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Arenson

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[54] GAS BURNER APPARATUS

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[52] **U.S. Cl.** **431/114**, 431/158, 431/238, 431/353

[51] **Int. Cl.**.....**F23d 15/02**

[58] **Field of Search**.....431/114, 158, 182, 238, 351–354

[56] **References Cited**

UNITED STATES PATENTS

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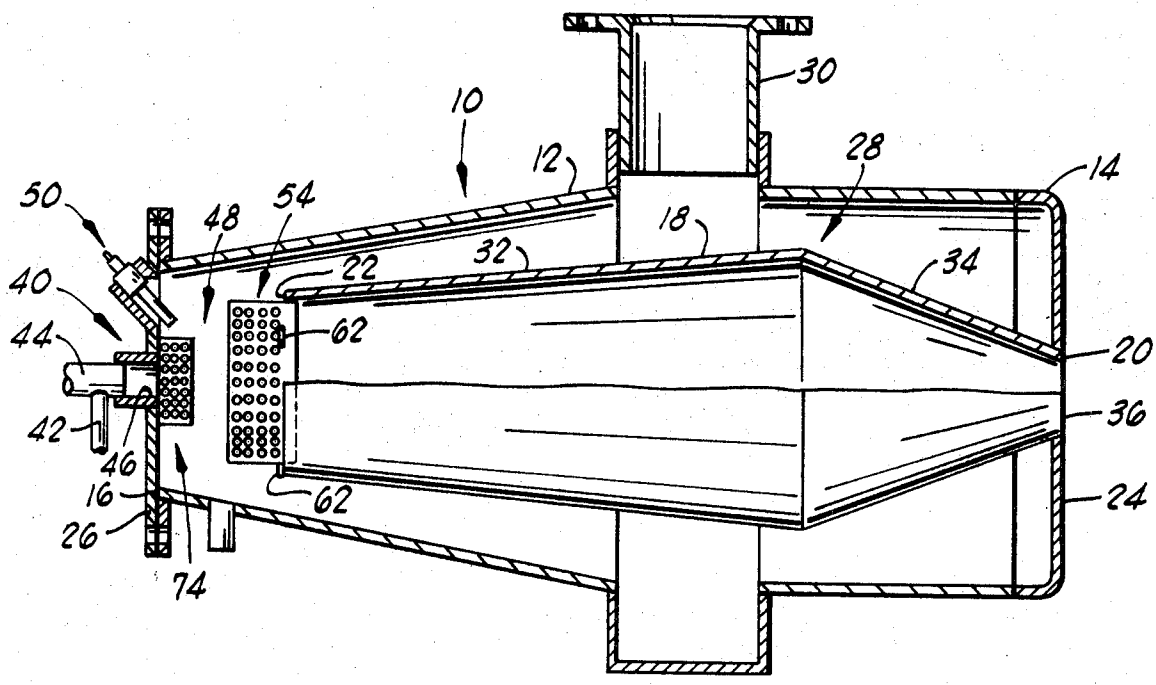
[57] **ABSTRACT**

An improved gas burner apparatus of the type having a hollow inner liner supported within an outer shell, such that combustion air injected between the inner liner and the outer shell travels in a generally helical path to the rear end portion of the inner liner and thoroughly mixes with fuel injected into the end of the outer shell, the fuel and combustion air being mixed and burned generally within the inner liner. The improved gas burner apparatus of the present invention includes a noise abatement apparatus secured to the rear end of the inner liner to diffuse a portion of the combustion air thereby substantially eliminating undesirable noise encountered during operation of the gas burner apparatus, and a flame protection apparatus encompassing the opening for injecting fuel into the outer shell to diffuse a portion of the combustion air thereby preventing the pilot flame from being blown-out.

10 Claims, 4 Drawing Figures



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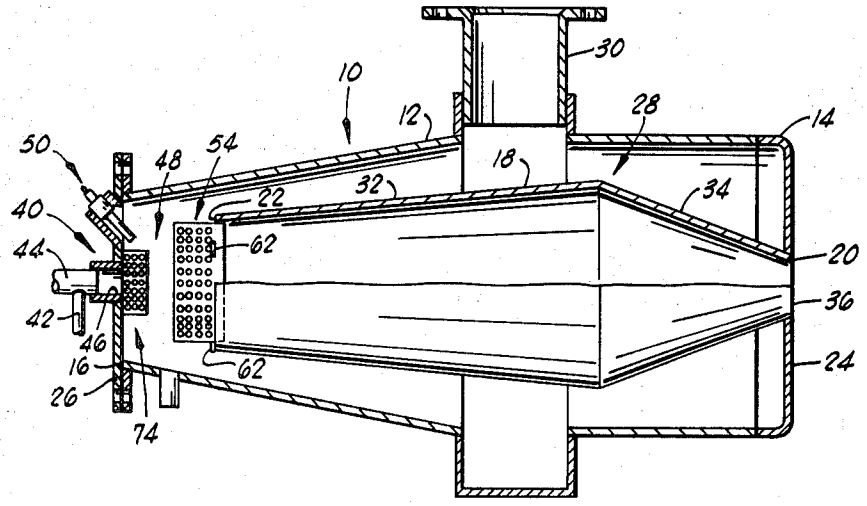

FIG. 1

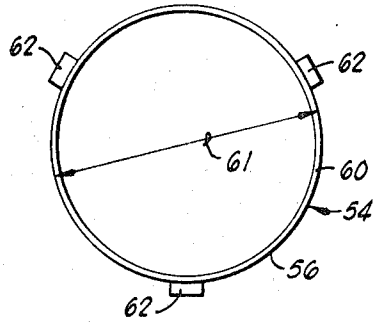

FIG. 3

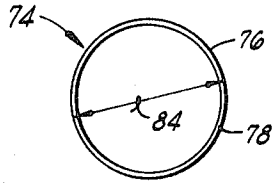

FIG. 4

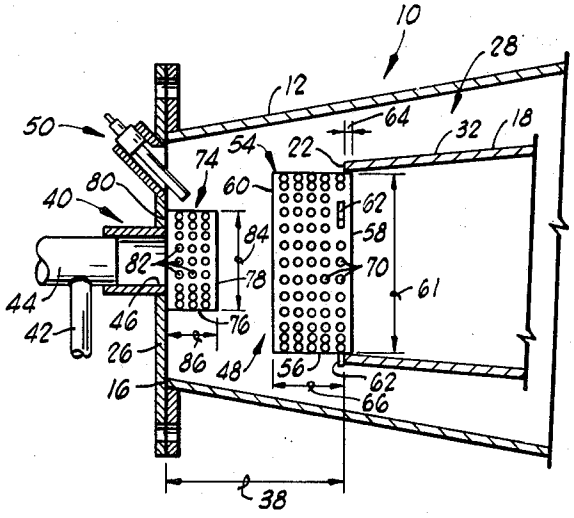

FIG. 2

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GAS BURNER APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to improvements in gas burner apparatus and, more particularly, but not by way of limitation, to a noise abatement apparatus and a flame protection apparatus for a gas burner.

2. Description of the Prior Art

A gas burner apparatus is disclosed in detail in U.S. Pat., No. 3,265,113, which is assigned to the assignee of the present invention, having an outer shell and a coaxial inner liner, wherein pressurized combustion air is injected into the space generally between the inner liner and the outer shell, and fuel is injected into a space generally between the rear end of the inner liner and the rear end of the outer shell. The combustion air injected into the gas burner apparatus travels in a helical path toward the fuel injection portion of the gas burner apparatus generating a vortex which results in a thorough mixing of the fuel and the combustion air, the mixed fuel and combustion air being burned generally within the interior of the inner liner.

The patent discloses a plurality of radially extending plates disposed generally within the fuel entrance passageway, the radially extending plates being provided to disturb the combustion air vortex thereby preventing the blowing out of the pilot flame. The gas burner apparatus described in the patent also included noise plates disposed generally adjacent the rear end of the outer shell and spaced generally along the inner periphery of the outer shell, the noise plates being provided to reduce the noise level of the gas burner apparatus during the operation thereof.

Although the radially extending plates did, to some extent, reduce the problem of the pilot flame being blown-out by the combustion air vortex, it has been found that, in many instances, the plates were not sufficient to prevent the blowing out of the flame, particularly in those instances wherein the flame was to be reduced while attempting to maintain the combustion air flow through the gas burner substantially at a maximum. It was therefore found necessary to include various control devices to reduce the flow of combustion air into the gas burner in proportion to the cut-back in fuel supplied to the burner during operational cycles of the gas burner apparatus. It has also been found that, even in those instances where such control devices have been provided, that the combustion air vortex created within the gas burner apparatus, in many instances, was still of a sufficient velocity to blow the pilot flame out, thereby requiring an automatic or a manual re-igniting sequence. It has also been found that, although the plates disposed about the inner periphery of the outer shell did, to some extent, reduce the noise level of the gas burner apparatus, that in many applications the undesirable noise level of the gas burner apparatus still remained significantly high.

SUMMARY OF THE INVENTION

The present invention contemplates an improved gas burner apparatus including: a hollow outer shell, having a front end and a rear end. A front end wall is secured to the front end, and a rear end wall, having an opening formed therethrough, is secured to the rear end of the outer shell, thereby closing the rear end. A hollow inner liner, having a front end and a rear end, is supported within the hollow portion of the outer shell and is spaced from the outer shell to form an air passageway between the outer shell and the inner liner, the front end of the inner liner extending through the front end wall and rear end of the inner liner being spaced a predetermined distance from the rear end wall. An air inlet is formed in the outer shell and is spaced from the rear end thereof for admitting combustion air into the air passageway. The gas burner apparatus also includes means for injecting fuel through the opening in the rear end wall and into the hollow portion of the outer shell, generally between the rear end of the inner liner and the rear end wall, the fuel and combustion air being mixed and burned generally within the hollow portion of the inner liner. A noise abatement apparatus, having an aperture means formed therethrough, is secured to the rear end of the inner liner and extends a distance therefrom generally between the rear end of the inner liner and the rear end wall, to diffuse a portion of the combustion air thereby substantially eliminating undesirable noise during the operation of the gas burner apparatus. A flame protection apparatus, having an aperture means formed therethrough is secured to a portion of the rear end wall, and substantially encompasses the opening through the rear end wall to diffuse a portion of the combustion air thereby preventing the combustion air from blowing out the pilot flame.

An object of the invention is to provide gas burner apparatus having a substantially reduced noise level during the operation thereof.

Another object of the invention is to provide a gas burner apparatus wherein the pilot flame is protected from being blown-out during the operation thereof.

An additional object of the invention is to provide a gas burner apparatus utilizing injected, pressurized combustion air, wherein the heat output of the gas burner apparatus can be controlled independent of the flow of injected, pressurized combustion air.

A further object of the invention is to provide a noise abatement apparatus and a flame protection apparatus for utilization in a gas burner, which is economical in construction and operation.

One other object of the invention is to provide a more efficient gas burner apparatus which is economical in construction and operation.

Other objects and advantages of the invention will be evident from the following detailed description when read in conjunction with the accompanying drawings which illustrate a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectional, partial diagrammatical view of a gas burner apparatus constructed in accordance with the present invention.

FIG. 2 is an enlarged view of one end portion of the gas burner apparatus of FIG. 1, showing the noise abatement apparatus and the flame protection apparatus in greater detail.

FIG. 3 is an end view of the noise abatement apparatus of the gas burner apparatus of FIG. 1.

FIG. 4 is an end view of the flame protection apparatus of the gas burner apparatus of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in detail, and to FIG. 1 in particular, shown therein and designated by the general reference numeral **10** is a gas burner which includes; a hollow outer shell **12**, having a front end **14** and a rear end **16**; and a hollow inner liner **18**, having a front end **20** and a rear end **22**, which is supported generally within the hollow portion of the outer shell **12**. A front end wall **24** is secured to the front end **14** of the outer shell **12**, thereby closing the front end portion **14**, as shown in FIG. **1**. A rear end wall **26** is secured to the rear end portion **16** of the outer shell **12**, thereby closing the rear end **16**.

The the inner liner **18** is supported withing the hollow portion of the outer shell **12** and spaced a distance therefrom about the entire outer periphery of the inner liner **18**, to form an air passageway, designated in FIG. **1** by the reference numeral **28**, generally between the inner liner **18** and the outer shell **12**.

An air inlet **30** is formed in a portion of the outer shell **12** and, more particularly, the air inlet **30** is constructed and connected to the outer shell **12** to direct pressurized combustion air into the air passageway **28**, generally tangential to the inner periphery of the outer shell **12**, the air inlet **30** being preferably volute-shaped to increase the rotational flow and the energy of the pressurized combustion air entering the outer shell **12** via the air inlet **30**. It should be noted that the term "-combustion air," as used above and below, denotes a fluid product which is mixed with a fuel during the operation of the gas burner apparatus **10** and may be air or oxygen for example.

In a preferred form, a rearward end portion **32** of the inner liner **18** is frusto-conically shaped, converging toward the rear end thereof. A forward end portion **34** of the inner liner **18** converges toward the front end **20** thereof and, in a preferred form, the forward end portion **34** is also frusto-conically shaped and converges in such a manner that an elongated narrow outlet **36** is formed at the front end **20** of the inner liner **18**.

As shown in FIG. **1**, the front end **20** of the inner liner **18** extends through the front end wall **24**, and the inner liner **18** is supported within the outer shell **12** such that the rear end **22** thereof is spaced a distance **38** from a center line through rear end wall **26**, as shown in FIG. **2**, which in a preferred form, is at least one-half the diameter of the hollow portion of the inner liner **18**, generally adjacent the rear end **22** thereof. The outer shell **12** is preferably shaped such that the inner liner **18** and the outer shell **12** are coaxially positioned.

A burner assembly **40** is supported near the rear end wall **26** and includes: a pilot gas line **42** and a main gas line **44**. An opening **46** is formed through the rear end wall **26** and the pilot gas line **42** and the main gas line **44** communicate with an ignition space **48** via the opening **46**. The burner assembly **40** also includes an ignition assembly **50** which, in one form, may be a spark plug type ignition device. The gas burner apparatus **10** is thus constructed such that combustion air is injected into the hollow portion of the outer shell **12** or, more particularly, into the air passageway **28** via the air inlet **30** and follows a helical path toward the ignition space **48** generally between the rear end wall **26** and the rear end **22** of the inner liner **18**, in such a manner that an angular velocity is imparted to the combustion air.

The combustion air creates an air vortex generally within the ignition space **48**, and the combustion air is mixed with the fuel gas entering the ignition space **48** via the main gas line **44**. The diverging-converging shape of the inner liner **18** causes the helically flowing air to create a vortex and the combustion product flows generally toward the outlet or front end **20** of the inner liner **18**, and is reversed into the center of the inner liner **18** to provide complete combustion of the fuel products and to insure that the combustion is completed within the inner liner **18**. A gas burner, which operates in a manner generally as described above, is disclosed in detail in the U. S. Pat., No. 3,265,113, and therefore a detailed description of the combustion process which occurs within this type of apparatus is not given herein.

As shown in FIGS. **1** and **2**, a noise abatement apparatus **54** is secured to the rear end **22** of the inner liner **18**, and extends a distance therefrom generally between the rear end **22** of the inner liner **18** and the rear end wall **26**. The noise abatement apparatus **54** has an outer periphery **56** and opposite ends **58** and **60** and, as shown more clearly in FIGS. **2** and **3**, the noise abatement apparatus **54** is, in a preferred form, cylindrically shaped, having an outer diameter **61**. It should be particularly noted that the diameter **61** is substantially equal to the inner diameter of the inner liner **18**, generally near the rear end **22** thereof, for reasons to be made more apparent below.

As shown in FIGS. **2** and **3**, a plurality of stops **62** are secured to the outer periphery **56** of the noise abatement apparatus **54**, each stop **62** extending a distance radially from the outer periphery **56** of the apparatus **54** and being spaced circumferentially thereabout. As shown more clearly in FIG. **2**, each stop **62** is spaced a distance **64** from the end **58** of the noise abatement apparatus **54**. The outer periphery **56** of the apparatus **54** is shaped to conform to the inner periphery of the inner liner **18**, generally near the rear end **22** thereof so that the apparatus **54** can be slid axially, inwardly into the hollow portion of the inner liner **18**, to a position wherein each stop **62** engages a portion of the rear end **22** of the inner liner **18** to limit the inward movement of the apparatus **54** and to position the apparatus **54** in an assembled position with respect to the inner liner **18**, as shown in FIGS. **1** and **2**. In the assembled position of the noise abatement apparatus **54**, each stop **62** is secured to the rear end **22** of the inner liner **18**, such as by tack welding thereto.

The axial width of the noise abatement apparatus **54** is sized such that the apparatus extends a distance **66** beyond the rear end **22** of the inner liner **18**, generally toward the rear end wall **26**, in an assembled position thereof, as shown in FIG. **2**. As shown in FIGS. **1** and **2**, a plurality of apertures **70** are formed through the outer periphery **56** of the apparatus **54**, the apertures **70** being spaced about the outer periphery **56** and positioned to diffuse the combustion air passing therethrough, and thereby diffusing that portion of the combustion air vortex created generally about and near the rear end **22** of the inner liner **18**. In a preferred form, it has been found that the noise abatement apparatus **54** should preferably be sized such that the

distance 66 is approximately one-fourth of the distance 38, generally between the rear end 22 of the inner liner 18 and the center line of the rear end wall 26. In one form, it has been found that apertures having a three-eighths inch diameter and spaced about the outer periphery 56 on one-half inch centers provide adequate diffusion. In this manner the noise abatement apparatus 54 functions to diffuse a significant portion of the air vortex causing the undesirable noise during the operation of the gas burner 10, yet does not substantially interfere with the combustion air flow pattern through the gas burner 10 so as to have any deleterious effect on the combustion and flame pattern therein.

As shown in FIGS. 1 and 2, a flame protection apparatus 74, having an outer periphery 76 and opposite ends 78 and 80, is disposed adjacent the rear end wall 26, and positioned thereon to encompass the opening 46 through the rear end wall 26. The flame protection apparatus 74 is, in a preferred form, cylindrically shaped, as shown in FIG. 4. The flame protection apparatus 74 includes a plurality of apertures 82 formed through the outer periphery 76 thereof and has a diameter 84 formed by the outer periphery 76.

As shown in FIG. 2, the end 80 of the flame protection apparatus 74 is secured to the rear end wall 26 and the apparatus 74 extends a distance 86 from the rear end wall 26, generally toward the rear end 22 of the inner liner 18. In a preferred form, the distance 86 is 35 to 40 percent of the dimension 38; the diameter 84 of the apparatus 74 is approximately 50 percent of the inner diameter of the inner liner 18 generally near the rear end 22 thereof, or, in other words, approximately equal to 50 percent of the diameter 61; and the apertures 82 have a three-eighths inch diameter and are spaced about the outer periphery 76 on one-half inch centers. In this configuration it has been found that the flame protection apparatus 74 diffuses a sufficient portion of the combustion air vortex to prevent the pilot flame from being blown out, and yet the flame protection apparatus 74 does not interfere with the combustion air flow pattern through the gas burner apparatus 10 so as to have any deleterious effect on the combustion or flame pattern therein.

OPERATION OF THE PREFERRED EMBODIMENT

During the operation of the gas burner 10, the pressurized combustion air is injected through the air inlet 30 into the air passageway 28 between the inner liner 18 and the outer shell 12, the air being forced into the air passageway 28 generally tangentially from a compressor or the like (not shown). The air fills the air passageway 28 and is moved in a helical path about the inner liner 18 generally toward the rear end wall 26 of the gas burner 10 to create a low pressure area generally near the opening 46 or, in other words, generally near the fuel injection point, thereby allowing the use of low pressure fuel, and the combustion air vortex thus created causes a rapid mixing of the fuel and combustion air in the ignition space 48. The flow is then directed into the inner liner 18 generally toward the outlet 36, where a reversal of flow occurs due to the convergence of the forward end portion 34 of the inner liner 18, thereby providing thorough mixing and complete combustion of the fuel and air within the inner liner 18. It should also be noted that an excess of combustion air exists in the hollow portion of the outer shell 12 which is utilized to cool the inner liner 18, thereby allowing a substantial portion of the gas burner apparatus 10 to be constructed of a metal and thus eliminating excessive utilization of various refractory materials in the construction thereof.

A portion of the combustion air vortex existing in the ignition space 48 is diffused by the noise abatement apparatus 54. More particularly, a portion of the combustion air vortex in the ignition space 48 generally near the rear end 22 of the inner liner 18 is diffused by the noise abatement apparatus 54, during the operation of the gas burner apparatus 10. It has been found that the velocity of the combustion air and the combustion air vortex per se existing generally near the rear end 22 of the inner liner 18 has contributed substantially to the high noise level, common in gas burners of a design similar to that described above with respect to the gas burner 10. Therefore, the noise abatement apparatus 54 is positioned on the inner liner 18 to substantially diffuse the portion of the combustion air vortex which contributes to the undesirable noise level thereby substantially eliminating the noise level of the gas burner 10, without substantially interfering with the efficiency of the gas burner 10. The flame protection apparatus 74 is positioned in the ignition space 48 to diffuse a substantial portion of the combustion air vortex generally near the opening 46 in the rear end wall 26 to prevent the combustion air from blowing out the pilot flame during the operation of the gas burner 10, in such a manner that the flame protection apparatus 74 does not interfere with the efficiency nor the desirable operational characteristics of the gas burner apparatus 10.

In most installations, the gas burner apparatus 10 is utilized to provide heat for a process fluid, and the amount of heat being provided by the gas burner apparatus 10 at any particular instant is controlled by various process characteristics. It thus becomes necessary, in many instances, to cycle the operation of the gas burner apparatus 10 or, in other instances, to reduce the amount of heat being provided by the gas burner apparatus 10 at a particular time. During such times when the gas burner apparatus 10 is cut-off or the heat being provided thereby is substantially reduced, it is desirable, in most instances to maintain the flow of combustion air through the gas burner apparatus 10 at or near a maximum, thereby permitting the combustion air to be utilized to cool the process fluid.

Utilizing the flame protection apparatus 74, constructed in a manner described above, the flame provided via the gas burner apparatus 10 can be effectively controlled, independent of the combustion air flow through the air inlet 30. In other words, the heat output of the gas burner apparatus 10 can be controlled over a wide range while leaving the combustion air flow to the gas burner apparatus 10 at or near a predetermined maximum flow level. During those times when the heat output is reduced, the flame protection apparatus 74 substantially prevents the combustion air from blowing out the pilot flame, thereby permitting the gas burner apparatus 10 to be utilized more efficiently in an overall process.

It should also be noted that the utilization of the flame protection apparatus 74 substantially eliminates

the need for a large number of control components, which in the past have been utilized to proportionately control the flow of the combustion air into the gas burner apparatus with respect to the amount of heat being supplied via the gas burner apparatus **10**.

The gas burner apparatus **10** thus provides a gas burner which can be more economically and efficiently operated and which will operate in a more efficient manner in cooperation with a particular process. The gas burner apparatus **10** can thus be constructed in a more economical manner, and will operate at a substantially reduced noise level and in such a manner that the maintaining of the pilot flame is virtually assured.

Changes may be made in the construction and the arrangement of the various parts or the elements as disclosed herein without departing from the spirit or scope of the invention as defined in the following claims:

What is claimed is:

1. A gas burner apparatus, comprising:

a hollow outer shell having a front end and a rear end;

a front end wall secured to the front end of the outer shell, thereby closing the front end;

a rear end wall, having an opening formed therethrough, secured to the rear end of the outer shell, thereby closing the rear end;

a hollow inner liner, having a front end and a rear end, the inner liner supported within the hollow portion of the outer shell and being spaced from the outer shell to form an air passageway between the outer shell and the inner liner, the front end of the inner liner extending through the front end wall and rear end of the inner liner being spaced a predetermined distance from the rear end wall;

an air inlet formed in the outer shell and spaced from the rear end thereof for admitting combustion air into the air passageway;

means for injecting fuel through the opening in the rear end wall and into the hollow portion of the outer shell, generally between the rear end of the inner liner and the rear end wall, the fuel and combustion air being mixed and burned generally within the hollow portion of the inner liner;

a noise abatement apparatus, including an annular member having perforations about its periphery and, secured to the rear end of the inner liner and extending a distance therefrom generally between the rear end of the inner liner and the rear end wall, to diffuse a portion of the combustion air thereby substantially eliminating undesirable noise during the operation of the gas burner apparatus; and

a pilot flame protection apparatus, an annular member having perforations about its periphery secured to a portion of the rear end wall, the flame protection apparatus substantially encompassing the opening through the rear end wall to diffuse a portion of the combustion air thereby preventing the combustion air from blowing out said pilot flame.

2. The gas burner apparatus of claim **1** where the inner liner includes, a frusto-conical section converging toward the rear end thereof and a frusto-conical section converging toward the front end thereof; and wherein the outer shell is defined further as being shaped such that the inner liner and the outer shell are coaxially positioned.

3. The gas burner apparatus of claim **1** wherein the rear end of the inner liner is defined further as being spaced a distance from the rear end wall, the distance being at least one-half the diameter of the hollow portion of the inner liner, generally adjacent the rear end thereof.

4. The gas burner apparatus of claim **1** wherein the air inlet is defined further as being volute shaped to provide tangential combustion air into the air passageway.

5. The gas burner apparatus of claim **1** wherein the noise abatement apparatus is defined further as extending a distance from the rear end of the inner liner, the distance being substantially equal to one-fourth of the distance between the rear end of the inner liner and the rear end wall.

6. The gas burner apparatus of claim **1** wherein the noise abatement apparatus is defined further as being generally cylindrically shaped, the diameter of the outer periphery of the noise abatement apparatus being sized to be slid into the hollow portion of the inner liner, generally adjacent the rear end of the inner liner.

7. The gas burner apparatus of claim **6** wherein the noise abatement apparatus is defined further to include: a plurality of stops, each stop being secured to a portion of the outer periphery of the noise abatement apparatus and extending a distance radially therefrom, each stop engaging a portion of the rear end of the inner liner to position the noise abatement apparatus in an assembled position within the hollow portion of the inner liner.

8. The gas burner apparatus of claim **1** wherein the flame protection apparatus is defined further as extending a distance from the rear end wall generally toward the rear end of the inner liner, the distance being generally between 35 and 40 percent of the distance between the rear end of the inner liner and rear end wall.

9. The gas burner apparatus of claim **1** wherein the flame protection apparatus is defined further as being generally cylindrically shaped, the diameter of the flame protection apparatus being approximately equal to 50 percent of the diameter of the hollow portion of the inner liner, generally adjacent the rear end thereof.

10. A gas burner apparatus, comprising:

a hollow outer shell having a front end and a rear end;

a front end wall secured to the front end of the outer shell, thereby closing the front end of the outer shell;

a rear end wall secured to the rear end of the outer shell, thereby closing the rear end of the outer shell;

a hollow inner liner, having a front end and a rear end, the inner liner supported withing the hollow portion of the outer shell and positioned therein to provide an air passageway generally between the outer shell and the inner liner, the front end of the inner liner extending through the front end wall and the rear end of the inner liner being spaced a distance from the rear end wall;

an air inlet in the outer shell, spaced a distance from the rear end of the outer shell for admitting combustion air into the air passageway;

means for injecting fuel into the hollow portion of the outer shell generally between the rear end of the inner liner and the rear end wall; and

a noise abatement apparatus secured to the rear end of the inner liner and extending a distance therefrom, generally between the rear end of the inner liner and the rear end wall, the noise abatement apparatus including an annular member having perforations about its periphery to diffuse a portion of the combustion air to substantially reduce the undesirable noise during the operation of the gas burner apparatus.

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