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Ebeling et al.

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[54] **WASTE GAS INCINERATOR**

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[21] Appl. No.: **328,775**

[52] **U.S. Cl.** ..... **23/277 C,** 431/116, 431/5, 431/9, 110/8 A

[51] **Int. Cl.** **F23g 7/06**

[58] **Field of Search** ..... 23/277 C; 110/8 A; 431/5, 431/9, 116, 173, 182, 195, 201, 200, 238

[56] **References Cited**

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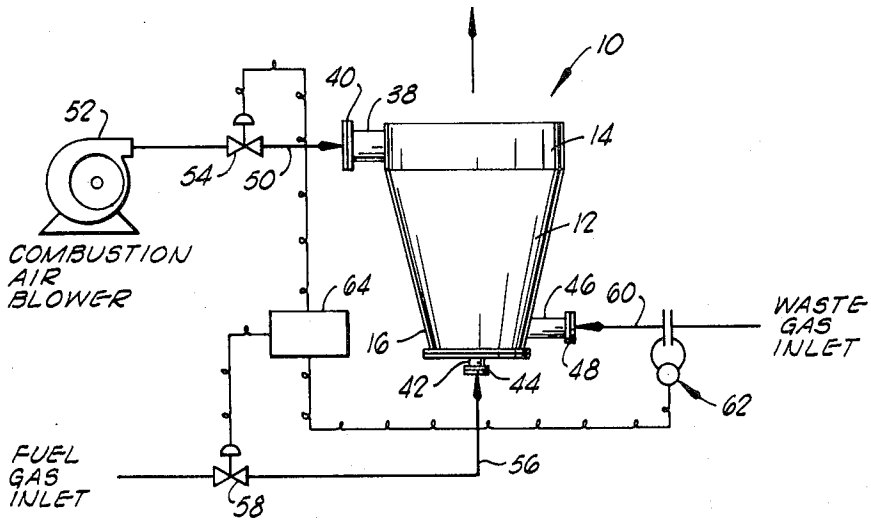
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Assistant Examiner—Timothy W. Hagan
Attorney, Agent, or Firm—Dunlap, Laney, Hessin, Dougherty & Codding

[57] **ABSTRACT**

Apparatus for incinerating waste gas which includes a hollow outer shell having a hollow inner liner supported therein so that an air passageway is formed therebetween. Front and rear walls are provided secured to the outer shell, and an intermediate wall having an opening disposed therein is secured within the outer shell. An air inlet is formed in the outer shell adjacent to the forward end thereof for admitting combustion air into the air passageway and means for injecting fuel gas into the outer shell at a position between the rearward end of the inner liner and the intermediate wall are provided. A waste gas inlet is formed in the outer shell for admitting waste gas thereto between the rear wall and the intermediate wall.

5 Claims, 4 Drawing Figures



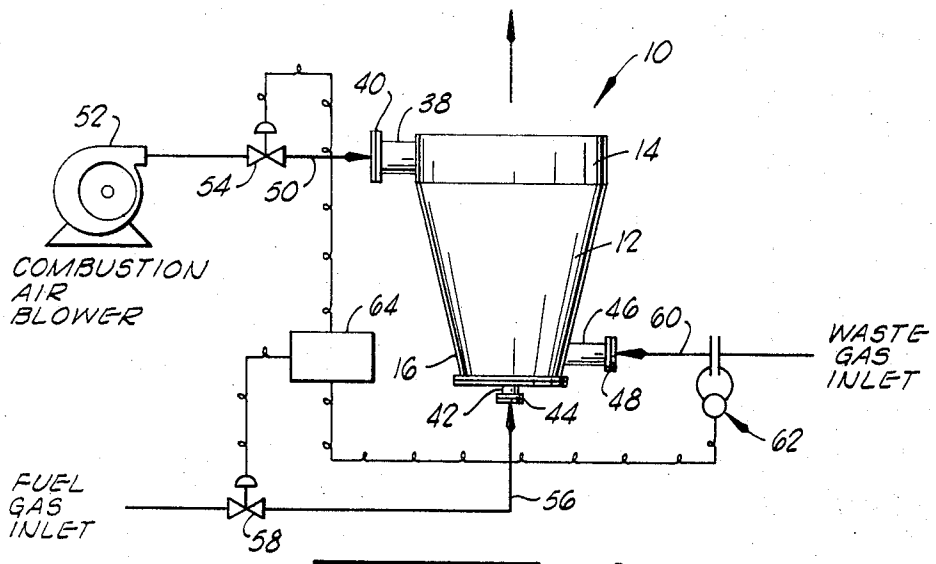


FIG. 1

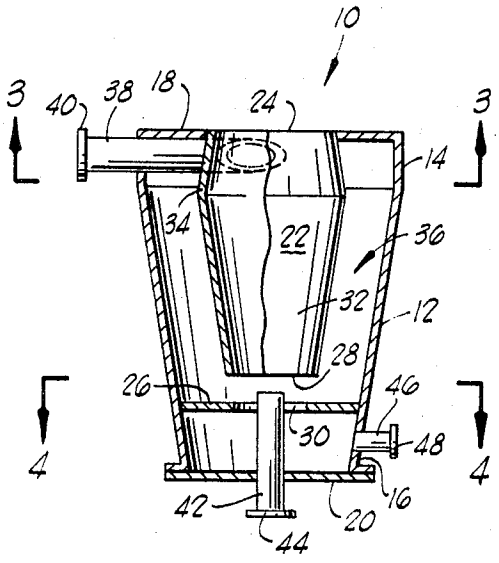


FIG. 2

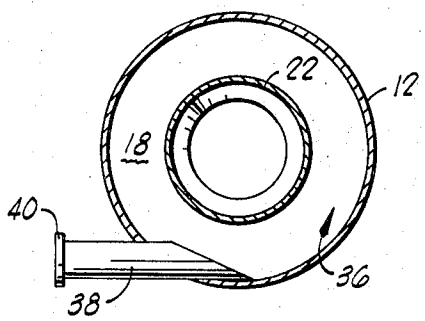


FIG. 3

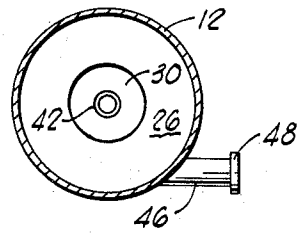


FIG. 4

WASTE GAS INCINERATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to waste gas incinerators, and more particularly, but not by way of limitation, to apparatus for incinerating waste gas wherein the waste gas is mixed with fuel and air and the resulting mixture is combusted.

2. Description of the Prior Art

A variety of waste gas incinerating apparatus have been developed and used heretofore. Generally, such apparatus have suffered from the disadvantage that inefficient or incomplete incineration of the waste gas is achieved and/or elaborate and expensive apparatus is required.

While waste gas incinerators incorporating high intensity combustion burners of the type described in U.S. Pat. No. 3,265,113, which is assigned to the assignee of the present invention, have been developed and used heretofore, such incinerators have generally included mixing chambers or secondary combustion chambers for mixing the waste gas with the hot products of combustion exiting the high intensity burners so that the waste gas is incinerated by reaction with the hot products of combustion; or, if the waste gas incinerated is combustible to some extent, the incinerator apparatus has included provision for mixing the waste gas with the fuel gas and combustion air prior to combusting the mixture which often brings about a low heat release and incomplete incineration due to the dilution of the fuel gas requiring the use of excess fuel gas and oversized apparatus.

High intensity burners of the type described in the afore-mentioned patent include an outer shell and a coaxial inner liner wherein combustion air is injected into the space between the inner liner and the outer shell and fuel is injected into the space generally between the rearward end of the inner liner and the rearward end of the outer shell.

By the present invention, a waste gas incinerator apparatus is provided which is similar to a high intensity combustion burner, but which obviates the requirement for a mixing chamber and/or other associated apparatus heretofore used in order to bring about complete incineration of the waste gas.

SUMMARY OF THE INVENTION

By the present invention, a waste gas incinerator is provided which includes a hollow outer shell having a forward end and a rearward end with a front wall secured to the forward end and a rear wall secured to the rearward end. An intermediate wall having an opening disposed therein is secured within the hollow portion of the outer shell and a hollow inner liner is supported within the outer shell in a manner such that an air passageway is formed between the outer shell and the inner liner. The forward end of the inner liner extends through the front wall secured to the outer shell and the rearward end of the inner liner is spaced a predetermined distance from the intermediate wall. An air inlet is formed in the outer shell adjacent to the forward end thereof for admitting combustion air into the air passageway and means are provided for injecting fuel gas into the outer shell at a position intermediate the rearward end of the inner liner and the intermediate wall so that fuel gas and combustion air are mixed and combusted generally within the hollow portion of the inner liner. A waste gas inlet is formed in the outer shell for admitting waste gas into the outer shell between the rear wall and the intermediate wall, the waste gas passing through the opening of the intermediate wall and being incinerated in the hollow portion of the inner liner by the combustion of the fuel and air therein.

It is, therefore, a general object of the present invention to provide a waste gas incinerator.

A further object of the present invention is the provision of apparatus for incinerating waste gas by the high intensity combustion of fuel and air which apparatus does not require a supplemental mixing chamber, a secondary combustion chamber or other associated apparatus for achieving complete incineration of the waste gas.

Yet a further object of the present invention is the provision of a waste gas incinerator which is inexpensive and simple to install and operate.

Other and further objects, features and advantages of the present invention will be evident from the following description of preferred embodiments when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevational view of the waste gas incinerator apparatus of the present invention shown diagrammatically connected to a combustion air blower, a source of fuel gas and a source of waste gas,

FIG. **2** is a side elevational view of the waste gas incinerator apparatus of FIG. **1** in cross-section,

FIG. **3** is a cross-sectional view of the apparatus of FIG. **2** taken along line **3—3**, and

FIG. **4** is a cross-sectional view of the apparatus of FIG. **2** taken along line **4—4.**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and particularly to FIGS. **1** and **2**, the apparatus of the present invention for incinerating waste gas is illustrated and generally designated by the numeral **10.** The apparatus **10** basically comprises a hollow outer shell **12** having a forward end **14** and a rearward end **16.** A front wall **18** is secured to the forward end **14** and a rear wall **20** is secured to the rearward end **16.** A hollow inner liner **22** is supported within the outer shell **12** with the forward end **24** thereof passing through and being attached to the forward wall **18,** thereby forming an outlet for products of combustion exiting the apparatus **10.** An intermediate wall **26** is provided secured within the outer shell **12** at a position intermediate the rear wall **20** and the rearward end **28** of the inner liner **22.** As will be further described herein, the rearward end **28** of the inner liner **22** is spaced a particular distance from the intermediate wall **26.** The intermediate wall **26** includes an opening **30** disposed concentrically therein.

As best shown in FIG. **2,** the inner liner is preferably formed in a manner such that it includes a frusto-conically shaped rearward end portion **32** converging toward the rearward end **28** thereof, and a frusto-conically shaped forward portion **34** converging toward the forward end **24** thereof. The outer shell **12** is preferably formed of a generally frusto-conical shape converging toward the rear end **16** thereof, and the inner

liner **22** is supported within the hollow portion of the outer shell **12** in a manner such that an air passageway is formed between the inner liner and the outer shell, which air passageway is designated in FIGS. **2** and **3** by the numeral **36.**

An air inlet **38** for admitting air to the air passageway **36** is formed in the outer shell **12** adjacent the forward end **14** thereof. As best shown in FIGS. **2** and **3**, the air inlet **38** is comprised of a conduit having a conventional flange connection **40** at the outer end thereof and having the inner end passing through and sealingly attached to the outer shell **12.** Preferably, as shown in FIG. **3,** the air inlet **38** is arranged with respect to the outer shell **12** so that a volute-shape results. That is, the inlet **38** is positioned with respect to the shell **12** so that air passing through the inlet **38** enters the shell **12** tangentially and is caused to follow a generally helical path as it passes through the air passageway to the rearward end **28** of the inner liner **22.** The end **28** of the inner liner **22** is spaced a distance from the intermediate wall **26** so that the helical flow of air is caused to change directions and extend into the hollow portion of the inner liner and an air vortex is generated between the inner liner and the intermediate wall **26.**

Means for injecting fuel at the point of the air vortex between the intermediate wall **26** and the rearward end **28** of the inner liner **22** are provided attached to the wall **20.** More specifically, a fuel gas inlet conduit **42** having a conventional flange connection **44** at the outer end thereof is sealingly attached through the wall **20.** The inner end of the conduit **42** passes through the opening **30** in the intermediate wall **26** and terminates open-ended at a point between the inner liner **22** and the intermediate wall **26.** Preferably, the opening **30** is a concentrically positioned circle, and the outer shell **12,** the inner liner **22** and the conduit **42** are positioned coaxially.

A waste gas inlet conduit **46** is provided in the outer shell **12** for admitting waste gas into the outer shell between the rear wall **20** and the intermediate wall **26.** More specifically, the waste gas inlet **46** is comprised of a conduit having a conventional flange connection **48** at the outer end thereof, the inner end passing through and being sealingly attached to the outer shell **12** and terminating open-ended within the outer shell **12** at a position between the rear wall **20** and the intermediate wall **26.** Preferably, the waste gas inlet **46** is positioned so that waste gas passing therethrough enters the outer shell **12** tangentially and is caused to follow a generally helical path within the outer shell **12.**

OPERATION OF THE APPARATUS **10**

Referring specifically to FIG. **1,** the apparatus **10** is diagrammatically illustrated connected to sources of combustion air, fuel gas and waste gas. That is, the flange connection **40** of the air inlet **38** is connected by a conduit **50** to a conventional air blower **52.** A conventional flow control valve **54** is provided disposed in the conduit **50.** The flange connection **44** of the fuel gas inlet **42** is connected to a source of fuel gas by a conduit **56** and a conventional fuel gas flow control valve **58** is disposed in the conduit **56.** The flange connection **48** of the waste gas inlet **46** is connected by a conduit **60** to a source of waste gas to be incinerated. A conventional flow rate transmitter assembly **62** is disposed within the conduit **60.** The flow rate transmitter **62** is operably connected to a conventional flow ratio controller **64** which is in turn operably connected to the flow control valves **54** and **58.**

In operation of the apparatus **10,** a waste gas stream to be incinerated is conducted to the inlet **46** of the apparatus **10** by way of the conduit **60.** Simultaneously, a stream of pressurized, e.g., 20-inch water column, combustion air is caused to flow from the combustion air blower **52** to the inlet connection **38** of the apparatus **10** by way of the conduit **50,** and a stream of fuel gas is caused to flow by way of the conduit **56** to the fuel gas inlet **42** of the apparatus **10.**

The combustion air injected through the inlet **38** is caused to follow a helical path within the air passageway **36** due to the volute shape of the inlet and flow toward the rearward end **28** of the inner liner **22.** The flow of air in the air space completely surrounding the exterior of the inner liner **22** functions to cool the inner liner **22.** The helical flow of inlet air creates a low pressure area or vortex at the fuel injection point, i.e., in the space between the rearward end **28** of the inner liner **22** and the intermediate wall **26.** This low pressure vortex brings about the rapid mixing of the fuel gas discharged from the fuel gas inlet conduit **42** in the area between the intermediate wall **26** and the inner liner **22** with the combustion air so that combustion of the fuel-air mixture readily takes place in the ignition zone as the mixture flows into the interior of the inner liner **22.** As will be understood, the mixture of fuel and air is continuously combusted within the interior of the inner liner **22.** Because of the convergent portion **34** of the inner liner **22,** a reversal of flow and recirculation of the products of combustion within the inner liner **22** takes place thereby providing complete combustion of the fuel and air and complete incineration of the waste gas within the inner liner **22.**

The stream of waste gas preferably flowing into the outer shell **12** by way of the volute-shaped inlet **46** follows a helical path between the intermediate wall **26** and the rear wall **20** and through the opening **30** of the intermediate wall **26.** As the waste gas flows into the low pressure air vortex which exists between the end **28** of the inner liner **22** and the intermediate wall **26,** it is intimately mixed with the combusting air and fuel gas mixture. As the fuel gas-combustion air mixture is combusted within the interior of the inner liner **22,** the waste gas combined therewith is incinerated. As will be understood, if the waste gas is combustible by itself to some extent it will be combusted along with the fuel gas. The resulting products of combustion and incinerated waste gas exit the apparatus **10** by way of the forward end **24** of the inner liner **22** from where they may be released to the atmosphere or conducted to a point of further processing.

As will be understood by those skilled in the art, the intermediate wall **26** functions to prevent substantial mixing of the waste gas with the fuel gas or combustion air until after the fuel gas and air have been intimately mixed and ignited. This prevents the waste gas from diluting the fuel gas and inhibiting combustion whereby a low heat release and incomplete incineration of the waste gas would result.

While a variety of control systems may be utilized for providing the proper flow rates and ratios of combustion air and fuel gas to the apparatus **10,** a preferred such system is illustrated in FIG. **1.** Specifically, the flow of waste gas to the apparatus **10** to be incinerated

is measured and transmitted by the transmitter assembly **62** to the flow-ratio controller **64.** The flow-ratio controller **64** in turn opens and closes the flow rate control valves **54** and **58** so that predetermined flow rates of combustion air and fuel gas are caused to flow into the apparatus **10** and the desired ratio of fuel gas to combustion air is maintained. Thus, if the flow rate of waste gas to the incinerator **10** increases or decreases, the flow rates of combustion air and fuel gas to the apparatus **10** are increased or decreased proportionately thereby insuring proper combustion within the apparatus **10** and complete incineration of the waste gas stream.

Because the apparatus **10** functions to bring about complete combustion of the fuel air mixture and incineration of the waste gas stream within the inner liner **22,** secondary combustion chambers and/or waste gas mixing chambers are not required. The waste gas incinerator apparatus **10** can thus be constructed in a more economical manner as well as installed and operated economically.

As will be understood by those skilled in the art, changes can be made in the shape and construction of the various parts of the apparatus **10** described herein without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. A waste gas incinerator comprising:

a hollow outer shell having a forward end and a rearward end;

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

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

an intermediate wall secured within the outer shell between the front wall and the rear wall, the intermediate wall having an opening concentrically disposed therein;

a hollow inner liner having a forward end and a rearward end supported within the outer shell so that an air passageway is formed between the outer shell and the inner liner, the forward end of the inner liner extending through the front wall and the rearward end of the inner liner being spaced a predetermined distance from the intermediate wall;

an air inlet formed in the outer shell adjacent the forward end thereof for admitting combustion air into the air passageway;

means attached to the outer shell for injecting fuel gas into the outer shell at a position between the rearward end of said inner liner and the intermediate wall; and

a waste gas inlet formed in the outer shell for admitting waste gas into the outer shell between the rear wall and the intermediate wall, the waste gas passing through the opening in the intermediate wall and being incinerated within the interior of the inner liner by the combustion of fuel gas and combustion air therein.

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

3. The apparatus of claim **2** wherein the means for injecting fuel gas into the outer shell comprises a conduit positioned coaxially with the inner liner extending through the rear wall and the opening in the intermediate wall and terminating open-ended at a position between the rearward end of the inner liner and the intermediate wall.

4. The apparatus of claim **3** wherein the air inlet forms a volute shape with the outer shell whereby the combustion air is caused to follow a helical path within the air passageway.

5. The apparatus of claim **4** wherein the waste gas inlet forms a volute shape with the outer shell whereby the waste gas is caused to follow a helical path within the interior of the outer shell.

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