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COMBINATION OIL AND GAS BURNER
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FIG. 1 is a perspective view of a circular ring 40. The ring has a thick, multi-layered structure. Eight pins 43 are arranged in a circle around the inner circumference of the ring. One pin is specifically labeled 40A. A handle 42 is attached to the bottom of the ring, extending downwards. The handle has a rounded, bulbous shape at its base.

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COMBINATION OIL AND GAS BURNER

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This invention relates to a combination oil and gas burner, and particularly to a large capacity, low draft loss combination oil and gas burner. More specifically this invention is directed to an improvement over the burner construction disclosed in a co-pending application S.N. 632,884 filed January 7, 1957, now Patent No. 2,982,347.

In relatively large vapor generating units, it is customary to fire such units with a plurality of burners capable of burning gas or oil, either separately or in combination, depending on the amount or kind of fuel available. Heretofore, the known combination oil and gas burners were capable of attaining an individual maximum heat output of only 70 to 90 million B.t.u.'s per hour due to their inherent structural and functional characteristics. The trend to ever increasing vapor generating unit sizes has necessitated a steady increase in the number of such burners for firing a given unit. In some instances the burners required to fire a single large unit could easily number 32 or more. Such multiplicity of burners obviously greatly complicated the burner wall and windbox construction of a given unit. The use of such large number of burners further complicated the problems of air distribution to the burners and the burner controls; the latter being particularly aggravated when remote burner light-off and individual flame failure protection are required. Also the need for so many burners to fire a given unit greatly increased the amount of initial capital investment required for the construction of such units, the increase being reflected in the cost of each individual burner, and compounded by the cost of their respective auxiliary equipment such as lighters and burner controls. Consequently, the cost of burner maintenance, repair and replacement for the ever growing modern day vapor generating units increase as the number of burner installations required to fire a given unit increased.

Therefore, an object of this invention is to provide combination oil and gas burner arrangement capable of extending the maximum heating capacity or output of a burner to include loads up to 240 million B.t.u.'s per hour, and thereby greatly reduce the number of burners otherwise required to fire a given vapor generating unit.

Another object is to provide a combination gas and oil burner capable of attaining a maximum output of 240 million B.t.u.'s per hour with a relatively low draft loss, and yet maintain efficient air direction so as to obtain maximum mixing of the fuel and air with the available energy.

Another object is to provide in a combination oil and gas burner, an improved multiple gas spud arrangement in which the length of the respective spuds in combination with their particular orifice drillings cooperate to attain optimum initial distribution of the gas streams with respect to the combustion air so as to effect a balance of good flame stability and low draft loss.

The foregoing objects, features and advantages in accordance with this invention are attained by a combination oil and gas burner having an air register provided with an axially disposed air outlet spaced from a burner port in a furnace wall by means of a burner sleeve. The oil burner portion of the burner comprises an oil atomizing means located along the longitudinal axis of the burner sleeve and an impeller is connected adjacent the discharge end of the atomizing means. The gas burner

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portion comprises a gas manifold circumscribing the burner port adjacent the discharge end of the burner sleeve. In accordance with this invention a plurality of circumferentially spaced gas spuds are connected to the gas manifold so that they extend inwardly toward the axis of the burner in a substantially radial direction. The arrangement of the spuds is such that each projects into the air stream directed to the burner port through the burner sleeve to a substantial extent, and each spud has its gas discharge orifices arranged to provide optimum distribution and intermixing of the gas with the combustion air. The arrangement is such that the projection of the gas spuds into the air stream and the specific arrangement of the orifices in each of the respective spuds cooperate to effect a balance of good flame stability and low draft loss.

In the drawings:

FIG. 1 is a sectional side of the improved oil and gas burner constructed in accordance with this invention.

FIG. 2 is a detail front end view of the improved gas burner portion of the burner.

FIG. 3 is a detail side view of an individual spud.

FIG. 4 is a plan view of the gas spud of FIG. 3.

FIG. 5 is an enlarged fragmentary detail of the gas burner portion of the invention illustrating the relative position of the spud drilling with respect to the air flow through the burner sleeve.

In order to meet the capacity and operational demands of a modern steam generating unit and the like with a minimum number of fuel burners and thereby reduce the complexity of the burner wall construction, as well as burner operation and control, there is shown in the drawings, an improved burner construction capable of attaining a maximum heating capacity approximately 3 times that of the standard 27 inch circular burner commonly in use at the present time. The defined maximum operating capacity of the instant burner is rated at 240 million B.t.u.'s per hour. While the burner construction, as will be herein described, is equally suitable for independently firing different kinds of fuel, it is herein illustrated and described as a combination oil and gas burner which is capable of burning oil or gas either separately or in combination.

Referring to FIG. 1, numeral 10, is directed to a water cooled furnace wall of a vapor generating unit having a circular burner opening or port 11, approximately 43 inches in diameter, extending therethrough. Generally the port 11 is formed of a suitable heat resistant refractory material having a relatively short cylindrical throat section 12 and a connected frusto-conical section 13 diverging toward the furnace side 14 of wall 10 preferably at an included angle of 75°. A fluid cooling tube 15 may be provided for cooling the refractory lining of the burner port.

Spaced from the furnace wall 10 is a windbox casing 16 to define therebetween a windbox or passageway 17 in which combustion air is delivered from a suitable source or blower (not shown) to the burner assembly 18.

In accordance with this invention the burner assembly 18 includes an air register means 19 with an approximate 51 inch diameter supported on and between the furnace wall 10 and the windbox casing 16. As shown, the air register 19 is located entirely within the windbox passageway 17 and comprises a pair of spaced annular members 20 and 21 to define the front and rear end walls respectively of the air register. Circumferentially spaced and pivotally mounted between end walls 20 and 21 of the air register 19 and adjacent the outer periphery thereof are a plurality of register doors 22 which are adapted to pivot between open and closed positions. With the air register doors 22 in open position, the air register 19 is rendered in communication with the windbox passageway

17. If desired the air doors 22 may be suitably geared, linked, or otherwise connected so as to be responsive to an operating means 23 which may be either manually or automatically controlled for simultaneously operating the doors 22 in response to the actuation thereof. Thus it will be noted that in the event it is necessary to shut down the burner, all of the air register doors 22 may be simultaneously moved to a closed position to cut off the air supply to the air register 19. Accordingly the air doors 22 are suitably arranged so as to impart to the air a whirling, spinning or angular velocity, upon entering the air register 19 from the windbox 17. Thus while the combustion air is admitted into the air register 19 through substantially tangential inlets formed between adjacent register doors 22, the air is discharged axially therefrom through an outlet 24 which is disposed in spaced axial alignment with respect to the burner port 11.

In accordance with this invention, a cylindrical sleeve or duct 24A is connected to the axial outlet 24 and extended forwardly thereof to direct the whirling air discharging from the register 19 toward the burner port 11 in the furnace wall 10. As shown in FIG. 1, the discharge end of the burner sleeve 24A is defined by a frusto-conical entrance piece 25 which converges toward the burner port 11 with the small end of the entrance piece 25 having a diameter substantially equal to the diameter of the throat section 12 of the burner port 11. Connected to the small end of entrance piece 25 and extending toward the burner throat 12 is a cylindrical extension or collar 26. As shown the collar is extended into the burner port to engage the inner surface thereof and forms the front support of the burner assembly. Also collar 26 is provided with a plurality of circumferentially spaced, notches 26A through which the gas spuds of the gas burner are adapted to project as will be herein described.

The rear end of the burner assembly 13 is supported by the windbox casing 16 by means of a cylindrical housing 27 which is co-axially connected to the rear end wall 21 of the air register. The outer end 27A of housing 27 is supported in the opening of an annular closure member 28 closing the burner access opening 29 in the windbox casing 16, and through which the burner assembly is adapted to be bodily inserted or removed. Closing the outer end of the housing 27 in the plane of windbox casing 16 is an access door 30, which if desired, may be pivotally connected to the windbox casing 16 for swinging between opened and closed positions.

The oil burning portion of the burner 31 comprises an oil supply barrel or distance piece 32 extended along the central longitudinal axis of the burner assembly and it is supported in a sleeve 33 having one end extended through an opening in the circular door 30, and its other end supported by suitable spider 34. Fuel oil is supplied to the distance piece 32 through a fuel line 35 which is detachably coupled to the rear end of the distance piece 32 and is discharged therefrom through a suitable atomizing spray nozzle 35 in the form of a conical spray. An 18 inch conical impeller 36 is connected to the distance piece adjacent the spray nozzle 35. As shown the distance piece 32 may be rendered axially adjustable so that for straight gas firing of the burner, the nozzle end of the distance piece and impeller connected thereto may be moved away from the intense radiant heat of the furnace.

In accordance with this invention, the gas burning portion comprises a ring manifold 40 positioned adjacent the outer surface 41 of the furnace wall and the discharge end of the burner sleeve 24A. As shown the ring manifold 40 is connected to a source of gas supply by a supply conduit 42.

A plurality of gas spuds 43 are circumferentially spaced about the ring manifold 40 with each gas spud 43 arranged to project through the respective notches 26A of collar 26 and each is extended in a substantially radial direction inwardly of the ring manifold 40. The arrangement of the gas spuds is such that each is extended a sub-

stantial distance into the combustion air stream flowing through the burner sleeve 24A outwardly of the air register 19 and toward the burner port 11.

To facilitate assembly and disassembly, the gas spuds 43 may be individually and detachably connected to the manifold 40 by providing the spud with a threaded portion which can then be readily threaded into a nipple 40A welded to the ring manifold. Alternatively, the spuds may be welded or otherwise fixed to the nipple 40A or ring 40.

Referring to FIGS. 3 and 4, each spud 43 is formed with a tip end 43A which includes a pair of truncated side faces 44, 45 disposed in planes extending at substantially equal and opposite oblique angles to an axial plane of the spud 43. The planes containing side faces 44, 45 are arranged to intersect in the axial plane, but the faces 44, 45 are terminated short of the plane of intersection, and are joined by a comparatively narrow, short, flat, central face 46 disposed perpendicular to the axial plane of the spud. The central face 46 in turn terminates in end faces 47 and 48 which also extend in equal and opposite oblique planes. According to this invention each of the end faces 47, 48 and connected central face 46 is provided with one or more discharge orifices 47A, 48A and 46A respectively.

Each spud is further provided with rows of spaced orifices disposed longitudinally along the length thereof. As shown, each spud 43 is provided with opposed wall portions, each wall portion having therein a diametrically opposed row of spaced orifices 49, 50, longitudinally spaced along the length of the respective wall portions, so that the centerline of each row lies in a diametrical plane disposed normal to the major axis of central face 46. Angularly disposed with respect to each row of orifices 49 and 50, preferably at a 30° angle, is a second row of orifices 51, 52. As shown, the rows of orifices 51 and 52 are disposed at the same side of the diametrical plane containing the centerline of rows containing orifices 49, 50. In other words, the included angle "C" formed between the center or axis of orifices 51 and 52, as seen in FIG. 4 defines an angle which is less than a straight angle.

An important feature to be noted of the orifice arrangement described is that the orifices 46A, 47A, 48A in the top end of the spud are made larger than the orifices 49, 50, 51 and 52 extending along the length of the spuds. As for example the orifices 46A, 47A and 48A in the tip end may have a 1/4" diameter, whereas the orifices 49, 50, 51, and 52 are formed with a 1/8" diameter. With the above described relative difference in orifice sizing, it will be noted that any heavy particles or impurities present in the gas flow through the respective spuds will tend to be carried out through the end orifices 46A, 47A, 48A and thus the chances of plugging the orifices along the length of the gas spuds, which are disposed normal to the gas flow therethrough, is greatly minimized.

As shown in FIGS. 1 and 5, it is to be noted that each spud is connected to the ring manifold 40 in manner such that the axes of the central faces 46 of each spud are disposed parallel to the central axis of the burner. In this position of the gas spuds streams of gases are discharged through orifices 49 and 50 in a direction substantially normal to the direction of air flowing through the burner sleeve 24A. In the described position of the gas spuds, orifices 51 and 52 are arranged so that the gas streams discharging therefrom have a directional component that is counter to the axial flow of air through sleeve 24A. Thus adequate turbulence is created to assure optimum mixing of the gas stream and combustion air.

The spacing of air register 19 from the burner port 11 by a spacer or burner sleeve 24A has been found to reduce burner pulsation, and thereby result in very desirable smooth operation. Also it is to be noted that spacing of the register 19 from the burner wall 10, removes the register from the intense radiant heat of the furnace, and thus overheating and subsequent warpage occasioned

thereby is greatly minimized. Another important feature attributed to the burner sleeve is that it tends to decrease the whirling movement of the air flowing therethrough thus effecting better utilization of the entire throat area, i.e., the air is more uniformly distributed throughout the cross-section area of the throat. Consequently lower peak air velocities and subsequently less draft loss is attained thereby. Experiments have proven that the instant burner construction enables the burner to attain a maximum heating output of 240 million B.t.u.'s per hour with a draft loss ranging between 7 to 9 inches of water. Experiments have also shown that the 75° included throat outlet angle contributed significantly to minimization of burner vibration, improved oil turn down and further helped to reduce the draft loss.

The distinct characteristics of the instant described burner is its large size and capacity, very low draft loss; and its ability to satisfactorily mix fuel and air with the limited available energy as a result of the very low draft loss. Thus the burner herein described with a capacity of 240 million B.t.u.'s per hour permits the use of less burners to obtain a given heat input in large utility boilers. Savings are thus reflected not only in burner cost, but also in the cost of auxiliary equipment such as lighters and controls, and the subsequent maintenance thereof. Also the ring manifold 40 is shielded from the harmful effects of furnace radiation.

While the instant invention has been disclosed with reference to a particular embodiment thereof, it is to be appreciated that the invention is not to be taken as limited to or of the details thereof as modifications and variations thereof may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. In combination with a furnace wall having a burner port therein, a high capacity burner having a relatively low draft loss comprising an air register for receiving combustion air, said air register having an air inlet and an axial air outlet, means for imparting a whirling movement to the air flowing through said air register, a longitudinally extending burner sleeve connected at one end to said register outlet and having a diameter greater than that of said burner port whereby the length of said sleeve tends to diminish the whirling movement of the air flowing therethrough, a frusto-conical entrance piece connected to the other end of said burner sleeve and converging toward said burner port, a gas manifold circumscribing said entrance piece adjacent said burner port, and a plurality of circumferentially spaced gas spuds, each of said spuds extending inwardly from said manifold in a substantially radial direction and having a major portion of its length exposed to the air flowing through said entrance piece, each of said spuds having diametrically opposed rows of spaced orifices extending longitudinally along the length of said spud and the axes of said orifices lying in a plane substantially parallel to said furnace wall, said axes of said orifices extending in a substantially non-radial direction with respect to the longitudinal axis of said burner so that a sheet of gas is discharged from said rows of orifices substantially normal to the flow of air and substantially normal to the longitudinal axis of said burner.

2. In combination with a furnace wall having a burner port therein, a high capacity burner having a relatively low draft loss comprising an air register for receiving combustion air, said air register having an air inlet and an axial air outlet, means for imparting a whirling movement to the air flowing through said air register, a longitudinally extending burner sleeve connected at one end to said register outlet and having a diameter greater than that of said burner port whereby the length of said sleeve tends to diminish the whirling movement of the air flowing therethrough, a frustoconical entrance piece connected to the other end of said burner sleeve and converging toward said burner port, a notched collar co-

axially disposed relative to said sleeve connected to the converging end of said entrance piece and embracing the inner periphery of said burner port, a gas manifold circumscribing the outer periphery of said collar, and a plurality of circumferentially spaced gas spuds, each of said spuds extending substantially radially inwardly from said manifold projecting through a notch of said collar and having a major portion of its length exposed to the air flowing through said entrance piece, each of said spuds having diametrically opposed rows of spaced orifices extending longitudinally along the length of said spud and the axes of said orifices lying in a plane substantially parallel to said furnace wall, said axes of said orifices extending in a substantially non-radial direction with respect to the longitudinal axis of said burner so that a sheet of gas is discharged from said rows of orifices substantially normal to the flow of air and substantially normal to the longitudinal axis of said burner.

3. In combination with a furnace wall having a burner port therein, a high capacity burner having a relatively low draft loss comprising an air register for receiving combustion air, said air register having an air inlet and an axial air outlet, means for imparting a whirling movement to the air flowing through said air register, a longitudinally extending burner sleeve connected at one end to said register outlet and having a diameter greater than that of said burner port whereby the length of said sleeve tends to diminish the whirling movement of the air flowing therethrough, a frustoconical entrance piece connected to the other end of said burner sleeve and converging toward said burner port, a gas manifold circumscribing said entrance piece adjacent said burner port, and a plurality of circumferentially spaced gas spuds, each of said spuds extending inwardly from said manifold in a substantially radial direction and having a major portion of its length exposed to the air flowing through said entrance piece, each of said spuds having diametrically opposed rows of spaced orifices extending longitudinally along the length of said spud and the axes of said orifices lying in a plane substantially parallel to said furnace wall, said axes of said orifices extending in a substantially non-radial direction with respect to the longitudinal axis of said burner so that a sheet of gas is discharged from said rows of orifices substantially normal to the flow of air and substantially normal to the longitudinal axis of said burner, and a second row of orifices disposed in each of said wall portions of said spuds adjacent said first row of orifices, said second row of orifices being disposed on the same side of the plane in which the axes of said first row of orifices lie.

4. In combination with a furnace wall having a burner port therein, a high capacity burner having a relatively low draft loss comprising an air register for receiving combustion air, said air register having an air inlet and an axial air outlet, means for imparting a whirling movement to the air flowing through said air register, a longitudinally extending burner sleeve connected at one end to said register outlet and having a diameter greater than that of said burner port whereby the length of said sleeve tends to diminish the whirling movement of the air flowing therethrough, a frustoconical entrance piece connected to the other end of said burner sleeve and converging toward said burner port, a gas manifold circumscribing said entrance piece adjacent said burner port, and a plurality of circumferentially spaced gas spuds, each of said spuds extending inwardly from said manifold in a substantially radial direction and having a major portion of its length exposed to the air flowing through said entrance piece, each of said spuds having substantially all of its orifices arranged as diametrically opposed rows of spaced orifices extending longitudinally along the length of said spud and the axes of said orifices lying in a plane substantially parallel to said furnace wall, said axes of said orifices extending in a substantially non-radial direction with respect to the longitudinal axis of

said burner so that a sheet of gas is discharged from said rows of orifices substantially normal to the flow of air and substantially normal to the longitudinal axis of said burner, and a minor number of orifices arranged in the end of said spuds.

5. In combination with a furnace wall having a burner port therein, a high capacity burner having a relatively low draft loss comprising an air register for receiving combustion air, said air register having an air inlet and an axial air outlet, means for imparting a whirling movement to the air flowing through said air register, a longitudinally extending burner sleeve connected at one end to said register outlet and having a diameter greater than that of said burner port whereby the length of said sleeve tends to diminish the whirling movement of the air flowing therethrough, a frustoconical entrance piece connected to the other end of said burner sleeve and converging toward said burner port, a notched collar coaxially disposed relative to said sleeve connected to the converging end of said entrance piece and embracing the inner periphery of said burner port, a liquid fuel atomizing means extending along the longitudinal axis of said burner toward said port, a gas manifold circumscribing the outer periphery of said collar, and a plurality of circumferentially spaced gas spuds, said spuds extending substantially radially inwardly from said manifold projecting through said notches in said collar and having a major portion of their length exposed to the air flowing through said entrance piece, each of said spuds having diametrically opposed rows of spaced orifices ex-

tending longitudinally along the length of said spud and the axes of said orifices lying in a plane substantially parallel to said furnace wall, said axes of said orifices extending in a substantially non-radial direction with respect to the longitudinal axes of said burner so that a sheet of gas is discharged from said rows of orifices substantially normal to the flow of air and substantially normal to the longitudinal axis of said burner.

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