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COMBINATION OIL AND GAS BURNER

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2 Sheets-Sheet 2

FIG. 2

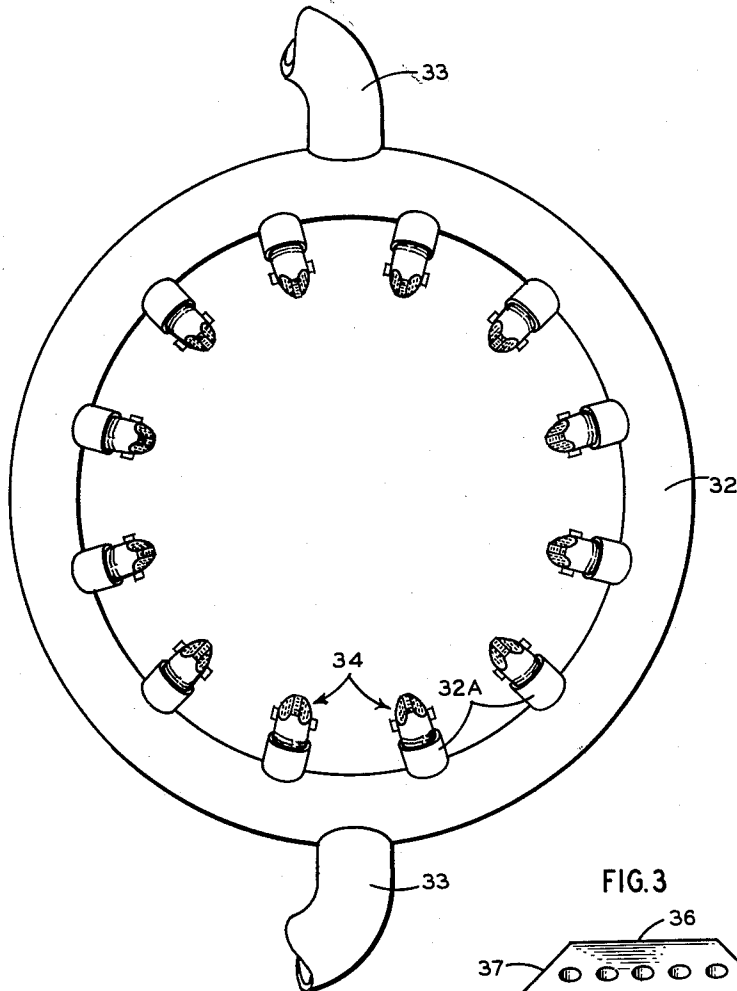


FIG. 4

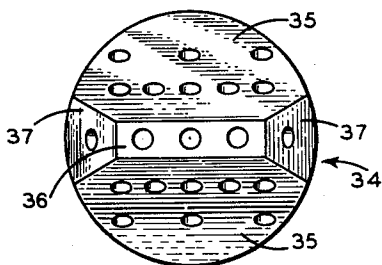
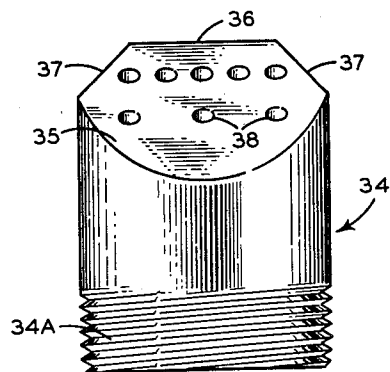


FIG. 3



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COMBINATION OIL AND GAS BURNER

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This invention relates to a fuel burner and more particularly to an improved gas burner. The gas burner in this invention is especially adapted to be used in conjunction with an oil burner to form a combination gas-oil burner capable of burning gas and/or oil, either separately or in combination.

To provide for overall fuel economy, a furnace or combustion chamber of a steam boiler is generally fired by one or more compact fuel burners capable of burning either fuel gas and/or oil depending on the amount and availability of a kind of fuel. Heretofore, the gas burner element of such combination gas and oil burners generally consisted of an annular gas header or gas ring having a plurality of gas discharge ports or openings spaced therearound. Usually the gas ring surrounded or was otherwise integrally formed or connected to the nozzle of the oil burning portion of a combined gas-oil burner.

Experience has shown that such combined gas-oil burner arrangements are unsatisfactory due to the relatively short useful life of such gas burner elements and the large amount of burner maintenance required to keep the gas ring elements in working condition. The inherent difficulties of such gas rings are attributed to the fact that the gas rings are exposed to conditions which result in extremely high temperature differentials to occur across the gas element when they are contributing but a small percentage of the total burner output; consequently severe stresses are set up in the element. When this happens, the gas ring generally cracks or is otherwise seriously damaged, thereby requiring frequent and constant repair or replacement of the part.

These conditions of severe thermal stress are especially aggravated when such burner combinations are firing less than 20% gas and the remainder 80 to 100% on oil. It is believed that under such firing conditions the relatively large volume of the air and oil products of combustion passing across the gas ring prevents the gas flame from leaving the vicinity of the gas ring. Thus the portion of the gas ring facing the furnace absorbs more heat than the portion of the gas ring more remote therefrom. Consequently, severe thermal stresses are set up within the ring.

It has been actually shown by test that when little or no gas is being fired, the metal temperatures of the gas element can exceed 2600° F. Experiments have also shown that with known gas ring type burners, reasonable gas ring metal temperatures are not attainable unless 20% or more of the total heat input is being supplied by the gas burner. Consequently in those combination gas and/or oil burner installations wherein gas constitutes the stand-by or the auxiliary fuel rather than the main fuel, the cost of gas burner ring maintenance and repair runs exceedingly high.

An object of this invention is to provide an improved gas burner arrangement and element which when utilized in conjunction with an oil burner can be maintained within reasonable temperature limits even when the oil burning portion of the burner is supplying 100% of the heat output over an extended period of time.

Another object is to provide an improved gas burner which exhibits an unusual range of stability even under adverse conditions of gas pressure and flow.

The above objects and other features and advantages

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in this invention are attained in a gas burner arrangement which includes an air register having an axial outlet positioned adjacent a burner port or throat located in a furnace wall. Disposed about the axial outlet and adjacent the burner port is a means forming a plenum chamber through which a cooling fluid is permitted to circulate. For example, the plenum chamber may be connected in open communication with either the windbox which surrounds the air register and/or with the air register proper so that combustion air from either the windbox and/or the air register is free to circulate through the plenum chamber.

According to this invention a gas ring or manifold is disposed in the plenum chamber and is cooled by the combustion air circulating therethrough. Connected to the manifold are a plurality of circumferentially spaced gas spuds which extend radially inward of the gas ring. The tips of the spuds are formed with obliquely disposed, perforated, face portions intersecting in an axial plane of the respective spud. The arrangement of the spuds is such that they project radially into the outer periphery or marginal portion of the combustion air stream flowing through the axial outlet of the air register with the relative position of the line of intersection of the oblique spud faces arranged parallel to the longitudinal axis of the burner assembly.

A feature of this invention resides in the provision that the gas ring is cooled and maintained at a temperature close to that of the ambient combustion air circulating through the plenum chamber.

Another feature resides in the provision that only a limited or small area of the gas spuds is exposed to the heat of a high temperature gas zone and the spud elements so exposed are arranged to transfer the heat absorbed thereby at a high rate back to the cooled parts of the gas manifold. Thus the gas spuds cannot become objectionably hot.

Still another feature of the invention resides in the projection of the gas spuds radially into the outer peripheral portion of the combustion air stream an amount sufficient to set up local eddy currents to establish a flame holding condition thereat.

The various features of novelty which characterize this invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

In the drawings:

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

FIG. 2 is an enlarged detail front view of the gas burner element as shown in FIG. 1.

FIG. 3 is a detailed elevation view of an individual gas spud.

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

FIG. 5 is a detailed side view of a modified embodiment of the air register axial outlet and collar.

FIG. 6 is a fragmentary back view of FIG. 5.

While the burner embodying the inventive concepts herein set forth may be utilized as a gas burner only, the novel gas burner arrangement and element to be hereinafter described is readily adapted for use in a burner assembly having in combination therewith either a liquid fuel atomizing means and/or even a pulverized coal burning means, so that various kinds of fuel can be fired either separately and/or in combination. However, the improved gas burner arrangement and element of this invention is illustrated in combination with a liquid fuel burning means.

Referring to FIG. 1, reference numeral 10 is directed to a water cooled furnace wall of a vapor generating unit or the like having a circular burner opening or port 11 extending therethrough. Generally the port 11 is formed of a suitable heat resistant refractory material and includes a relatively short cylindrical throat section 12 and a section 13 diverging toward the furnace side 14 of the wall 10. A plurality of fluid cooled tubes 15 are disposed adjacent the burner port 11 to provide effective cooling of the port. Spaced from the furnace wall 10 is a burner wall 16, and which defines therebetween a windbox or passageway 17 in which combustion air is delivered from a suitable air blower, not shown, to the burner assembly 18.

The burner assembly 18, which includes an air register means 19, is supported on and between the furnace wall 10 and burner wall 16. In accordance with this invention the air register 19 which is located entirely within the windbox 17 comprises a pair of spaced annular members 20, 21 which form the front and rear end walls, respectively, thereof. A cylindrical duct or burner casing 22 connected to and extending forwardly of the front end wall 20 of the air register spaces the front end of the air register from the furnace wall 10. A circular collar 23 concentrically disposed about the burner port 11 is arranged to receive the burner casing 22 and forms the support for the front end of the burner assembly on furnace wall 10. Suitable packing material 24 seals the space between the burner casing 22 and the supporting collar 23.

The rear end of the burner assembly 18 is supported on the burner wall 16 by means of a circular burner housing or casing 25 connected to the rear end wall 21 of the air register 19 and extended toward the burner wall. The outer end of the casing 25A is supported by an annular closure member 26 which forms the cover of the burner assembly access opening 27 in burner wall 16. Closing the outer end 25A of the burner casing 25 in the plane of the burner wall is an access door 28 which may be pivotally connected to the burner wall 16 for swinging between open and closed position.

Circumferentially spaced and pivotally mounted between the end walls 20, 21 of the air register 19 and adjacent the outer periphery thereof are a plurality of register doors 29 which are adapted to pivot between open and closed position. With the air register doors 29 in open position, the air register is rendered in communication with the windbox 17. If desired, the air doors may be suitably geared, linked or otherwise connected so as to be responsive to an operating means (not shown) which may be either manually or automatically controlled to simultaneously operate the doors in response to the actuation thereof. Thus it will be noted that in the event it is necessary to shut down the burners all the air register doors may be simultaneously moved to closed position, thereby cutting off the air supply.

The air doors are suitably arranged to impart to the air entering into the air register 19 from the windbox 17 a whirling, spinning or angular velocity. While combustion air is admitted tangentially into the air register, it is discharged therefrom axially through an outlet 30 in axial alignment with the burner throat 12.

As shown, the axial outlet is defined by a frusto-conical shape entrance piece or sleeve 30A which converges toward the burner port 11. The small end of the entrance sleeve has a diameter substantially equal to that of the burner throat 12 and has connected thereto a cylindrical extension or collar 30B which extends toward the burner throat. In the arrangement described, the burner casing 22, entrance cone 30A, connected collar 30B and the burner wall 10 define the boundaries of an annular plenum chamber 31 which circumscribes the burner throat 12. According to this invention, a gas ring manifold 32 is positioned within the plenum chamber 31. Connecting the gas manifold to a source of gas supply

are a pair of gas supply conduits 33, preferably the supply conduits connect to opposite portions of the gas ring at a point between gas spuds 34.

The gas spuds 34 are circumferentially spaced about the gas manifold 31, each spud being arranged to extend radially inward of the gas ring as shown in FIGS. 1, and 2. The arrangement of the spuds 34 is such that they extend into the outer periphery or marginal portion of the combustion air stream flowing outwardly of the air register axial outlet 30. As shown, the collar 30B is provided with a plurality of spaced spud ports or notches 30C through which the respective gas spuds extend. To facilitate assembly and disassembly, the gas spuds 34 are individually and detachably connected to the gas manifold by providing the spud with a threaded portion 34A which can be readily connected to a threaded nipple 32A welded to the gas manifold.

Referring to FIG. 4 the tip of each gas spud 34 includes a pair of truncated side faces 35 disposed in planes extending at substantially equal and opposite oblique angles to an axial plane of the spud. The planes of the oblique faces 35 intersect in the axial plane, but the faces terminate short of the plane intersection and are joined by comparatively narrow short flat central face 36 disposed perpendicular to the axial plane of the spud, and the central face 36 terminates in end faces 37 which extend in equal and opposite oblique planes. A plurality of discharge orifices 38 are drilled in each of the oblique faces 35 and one or more discharge orifices may likewise be provided in the central face 36 and each of the end faces 37.

The fuel oil burner means 40 comprises generally a fuel oil conduit 41 which extends along the central axis of the burner assembly. As shown, the access door 28 of the rear burner casing 25 supports a central sleeve 42 through which the conduit 41 extends in a direction toward the burner port 14. If desired, the conduit 41 is rendered axially adjustable along the central axis of the burner assembly. At the outer end of the conduit there is connected a liquid fuel supply line 43. Connected to the conduit 41 at its inner end is a fuel oil atomizing head 44 preferably of the type producing a conical spray co-axial with the burner port; and attached to the oil conduit 41 adjacent the atomizing head 44 is an impeller means 45. Completing the burner assembly is an observation means 46 and igniter means 47.

When the burner assembly described is being fired by oil alone, or on a combination of gas and oil in which the gas burner is supplying less than 20% of the total heat output, the gas ring 32 is prevented from overheating and thus becoming overstressed by the circulation of cooling combustion air through the plenum chamber 31. In this manner the gas ring 32 is maintained at a metal temperature substantially equal to that of the combustion air regardless of the proportionate amount of the total heat input to the furnace which is attributed to the gas burner. This result is readily obtained by locating a plurality of openings or apertures 48 in the burner casing 22 to render the plenum chamber 31 in open communication with the interior of the windbox 17. Consequently, a portion of the air flowing through the windbox is free to circulate through the plenum chamber 31 and effectively cools the gas manifold 32, the cooling combustion air circulating through chamber 31 discharging therefrom through openings 30C which receive the spuds and around the end 30D of the collar spaced from the furnace wall.

As an alternative construction as shown in FIGS. 4 and 5 the conical portion 30A' of the entrance piece 30' may be provided with a plurality of spaced apertures 49 so that the plenum chamber 31 may be directly connected in open communication with the air register 19. In this case, the combustion air flowing through the air register is free to circulate through the chamber to perform the cooling function of the gas manifold. In either embodiment, the openings formed either in the burner casing 22

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or the conical entrance piece 30A' are sized so that a predetermined amount of the air required for combustion is permitted to flow therethrough.

Even though the gas spuds 34 have the tip portion thereof directly exposed to a high temperature, they do not become overheated because the heat absorbed thereby is quickly transferred back to the air cooled gas ring.

During actual test operations of the burner arrangement described, an analysis of burner metal temperature, showed a maximum variation of 50° F. between the inside and outside surfaces of the gas ring or manifold 32, and 60° F. between the left and right side of the gas ring. The following table shows the highest temperature recorded for the critical burner parts.

Part	Temperature, F	Rate	Air temp., F
1. Inner collar 30A.....	860	1/2 load gas...	485
2. Gas ring 32.....	560	1/2 load oil...	490
3. Spud tips 34.....	775	do.....	490

The gas burner arrangement 18, in addition to maintaining the critical metal parts thereof within reasonable temperature limits and thereby enabling the useful life thereof to be substantially increased, also achieves unusual stability even under adverse conditions of gas pressure and flow. It is believed that most of this stability is due to the fact that the spuds extend slightly within the peripheral portion of the combustion air stream discharging axially of the air register. The projection of the spuds into the marginal portion of the whirling combustion air stream disrupts the air flow, thus setting up local eddy currents in the vicinity of the gas spuds which tend to establish a flame holding condition thereat. Also it is believed that stability of the burner is enhanced due to a division of combustion air and subsequent intermixing of the same, i.e., the portion of the combustion air circulating through the plenum chamber is introduced radially into that portion of the combustion air stream discharging axially of the air register. The meeting of these two bodies of air in the vicinity of the gas spud produces a turbulence which enhances the mixing of the gas and air.

An important feature of the present invention is that burner installations utilizing the conventional type gas ring burner in conjunction with an oil burner can be readily converted to the arrangement herein described with a minimum of cost and of alteration to the existing structure.

While in accordance with the provisions of the statutes there is illustrated and described herein the best form and mode of operation of the invention now known to us, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by our claims, and that certain features of our invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. In combination with a furnace within which high temperature gases are generated and formed in part by a wall having a burner port therein, the improvement of a multiple fuel burner for firing said furnace comprising an air register having a tangential inlet and an axial outlet end through which air for supporting combustion flows, said axial outlet end being disposed adjacent said port in substantially axial alignment therewith, said outlet end being defined by a truncated cone converging toward said port and a cylindrical collar having a diameter substantially equal to said port connected to the converging end of said cone, said collar having a plurality of circumferentially spaced notches therein, a plenum chamber surrounding said axial outlet end disposed between the furnace wall and said air register, an oil atomizing means extending through said register along the longi-

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tudinal axis thereof toward said port, a gas manifold circumscribing said axial outlet disposed wholly within said plenum chamber, means connecting said gas manifold to a supply of gaseous fuel, said truncated cone having a plurality of openings therein for connecting said chamber in communication with said register to provide circulation of register air through said chamber, and a plurality of circumferentially spaced gas spuds connected to said manifold, said spuds extending through the notches of said collar inwardly toward the central axis of said burner, said notches being larger than said gas spuds so as to define therewith an outlet for the air circulating through said plenum chamber, each of said spuds having a tip provided with a plurality of gas discharge orifices, said tips projecting into the outer periphery of the air streams discharging from said axial outlet end so that only a small area of the respective spuds is exposed to the heat of the high temperature gases which heat is absorbed at a high rate back to the gas manifold, and whereby local eddy currents are formed about each of said spuds to establish a flame holding condition thereat.

2. In combination, a furnace wall having a circular burner port therein, a fuel burner assembly comprising an air register of circular cross-section having a discharge end opening to said burner port, means forming an annular plenum chamber surrounding the discharge end of the register and formed with a plurality of circumferentially spaced spud ports opening into the discharge end of the register at a location near to said burner port, an annular gas manifold wholly disposed within and completely enclosed and shielded from furnace radiation by said plenum chamber, means supplying a combustible gas to said manifold, means supplying combustion air to said register for flow through the register to and through said burner port, said manifold having a plurality of circumferentially spaced gas spuds each projecting through a corresponding spud port into the combustion air stream flowing through said register and arranged to discharge combustible gas into said air stream, each of said spuds and its corresponding port being so sized as to provide an air flow space therebetween, and means for supplying manifold and spud cooling air to said plenum chamber and effecting flow therethrough and over the manifold and spuds to and through the air flow spaces between the spuds and their corresponding spud ports.

3. In combination, a furnace wall having a circular burner port therein, a fuel burner assembly comprising an air register of circular cross-section having a discharge end opening to said burner port, means forming an annular plenum chamber surrounding the discharge end of the register and formed with a plurality of circumferentially spaced spud ports opening into the discharge end of the register at a location near to said burner port, an annular gas manifold wholly disposed within and completely enclosed and shielded from furnace radiation by said plenum chamber, means supplying a combustible gas to said manifold, means supplying combustion air to said register for flow through the register to and through said burner port, said manifold having a plurality of circumferentially spaced radially inwardly extending gas spuds each projecting through and slightly beyond a corresponding spud port into the combustion air stream flowing through said register and arranged to discharge combustible gas into said air stream, each of said spuds and its corresponding port being so sized as to provide an air flow space therebetween, and means for supplying manifold and spud cooling air to said plenum chamber and effecting flow therethrough and over the manifold and spuds to and through the air flow spaces between the spuds and their corresponding spud ports.

4. In combination, a furnace wall having a circular burner port therein, a fuel burner assembly comprising an air register of circular cross-section having an axial extension formed in the shape of a truncated cone converging in the direction of said burner port and formed

at its small end with a cylindrical collar opening to said burner port, means cooperating with said furnace wall and said axial extension of said air register to form an annular plenum chamber surrounding said axial extension, said collar being formed with a plurality of circumferentially spaced spud ports opening therethrough at a location near to said burner port, an annular gas manifold wholly disposed within and completely enclosed and shielded from furnace radiation by said plenum chamber, means supplying a combustible gas to said manifold, means supplying combustion air to said register for flow through the register and the axial extension thereof to and through said burner port, said manifold having a plurality of circumferentially spaced radially inwardly extending gas spuds each projecting through and slightly beyond a corresponding spud port into the combustion air stream flowing through said axial extension of the register and arranged to discharge combustible gas into said air stream, each of said spuds and its corresponding port being so sized as to provide an air flow space therebetween, and means for supplying manifold and spud cooling air to said plenum chamber and effecting flow therethrough and over the manifold and spuds to and through the air flow spaces between the spuds and their corresponding spud ports.

5. In combination with a furnace in which high temperature heating gases are generated and having a wall portion with a burner port therein, a burner assembly for generating heating gases in said furnace, said assembly comprising an air register having an inlet and an axial outlet end through which air for supporting combustion is supplied to said port, said axial outlet end being disposed adjacent said port in substantially axial alignment therewith, said axial outlet end being defined by a truncated cone converging toward said port and a collar having a diameter substantially equal to said port connected to the converging end of said cone, said collar having a

plurality of circumferentially spaced notches therein, a plenum chamber surrounding said axial outlet end disposed between the furnace wall and said air register, a gas manifold circumscribing said axial outlet end and disposed wholly within said plenum chamber, means connecting said gas manifold to a supply of gaseous fuel, said truncated cone having a plurality of openings therein for connecting said plenum chamber in communication with said register to provide for the introduction of register air into said plenum chamber, a plurality of circumferentially spaced gas spuds connected to said manifold, said spuds extending through the notches of said collar inwardly toward the central axis of said burner, said notches being larger than said gas spuds so as to define therewith an outlet to permit circulation of air through said plenum chamber at a rate sufficient to maintain said manifold air-cooled to a temperature substantially that of the ambient air circulating through said plenum chamber, and each of said spuds having a tip projecting into the outer periphery of the air stream discharging from said axial outlet end so that only a small area of the respective spuds is exposed to the heat of the high temperature gases in said furnaces, which heat is absorbed at a high rate back to the gas manifold.

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