. The valve may be under the control of a burner attendant, or it may be opened periodically by automatic means if desired. The attendant may wish to clean the gas delivery tube by the aforesaid pressure method only when the burner is out of operation, and this procedure may be adequate under most conditions of usage. The accumulations leave the burner through the nozzle at.

The exterior of the burner comprises the large large tube, which extends from the flange to the nose of the burner, and serves as the outer jacket member for cooling fluid. This tube is commonly known as the pipe, which connects with the tube near the burner nose, and supplies water as cooling fluid to the cooling jacket. A deflector or baffle directs some of the coolant forwardly about the burner nose and certain structural parts thereof, which are exposed to the destructive heat of the furnace. The coolant exhaust pipe
26 conveys coolant from the jacket 31 as rapidly as it enters by way of pipe 22.

The nose end of the burner will now be described with reference to Figs. 3, 4, 7 and 8 of the drawings. From Fig. 7, it will be noted that the forward end of the outer cooling jacket tube 10 carries a burner nose ring 18 applied thereto by means of a circumferential weld 17. The tip of the ring carries a part 12, which may be a machined weld of heat resistant metal or alloy, shaped as shown to provide a circumferential exterior groove 19 bounded by a rather sharp annular edge 80 extending radially outwardly. The groove and the sharp edge cooperate for precluding the accumulation of slag and other furnace impurities in such quantity as might close the burner nose. This tip construction will not be further detailed here, as it forms the subject of another patent already issued.

The ring 16 and part 19 are machined to provide an interior annular seat 84 adapted to receive snugly therein the forward edge of an enlarged cylindrical extension 82 of the gas delivery tube 53. The extension may be provided at one end with an internal flange 88, which may be welded or otherwise fixed to tube 53, as at 64. The opposite end of the extension carries a retaining member 66, as shown. The annular groove 89 of the annular interior groove 19 of the nose, as shown. The ring 85 is adapted to retain the parts of the nose structure for assembly purposes.

Embraced, within the cylindrical extension or cage 82, is an assembly which properly may be referred to, as a fluid-curtain generator, the function of which is to maintain over the open end of the burner nose, a cone-shaped screen or curtain of steam or equivalent fluid. Such curtain or screen serves to prevent passage of furnace impurities or flying particles into the burner nose, and shields the open forward ends of the tubes 35 and 45, from oxidation and carbonization. In the presence of the generated and reflected heat within the furnace, thereby to avoid frequent cleaning and dressing of these and other parts of the burner nose.

The curtain generator comprises the parts illustrated by Figs. 3 and 4. In Fig. 3, the character 86 indicates generally the main body of the generator, which includes a cylindrical forepart or snout 87 having an enlarged annular flange 88. A diametral web 89, best illustrated by Fig. 8, extends partly within and partly outside the snout, and this web is enlarged at opposite sides of its middle to provide the hubs or bosses 90 and 91. The hubs or bosses are bored or bored to receive and support the forward ends of jacket tubes 37 and 50 (Fig. 7). Other bosses 92 and 93 receive and support, respectively, the forward ends of the viscous fuel delivery tube and the oxygen delivery tube. The forward ends of the four tubes are supported by the main body part 88 of the fluid-curtain generator.

At the locations 94 and 95, the opposite ends of the web are provided with diametral bosses which form radially disposed steam ports or passage ways opening outwardly to the exterior of the main body part 88. From the disclosure of Fig. 7, it will be seen that the ports 94 communicate with the steam jackets 37 and 51. To confine and direct the steam passing outwardly through the ports, an outer cylinder 95 (Fig. 4) is slipped over the forepart or snout 87 of the body 56. From Fig. 7 it is apparent that an annular seat 96 of the outer cylinder receives the flange 88 of the main body part 87, thereby to establish an annular jacket or chamber 85 between the parts. The ports 94 and 54 communicate with this chamber, and direct into it the steam or heating fluid from the tube jackets 37 and 51.

As previously stated, a fluid-curtain is to be established ahead of the burner nose. The steam from the chamber 91 is utilized for this purpose.

Referring to Fig. 7, it may be noted that the outer cylinder 95 of the fluid-curtain generator has an inwardly directed lip 86 which follows the periphery of the cylinder all the way around. The inner face of the lip, indicated as at 95, is at an angle to the plane of the forward face of the lip, for the purpose of directing the steam from chamber 91 in a forward and inward direction toward the burner axis. It may be noted that the forward edge of snout 85 is chamfered, as at 100 (Fig. 3), so that the chamfer in conjunction with the inclined lip face 86 forms an annular nozzle capable of establishing a conical curtain of steam, the apex of which is formed forwardly of the burner nose substantially upon the axis of the curtain generator. The force of the steam issuing from the nozzle 99-100 is considerable, and its direction is such as to aid ejection of the various fuels from the jets of the burner. The arrangement of annular seat 96 of furnace impurities or particles into the burner nose from the front.

From the foregoing description, it is evident that the curtain generator assembly performs the several functions of supporting the several tubes 35, 37, 45 and 50, of collecting the steam from the heater jackets 38 and 51, and of delivering the jacket steam as a protective screen or screen for the purposes above stated. The ports 54 and 94 are sufficient in size, or number, to freely relieve the heater jackets 38 and 51 of steam or heating fluid issuing therefrom. While in the drawings the generator assembly is shown as being constructed of the two parts illustrated by Figs. 3 and 4, it may be desirable in practice to fabricate the part of Fig. 3 from a number of constituent pieces welded or otherwise joined together, to avoid complications in machining or molding. The number and nature of the parts constituting the complete element shown in Fig. 3, is a matter immaterial to the invention so far as performance is concerned, but from the standpoint of efficient shop practice, the web portion 89 may be initially build up from one or more pieces assembled and welded into the main body 88.

As indicated upon Figs. 7 and 8, the bores 92 and 93 which support the fuel tubes 36 and 46, respectively, may be milled out or otherwise cut away at 101 and 102, to provide a limited space about a portion of the circumference of each fuel tube, from which a limited amount of steam may escape about the fuel tube ends without passing through the annular nozzle 99-100. The auxiliary jets, thereby provided, are designed to remove from the web 89 any drippings from the fuel tube 36 before the drippings can solidify, and in addition, the jets may serve as blow-out ports for any scale, dirt, or condensate that might otherwise tend to accumulate on the forward portions of the fuel tubes 36 and 46. Spaces 103 may be connected as at 104, if desired.

Fig. 2 illustrates a supporting member or spider 104 which may be employed at one or more locations within the length of the burner barrel, for precluding vibration and sagging of the jacket tubes 37 and 90. The spider may include several
radial legs 105, the outer ends of which rest against the inner surface of the gaseous fuel tube 50. The gas in traveling through the tube 58 toward the burner nose, flows freely all around the spider legs and the tubes supported thereby. The spider legs may be secured to the tubes by set screws 106 or any other form of fastening means.

Attention is directed to the fact that the atomizer illustrated at the left of Fig. 5 may atomize or condition for combustion, oil, tar, pitch or other viscous fuel introduced therein by way of the supply pipe 19, and discharged under pressure through nozzle 33 into the mixing chamber 34. Steam or other atomizing fluid under pressure enters the chamber by way of supply pipe 22, and acts upon the viscous fuel to atomize it prior to discharge through the ports 35 and fuel delivery tube 36. The atomizing fluid pressure may be controlled at the source, or by placing a suitable control valve in the supply line 22, as will be understood. The nature or type of atomizer employed is a matter wholly immaterial to the present invention, as any known form of atomizer having the necessary capacity will suffice.

In the modified form of burner illustrated by Figs. 9 and 10, the jacketed tube for supplying oxygen or other combustion-supporting gas has been eliminated, but in all other respects the modified form carries all of the features of the burner hereinafore described. The similarity is most clearly indicated by the application to Figs. 9 and 10, of the same reference characters appearing in Figs. 7 and 8, with the digit "1" prefixed thereto. Accordingly, in Figs. 9 and 10, 138 and 137 are the atomized fuel delivery tube and its jacket, respectively, surrounded by the inner cooling jacket tube 158 which conveys gaseous fuel to the forward end of the burner. The space 138 between tubes 138 and 131 conveys steam or other heating fluid along the length of the fuel delivery tube, discharging same into the radial ports 194 and annular chamber 197, whence it emerges under pressure through the annular slit or nozzle 198 to 1100 to furnish the protective curtain or screen ahead of the burner nose as previously described.

The modified form of burner is to be supplied with atomized viscous fuel, gaseous fuel, and jacket steam, in substantially the manner explained in connection with Figs. 1 to 8, inclusive, and will of course include a high pressure cleaning nozzle for the gaseous fuel tube as indicated at 72 upon Figs. 5 and 6. In this instance, as well as in Fig. 1, the high pressure cleaning nozzle may receive its steam pressure from the supply pipe 22 as the two-way valve is manipulated at the will of the operator. It should be understood, however, that in either form of the device the nozzle pressure may be supplied otherwise.

Actual tests in open hearth furnaces have proven the superiority of the present burner over all others heretofore used or proposed. The improved burner of this invention has operated for greatly extended periods of time without need of cleaning, or shutting down for any reason. The flame produced was much hotter than usual, and it was found that the fuels leaving the burner nose were in a more favorable condition for combustion than could have been expected in any other known form of burner.

The self-cleaning features of the improved burner are highly advantageous, for obvious reasons; and the presence of the fluid-curtain or screen over the end of the burner nose con-
and a delivery tube for a combustion supporting gas, both extending lengthwise within the inner main tube, and each having a forward open end terminating near the forward end of the inner main tube, a pair of jacket tubes, one surrounding each of the delivery tubes in spaced relation, each jacket tube having an open forward end, means for supplying a heating fluid to the spaces defined by the jacket tubes, for maintaining an elevated temperature of the delivery tubes, means for supplying viscous fuel and a combustion supporting gas to the respective delivery tubes for discharge from the forward open ends thereof, and means for collecting fluid emitted from the jacket tubes, and discharging said fluid as a screen across the forward open end of the inner main tube, to deflect extraneous foreign matter tending to enter said main tube.

4. A burner of the class described, comprising in combination, an inner elongate main tube having a cooling jacket, the inner tube being open at its forward and rearward ends, means for supplying gaseous fuel to the rearward end of said inner main tube, a jacket surrounding the inner main tube, one surrounding each of the delivery tubes in spaced relation, each jacket tube having an open forward end, means for supplying a heating fluid to the spaces defined by the jacket tubes, for maintaining an elevated temperature of the delivery tubes, means for supplying viscous fuel and a combustion supporting gas to the respective delivery tubes for discharge from the forward open ends thereof, means for directing the heating fluid from the jacket as a protective screen across the forward open end of the inner main tube, and high pressure fluid means including a nozzle located near the open rearward end of the inner main tube, for blowing from said tube foreign matter deposited therein by the gaseous fuel.

5. A burner of the class described, comprising in combination, an inner elongate main tube having a cooling jacket, the inner tube being open at its forward and rearward ends, a viscous fuel tube and a tube for conveying a combustion supporting gas, both extending lengthwise within the inner main tube, and each having a forward end open and terminating near the forward end of the inner main tube, a jacket surrounding the viscous fuel tube in spaced relation, and open at its forward end, for conveying a heating fluid along the length of said fuel tube to maintain an elevated temperature of the latter, a second jacket tube similarly related to the tube for conveying combustion supporting gas, said second jacket tube having an open forward end terminating near the open forward end of the first inner jacket tube of fluid near the rearward end of the burner for supplying viscous fuel to the viscous fuel tube, means for supplying a combustion supporting gas to the combustion supporting gas tube, means for supplying gaseous fuel of the interior of the inner main tube, and means for supplying a heating fluid under pressure defined by the jacket tubes aforesaid, and means for directing the heating fluid issuing from said jacket tubes, to form a protective screen across the forward end of the inner main tube of the burner.

6. A burner of the class described, comprising in combination, an elongate barrel having a forward nose end, tube means within the barrel for delivering combustible fuel to and through the nose end of the barrel, said said tube means having connection with a source of combustible gas which may carry particles of impurities capable of accumulating in the gas tube, and high pressure fluid means including a nozzle having a mouth in the path of gas movement to blow out the particles of impurities from the gas tube in the general direction of the barrel, said nozzle mouth being located under the gas tube and in a vertical plane passing through the center of the gas tube.

7. A burner of the class described, comprising in combination, an elongated barrel having a forward nose end, the means within the barrel for delivering combustible fuel to and through the nose end of the barrel, one of said tube means having an open end within the barrel, said open end being in communication with a source of gaseous fuel to be discharged through said tube means toward the rearward end of the barrel, controllable high pressure fluid means including a nozzle having an arcuate mouth for directing a fluid into the barrel, the mouth being disposed in close proximity to said open end, and substantially coinciding with a portion of the curvature of the inner wall of said open-ended tube, where by a selected area of the tube interior is exposed to the scouring action of a high pressure fluid emitted by the arcuate mouth of the nozzle.

8. A burner of the class described, comprising in combination, an elongate barrel having a forward nose end, tube means within the barrel for discharging combustible material under pressure through the nose end of the barrel, heating jacket means about said tube means, adapted to convey a heating fluid along the tube means toward the nose end of the barrel, a fluid-screen generator disposed within the nose end of the barrel, including chamber means for collecting the heating fluid, and an annular nozzle in communication with said chamber means, said annular nozzle including a lip angularly inclined to direct a conical screen of fluid inwardly and forwardly of the barrel nose end, and through which screen the combustible material passes in leaving the nose end of the barrel.

9. A burner of the class described, comprising in combination, an elongate barrel having a forward nose end, tube means within the barrel for discharging combustible material under pressure through the nose end of the barrel, heating jacket means about said tube means, adapted to convey a heating fluid along the tube means toward the nose end of the barrel, a fluid-screen generator disposed within the nose end of the barrel, including chamber means for collecting the heating fluid, and an annular nozzle in communication with said chamber means, said annular nozzle including a lip angularly inclined to direct a conical screen of fluid inwardly and forwardly of the barrel nose end, and through which screen the combustible material passes in leaving the nose end of the barrel, and means for supporting said tube means in substantially parallelism with the barrel.

10. A burner of the class described, comprising in combination, an elongate barrel having a forward nose end, and means for discharging atomized fuel therefrom, tube means within the barrel for delivering oxygen under pressure through the nose end of the barrel, heating jacket means
about said tube means, adapted to convey a heating fluid along the tube means toward the nose end of the barrel, and nozzle means within said nose end of the barrel, providing, an annular chamber, said chamber having an interior port in communication with the heating jacket of the oxygen-delivering tube means, the nozzle means including an annular mouth in communication with the chamber, and a lip at the mouth annularly arranged to direct a conical stream of the heating fluid from said jacket inwardly and forwardly in advance of the barrel nose end.

11. A burner of the class described, comprising in combination, an inner elongate main tube open at its forward and rear ends, a multi-chambered housing secured relative to the tube in substantial alignment therewith at the rear end, one chamber of the housing being in communication with the open rear end of the tube, means supplying a gaseous fuel to said chamber for ejection through the main tube and its forward end, a viscous fuel delivery tube extending lengthwise through the main tube and through the gaseous fuel chamber, to a location exteriorly of the housing, said viscous fuel delivery tube having an open forward end terminating near the open forward end of the main tube, means supplying atomized viscous fuel to the opposite end of said delivery tube, a heating jacket tube surrounding substantially the full length of the fuel delivery tube and laterally spaced therefrom to provide a heating jacket, one end of the jacket tube being open at the forward end of the main tube, and the other end being open exteriorly of the housing, means supplying a heating fluid under pressure to said other end of the jacket tube, a nozzle formed in the housing and having communication with a second chamber of the housing, means supplying a high pressure fluid to said second chamber for feeding said nozzle, the nozzle being disposed in close proximity to the open forward end of the main tube for directing a scouring stream lengthwise through the interior of the tube.

12. A burner of the class described, comprising in combination, an inner elongate main tube open at its forward and rear ends, a multi-chambered housing secured relative to the tube in substantial alignment therewith at the rear end, one chamber of the housing being in communication with the open rear end of the tube, means supplying a gaseous fuel to said chamber for ejection through the main tube and its forward end, a viscous fuel delivery tube extending lengthwise through the main tube and through the gaseous fuel chamber, to a location exteriorly of the housing, said viscous fuel delivery tube having an open forward end terminating near the open forward end of the main tube, means supplying atomized viscous fuel to the opposite end of said delivery tube, a heating jacket tube surrounding substantially the full length of the fuel delivery tube and laterally spaced therefrom to provide a heating jacket, one end of the jacket tube being open at the forward end of the main tube, and the other end being open exteriorly of the housing, means supplying a heating fluid under pressure to said other end of the jacket tube, a nozzle formed in the housing and having communication with a second chamber of the housing, means supplying a high pressure fluid to said second chamber for feeding said nozzle, the nozzle being disposed in close proximity to the open forward end of the main tube for directing a scouring stream lengthwise through the interior of the tube.
...3 delivery tube, said delivery tubes being spaced apart and disposed one above another within the tube for gaseous fuel, all of said tubes having corresponding open ends adjacent to one end of the elongate hollow barrel, fluid conducting means about each of said delivery tubes for maintaining a heated condition of said delivery tubes, and means near the open ends of said tubes for establishing a protective fluid curtain transversely thereof.

17. A burner of the class described, comprising in combination, an elongate hollow barrel, a tube therein for conveying gaseous fuel, a delivery tube for atomized viscous fuel, and an oxidizing-fluid delivery tube, said delivery tubes being spaced apart and disposed one above another within the tube for gaseous fuel, all of said tubes having corresponding open ends adjacent to one end of the elongate hollow barrel, fluid conducting means about each of said delivery tubes for maintaining a heated condition of said delivery tubes, and means near the open ends of said tubes for establishing a protective fluid curtain transversely thereof, utilizing that heating medium which heats the delivery tubes for viscous fuel and the oxidizing-fluid.

18. A burner of the class described, comprising in combination, an elongate hollow barrel, an inner jacket tube therein, a delivery tube for atomized viscous fuel, and an oxidizing-fluid delivery tube, said delivery tubes being spaced apart in substantial parallelism within the inner jacket tube of the barrel, and each having an open end exposed adjacent to one end of the barrel, a heating jacket member surrounding the oxidizing-fluid delivery tube in spaced relation, means for feeding a heating medium under pressure into the space between the oxidizing-fluid delivery tube and its surrounding jacket member, the direction of heating medium feed being toward the aforesaid open ends of the delivery tubes, with release of the heating medium occurring about the exposed open end of the oxidizing-fluid delivery tube.

19. A burner of the class described, comprising in combination, an elongate hollow barrel, an inner jacket tube therein, a delivery tube for atomized viscous fuel, and an oxidizing-fluid delivery tube, said delivery tubes being spaced apart in substantial parallelism within the inner jacket tube of the barrel, and each having an open end exposed adjacent to one end of the barrel, a heating jacket member surrounding the oxidizing-fluid delivery tube in spaced relation, means for feeding a heating medium under pressure into the space between the oxidizing-fluid delivery tube and its surrounding jacket member, the direction of heating medium feed being toward the aforesaid open ends of the delivery tubes, with release of the heating medium occurring about the exposed open end of the oxidizing-fluid delivery tube.

20. A burner of the class described, comprising in combination, an elongate hollow barrel, an inner jacket tube located inside the barrel and having rear and front ends, a delivery tube for atomized viscous fuel, and an oxidizing-medium delivery tube, said delivery tubes being spaced apart in substantial parallelism within the hollow interior of the inner jacket tube of the barrel, and each having an open end exposed near the nose end of said barrel, a heating jacket member surrounding the oxidizing-medium delivery tube in spaced relation thereto and extending substantially the full length of the respective delivery tubes, means supplying atomized viscous fuel to the fuel delivery tube for discharge at the nose end of the barrel, means supplying an oxidizing medium to the oxidizing-medium delivery tube for discharge likewise at the nose end of the barrel, and means supplying a heating medium under pressure to the spaces between the delivery tubes and their respective jacket tubes, in a common direction toward the open forward ends of the delivery tubes.

21. A burner of the class described, comprising in combination, an elongate hollow barrel having a forward open nose end, a delivery tube for atomized viscous fuel, and an oxidizing-medium delivery tube, said delivery tubes being spaced apart in substantial parallelism within the hollow interior of the barrel, and each having an open end exposed near the nose end of said barrel, separate heating jacket tubes surrounding said delivery tubes in spaced relation thereto, and extending substantially the full length of their respective delivery tubes, means supplying atomized viscous fuel to the fuel delivery tube for discharge at the nose end of the barrel, means supplying an oxidizing medium to the oxidizing-medium delivery tube for discharge likewise at the nose end of the barrel, and means supplying a heating medium under pressure to the spaces between the delivery tubes and their respective jacket tubes, in a common direction toward the open forward ends of the delivery tubes.

22. A burner of the class described, comprising in combination, an elongate hollow barrel having a forward open nose end, a delivery tube for atomized viscous fuel, and an oxidizing-medium delivery tube, said delivery tubes being spaced apart in substantial parallelism within the hollow interior of the barrel, and each having an open end exposed near the nose end of said barrel, separate heating jacket tubes surrounding said delivery tubes in spaced relation thereto and extending substantially the full length of their respective delivery tubes, means supplying atomized viscous fuel to the fuel delivery tube for discharge at the nose end of the barrel, means supplying an oxidizing medium to the oxidizing-medium delivery tube for discharge likewise at the nose end of the barrel, and means supplying a heating medium under pressure to the spaces between the delivery tubes and their respective jacket tubes, in a common direction toward the open forward ends of the delivery tubes, said spaces being open near the nose end of the barrel to release the heating medium in the general direction of fuel ejection.

23. A burner of the class described, comprising in combination, an elongate hollow barrel having a forward open nose end, a delivery tube for atomized viscous fuel, and an oxidizing-medium delivery tube, said delivery tubes being spaced apart in substantial parallelism within the hollow interior of the barrel, and each having an open end exposed near the nose end of said barrel, separate heating jacket tubes surrounding said delivery tubes in spaced relation thereto and extending substantially the full length of the delivery tubes, means supplying atomized viscous fuel to the fuel delivery tube for discharge at the nose end of the barrel, means supplying an oxidizing medium to the oxidizing-medium delivery tube for discharge likewise at the nose end of the barrel, and means supplying a heating medium under pressure to the spaces between the delivery tubes and their respective jacket tubes, in a common direction toward the open forward ends of the delivery tubes, said spaces being open near the nose end of the barrel to release the heating
medium in the general direction of fuel ejection, and means deflecting the released heating medium as a protective screen transversely of the nose end of the burner barrel.

24. A self-cleaning burner of the class described, comprising in combination, an elongate hollow barrel having a forward nose end, a delivery tube for atomized viscous fuel, and an oxidizing-medium delivery tube, said tubes being spaced apart in substantial parallelism one above the other within the confines of the hollow barrel, and each having an open end exposed near the nose end of the barrel, a support member bored to receive snugly the open end portions of the delivery tubes, said bores being cut away outwardly along a limited portion of their circumference, at locations beneath the fuel delivery tube and above the oxidizing-medium delivery tube, to provide jets adjacent to the peripheral edges of the delivery tubes, and means supplying a high pressure fluid to said jets, traveling therethrough forwardly of the burner nose and adjacent to the peripheral edges of the delivery tubes, to perform a cutting action upon solids dripping from the forward end of the fuel delivery tube.

JAMES WILLIAM PENNINGTON.

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